

End Notes

¹ Fossil fuel companies, auto industry, many oil producing nations, and a variety of right wing think tanks.

The leading journalist covering this is Ross Gelbspan. In 1995, he was briefly fooled by dishonest work from “global warming skeptics” Pat Michaels, S. Fred Singer and Richard Lindzen; when a look at the actual science showed him he had been lied to, he was angry enough to write the book “The Heat is On” to expose both their junk science, and the cranks and liars behind it He has probably been the leading journalist exposing the carbon lobby since then, and has essentially given up the rest of his career to focus fulltime on the global warming and the carbon lobby.

Ross Gelbspan, *The Heat Is on: The Climate Crisis, the Cover-Up, the Prescription* (New York: Perseus Book Group, 1997). (Still an excellent source for history of the Carbon Lobby.)

Ross Gelbspan, *Boiling Point: How Politicians, Big Oil and Coal, Journalists and Activists Have Fueled the Climate Crisis - and What We Can Do to Avert Disaster* (New York: Perseus Book Group - Basic Books, 2004). (Focuses more on his view of solution – but also brings Carbon Lobby history up to date.)

Ross Gelbspan, "Snowed," *Mother Jones* May/June 2005, The Foundation for National Progress, 10/June/2005 <<http://www.motherjones.com/news/feature/2005/05/snowed.html>>. (Part of excellent May 2005 issue of Mother Jones, which contains a good survey of the current state of the Carbon Lobby.)

Another good source for current state of the Carbon Lobby is the Union of Concerned Scientists. Union of Concerned Scientists, *Global Warming - Skeptic Organizations*. 2005, Union of Concerned Scientists, 30/Sep/2005 <http://www.ucsusa.org/global_warming/science/skeptic-organizations.html>.

To find out more about individual organizations, I recommend *SourceWatch* published online by The Center For Media and Democracy. You will find that along with groups devoted primarily to global warming denial, much Carbon Lobby funding goes to general right wing groups that include it as one activity among many.

Center for Media and Democracy, *SourceWatch - SourceWatch*. SourceWatch Applies It's Standards to Itself - Reveals Own Funding Just as It Does Others, 2005, Center for Media and Democracy, 10/June/2005 <<http://www.sourcewatch.org/index.php?title=SourceWatch>>.

² Just about every public opinion survey by respectable sources shows about 75% of the public convinced that global warming is a real and serious problem, and about 25% convinced of the opposite or uncertain.

The Gallup poll for March 2005 shows nearly 80% of the population now believes human caused global warming is real.

Gallup Poll, *Environment: The Gallup Poll March 7-10 2005*. 01/07 2005, The Polling Report, 02/07/2005 << <http://www.pollingreport.com/enviro.htm> >>.

A series of public opinion polls regarding global warming compiled by the highly regarded Program on International Policy Attitudes:

"The Reality and Urgency of Global Warming," *Americans & the World*, Program on International Policy Attitudes - Jointly Established by the Center on Policy Attitudes (COPA) and the Center for International and Security Studies at Maryland (CISSM), School of Public Affairs, University of Maryland, 20/03 2005, 01/01/2005 <http://www.americans-world.org/digest/global_issues/global_warming/gw1.cfm>.

These include the following:

In September 2002, 74% said they "believe the theory that increased carbon dioxide and other gases released into the atmosphere will, if unchecked, lead to global warming and an increase in average temperatures" "Majorities Continue to Believe in Global Warming and Support Kyoto Treaty", *The Harris Poll*, Harris Interactive #56, October-23-2002
<http://www.harrisinteractive.com/harris_poll/index.asp?PID=335> ((January 2, 2005)

--In March 2001, 64% said they "believe that emissions of gases like carbon dioxide are causing global temperature increases"; 23% did not (Time/CNN).

--In an August 2000 Harris poll, 72% said they "believe[d] the theory" of global warming, while 20% said they did not--up from December 1997 when in response to the same question 67% said they believed it and 21% said they did not.

--In a July 1999 NBC News/Wall Street Journal poll, only 11% took the position that "concern about global climate change is unwarranted."

--In a September 1998 Wirthlin poll, 74% embraced the belief that "global warming is real" even when the belief was defined in terms of global warming having "catastrophic consequences," while just 22% said they did not believe in it.

--An October 1997 Ohio State University survey asked about "the idea that the world's temperature may have been going up slowly over the last 100 years" and found that 77% thought "this has probably been happening," while 20% thought "it probably hasn't been happening." Likewise, 74% thought the world's average temperature would go up in the future, while 22% thought it would not.

The Pew Research Center for People and the Press, *Americans Support Action on Global Warming: Progress Seen On AIDS, Jobs, Crime and the Deficit*. 21/11 1997, 02/07/2005 <<http://people-press.org/reports/display.php3?ReportID=100>>.

³Jennifer O'Connor, *Survey on Actual Service Lives for North American Buildings*, Oct 2004). Sep 2004. Presented at *Woodframe Housing Durability and Disaster Issues Conference*, 16/Jun/2006
<http://www.northernrockies.org/Departments/Fire/Wood_Buildings/Wood%2520Buildings%2520Service_Life_E.pdf>.

A good indicator is that the Australian government thinks that most Australian homes (which have to meet tougher standards than U.S. ones do) have a lifespan of around 50 years.

Chris Reardon, *Your Home Technical Manual - Design for Lifestyle and the Future - 3.0 Materials Use Introduction*. 1/Mar/2004, Commonwealth of Australia/Joint Initiative of the Australian Government and the Design and Construction Industries, 9/Jan/2005
<<http://www.greenhouse.gov.au/yourhome/technical/fs30.htm>>.

⁴The Old House Web, *Schedule of Normal Life*. 1995, 1/Jan/2005
<<http://www.oldhouseweb.net/stories/Detailed/267.shtml>>.

⁵Hawkins, Dominique M., *Saving Wood Windows*. 24/Sep 2004, *State of New Jersey Department of Environmental Protection Division of Parks & Forestry Natural & Historic Resources Historic Preservation Office*, 2/Jan/2005 <<http://www.state.nj.us/dep/hpo/4sustain/windowsave.pdf>>.

⁶The Minnesota Green Affordable Housing Guide, published by University of Minnesota College of Architecture and Landscape Architecture cites a 25 year lifespan

Regents of the University of Minnesota, *The Minnesota Green Affordable Housing Guide - Components: Cladding (Siding)*, 30/June 2004, 2004 Regents of the University of Minnesota, 09/Jan/2005 <http://www.greenhousing.umn.edu/comp_cladding.html>.

So does the Commonwealth of Massachusetts Historical Commission Carol DiNinno and Ann Lattinville, "Technical Assistance Tips: Vinyl Siding," . *Preservation Advocate*, no. Spring 2003 (2003), Commonwealth of Massachusetts Historical Commission, 06/Jul/2005 <<http://www.sec.state.ma.us/mhc/mhcpdf/pasp03.pdf>>. P5.

Jim Cory, "Siding Replacement", *Remodeling Magazine*, no. November 2002 November 2002: 2002 Cost vs. Value Report, Hanley Wood, 10/Mar/2004 <http://www.remodeling.hw.net/pages/remodelingonline/Story.nsp?story_id=1000027503&ID=newsreal&scategory=Computers&type=break>.

Note that many "authoritative" sources give longer, life spans, based upon exaggerated manufacturers claims, rather than real life experience. For instance, one of the sources most commonly cited for lifespans is the September 2002, **Baseline Measures for Improving Housing Durability**, published by the U.S. Department of Housing and Urban Development

Robert E. Chapman and Christine A. Izzo, *Baseline Measures for Improving Housing Durability*, NISTIR 6870. September 2002. *US. Department of Commerce National Institute of Standards and Technology Building and Fire Research Laboratory/U.S. Department of Housing and Urban Development Office of Policy Development and Research*, 06/Jul/2005 <<http://fire.nist.gov/bfrlpubs/build02/PDF/b02159.pdf>>.

If you look at footnote 26 at the bottom of page 38 of that article, it turns out that average (as opposed to minimum) lifetimes are based on "Life Expectancy of Housing Components" published by Ahluwalia, Gopal, and Angela Shackford. in the August 1993 *Housing Economics* pp. 5-9 – based on surveys of manufacturers, trade industry associations and researchers. Given that at least two thirds of the sources would tend to be biased towards optimism, I would expect lifespans from such a source to be wildly exaggerated. Let's test this by focusing in on one example – vinyl siding.

The 50 year average estimated lifespan for vinyl siding is widely cited. The *Housing Economics* is not the sole source of course. The Vinyl Institute promotes this figure as much as possible. But does it make sense compared to environmental and remodeling sources?

Most vinyl siding offers a 50+ year warranty. That appears devastating until you look at what kind of warranty is offered. Many of the warranties are prorated. Those that are not usually have a kicker: they are invalidated or become prorated when the home is sold. Because most people do not stay in the same house for 25 year, the vast majority of these warranties will expose the seller to no significant liability past after a couple of decade. (I know there are exceptions. But, looking at it from the point of view of how much money a warranty will cost the issuer, the exceptions are not significant.

Let's look at one vinyl siding warranty (<http://www.mastic.com/warrantyvs.asp>) a warranty for Mastic Vinyl Siding from Alcoa, downloaded February 2, 2005 – one that advertises itself as non-pro-rated, transferable. That sounds good – except that as soon as it is transferred it becomes very heavily prorated indeed.

For a second owner, by the time 14 years have passed the warranty covers only 20% of the original cost of the siding. Bear in mind that decently installed, well maintained vinyl siding will last 25-30 years. So imagine every most (non-original owners have problems and try to collect on the warranty 20 years from now. That means the manufacturer will have to pay out 20% of siding sales price in 20 years. But having to pay a dollar twenty years from now does not cost the same as having to pay it now. Using a discount rate of 6.5% that 20% 20 years from now is worth only 3.5% of the current sales dollar. In other words, the manufacturer (knowing that most homes will be occupied by a second (or third or fourth owner)) needs only add 3.5% to the selling price to cover the cost of this 50 year warranty. Actually that is overstating; in

practice by the time the home has passed through a number of hands, a lot of people won't even think of checking to see whether there is a warranty out on siding 20+ years old. What about siding that goes bad sooner? Well remember this particular warranty hits that 20% mark after 14 years. Even badly installed and maintained siding tends to last for 15. But if the siding was improperly installed or poorly maintained that invalidates the warranty in any case. In other words offering a 50 year warranty under those particular terms is a worthwhile investment in marketing terms, even if the siding does not in fact last 50 years. So the existence of such a warranty does not tell you very much.

Also by the time the manufacturers face a significant number of people trying to collect on the warranty, whoever made the recommendation to offer it will be working for a different company or retired.

Fundamentally vinyl (as it is normally installed) just is not sturdy enough to last more than 30 years in the conditions house siding normally faces. It becomes brittle with age, and also brittle in extremely cold (and sometimes in extremely hot) weather. You can harmlessly bounce a hammer off newly installed vinyl siding; try it ten years later and you will shatter your vinyl. The same thing is true in really cold weather. Hit vinyl siding with a snow-blower or lawnmower and it won't hold up very well. As it grows older, you can damage vinyl siding by leaning a ladder against it to repair a roof or a window. Top quality vinyl siding, perfectly installed and maintained might well last fifty years or longer. But that is not the average case – especially the perfect installation and maintenance.

⁷Robin Suttell, "Intelligent and Integrated Buildings: Technologies and Current Market Conditions Break Down Conventional Barriers," *Buildings Magazine* November 2002, Statmats Business Media, 5/Jan/2005 <<http://www.buildings.com/Articles/detail.asp?ArticleID=1095>>.

⁸OUS Capital Construction, *The Oregon University System Sustainable Renewal Program for Failing Assets*. 19/Jul 2004, 02/Jan/2005 <<<http://www.ous.edu/board/dockets/ddoc040716-DM.pdf>>>.

⁹. Engelbert Westkämper, director of the Institute of Manufacturing and Factory Operation at the University of Stuttgart says "... A factory building normally lasts 30 years, but it doesn't stay the same for 30 years. Machines and systems have an average life span of ten years; in some cases only five years..."

"Prof. Engelbert Westkämper, 56, is a leading expert in the field of manufacturing engineering. Since 1995 he has served as Director of the Fraunhofer Institute for Production Engineering and Automation in Stuttgart, Germany and as Director of the Institute of Manufacturing and Factory Operation at the University of Stuttgart. A mechanical engineer, Westkämper also has a hands-on industrial background, including positions as Manager of Manufacturing Engineering and Technology at MBB in Munich and as Manager of Production Engineering at AEG in Frankfurt. He was also responsible for manufacturing technology at Airbus in Hamburg and Bremen.

"Visualizing Tomorrow's Industrial Environments: Interview with Engelbert Westkämper," *Siemens Webzine*, no. Pictures of the Future - Fall 2002 (2002), Siemen, 02/Jan/2005 <http://w4.siemens.de/FuI/en/archiv/pof/heft2_02/artikel08/>.

The OECD gives the average service life for capital equipment (weighted by value) as 15 years - not the same as in the U.S., but indicative.

Paul Schreyer, *Capital Stocks, Capital Services, and Multi-Factor Productivity Measures. Economic Studies*, Draft. 3/Nov 2003, OECD Statistics Directorate, 3/Jan/2005 <<http://www.oecd.org/dataoecd/30/46/29877839.pdf>>. P10.

According to the Deutsche Bundesbank, U.S. capital equipment generally lasted about 25 years in 1987, and the rate of depreciation has risen drastically every one of the 18 years that followed (meaning lifespan has fallen).

Ulf von Kalckreuth and Jurgen Schröder, *Monetary Transmission in the New Economy: Service Life of Capital, Transmission Channels and the Speed of Adjustment*, Discussion Paper 16/02. 16/June 2002, Economic Research Centre of the Deutsche Bundesbank, p2, 03/Jan/2005
<<http://www.bundesbank.de/download/volkswirtschaft/dkp/2002/200216dkp.pdf>>.

Some U.S. economists calculate an average 5.9% depreciation rate for U.S. physical capital, which is consistent with a 20 year lifespan:

M. Ishaq Nadiri and Ingmar R. Prucha, "Estimation of the Depreciation Rate of Physical and R&D Capital in the U.S. Total Manufacturing Sector," *Economic Inquiry* XXXIV January 1996: 43-56, Western Economic Association International, 03/Jan/2005 <<http://www.econ.nyu.edu/user/nadiri/pub86.PDF>>.

¹⁰Region 2 United States Environmental Protection Agency, *Life Cycle of Old Computers - Problem Continued*. 15/October 2002, U.S. EPA, 3/July/2005 <<http://www.epa.gov/region02/r3/problem.htm>>.

¹¹ "The generally accepted standard for the normal effective lifespan of a coke oven is 25 to 30 years."

Office Technology Assessment, "Technology and Raw Materials Problems - Chapter 7," *Technology and Steel Industry Competitiveness*, June 1980), NTIS Order #PB80-208200. 1996, 223. *Office Technology Assessment*, Princeton University, 02/Jan/2005 <<http://www.wws.princeton.edu/cgi-bin/byteserv.prl/~ota/disk3/1980/8019/801909.PDF>>.

¹²American Society Civil Engineers, *ASCE Report Card for America's Future: 2003 Progress Report And Update to the 2001 Progress Report*. September 2003, 1, ASCE, 10/Jan/2005
<<http://www.asce.org/reportcard/pdf/fullreport03.pdf>>.

The EPA sponsored a study that focused on water infrastructure, and concluded the ASCE was too generous.

American Water Works Service Co. Inc. Engineering Department, *Deteriorating Buried Infrastructure Management Challenges and Strategies*. May 2002. *Environmental Protection Agency*, 10/Jan/2005
<<http://www.epa.gov/safewater/tcr/pdf/infrastructure.pdf>>.

¹³S. Lu, *VEHICLE SURVIVABILITY AND TRAVEL MILEAGE SCHEDULES*, DOT HS 809 952. Jan 2006, : NHTSA's National Center for Statistics and Analysis NCSA, 12/Jan/2007 <<http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/Rpts/2006/809952.pdf>>.

Florida Department of Highway Safety and Motor Vehicles, *How to Buy a Used Car*. 21/May 2004, 3/July/2005 <<http://www.hsmv.state.fl.us/dmv/usedcar.html>>.

¹⁴ Freightline Custom Chassis, *Commercial Bus Chassis: Frequently Asked Questions*. 03/Jan/2005
<http://www.freightlinerchassis.com/cb_default.asp?page=cb_faqs&nav=mb>.

^{2nd} source:

Research and Special Programs Administration John A. Volpe National Transportation Systems Center, *Transit Security Design Considerations: Final Report*. November 2004, 7-8. *Federal Transit Authority of the U.S. Department of Transportation*, 05/Jul/2005
<<http://transit-safety.volpe.dot.gov/security/SecurityInitiatives/DesignConsiderations/CD/ftasesc.pdf>>.

¹⁵ We have to combine two figures here, average number of miles traveled annually by heavy trucks, and engine life in miles. The Department of Transportation suggests that heavy trucks average 47,022 miles annually in the U.S.

Stacey C. Davis and Susan W. Diegel, *TRANSPORTATION ENERGY DATA BOOK: - Edition 23*, ORNL-697 (Edition 23 of ORNL-5198). October 2003, Chapter 5: Heavy Vehicles and Characteristics, Page 5-7, Table 5-Truck Statistics by Size - 1997. *Oak Ridge National Laboratory for the U.S. Department of Energy Office of Planning, Budget Formulation and Analysis Energy Efficiency and Renewable Energy*, 24/Feb/2003 <http://www-cta.ornl.gov/data/tedb23/Full_Doc_TEDB23.pdf>.

The Pacific Northwest National Laboratory suggest that a heavy truck, on average, needs a major overhaul at between 400,000 and one million miles. (A truck that is used a lot, but run at a low mileage, spending a lot of time idling or in stop and go traffic, or turning around in narrow streets and parking lots will wear out in a lot fewer miles, so the range makes sense.) Therefore if we assume that million miles, divide the 47,022 miles traveled annually into it and calculate a 21 year life span, we are projecting an optimistic length of time between major overhauls for an “average” heavy truck.

PNNL, "Need For Transportation Technologies Heads Into Overdrive,". *PNNL Breakthroughs Magazine: Science, Technology, Innovation* Fall 2002, Pacific Northwest National U.S. Department of Energy Multiprogram National Laboratory - Richland WA, 3/Jan/2005 <<http://www.pnl.gov/breakthroughs/fall02/special.stm>>.

¹⁶"When Should Part-Life Engines Be Built?" *Engine Yearbook 2005*. 2005. Aviation Industry Press Ltd., London, 11/Jan/2005 <http://www.aviation-industry.com/atem/newpages/eyb2003pdfs/E2005_TES.pdf>.P30.

¹⁷ "Commercial Aero-Engine MRO Outlook - a New Dawn?" *Engine Yearbook 2005*. 2005. Aviation Industry Press Ltd, 11/Jan/2005 <http://www.aviation-industry.com/atem/newpages/eyb2003pdfs/E2005_aerostrat.pdf>.p4.

¹⁸Charles River Associates for Diesel Technology Forum, *Diesel Technology and the American Economy*, Report D02378-00. October 2000, 12/Jan/2005 <<http://www.dieselforum.org/enews/downloads/DTF-Economic-Study.PDF>>. p2.

For rail transport in general the same figure seems to be 12 years (ibid 14:Volpe above)

¹⁹ “Locomotive engines are expected to last for at least 40 years, which places greater emphasis on durability. This low turnover rate also limits the penetration rate of new technologies; however, locomotives undergo many overhauls, providing opportunities for modifications throughout their lives.”

Frank Stodolsky, *Railroad and Locomotive Technology Roadmap*, ANL/ESD/02-6. December 2002. Center for Transportation Research, Energy Systems Division - Argonne National Laboratory, 11/Jan/2005 <<http://www.transportation.anl.gov/pdfs/RR/261.pdf>>.p13.

²⁰Yes, this is a press release – a press release boasting about an extraordinary example of product life – with no claim that it represents typical results. The estimate is likely to be high rather than low; and higher numbers are less favorable to the case we are making.

Torben Klingenberg, *Press Release: Heading for 30 000 Operating Hours with HFO GenSets*. October 2003. *MAN B&W Diesel A/S*, 17/Jan/2005 <http://www.manbw.com/files/news/files/3003/CP_ships_pr_nov.pdf>.

²¹As previously noted, the following press release is more likely to give a high than a low lifespan estimate.

Vesa Tompuri, "Wärtsilä's New Medium-Speed Diesel Engine Has the Lowest Emissions on the Market," *WATTSON: Wärtsilä's Investor Magazine*. 2004. *Sanoma Magazines Custom Publishing Division* for

Wärtsilä Corporation, 13/Jan/2005

<http://www.wartsila.com/Wartsila/docs/en/investors/English_lowres.pdf>.p13.

2nd source: a 1999 study was pessimistic about reducing greenhouse gas emissions in ships, because they have lifespans of 20 years or more.

Bronson Consulting Group CPCS Transcom Ltd. for Marine Sub-Group of the Transportation Table on Climate Change, *Marine Summary:Transportation &Climate Change : Assessment of Opportunities to Reduce GHG Emissions in the Marine Transportation Industry*. July 1999, 18/Nov/2003
<http://www.tc.gc.ca/programs/environment/climatechange/subgroups1/marine/Exec_Summary/English/Marine.htm>.

22" .Only one percent of total material flow ends up in, and is still being used within, products six months after their sale..."

Paul Hawken, Amory Lovins, and L.Hunter Lovins, *Natural Capitalism: Creating the Next Industrial Revolution* (Boston: Little, Brown and Company/Back Bay, 2000). p81. Page citations are to the Back Bay paperback edition. Along with Barry Commoner, Amory Lovins is one of the key popularizers of the idea that increased efficiency and more use of renewables could supply most of our energy.

23 Friedrich Bio Schmidt-Bleek, "Energy," *Factor 10 Manifesto*, Jan 2000). May 2000. *Factor 10 Institute*, 2/Feb/2004 <<http://www.factor10-institute.org/pdf/F10Manif.pdf>>.p5.

24 David Malin Roodman and Nicholas Lenssen, *Worldwatch Paper #124: A Building Revolution: How Ecology and Health Concerns Are Transforming Construction*. Single Page Summary of Book, March 1995, Worldwatch Institute, 22/Aug/2005 <<http://www.worldwatch.org/pubs/paper/124>>. (note one page summary, not entire 67 page paper)

25 California Institute of Earth Art and Architecture, *Nader Khalili*. Jan 2004, California Institute of Earth Art and Architecture, 23/Aug/2005 <<http://www.caearth.org/khalili.htm>>.

26 California Institute of Earth Art and Architecture, *CalEarth Forum*. July 2005, California Institute of Earth Art and Architecture, 23/Aug/2005 <<http://www.caearth.org/>>.

27 Ernst von Weizsacker, Amory B. Lovins, and L. Hunter Lovins, *Factor Four - Doubling Wealth, Halving Resource Use - The New Report to the Club of Rome* (London: Earthscan, 1997).

Wayne Trusty and Jamie Meil, *The Environmental Implications of Building New Versus Renovating an Existing Structure*. Jan 2001. ATHENA™ Sustainable Materials Institute, 23/Aug/2005
<http://www.athenasmi.ca/papers/down_papers/SB2000_paper.pdf>.

28 Ernst von Weizsacker, Amory B. Lovins, and L. Hunter Lovins, *Factor Four - Doubling Wealth, Halving Resource Use - The New Report to the Club of Rome* (London: Earthscan, 1997).

Wayne Trusty and Jamie Meil, *The Environmental Implications of Building New Versus Renovating an Existing Structure*. Jan 2001. ATHENA™ Sustainable Materials Institute, 23/Aug/2005
<http://www.athenasmi.ca/papers/down_papers/SB2000_paper.pdf>.

29 Amazon Nails, *Information Guide to Straw Bale Building for Self-Builders and the Construction Industry*, 2001). 2003. *Amazon Nails*, 23/Dec/2003
<<http://www.strawbalefutures.org.uk/pdf/strawbaleguide.pdf>>.p2.

30 Canadian Architect, "Measures of Sustainability - Embodied Energy," *Measures of Sustainability*, 2002, Canadian Architect, 02/Feb/2003

<http://www.cdnarchitect.com/asf/perspectives_sustainability/measures_of_sustainability/measures_of_sustainability_embodied.htm>.

³¹ Amazon Nails, *Information Guide to Straw Bale Building for Self-Builders and the Construction Industry*, 2001). 2003. *Amazon Nails*, 23/Dec/2003

<<http://www.strawbalefutures.org.uk/pdf/strawbaleguide.pdf>>.p2.

³² 4, "Wheat-Straw Particleboard,". *Environmental Building News*, no. 6 Nov/Dec 1995: Product Review, BuildingGreen.Com, 23/Aug/2005

<<http://www.buildinggreen.com/auth/article.cfm?fileName=040608a.xml>>.

³³ International Bamboo Foundation, *Bamboo Technologies / About Bamboo*. 15/May 2004, International Bamboo Foundation, 26/Oct/2005 <<http://www.bambootechnologies.com/allabout.htm>>.

International Network for Bamboo and Rattan, *International Network for Bamboo and Rattan (INBAR) / Bamboo and Rattan Facts*. 2005, International Network for Bamboo and Rattan, 26/Oct/2005

<<http://www.inbar.int/facts.htm>>.

International Fund for Agricultural Development, *Agricultural Research Grants / Programme for Development and Diffusion of Technologies for Smallholder Bamboo- and Rattan-Based Producers – Phase II*. 2005, International Fund for Agricultural Development, 26/Oct/2005

<<http://www.ifad.org/grants/tags/518.htm>>.

³⁴ United States Department of Agriculture Natural Resources Conservation Service, *PLANTS National Database Reports and Topics - Arundinaria Gigantea*. 22/Aug 2005, United States Department of Agriculture Natural Resources Conservation Service <

http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=ARGI>.

³⁵ David Linvill, Frank Linton, and Michael Hotchkiss, *Growing Bamboo in Georgia*. 9/May 2001, Cooperative Extension Service - The University of Georgia College of Agricultural and Environmental Sciences, 23/Aug/2005 <<http://pubs.caes.uga.edu/caespubs/horticulture/GrowingBamboo.htm>>.

Carol A. Miles, Chuhe Chen, and Tamera Flores, *Washington State University Bamboo Research Report 2000 - On-Farm Bamboo Production in the Pacific Northwest*, 2000). May 2001. *Extension Agricultural Systems Program, Washington State University Research and Extension Center*, 23/Aug/2005

<<http://agsyst.wsu.edu/BambooReport2000.pdf>>.

³⁶Kevin K. C. Cheung, *Multi-Storey, Multi-Family Wood-Frame Construction in the USA*, 27/Sep/2000). *International Conference on the Seismic Performance of Traditional Buildings: Istanbul, Turkey, Nov. 16-18, 2000*. 15/Nov 2001. *International Council on Monuments and Sites: International Wood Committee*, 23/Aug/2005 <<http://www.icomos.org/iwc/seismic/Cheung-K.pdf>>.

³⁷Laura Soullière Harrison, "National Park Service: Architecture in the Parks (Old Faithful Inn)," *Architecture in the Parks: Excerpts from a National Historic Landmark Theme Study*, Nov 1986). 26/Feb 2001. *National Park Service - Department of the Interior*, 23/Aug/2005

<http://www.cr.nps.gov/history/online_books/harrison/harrison3.htm>.

Chateau at the Oregon Caves, *Oregon Caves Outfitters - An In-Depth Description of the Chateau*. 2003, Chateau at the Oregon Caves, 23/Aug/2005

<<http://www.oregoncavesoutfitters.com/AbouttheChateau.asp>>.

³⁸Jamie Meil et al., *CORRIM: Phase I Final Report - Module J: Environmental Impacts of a Single Family Building Shell - From Harvest to Construction (Review Draft)*. 23/Aug 2004. *Consortium for Research on Renewable Industrial Materials (CORRIM)*, 23/Aug/2005

<http://www.corrim.org/reports/final_report_2004/Module%2520J_%2520August%252023.pdf>.

³⁹ Ann Edminster and Sami Yassa, *Efficient Wood Use in Residential Construction: A Practical Guide to Saving Wood, Money, and Forests*, 1998). *Natural Resources Defense Council*, 19/Feb/2006 <<http://www.nrdc.org/cities/building/rwoodus.asp>>.

⁴⁰ Zongjin Li, Ding Zhu, and Yunsheng Zhang, *Development of Sustainable Cementitious Materials. International Workshop on Sustainable Development and Concrete Technology: Beijing, May 20–21, 2004*. 25/Mar 2004, 23/Aug/2005 <<http://www.ctre.iastate.edu/pubs/sustainable/lisustainable.pdf>>.p57.

⁴¹ Siloxo Pty Ltd, *Siloxo -Melbourne Australia*. Siloxo -Products and Services, 15/Aug 2003, Siloxo Pty Ltd, 18/Aug/2004 <<http://www.siloxo.com/products.htm>>.

⁴² Rastra Found., *What is RASTRA®*. 16/Mar 2005, Rastra Found., 4/Sep/2005 <http://rastra.net/rastracom/web-site/wi_ra.htm>.

⁴³ Rastra Found., *What is RASTRA®*. 16/Mar 2005, Rastra Found., 4/Sep/2005 <http://rastra.net/rastracom/web-site/wi_ra.htm>.pp1-2.

⁴⁴ Wooden pagodas the height of small skyscrapers have been documented historically. China Internet Information Center, "Introduction," *China Through a Lens*, 25/Sep 2002, China Internet Information Center - Authorized Government Portal Site to China, 4/Sep/2005 <<http://www.china.org.cn/english/TR-e/43461.htm>>.

Edwin Karmioli, *Mysteries of Japanese Pagodas Unlocked*. 17/Aug 2002, *Asia Times*, 4/Sep/2005 <<http://www.atimes.com/atimes/Japan/DH17Dh01.html>>.

Bamboo is used as scaffolding in building skyscrapers today.

Mark Landler, "Foreign Desk: Hong Kong Journal; For Raising Skyscrapers, Bamboo Does Nicely (Abstract)". *NY Times*, no. Late Edition - Final 27/Mar 2002: Section A, Page 4, Column 3, 23/Aug/2005 <<http://query.nytimes.com/gst/abstract.html?res=FB0917F9385F0C748EDDAA0894DA404482>>.

Now there was one huge problem with traditional pagodas. While they were sturdy, and wonderfully insect and earthquake resistant, when exposed to fire they went up like, well, tinder. Fortunately, today there are all sorts of fire barriers you can wrap wood in. In point of fact, protected wood, guarded by a multi-hour graded fire barrier can be more fire safe than steel - because wood does not have the huge thermal conductivity steel has; it simply does not have the capability of growing as hot. How far beyond seven stories wood (and possibly bamboo construction) can grow safely is hard to guess. But seven stories is probably not the limit.

⁴⁵ Michelle Clark Hucal, "Recycled Roofing,". *Environmental Design and Construction*, no. Cool Roofing - May 2003 Supplement 1/May 2003, BNP Media, 5/Sep/2005 <http://www.edcmag.com/CDA/ArticleInformation/features/BNP__Features__Item/0,4120,97795,00.html>.

⁴⁶ Ibid 22 "Chapter 7, Muda, Service and Flow" pp.139-141.

⁴⁷ Wuppertal Institute for Climate, Environment and Energy, *Material Intensity of Materials, Fuels, Transport Services*, Version 2;28.10.2003. May 2004. *Wuppertal Institute for Climate, Environment and Energy*, Wuppertal Institute for Climate, Environment and Energy, 5/Sep/2005 <http://www.wupperinst.org/Projekte/mipsonline/download/MIT_v2.pdf>.p3(clay),p8(cement).

American Clay Enterprises, *American Clay Finishes™ Clay Veneer Plaster Product Specifications*. 18/Dec 2003. *American Clay Enterprises*, 5/Sep/2005 <<http://www.americanclay.com/pdfs/ProductSpecs.pdf>>.

Athena Swentzell Steen and Bill Steen, *Artistry in Clay & Lime*. 3/Jun 2005, The Canelo Project, 5/Sep/2005 <<http://www.caneloproject.com/pages/workshops/clayartistry.html>>.

⁴⁸Michael Clar, *Buckeye Development, LLC - Pembroke Woods Low Impact Development*. Feb 2000, Buckeye Development, LLC, 5/Sep/2005 <<http://www.buckeyedevelopment.net/lowimpactdevelopment.htm>>.

⁴⁹U.S. Department of Housing and Urban Development Partnership for Advancing Technology in Housing, *Affordability and Value Through Housing Technology Program and Services Guide*. 20/Jun 2002. U.S. Department of Housing and Urban Development Partnership for Advancing Technology in Housing, 5/Sep/2005 <<http://www.huduser.org/publications/pdf/guidetoserv.pdf>>.p3.

⁵⁰The Aluminum Association, Inc., *Aluminum Association | Climate Change*. 2004, Environment and Climate Change - Conservation, Preservation, and Recycling, The Aluminum Association, Inc., 5/Sep/2005 <http://www.aluminum.org/Content/NavigationMenu/The_Industry/Government_Policy/Climate_Change/Climate_Change.htm>.

⁵¹Alex Wilson, "Insulation Materials: Environmental Comparisons," *Environmental Building News* 4, no. 1 Jan/Feb 1995, BuildingGreen.Com, 5/Sep/2005 <<http://www.buildinggreen.com/auth/article.cfm?fileName=040101a.xml>>.

More recent data from the United States National Institute of Standards and Technology suggests essentially the same thing.

Barbara C. Lippiatt, BEES 2.0 -Building for Environmental and Economic Sustainability Technical Manual and User Guide, Jun/2000). June 2000. Office of Applied Economics, Building and Fire Research Laboratory, National Institute of Standards and Technology, 5/Sep/2005 <<http://museum.nist.gov/exhibits/timeline/PDF/BEES.PDF>>.pp 62,65.

A contractor for the EPA analyzed the same BEES database and came to the opposite conclusion: United States Environmental Protection Agency Office of Research and Development, Framework for Responsible Environmental Decision Making (FRED): Using Life Cycle Assessment to Evaluate Preferability of Products, Oct 2000), EPA/600/R-00/095. June 2001. United States Environmental Protection Agency Office of Research and Development, 5/Sep/2005 <<http://www.lcacenter.org/library/pdf/fred.pdf>>.pB-5.

Their conclusion does not seem to match the data. Where BEES database, as added up in manual site shows cellulose requiring about one fifth the energy input (for manufacturing and raw materials combined) as fiberglass, the FRED example shows cellulose requiring more than **20 times** the energy per kilogram. Since this varies from every other analysis ever done to be believed it would have to more specific as to where the difference came from.

For example the Minnesota Building Database shows about one tenth the global warming impact for cellulose as fiberglass

University of Minnesota College of Architecture and Landscape Architecture Center for Sustainable Building Research, "Minnesota Building Materials Database - Generic Fiberglass Batt," *Minnesota Building Materials Database*, 26/May 2004, University of Minnesota College of Architecture and Landscape Architecture Center for Sustainable Building Research, 5/Sep/2005 <http://www.buildingmaterials.umn.edu/07211_batt_be.html>.

University of Minnesota College of Architecture and Landscape Architecture Center for Sustainable Building Research, "Minnesota Building Materials Database - Blown Cellulose," *Minnesota Building Materials Database*, 26/May 2004, University of Minnesota College of Architecture and Landscape Architecture Center for Sustainable Building Research, 5/Sep/2005 <http://www.buildingmaterials.umn.edu/07210_blown_be.html>.

⁵² Food and Agriculture Organization of the United Nations (FAO)., "Food Balance Sheet," *FAOSTAT Online Database 2004. Commodity Balances Database - Production*. Aug 2004, Food and Agriculture Organization of the United Nations (FAO)., 10/Sep/2005
<<http://faostat.fao.org/faostat/servlet/XteServlet3?OutputLanguage=english&Areas=ALL&Items=2901&Years=2001&Years=2000&Domain=FBS&ItemTypes=FBS&language=EN&Codes=ShowCodes>>.

⁵³Economic Research Unit United States Department of Agriculture, *ERS/USDA Briefing Room - Global Food Security: Questions and Answers*. 11/May 2005, Economic Research Unit United States Department of Agriculture, 10/Sep/2005 <<http://www.ers.usda.gov/Briefing/GlobalFoodSecurity/questions/>>.

⁵⁴Institute of Medicine of the National Academies, *Dietary Reference Intakes: Macronutrients*. May 2005, National Academy of Sciences, 10/Sep/2005 <<http://www.iom.edu/Object.File/Master/7/300/0.pdf>>.p4.

⁵⁵ U.S. Census Bureau, "World Population: Total Midyear Population," *Intenational Data Base*, 30/April 2004, U.S. Census Bureau, 25/May/2004 <<http://www.census.gov/ipc/www/worldpop.html>>.

⁵⁶ Brian Halweil, "Can Organic Farming Feed Us All?". *World Watch Magazine* 19, no. 3 May/Jun 2006*The Organic Center*, Worldwatch Institute, Jan-03-2007 <<http://www.organic-center.org/reportfiles/EP193A.Halweil.pdf>>.

⁵⁷ Food and Agriculture Organization of the United Nations (FAO)., *FAOSTAT Online Database 2004 - Crops Primary*. Aug 2004, Food and Agriculture Organization of the United Nations (FAO)., 10/Sep/2005 <<http://faostat.fao.org/faostat/servlet/XteServlet3?Areas=231&Items=%3E1714&Elements=31&Years=2000&Format=Table&Xaxis=Countries&Yaxis=Items&Aggregate=&Calculate=&Domain=SUA&ItemTypes=Production.Crops.Primary&language=EN>>.

U.S. Grain harvest in 2000 in hectares equal	58,497,083
U.S. agricultural harvest from cropland in 2000 equals	136,057,883

So ~43% of total cropland harvested in 2000 was grain.

World Resources Institute, "Meat Consumption: Grain Fed to Livestock as a Percent of Total Grain Consumed," *EarthTrends Environmental Portal - Environmental Information Database*, 2004, World Resources Institute, 10/Sep/2005 <http://earthtrends.wri.org/searchable_db/results.cfm?years=1999-2000,2000-2001,2001-2002,2002-2003,2003-2004&variable_ID=348&theme=8&cID=190&ccID=0>.
From 60% to 65% of U.S. grain is fed to animals,
So around 27% of U.S. cropland used to grow food for animals

⁵⁸ Food and Agriculture Organization of the United Nations (FAO)., *FAOSTAT Online Database 2003 - Crops Primary*. Aug 2004, Food and Agriculture Organization of the United Nations (FAO)., 10/Sep/2005 <<http://faostat.fao.org/faostat/servlet/XteServlet3?Areas=862&Items=%3E1714&Elements=31&Years=2000&Format=Table&Xaxis=Years&Yaxis=Countries&Aggregate=&Calculate=&Domain=SUA&ItemTypes=Production.Crops.Primary&language=EN>>.

Total Crops Worldwide 2000 (Ha)	1,348,840,594
Total Crops World Wide Grain (Ha)	674,247,980

So ~50% of harvested primary crop acreage used for grain in 2000

World Resources Institute, "Meat Consumption: Grain Fed to Livestock as a Percent of Total Grain Consumed," *EarthTrends Environmental Portal - Environmental Information Database*, 2004, World Resources Institute, 10/Sep/2005 <http://earthtrends.wri.org/searchable_db/results.cfm?years=1999-2000,2000-2001,2001-2002,2002-2003,2003-2004&variable_ID=348&theme=8&cID=190&ccID=0>.
Around 37% of grain crops worldwide fed to animals.
~37% of ~50%=~18.5% of total cropland worldwide used to grow grain for animals.

⁵⁹Joel Salatin, a grass-fed beef pioneer and author makes the point from a stockman's viewpoint:

Roughly speaking, land that will produce 100 bushel-per-acre corn, will produce 400 cow-day[s] forage (one cow day is what one cow will eat in one day--cow-days are to graziers what inches are to carpenters and board-feet are to lumberjacks). If 100 bushels (average 60 pounds per bushel, weight 6,000 pounds), that will produce about 857 pounds of beef.

At 400 cow-days we can carry 600 stocker calves (400-800 lb.) gaining at least 1.5 pounds per day, yielding 900 lbs. (600 X 1.5 = 900) of beef per acre.

..... The point is to move the stock to mimic grazing patterns of native herbivores...

... Under good controlled grazing, we allow the grass to recuperate through its "blaze of growth" period before being regrazed... ..By keeping 98% of the farm at rest and in the fast growth period, not letting the forage get grazed too early or too late after growth slows down, we can see tremendous increases in forage growth...

.... Most parasites lose strength dramatically after being denied a host for three weeks. Since most paddock shifts occur at least three weeks apart..., this depletes parasite virility and reduces the need for wormers..

.... Because the animals lounge in different paddocks every day, they spread their manure more evenly over the pasture...

Joel Salatin, "Joel Salatin Introduces Livestock Grazing... 'Salad Bar Beef,'" *Acres USA - A Voice for Eco-Agriculture* March 1996 *Eco-Friendly Foods*, 10/Sep/2005
<<http://www.ecofriendly.com/index.cfm?section=4&page=20>>.

⁶⁰Cutler J. Cleveland and Charles A. S. Hall, "Climate Change Human Driving Forces, Biophysical Basis, and Likely Impacts," *Climate Change - Socioeconomic Dimensions and Consequences of Mitigation*, ed. Pentti Vartia, 2000). Oct 1999. *Fortum*, Boston University, 11/Sep/2005
<<http://www.bu.edu/cees/research/workingp/pdfs/9910.pdf>>.p9.

⁶¹Jimmy Henning et al., *Rotational Grazing*, 2000), ID-143. 2000. *Cooperative Extension Service - University of Kentucky, Department of Agriculture*, 13/Sep/2005
<<http://www.ca.uky.edu/agc/pubs/id/id143/id143.pdf>>.

State of Illinois Department of Agriculture Illinois Sustainable Agriculture Committee, "S/A 98-18 Sustainable Beef Production - Management Intensive Grazing Vs Corn Silage Program for Beef Stocker Calves.," *Sustainable Agriculture Grant Review Committee C2000 Sustainable Agriculture Grant Projects - ON-FARM RESEARCH AND DEMONSTRATION*. Oct 2001. *State of Illinois Department of Agriculture Illinois Sustainable Agriculture Committee*, State of Illinois Department of Agriculture Illinois Sustainable Agriculture Committee, 13/Sep/2005
<<http://www.agr.state.il.us/C2000/fy00/FY00Report.pdf>>.pp6-17

(*Note: total beef production over the three year period was about one third the per acre production from corn.. However this was an experimental program grazing basically two forages - alfalfa /orchard grass during warm weather, and small grain cereal rye during cool. A more experienced grazer with a wider variety of forages could expect better results - especially if drought resistant varieties were used. Also the cattle tested were largely bred as feedlot animals. Forage animals in pasture compared to feedlot breeds on grain would be a better test. However, even with the lower production per acre, cost per pound of beef, and especially labor per pound of beef was lower with grass raised.)

Center for Integrated Agricultural Systems of the University of Wisconsin's College of Agricultural and Life Sciences, *CIAS: Management Intensive Rotational Grazing's Sense..and Dollars*. April 1996, Center for Integrated Agricultural Systems of the University of Wisconsin's College of Agricultural and Life Sciences, 13/Sep/2005

<http://www.cias.wisc.edu/archives/2000/01/04/dairy_grazing_can_provide_good_financial_return/index.php>.

(The milk per acre is slightly lower, but labor costs are MUCH lower, as are feed costs and capital costs. So even with no price premium the farmer would make higher profits.)

Also, Ibid 59

⁶²Richard Cowan, "U.S. Group Blasts Creekstone Mad Cow Testing Plan," *Reuters Via Forbes.Com* 19/Apr 2004, Forbes, 14/May/2004
<<http://www.forbes.com/markets/newswire/2004/04/19/rtr1336959.html>>.

⁶³Donald Lobb, "No-Till Success Hinges on Developing a Complete Crop Production 'System,'" *Sustainable Farming*, no. Winter 94 (1994)*Ecological Agriculture Projects, McGill University (Macdonald Campus)*, Resource Efficient Agricultural Production - Canada (REAP-CANADA), 17/Sep/2005
<<http://www.eap.mcgill.ca/MagRack/SF/Winter%2094%20I.htm>>.

⁶⁴Sara Wright, *Glomalin: A Manageable Soil Glue*. 2004, USDA Sustainable Agricultural Systems Laboratory, 26/May/2004 <<http://www.ba.ars.usda.gov/sasl/research/glomalin/brochure.pdf>>.

⁶⁵Preston Sullivan, *Conservation Tillage*, Jul-2003). *Appropriate Technology Transfer For Rural Areas*. Aug 2003. *National Center for Appropriate Technology*, 26/May/2004 <<http://attra.ncat.org/attra-pub/PDF/consertill.pdf>>.Pp2-3.

Corliss Karasov, "No-Till Farming on Comeback Trail," *Environmental Health Perspectives* 110, no. 2 Feb 2002, 1/Jun/2004 <<http://www.greennature.com/article833.html>>.

⁶⁶Laura Sayre, "New Farm Research: Cover Crop Roller," *The New Farm*, 20/Nov 2003, The Rodale Institute, 7/May/2005 <http://www.newfarm.org/depts/NFfield_trials/1103/notillroller.shtml>.

⁶⁷Emma Marris, "Black is the New Green," *Nature* 442, no. 10 Aug 2006, Charcoal Sequestering Carbon in Soil, Nature Publishing Group, Jan-03-2007
<http://www.bestenergies.com/downloads/naturemag_200604.pdf>.

⁶⁸Greg Gunthorp and Lei Gunthorp, *Grassfarmer.Com - PASTURED PIGS ON THE GUNTHORP FARM*. 24/Feb 2004, American Farmland Trust, 13/Sep/2005 <<http://grassfarmer.com/pigs/gun1.html>>.

Sustainable Agriculture Network, *Profitable Pork:Strategies for Hog Producers. Livestock Alternatives*. Jul 2003. *Sustainable Agriculture Network*, Sustainable Agriculture Research and Education Program, 31/May/2004 <<http://www.sare.org/publications/hogs/profpork.pdf>>.

⁶⁹Roger Segelken (ED), "U.S. Could Feed 800 Million People with Grain That Livestock Eat, Cornell Ecologist Advises Animal Scientists," *Cornell University Science News*, 7/Aug 1997, Cornell University, 13/Sep/2005 <<http://www.news.cornell.edu/science/Aug97/livestock.hrs.html>>.

⁷⁰Hempopotamus, *All About Hemp*. 2004, Industrial Hemp, Hempopotamus, 22/Jun/2004
<<http://www.hemphouse.com/docs/hempinfo.html>>.

⁷¹John Jeavons, "Cultivating Our Garden: Biointensive Farming Uses Less Water, Land, Machinery, and Fertilizer - and More Human Labor," *In Context*, no. 42/Fall 1995 - A Good Harvest (1995), Context Institute, 17/Sep/2005 <<http://www.context.org/ICLIB/IC42/Jeavons.htm>>.p34.

⁷² United States Environmental Protection Agency, *How We Use Water In These United States*. 18/March 2003, United States Environmental Protection Agency, 06/Jul/2005
<<http://www.epa.gov/watrhome/you/chap1.html>>.

⁷³Micro-irrigation system (drip + sprinkler) about 5.7% of total irrigated acreage
Various gravity forms (at 50%) are about 43.9% of total irrigated acreage
Other sprinklers irrigate about 51.2% of total irrigated acreage
United States Department of Agriculture National Agricultural Statistics Department, *2003 Farm & Ranch Irrigation Survey (2002 Census of Agriculture) Volume 3, Special Studies, Part 1*. Nov 2004. United States Department of Agriculture National Agricultural Statistics Department, 28/Oct/2005
<<http://www.nass.usda.gov/census/census02/fris/fris03.pdf>>.p8.

Table 4. Land Irrigated by Method of Water Distribution: 2003 and 1998

Micro irrigation systems average around 82.5% irrigation efficiency
Gravity irrigation systems average around 50% irrigation efficiency
Other sprinkler average around 70% irrigation efficiency

Michael D. Dukes, *Types and Efficiency of Florida Irrigation Systems*, (Note: Data Used Was from National Sources). Dec 2002. University of Florida - Agricultural and Biological Engineering Dept, 28/Oct/2005
<http://www.gen.ufl.edu/~mdukes/publications/Types_and_Efficiency_of_Florida_Irrigation_Systems.pdf>..p8.

So applying the efficiency numbers from the second source to the acreage in the first, we can calculate that current average irrigation efficiency is around 62%. If that average efficiency was upgrade to micro-irrigation levels we would reduce water use for irrigation nationally by an average of one third.

⁷⁴I. Broner, *Irrigation: Tailwater Recovery for Surface Irrigation. Crop Series*, 4.709. 1998. Colorado State University Cooperative Extension, 17/Sep/2005 <<http://www.ext.colostate.edu/pubs/crops/04709.PDF>>.

⁷⁵Pacific Northwest Pollution Prevention Resource Center, "Topical Reports -Energy and Water Efficiency for Semiconductor Manufacturing," *Pollution Prevention (P2) Pays - N.C. Division of Pollution Prevention and Environmental Assistance*, Feb 2000, Pacific Northwest Pollution Prevention Resource Center, 17/Sep/2005 <<http://www.p2pays.org/ref/04/03271/>>.

⁷⁶Hidetoshi Wakamatsu, Akira Mayuzumi, and Norio Tanaka, "Effective Utilization Technology for Ultra Purewater, Chemical Liquids and Waste Materials on Semiconductor Manufacturing Plant,". *OKI Technical Review* 68, no. 188: Special Edition on the Environment Dec 2001, Oki Industry Co. Ltd - Environment Division, 23/May/2004 <<http://www.oki.com/en/otr/downloads/otr-188-06.pdf>>.pp23 – 27.

⁷⁷Stanford University News Service, *Can Computer Chip Makers Reduce Environmental Impact?* 5/Jun 1996, Stanford University News Service, 4/Jun/2004 <<http://www.stanford.edu/dept/news/pr/96/960605chipsenvir.html>>.

⁷⁸Eric Williams, "Energy Intensity of Computer Manufacturing: Hybrid Assessment Combining Process and Economic Input-Output Methods,". *Environmental Science & Technology* 38, no. 22 15/Nov 2004, American Chemical Society, 18/Sep/2005 <<http://www.it-environment.org/publications/hybrid%20PC%20LCA%20abstract.pdf> or full version(paid) <http://pubs.acs.org/cgi-bin/article.cgi/esthag/2004/38/i22/pdf/es035152j.pdf>>.pp6166 – 6174.

⁷⁹EEOCO - A Transico Company, *EEOCO-Greenä SILVER-THROUGH-HOLE DOUBLE-SIDED PRINTED CIRCUIT BOARDS PRODUCT OVERVIEW DESIGN CONSIDERATIONS FAQ's*. Dec 2003, EEOCO - A Transico Company, 22/May/2004 <<http://www.eecoswitch.com/PDF%20Files/STH%20FAQs.PDF>>.

⁸⁰Sumitomo Bakelite Co. Ltd., *Products That Provide Environmental Solutions*. Jan 2004. Sumitomo Bakelite Co. Ltd., 4/Jun/2004 <http://www.sumibe.co.jp/english/kankyoku/pdf/rc2003_E06.pdf>.

⁸¹ Jonathan G. Overly, Lori E. Kincaid, and Jack R. Geibig, "Chapter 3: LIFE-CYCLE IMPACT ASSESSMENT," *Desktop Computer Displays: A Life-Cycle Assessment*, EPA-744-R-01-004a. Dec 2001. Environmental Protection Agency, 18/Mar/2005 <<http://www.epa.gov/dfe/pubs/comp-dic/lca/Ch3.pdf>>.pp3-30.
Table 3-10. Baseline life-cycle impact category indicators

⁸²Sharp Corporation, *Sharp Environmental Report 2002*, April 2001 - March 2002. December 2002. Sharp Corporation, 20/Mar/2005 <http://sharp-world.com/corporate/eco/report/2002pdf/report_2002.pdf>.p9.

⁸³Richard T. Carson and Nadja Marinova, *Running on Air*, Sep-1999). *Institute on Global Conflict and Cooperation IGCC Policy Briefs*, ISSN 1089-8352 Policy Brief Number 13. 21/Feb 2005. *Institute on Global Conflict and Cooperation (IGCC)*, 18/Mar/2005 <<http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1088&context=igcc>>.

⁸⁴Keirsten Scanlon, *Poison PCs and Toxic TVs: California's Biggest Environmental Crisis That You've Never Heard of*. Jun 2001. *Silicon Valley Toxics Coalition; Californians Against Waste; Materials for the Future*, 6/Jun/2004 <<http://www.cawrecycles.org/Ewaste/PPCs%20and%20TTVs/ppc-ttv.pdf>>.
Citing: the Electronic Product Recovery and Recycling Baseline Report, published in May, 1999 by the US National Safety Council

⁸⁵Friedrich Bio Schmidt-Bleek, *MIPSBOOK or The Fossil Makers -Factor 10 and More*, ed. Reuben(Trans) Deumling, 1994), ISBN 3-7643-2959-9. *Birkhäuser: Basel, Boston, Berlin*, Wuppertal Institute for Climate, Environment, Energy, 3/Aug/2004 <<http://prog2000.casaccia.enea.it/nuovo/documenti/427.doc>>.

⁸⁶ "Steel Producers Target Canned Foods,". *Packaging World Magazine* July 1995*Packaging World Magazine Online*, Summit Publishing, 9/Jun/2004 <<http://www.packworld.com/articles/Features/1064.html>>.

Note: this is an article favoring steel cans over foil packs for coffee. I analyzed information from this article so as to make to make sure I was not being over-optimistic. So again I repeat - this is information from steel can makers - people who favor steel cans over foil packs.

Modern steel cans for coffee weigh 17 pounds vs. 3 pounds for a steel brick. This is still an 80%+ reduction.

Here are the invalid arguments:

- 1) The most popular can quantity is 13 pounds not 17 pounds. Right, but a 13 pound can holds fewer servings than a 3 pound brick. A 17 pound can remains the correct comparison. If you insist on using 13 pound cans as a comparison then you have to take a fraction of the weight of a second 13 pound can and allocate it - which would result in a less favorable result for steel than a single 17 pound can.
- 2) The second argument is one from recycling. About 64% of steel cans are recycled, whereas foil pack currently are not. The problem with this is that recycling a steel can does not cut its impact in half. It would not even if the steel cans were simple rinsed out and had a new lid put on them. But in fact that is not how steel cans are recycled. They are melted down and used as sources to make new steel from. That new steel does have about 1/2 the material intensity of steel from raw ore, but then the energy and impacts of shaping the steel and making the cans are about the same. So long as the foil pack is not recycled we end up with about a 65% reduction - still significant. However we are not looking just at current practices, but at what practices we need to adapt. So we could theoretically recycle close to 100% of steel cans (those cans being used in households to hold nails and such making up for those not recycled). So that ends up as only a 60% reduction using foil wrap - still better than coffee cans. But if

we are looking at this, it is not impossible to recycle this kind of wrap. If you reduce the variety of plastic, using only one metal and one plastic, as we shall see later on it is possible to separate out the metal and plastic. Or you can use the combination to make plastic lumber. So if you recycle both you end up with an 80% net reduction again.

⁸⁷Association of Cities and Regions for Recycling, *Good Practices Guide on Waste Plastics Recycling: A Guide by and For Local and Regional Authorities - 2004*, ed. Jean-Pierre Hannequart. Feb 2004. Association of Cities and Regions for Recycling, 10/May/2005 <<http://www.ecvm.org/img/db/ACRRReport.pdf>>.p83.

⁸⁸Azom.com Pty Ltd, *Aluminium Packaging (Focus on Europe)*. 2002, Azom.Com Pty Ltd, 9/Jun/2004 <http://www.azom.com/details.asp?ArticleID=1396#_Advantages_of_Aluminium>.

⁸⁹Environment and Plastics Industry Council (EPIC), *Plastics and Source Reduction*. Sep 2001. Environment and Plastics Industry Council (EPIC), 9/Jun/2004 <<http://www.cpia.ca/epic/docs/factsheets/Source%20Reduction.PDF>>.

⁹⁰Flexible Packaging Association, *Examples of Source Reduction*. Flexible Packaging Association, 9/Jun/2004 <<http://www.flexpack.org/enviro/09srexamples.htm>>.

⁹¹Envirowise, *Retail Supply Chain Distributes Cost Savings from Improved Packaging - A Case Study from the Book Industry*. Envirowise Case Studies, CS332. Mar 2002. Envirowise, 14/May/2004 <[http://www.envirowise.gov.uk/envirowisev3.nsf/0/EAE528C70CD5852480256CE5004C7095/\\$File/CS332.pdf](http://www.envirowise.gov.uk/envirowisev3.nsf/0/EAE528C70CD5852480256CE5004C7095/$File/CS332.pdf)>.

⁹²Envirowise, *Packaging Rethink Boosts Profits: A Good Practice Case Study At Harman Pro Audio Manufacturing*. Environmental Technology Best Practice Programme, GC275 Final Results. Oct 2000. Envirowise, 14/May/2004 <[http://www.envirowise.gov.uk/envirowisev3.nsf/0/17A681225D041DE080256CE5004C71EC/\\$File/GC275.pdf](http://www.envirowise.gov.uk/envirowisev3.nsf/0/17A681225D041DE080256CE5004C71EC/$File/GC275.pdf)>.

⁹³Figures for 1999, but without packaging, and with a total for 1998(not 1999) that excludes building paper: Peter J. Ince and Irene Durbak, "Pulpwood Supply and Demand: Development in the South, Little Growth Elsewhere,". *Journal of Forestry* 100, no. 2 1/Mar 2002, Society of American Foresters, 18/Sep/2005 <<http://www.fpl.fs.fed.us/documnts/pdf2002/ince02b.pdf>>.pp20-21.

Totals for 1998 and 1999 paperboard – which is the bulk of paper products not including building paper. James L. Howard, U.S. Timber Production, Trade, Consumption, and Price Statistics 1965-1999, FPL-RP-595. April 2001. United States Department of Agriculture Forest Service Forest Products Laboratory, 18/Sep/2005 <<http://www.fpl.fs.fed.us/documnts/fplrp/fplrp595.pdf>>.p71.

Table 45—Paperboard production, imports, exports, and consumption, 1965–1999

Using the growth consumption between 1998 and 1999 from the above I was able to take the 1998 total from the first source and estimate the 1999 total consumption. Given 1999 total consumption and every other category, 1999 packaging may then be calculated by subtraction.

⁹⁴Mark J Lytle, "Library Without Books,". *The Guardian (Guardian Unlimited)* 22/Apr 2004, 11/Jun/2004 <<http://www.guardian.co.uk/online/story/0,3605,1197495,00.html>>.

⁹⁵Reuters, *Let's Make Reading Better!* 9/Feb 2004, IT supplement of The Tribune, The Tribune of India, 20/Sep/2005 <<http://www.tribuneindia.com/2004/20040209/login/main3.htm>>.

⁹⁶Advertising accounts for around 65% of daily revenues, circulation for 35%, while newsprint accounts for about one third of total costs. Allowing for profit (so that one third of revenues does not equal one third of

costs), this means printing a typical daily U.S. newspaper costs well over half, and perhaps as much as 90% of the subscription price.

"Newspaper," *Microsoft® Encarta® Online Encyclopedia*. 2004, 11/Jun/2004 <http://encarta.msn.com/text_761564853___62/Newspaper.html>.

⁹⁷Lyad Atuan et al., *Life-Cycle Assessment of Desktop Computer Display*. Mar 2004. *None - Term Project in Masters Level Class*, 6/Jun/2004 <<http://s93889521.onlinehome.us/docs/mie415.pdf>>.

(Please note that this is only student project in a masters program. However it tracks quite closely to the EPA result for CRT and LED monitors, using differing sources. So it is not an unreasonable source for the saving for e-ink – especially since we are not talking about a big difference in any case.)

⁹⁸ 2002 paper consumption was 21.4 kg per person
Clare Walker, *Melbourne Central Green Office 2002 Performance Report*. Jul 2003. *BP Australia*, 11/Jun/2004 <http://www.bp.com.au/environmental_social/green_office_2002_report.pdf>.p6.

According to the 2001 report, the 1997 bench was 55 kg per person. So that was indeed a 61% reduction. Also there were layoffs and hours per person increased - so this may understate the saving.
Kerryn Schrank, *Melbourne Central Green Office 2001 Performance Report*. Aug 2002. *BP Australia*, 11/Jun/2004 <http://www.bp.com.au/environmental_social/green_office_2001_report.pdf>.p4.

⁹⁹Brad Wallace, "Paper Reduction Program Saves Money And The Environment," *Knowledge Bank Articles*, 28/Sep 2004, *Innovative Management Systems*, 20/Sep/2004 <http://www.solutions.ca/Knowledge_Bank/Articles/article.asp?doc_id=158>.

¹⁰⁰ Abigail J. Sellen and Richard Harper, *The Myth of the Paperless Office* (Cambridge MA USA: MIT Press, 2001).

¹⁰¹David Stewart, "Ensuring Effective Insurance Thanks to Paperless Office," *SiliconRepublic.Com - Ireland's Technology News Service* 19/Apr 2004 *Case Studies*, *Silcon Republic - Dublin*, 11/Jun/2004 <<http://www.siliconrepublic.com/news/news.nv?uid=lipowg&sid=C5mmenoD&storyid=single3087>>.

¹⁰² Mike Martin, "Paperless Office: Case Studies Show How and Why," *Computer Bits* 14, no. 1 Jan 2004, Bitwise Productions Portland Oregon, 14/Jun/2004 <<http://www.computerbits.com/archive/2004/0100/paperless.html> (if no longer good cache at: <http://66.102.7.104/search?q=cache:IrULwCmYYXYJ:www.computerbits.com/archive/2004/0100/paperless.html>)>.

¹⁰³ KP Products, *About The Kenaf Plant*. 14/Jan 2005, *KP Products*, 20/Sep/2005 <<http://www.visionpaper.com/kenaf2.html>>.

¹⁰⁴Jame A. Rydelius, *Growing Eucalyptus for Pulp and Energy. Mechanization in Short Rotation, Intensive Culture Forestry Conference, Mobile, AL, March 1-3, 1994*. Mar 1994, *Short Rotation Woody Crops Operations Working Group* (Established by DOE ORNL, USDA and EPRI), 14/Jun/2004 <<http://www.woodycrops.org/mechconf/rydeliu.html>>.

¹⁰⁵ Gene Stevenson, *90 Years' Results Say Yes to Winter Legumes, Crop Rotations*. 9/Feb 1989, *College of Agriculture: Auburn University Alabama Agricultural Experiment Station*, 15/Jun/2004 <<http://www.ag.auburn.edu/aaes/webpress/1989/rotations.htm>>.

¹⁰⁶Charles Mitchell, Wayne Reeves, and Dennis Delany, "Breaking Records: Sensible Management Helps Alabama's Long Term Experiments Net Record Yields," *Online Highlights: A Magazine of Research from the Alabama Agricultural Research Station at Auburn University* 48, no. 3 Fall 2001, *College of*

Agriculture: Auburn University Alabama Agricultural Experiment Station, 15/Jun/2004 <<http://www.ag.auburn.edu/aaes/communications/highlightsonline/fall01/fall-mitchell.html>>.

¹⁰⁷ Jane N. Abramovitz and Ashley T. Mattoon, *Paper Cuts:: Recovering the Paper Landscape*, ed. Jane A. Peterson, WorldWatch Paper 149. Dec 1999. *Worldwatch Institute*, 16/Jun/2004 <<http://www.worldwatch.org/pubs/download/EWP149/>>.p21.

Figure 5

¹⁰⁸ David R. Darr, *U.S. Forest Resources*. 28/Sep 2000, U.S. Forest Service, 15/Jun/2004 <<http://biology.usgs.gov/s+t/noframe/m1103.htm>>.

¹⁰⁹ Jim Motavalli, "Beyond Wood | Tree-Free and Chlorine-Free Papers Offer Sound Alternatives to Forest Destruction," *E, The Environmental Magazine* IX, no. 1 Jan-Feb 1998, Earth Action Network, Inc., 1/Oct/2005 <<http://www.emagazine.com/view/?41>>.

¹¹⁰ U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS); Iowa State University's Center for Survey Statistics and Methodology, *2002 Annual Natural Resources Inventory: Land Use*. April 2004. *U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS); Iowa State University's Center for Survey Statistics and Methodology*, 15/Jun/2004 <<http://www.nrcs.usda.gov/technical/land/nri02/landuse.pdf>>.p2.

¹¹¹ Thomas A. Rymza, "Firm Profile: Vision Paper," *Journal of Industrial Ecology* 7, no. 3-4 May 2004, Massachusetts Institute of Technology and Yale University, 16/Jun/2004 <http://www.visionpaper.com/speeches_papers/jiec_7_3-4_215_0.pdf>.p217.

¹¹² Ibid 107 p49.

¹¹³ European Commission, *Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques in the Pulp and Paper Industry*. Dec 2001. *European Commission*, 20/Sep/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/ppm_bref_1201.pdf>.

¹¹⁴ "In 2003 the U.S. paper recovery rate achieved an all-time high of 50.3%. Paper recovery has increased steadily from 33.5% in 1990, to its present level of 50.3%." (Note that not all of the 50.3% recovered can be used. So, the actual recycling rate is less than 50%.)

American Forest and Paper Association, "Recycling," *Environment and Recycling*, 2005, American Forest and Paper Association, 21/Jun/2005 <http://www.afandpa.org/Content/NavigationMenu/Environment_and_Recycling/Recycling/Recycling.htm>.

¹¹⁵ European Recovered Paper Council; Confederation of European Paper Industries, *The European Declaration on Paper Recovery Annual Report 2000*. 14/Sep 2001, European Recovered Paper Council; Confederation of European Paper Industries, 21/Jun/2005 <http://www.paperrecovery.org/files/ERPC%20AR%202000_2.pdf>.p17.

Table 2-2 - CEPI – European Paper and Board and Recovered Statistic by Country in 2000 – 1000 tonnes

¹¹⁶ Ibid 27

¹¹⁷ Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT) - Austrian Industrial Research Promotion Fund, *Forschungsforum 1/1998 - Development of Evaluation Fields for Ecodesign*. 2002, Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT) - Austrian Industrial Research Promotion Fund, 22/Jun/2004 <[http://www.nachhaltigwirtschaften.at/\(print\)/publikationen/forschungsforum/981/teil2.en.html](http://www.nachhaltigwirtschaften.at/(print)/publikationen/forschungsforum/981/teil2.en.html)>.

¹¹⁸Franklin Associates, LTD, *Life Cycle Analysis (LCA): Woman's Knit Polyester Blouse -Final Report*. June 1993, American Fiber Manufacturers Association, 22/Jun/2004 <<http://www.fibersource.com/f-tutor/LCA-Page.htm>>.

¹¹⁹Richard Way, "Soap-Free Washers Explained: Soap-Free Washers Have Become a Reality. Richard Way Looks at Their Potential,". *Electrical Retailing Weekly* 20/Jun 2002, DMG World Media (UK) Ltd\, 22/Jun/2004 <http://www.findarticles.com/p/articles/mi_m0KZC/is_2002_June_20/ai_88579178>.

¹²⁰Katherine Noble-Goodman, "Washing Machine to Reduce Water Use, Eliminate Detergent,". *U.S. Water News Online* Oct 2001, U.S. Water News Inc., 22/Jun/2004 <<http://www.uswaternews.com/archives/arconserv/1wasmac10.html>>.

¹²¹Greenpeace USA, *A Rating Of Dry Cleaning Methods Currently In Use In The U.S.* Jul 2001, Greenpeace USA, 23/Sep/2005 <<http://www.greenpeace.org/raw/content/usa/press/reports/what-s-in-what-s-out-a-ratin.pdf>>.

¹²²South Coast Air Quality Management District, *Noh Says Yes to Wet Cleaning: Orange County Dry Cleaner Converts to Non-Toxic Process*. 19/Dec 2001, South Coast Air Quality Management District, 22/Jun/2004 <http://www.aqmd.gov/news1/2001/OC_Wet_Cleaner.htm>.

¹²³Hangers America, *Hangers America: Liquid CO2: The Benefits to Hangers Owners*. 16/Mar 2005, Hangers America, 23/Sep/2005 <http://www.hangersdrycleaners.com/co2_4.html>.

¹²⁴European Commission, *Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques for the Textiles Industry*. Jul 2003. *European Commission*, 2/Oct/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/txt_bref_0703.pdf>.p304.
Section 4.6.1

¹²⁵United States Environmental Protection Agency - Office of Compliance, *Profile of the Textile Industry. Sector Notebook Project*, EPN3 10-R-97-009. Sep 1997, United States Environmental Protection Agency - Office of Compliance, 23/Ju/2004 <<http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/textilsn.pdf>>.p75.

¹²⁶Ibid 125 p77.

¹²⁷ Ibid 125 p100.

¹²⁸ Ibid 125 p79.

¹²⁹ Ibid 125 p78.

¹³⁰ Ibid 124 p265.
Section 4.3.3

¹³¹ Ibid 124 pp267-268.
Section 4.3.4

¹³²Ibid 125 p79.

¹³³ Ibid 125 p80.

¹³⁴ Ibid 125 p.85.

¹³⁵ Ibid 124 p446.
Section 5.1

¹³⁶ Ibid 124 p353.
Section 4.6.21.3

¹³⁷ Ibid 124 p370.
Section 4.7.8

¹³⁸ Ibid 124 p371.
Section 4.7.9

¹³⁹ Ibid 125 p81.

¹⁴⁰ Ibid 125 p82.

¹⁴¹ Ibid 125 p82.

¹⁴² Ibid 125 p93.

¹⁴³ Ibid 124 p368.
Section 4.7.7

¹⁴⁴ Hempopotamus, *All About Hemp*. 2004, Industrial Hemp, Hempopotamus, 22/Jun/2004
<<http://www.hemphouse.com/docs/hempinfo.html>>.

¹⁴⁵ John A. Dearien, Struthers Richard D., and Kent D. McCarthy, *CyberTran: A Systems Analysis Solution to the High Cost and Low Passenger Appeal of Conventional Rail Transportation Systems*. Nov 2001, CyberTran International, Inc, 22/Jun/2004 <<http://www.cybertran.com/ctpaper.pdf>>.

¹⁴⁶ Ibid 145 P.5 (Note the cost per seat in examples given is five to ten times less. But once you include greater utilization from computation or routes on the one tenth the cost becomes a conservative estimate.)

¹⁴⁷ Stacey C. Davis and Susan W. Diegel, *TRANSPORTATION ENERGY DATA BOOK: - Edition 22*, ORNL-6967 (Edition 22 of ORNL-5198). Sep 2002. *Center for Transportation Analysis Science and Technology Division of the Oak Ridge National Laboratory for the U.S. DOE*, 23/Sep/2005 < [www-cta.ornl.gov/cta/Publications/Reports/ORNL-6967.pdf](http://www.cta.ornl.gov/cta/Publications/Reports/ORNL-6967.pdf) >.
Page 2-14 Table 2.11 Passenger Travel and Energy Use in the United States, 2000

¹⁴⁸ Dylan Saloner and Neil Garcia-Sinclair, "Environmental Impact of Ultra Light Rail Transit: Lessening the External Costs of Transportation," Alameda, California, 9/October 2006.pp 20-21.

¹⁴⁹ Ibid 148 p 5.

¹⁵⁰ Zipcar, Inc, *Get a Zipcard*. 2005, Zipcar, Inc, 23/Sep/2005 <<http://www.zipcar.com/apply/>>.

¹⁵¹ Flexcar. 2005, Flexcar, 23/Sep/2005 <<http://www.flexcar.com/>>.

¹⁵² Nina Borweger et al., *Car Sharing in Practice: The Tosca Takeup Guide. Information Society Programme*, Project Number: 1st-1999-20856. 24/Jan 2002. *Rupprecht Consult;European Comission* <<http://www.atc.bo.it/progetti/tosca/Take%20Up%20Guide%20Final.pdf>>.

¹⁵³ Parsons Brinckerhoff Quade & Douglas; Cambridge Systematics, Inc.;NuStats International, *RT-HIS Regional Travel -Household Interview Survey GENERAL FINAL REPORT*. Feb 2000. *New York Metropolitan Transportation Council (NYMTC); North Jersey Transportation Planning Authority (NJTPA)*, 24/Feb/2004 <<http://www.nymtc.org/files/fr00321.pdf>>.p83.
Table 51

¹⁵⁴ Ibid 15 p8-6.

Table 8.5: Demographic Statistics from the 1969, 1977, 1983, 1990, 1995 NPTS and 2001 NHTS

¹⁵⁵ Ibid 15 p2-7.

Table 2.5 - Transportation Energy Use by Mode, 2000–2001

¹⁵⁶ Ibid 147

Table 2.11 Passenger Travel and Energy Use in the United States, 2000

¹⁵⁷ Ibid 15

Table 2.14 - Intercity Freight Movement and Energy Use in the United States, 2001

¹⁵⁸ For number of class I freight cars and locomotives

U.S. Census Bureau, "Section 23 - Transportation," *Statistical Abstract of the United States*, 2002. 2002, U.S. Census Bureau, 22/Jun/2004 <<http://www.census.gov/prod/2003pubs/02statab/trans.pdf>>.p689. Section 23 - Table No.1089.Railroads,Class I —Summary:1990 to 2000 (for number of class I freight cars & locomotives)

Ibid 15 for number of trucks

¹⁵⁹ Ibid 158 p669.

No.1053.Highway Mileage—Functional Systems and Urban/Rural:2000

¹⁶⁰ Ibid 158

¹⁶¹ Cathy Keefe, "Business and Convention Travelers' Habits Tracked in New Survey," *Press Releases*, 8/Feb 2005, Travel Industry Association of America (TIA), 23/Sep/2005 <<http://www.tia.org/pressmedia/pressrec.asp?Item=359>>.

¹⁶² 60% of air trips are 400 miles or fewer.

Joe Sharkey, "Rail Projects Are Sign of a Quiet Revolution in Short-Haul Trips," *EcoCity Cleveland - Transportation Choices*, 4/Jun 2002, New York Times Inc., 23/Sep/2005 <http://www.ecocitycleveland.org/transportation/rail/nytimes_rail_article.html>.

70% of European domestic flights are 621 miles or under

Caroline Dr. Lucas, *The Future of Aviation: The Government's Consultation Document on Air Transport Policy - Submission from Dr Caroline Lucas, MEP, Green Party, and Member of the European Parliament's Transport Committee*. 2001. *European Parliament*, Green Party UK, 23/Sep/2005 <http://archive.greenparty.org.uk/reports/2001/aviation/av_fut_mep_resp.pdf>.

Since Europe has much better long distance passenger rail infrastructure than the U.S., it would be reasonable to assume that at least 60% of U.S. domestic flights are same length. Thus 500 miles is a reasonable interpolation between the two data points. Even if the second is thrown out, it is a conservative extrapolation of the first data point alone.

¹⁶³ Conrad Schneider, *Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios*. Jun 2004. *Clean Air Task Force* Abt Associates Inc, 24/Aug/2004 <http://cta.policy.net/dirtypower/docs/abt_powerplant_whitepaper.pdf>.

¹⁶⁴ Note the following are the document versions I downloaded. Point your ftp enabled browser to <ftp://ftp.jrc.es/pub/eippcb/doc/> for the latest versions – since these documents are revised often, and the particular FTP documents will probably have been replaced by more recent versions.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control Draft Reference Document on Best Available Techniques in the Large Volume Inorganic Chemicals - Solid and Others Industry*, Draft August 2004, Aug 2004, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 17/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/lvic-s_d1_0804.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques for Mineral Oil and Gas Refineries*, Final. Feb 2003, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/ref_final_0203.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques in the Large Volume Organic Chemical Industry*. Feb 2003, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 24/Sep/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/lvo_bref_0203.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities*, Final. Jul 2004, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/mmr_bref_0704.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Smitheries and Foundries Industry*. Jul 2004, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/sfo_bref_0704.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control Reference Document on Best Available Techniques on Emissions from Storage*. Jan 2005, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/esb_final_0105.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector*. Feb 2003, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/cww_final_0203.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control Draft Reference Document on Best Available Techniques in the Production of Polymers*, Draft. April 2005, European Commission Directorate-General Joint Research

Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/pol_d2_0405.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control Draft Reference Document on Best Available Techniques in the Food, Drink and Milk Industry*, Draft. May 2003, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/fdm_d2_0503.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control Draft Reference Document on Best Available Techniques in the Ceramic Manufacturing Industry*, Draft. Oct 2004, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/cer_d1_1004.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control Draft Reference Document on Best Available Techniques for the Surface Treatment of Metals and Plastics*, Draft. Apr 2004, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/stm_d2_0404.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control Draft Reference Document on Best Available Techniques for the Surface Treatment Using Organic Solvents*, Draft. May 2004, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/sts_d1_0504.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques in the Ferrous Metals Processing*. Dec 2001, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/fmp_bref_1201.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Reference Document on the Production of Iron and Steel*. Dec 2001, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/isp_bref_1201.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control (IPPC) Best Available Techniques Draft Reference Document for Large Combustion Plants*, Draft. Nov 2004, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/lcp_d3_1104.pdf>.

European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, *Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques in the Chlor-Alkali Manufacturing Industry*. Dec 2001, European Commission Directorate-General Joint Research Centre (JRC) Institute for Prospective Technological Studies Sustainability in Industry, Energy and Transport European - IPPC Bureau, 18/May/2005 <ftp://ftp.jrc.es/pub/eippcb/doc/cak_bref_1201.pdf>.

¹⁶⁵Martin Patel et al., "Chapter 14 Life-Cycle Assessment of Bio-Based Polymers and Natural Fiber Composites," *Biopolymers, Volume 10, General Aspects and Special Applications. Biopolymers, 10 Volumes with Index*, ed. Alexander Steinbüchel. April 2003. Wiley, 11/Jun/2004 <<http://www.chem.uu.nl/nws/www/general/personal/Biopoly.pdf>>.p409. (Summarized in Section 5)

¹⁶⁶Committee on Biobased Industrial Products, National Research Council, *Biobased Industrial Products: Research and Commercialization Priorities - Executive Summary*. 2000. National Academy of Sciences, 24/Sep/2005 <http://books.nap.edu/execsumm_pdf/5295.pdf>.

¹⁶⁷Judy Kincaid, *Industrial Ecosystem Development Project Report*. May 1999. Triangle J Council of Governments, 23/Sep/2005 <<ftp://ftp.tjcg.org/pub/solidwst/ieprept.pdf>>.

¹⁶⁸*The Kalundborg Centre for Industrial Symbiosis*, Kalundborg Municipality;Asnæs Power Station;The Statoil Refinery;BPB Gyproc A/S; Soilrem A/S;Novo Nordisk A/S;Novozymes A/S;Novoren I/S;Industrial Development Council - Kalundborg Region, 14/Aug/2004 <<http://www.symbiosis.dk/>>.

¹⁶⁹Energy Information Administration Office of Energy Markets and End Use - U.S. Department of Energy, *Annual Energy Review 2001*, DOE/EIA-0384(2001). Nov 2002, Energy Information Administration Office of Energy Markets and End Use - U.S. Department of Energy, 25/Sep/2005 <<http://tonto.eia.doe.gov/FTP/ROOT/multifuel/038401.pdf>>.p51. Table 2.4 Manufacturing Inputs for Heat, Power, and Electricity Generation by End Use, 1998

¹⁷⁰Arvind C. Thekdi, "Guest Column: Energy Savings in Industry Through Use of Insulation and Refractories,". *Energy Matters* May/June 2000: Best Practices, U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Industrial Technologies Program, 25/Sep/2005 <http://www.eere.energy.gov/industry/bestpractices/may2000_guest.htm>.

¹⁷¹U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Industrial Technologies Program, *Energy-Saving Lightweight Refractory: New Refractory Material Allows For Thinner, Lighter, And More Cost-Effective Manufacturing Of Kiln Furniture. Inventions and Innovation Project Fact Sheet*, DOE/GO-102001-1037. Feb 2001, U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Industrial Technologies Program, 5/Sep/2004 <<http://www.eere.energy.gov/inventions/pdfs/silicar.pdf>>.

¹⁷²h Christine L. Grahl, "Saving Energy with Raw Materials,". *Ceramic Industry* 1/Jul 2002, BNP Media, 25/Sep/2005 <<http://www.ceramicindustry.com/CDA/ArticleInformation/coverstory/BNPCoverStoryItem/0,2708,80846,00.html>>.

¹⁷³Tourism and Resources Australia Department of Industry, "Steam Leaks,". *Australian Energy News*, no. 16 June 2000, Australia Department of Industry, Tourism and Resources, 25/Sep/2005 <<http://www1.industry.gov.au/archive/pubs/aen/aen16/34steam.html> (Same info as old ASE site page <http://www.ase.org/programs/industrial/steam.htm#Table%201> which has disappeared)>.

Weil-McLain, *Straight Talk About Boiler Efficiency*. 21/Jan 2005, Weil-McLain, 25/Sep/2005
<<http://www.weil-mclain.com/netdocs/straighttalk.htm>>.

Weil-McLain calculates that single (non-adjustable) boilers tend to run at around 65% average efficiency, whereas multiple (or adjustable) boilers tend to run at around 80% average efficiency. This translates into slightly less than a 20% savings from the more efficient to the less efficient boiler.

Note that this is talking commercial boilers – used for space and hot water heating. But the same principals apply to industrial boilers; a boiler operates much less efficiently when used at less than capacity. So multiple boilers turned on as needed, so that all running boiler operate near maximum efficiency are more efficient than one big boiler running at less than maximum efficiency most of the time. Note there are two major limits to this. One is cost: many small boilers cost more than a few big ones. The second is that warming up and cooling down a boiler also costs energy. If you have too many boilers and spend a lot of time turning them on and off, you will waste more energy than you save. But the optimum is fairly easy to calculate on a plant by plant basis, and we are nowhere near it.

¹⁷⁵Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, *Minimize Boiler Short Cycling Losses. Tip Sheets*, Tip Sheet 16. Dec 2000. *Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy*, 8/Oct/2005
<http://www.eere.energy.gov/industry/bestpractices/pdfs/boil_cycl.pdf>.

Pacific Gas & Electric Company, *Energy Efficient Operations and Maintenance Strategies for Industrial Gas Burners. PG&E Energy Efficiency Information* © “*Industrial Gas Boiler O&M Strategies*”. 25/Apr 1997, Pacific Gas & Electric Company, 8/Oct/2005
<http://www.pge.com/003_save_energy/003c_edu_train/pec/info_resource/pdf/GASBOILR.PDF>.

CANMET Energy Technology Centre, Natural Resources Canada, "Chapter 2: Getting the Most For Your Fuel Bill," *An Energy Efficiency and Environment Primer for Boiler and Heaters*. 22/Jan 2003, CANMET Energy Technology Centre, Natural Resources Canada, 8/Oct/2005
<http://www.energysolutionscenter.org/BoilerBurner/Resources/Primer/Primer_Chap2.pdf>.

¹⁷⁶The Delta Institute, *Sector-Based Pollution Prevention: Toxic Reductions Through Energy Efficiency and Conservation Among Industrial Boilers: A Report to the United States EPA Great Lakes National Program Office*, GL97514402. July 2002. *The Delta Institute*, 25/Sep/2005 <<http://delta-institute.org/publications/boilers/SectorBasedP2.pdf>>.p16. (8.5X11 Pages)
Table 3-3

(Note: recommendation 3 in table 3-3 appears to have a multi-century payback because a period was substituted for a comma. The same number appears in table 3-2 in the document <http://www.delta-institute.org/publications/boilers/Table3-2.pdf> with comma in the proper place.)

¹⁷⁷Consortium for Energy Efficiency, Inc, *Motor Decisions Matter Energy Efficiency/Usage Fact Sheet*. ~2002, Consortium for Energy Efficiency, Inc (Consortium of Motor Industry Manufacturers and Service Centers, Trade Associations, Electric Utilities and Government Agencies), 25/Sep/2005 <http://www.motorsmatter.org/press/press_kit/energy_facts.html>.

¹⁷⁸ Ibid 22 p115.

Chapter 6, Tunneling through the Cost Barrier | Integrating Design to Capture multiple Benefits

¹⁷⁹ U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Industrial Technologies Program, *Energy Tips: Reduce Pumping Costs Through Optimum Pipe Sizing: Motor Tip Sheet # 1*, DOE/GO-10099-879. Dec 1999. *U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Industrial Technologies Program*, 16/Aug/2004
<<http://www.energystar.gov/ia/business/industry/motor1.pdf>>.

¹⁸⁰Paul Hawken, Amory Lovins, and L.Hunter Lovins, "Additional Book Material -Appendix 5-D," *Natural Capitalism*, Additional Material for Hawken, Lovins&Lovins "Natural Capitalism" - On-Line Only, 1999, Rocky Mountain Institute, 25/Sep/2005
<http://www.natcap.org/sitepages/art58.php?pageName=Additional%20Book%20Material&article_refresh=%2Fsitepages%2Fpid27.php%3FpageId%3D27>.

¹⁸¹The Atlas Project of the European Commission, *Estimated Long Term Technical Energy Savings Potential*. 7/Mar 2002, The Atlas Project of the European Commission, 17/Aug/2004
<http://europa.eu.int/comm/energy_transport/atlas/htmlu/ioeneffa.html>.

¹⁸²U.S. Department of Energy - Energy Information Administration, *E.Ig World Energy Intensity (Total Primary Energy Consumption Per Dollar of Gross Domestic Product),1980-2002 (Btu Per 1995 U.S. Dollars Using Market Exchange Rates)*. 25/Jun 2004, U.S. Department of Energy - Energy Information Administration, 18/Aug/2004 < <http://www.eia.doe.gov/pub/international/iealf/tablee1c.xls>>.

¹⁸³Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, *Energy-Efficient Food-Blanching System: New Blanching System Increases Productivity While Saving Energy. NICE 3 - National Industrial Competitiveness Through Energy, Environment, and Economics*. Mar 2002, Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy <<http://www.oit.doe.gov/nice3/factsheets/key.pdf> (Note:removed from web along with a lot of other federal energy information. I kept a copy; substitute URL on book site.)>.

¹⁸⁴ Joseph J. Romm, *Cool Companies: Proven Results - Cool Buildings*. 2005, Romm,Joseph J., 22/Aug/2005 <<http://www.cool-companies.com/proven/buildings.cfm>>.

¹⁸⁵ Industrial Technologies Program - Energy Efficiency and Renewable Energy • U.S. Department of Energy, *American Water Heater Company: Compressed Air System Optimization Project Saves Energy and Improves Production at Water Heater Plant. BestPractices Case Study*, DOE/GO-102003-1716. Nov 2003, Industrial Technologies Program - Energy Efficiency and Renewable Energy • U.S. Department of Energy, 26/Sep/2005 <<http://www.nrel.gov/docs/fy04osti/33648.pdf>>.

¹⁸⁶Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, *Weldcomputer® Resistance Welder Adaptive Control: Sophisticated Welding Control System Saves Energy, Improves Quality, and is Affordable for General Industrial Use. Inventions and Innovation Success Story*, I-OT-588. Jan 2002, Fice of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, 4/Sep/2005
<<http://www.eere.energy.gov/inventions/pdfs/weldcomp.pdf>>.

¹⁸⁷Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, *Mobile Zone Spray Booth Technology For Ultra-Efficient Surface Coating Operations: New Technology Saves Energy And Reduces Pollution During Surface Coating Operations. Inventions & Innovation*, I-OT-489. Dec 2001, Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, 5/Sep/2004
<<http://www.eere.energy.gov/inventions/pdfs/clydesmith.pdf>>.

¹⁸⁸Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, *Irrigation Valve Solenoid Energy Saver • New Battery-Powered Controllers Save Energy in Irrigation Applications. Agriculture Success Story*, I-OT-698. Sep 2001, Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, 5/Sep/2004
<<http://www.eere.energy.gov/inventions/pdfs/alextronix.pdf>>.

¹⁸⁹Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, *ENS Fan Saver For Medium-Temperature Walk-In Refrigerators • New Fan Saver Reduces Energy Consumption up to 50%. Inventions & Innovation*, I-OT-670. Oct 2001, Office of Industrial Technologies -

Energy Efficiency and Renewable Energy • U.S. Department of Energy, 6/Sep/2004
<<http://www.eere.energy.gov/inventions/pdfs/ensfansaver.pdf>>.

¹⁹⁰Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, *Thermodyne™ Evaporator - A Molded Pulp Products Dryer • New Technology Revolutionizes Pulp Product Drying. Forest Products Success Story*, I-FP-529. Apr 2002, Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, 6/Sep/2004
<<http://www.eere.energy.gov/inventions/pdfs/merrillaireng.pdf>>.

¹⁹¹Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, *Meta-Lax® Stress Relief Process - Greatly Reduces Energy Consumption and Eliminates Pollution. Metal Success Story*, I-MC-412. Aug 2002, Office of Industrial Technologies - Energy Efficiency and Renewable Energy • U.S. Department of Energy, 6/Sep/2004
<<http://www.eere.energy.gov/inventions/pdfs/bonaltech.pdf>>.

¹⁹²Ross A. Leventhal, "Sustainable in Seattle," *Architecture Week*, no. 101 5/Jun 2002: Environment, Artifice Inc., 6/Sep/2004 <http://www.architectureweek.com/2002/0605/environment_2-2.html>.pE2.2.

¹⁹³"Journeys-to-work using public transportation continued to take twice as long as private transportation, though there is only a slight difference in travel distance."
Ibid 147 p11-15.

¹⁹⁴Ibid 147 p11-12.

¹⁹⁵ John A. Dearien (Junior), "Ultralight Rail and Energy Use," in *Encyclopedia of Energy*, ed. Cutler J. Cleveland (Elsevier Publishing, March 2004), 255-66.

¹⁹⁶ Energy Conversion Devices, Inc., *Energy Conversion Devices, Inc. 1997 Letter to Stockholders - Commercializing Technologies That Enable the Information and Energy Industries*. Dec 1997, Energy Conversion Devices, Inc., 26/Sep/2005 <<http://www.ovonic.com/PDFs/LtrstoShldrs/ecd97ltr.pdf>>.p3.

¹⁹⁷Mark Duvall et al., *Advanced Batteries for Electric-Drive Vehicles : A Technology and Cost-Effectiveness Assessment for Battery Electric, Power Assist Hybrid Electric, and Plug-in Hybrid Electric Vehicles*, Preprint Report, Version 16. 25/March 2003, Electric Power Research Institute (EPRI), 03-Jan-2007 <http://www.epri.com/corporate/discover_epri/news/downloads/EPRI_AdvBatEV.pdf>.
Page v. - Battery cycles are over 2,000 cycles with almost no loss of capacity with deep discharge, even better with shallow discharge in actual use. So we can conservatively estimate 1,000 cycles, which would last longer than the lifetime of the car.

Page vi - NiMH cost can reach \$320 per kWh capacity in volumes of 100,000 or more. (Remember that an automobile needs more than one)

So battery cost, interest, and electricity at 14 cents per kWh will still cost less than \$2.50 per gallon gas.

¹⁹⁸Rocky Mountain Institute, "The Hypercar® Concept," *Transportation*, 2004, Rocky Mountain Institute, 19/Aug/2004 <<http://www.rmi.org/sitepages/pid386.php>>.

¹⁹⁹ IAGS-Institute for the Analysis of Global Security, *Plug-in Hybrid Vehicles*. 14/Jan 2006, IAGS-Institute for the Analysis of Global Security, 17/Mar/2006 <<http://www.iags.org/pih.htm>>.

²⁰⁰ CalCars - The California Cars Initiative - 100 MPG Hybrids, *Plug-In Hybrids: State Of Play, History & Players*. 17/Mar 2006, 17/Mar/2006 <<http://www.calcars.org/history.html>>.

²⁰¹Hanne Siikavirta et al., "Effects of E-Commerce on Greenhouse Gas Emissions: A Case Study of Grocery Home Delivery in Finland," *Journal of Industrial Ecology* 6, no. 2 - E-commerce, the Internet,

and the Environment Spring 2002, MIT Press, 19/Aug/2004
<http://mitpress.mit.edu/journals/jiec/v6n2/jie_v6n2_83_0.pdf>.Pp 83-97.

²⁰²Ibid 147

Table 2.11 Passenger Travel and Energy Use in the United States, 2000

²⁰³Gerrit Knaap et al., *Government Policy and Urban Sprawl*. 2000. Illinois Department of Natural Resources, University of Illinois at Urbana-Champaign, 29/Jun/2005
<<http://dnr.state.il.us/orep/c2000/balancedgrowth/pdfs/government.pdf>>.

²⁰⁴Ibid 147 p2-19.

Table 2.14 - Intercity Freight Movement and Energy in the United States, 2000

²⁰⁵Cathy Keefe, "Business and Convention Travelers' Habits Tracked in New Survey," *Press Releases*, 8/Feb 2005, Travel Industry Association of America (TIA), 23/Sep/2005
<<http://www.tia.org/pressmedia/pressrec.asp?Item=359>>.

²⁰⁶Charles River Associates Incorporated;Polaris Research & Development, "A Summary of Key Statistics Across Airports," *AIR PASSENGERS FROM THE BAY AREA'S AIRPORTS, 2001 & 2002 - Final Report Volume 1: OVERVIEW AND METHODS*, CRA No. D03144-00. Sept 2003. Metropolitan Transportation Commission, 23/Sep/2005
<http://www.mtc.ca.gov/maps_and_data/datamart/survey/APS_report_volume_1.pdf>.p7.
(Note statistics are bay area statistics only.)

Inbound International travel 26%-30% primarily for business purposes. So 26% remains a conservative estimate at international level.

Bureau of Transportation Statistics, *BTS - U.S. International Travel and Transportation Trends - Overseas Travel Trends*. 2004, Inbound Overseas Travel; Bureau of Transportation Statistics, 23/Sep/2005
<http://www.bts.gov/publications/us_international_travel_and_transportation_trends/overtrends.html>.

21% of RPM business and first class. Since an increasing percent of business air travel is economy, that is consistent with 26% estimate.

Jim Corridore, "Industry Profiles - Industry Trends," *Standar & Poor's Industry Surveys: Airlines*. 25/Nov 2004. *Standards & Poor's Division of McGraw Hill*, 23/Sep/2005
<<http://libsys.uah.edu/library/mgt301/spairline.pdf>>.p11.

²⁰⁷D. Dimitriu et al., *Aviation and the Global Atmosphere -(Chapter 8) Air Transport Operations and Relations to Emissions - Executive Summary*. Apr 1999, GRID-Arendal Official United Nations Environment Programme (UNEP) Centre, 19/Aug/2004
<<http://www.grida.no/climate/ipcc/aviation/119.htm>>.

²⁰⁸Boeing World Headquarters, *Boeing 787-3 Dreamliner Facts*. 2003, Boeing Company, 21/Aug/2004
<http://www.boeing.com/commercial/7e7/facts_sr.html>.

²⁰⁹William R. Moomaw et al., *Climate Change 2001 - Mitigation - Working Group III: Mitigation - 3.4.4.8 Waterborne Transport*. 2001, Intergovernmental Panel on Climate Change, 19/Aug/2005
<http://www.grida.no/climate/ipcc_tar/wg3/103.htm>.

²¹⁰U.S. Army Corp of Engineers | Rock Island District | Mississippi Valley Division, *Transportation Mode Comparison - Energy Environment- Efficiency*. Jan 2002. *U.S. Army Corp of Engineers | Rock Island District | Mississippi Valley Division*, 26/Sep/2005 <<http://www2.mvr.usace.army.mil/UMR-IWWSNS/documents/tr-comp.pdf>>.p1.

²¹¹I'm conservatively estimating compressor change potential to be only a 1% savings though more probably between 2% and 4% of compressor energy could be saved in the U.S. through such means.

Compressor efficiency can vary from 50% to over 90% in natural gas pipelines. Southwest Research Institute (SwRI), *18-Services for the Pipeline Industry Brochure*. 2005, Southwest Research Institute (SwRI), 27/Sep/2005 <<http://www.swri.edu/3pubs/brochure/d18/pipeline/pipeline.htm>>.

We have an aging fleet of compressors 20-50 years old. While most the efficient gas compressors are about 91%, new electric compressor 92-95% efficient. (Note: these percents are comparisons to the thermodynamic limit, not to a thermodynamically impossible 100% efficiency. And yes, the gas used to generate the electricity for the electric compressors is taken into consideration; it is like hybrid cars; in some cases using heat to generate electricity to produce mechanical power can be more efficient than using heat directly to generate mechanical power).

Michael Crowley and Prem Bansal, *Development of an Integrated Electric Motor Compression System*. 3/Oct 2004, Gas Machinery Research Council | DOE NETL Research Review, 27/Sep/2005 <<http://www.gmrc.org/gmrc/2004finalpapers/Development%20of%20an%20Integrated%20Electric%20Motor%20Driven%20Compressor.pdf>>.

Although older less efficient compressors were more rugged and lasted up to 50 years, more typically a pipeline compressor lasts 30 years. Most U.S. compressors are under 90% efficiency, and almost none are above 91%. So even if the "compressor fleet" was new we could expect just about every compressor to be replaced over the next 30 years with one that is a percent or two more efficient. But in fact, as documented above we have a lot of old compressors, which are probably more in 75%-80% efficiency range. They will need to be replaced soon; replacing them with the most efficient compressors will save a lot more than a few percent. So actually 4% savings from compressor improvements would still be a conservative estimate. 1% leaves a huge margin of error.

²¹²Phil Ferber et al., *Gas Pipeline Optimization. 31st Annual Meeting - October 20-22, 1999 | St. Louis, Missouri*. Oct 1999, Pipeline Simulation Interest Group, 27/Sep/2005 <<http://www.psig.org/papers/1990/9905.pdf>>.p16.

This documents a 13.26% savings from just better (and very simple) software control. That cumulated with a 1% savings from improved compressors gives you better than 14% savings. And that does not even consider leaks: better controls can detect leaks more quickly and pinpoint them more accurately. More modern compressors cause fewer leaks to begin with. (Compressors are a major cause of leaks.) So that gives you an additional margin of error in an already very conservative estimate.

²¹³Jürgen Schnieders, *CEPHEUS - Measurement Results from More Than 100 Dwelling Units in Passive Houses*. May 2003. *Passive House Institute*, 23/Dec/2003 <http://www.passiv.de/07_eng/news/CEPHEUS_ECEEE.pdf>.

(Note: he documented an 80% reduction compared to German standards. But Germans use about half the energy per capita as the U.S.)

States Census Bureau, "Section 19 - Energy and Utilities," *Statistical Abstract of the United States 2002*. December 2002. *United States Census Bureau* <<http://www.census.gov/prod/2003pubs/02statab/energy.pdf>>.p847
Table No. 1350. Energy Consumption and Production by Country: 1990 and 2000

So this is a 90% savings, compared to U.S. standards. Actually it is a bit more, because the 80% savings compares to tougher requirements for new German homes, not average use.

²¹⁴U.S. Department of Energy - Energy Information Administration, "2001 Consumption and Expenditures Tables - Space-Heating Expenditures Tables," *A Look at Residential Energy Consumption in 2001*.

23/October 2003, 23/Dec/2003

<ftp://ftp.eia.doe.gov/pub/consumption/residential/2001ce_tables/spaceheat_expend.pdf>

Table CE2-9e. Space-Heating Energy Expenditures in U.S. Households by Northeast Census Region, 2001 - Preliminary Data

Table CE2-12e. Space-Heating Energy Expenditures in U.S. Households by West Census Region, 2001 - Preliminary Data

U.S. Department of Energy - Energy Information Administration, "2001 Consumption and Expenditures Tables - Electric Air-Conditioning Expenditures Tables," *A Look at Residential Energy Consumption in 2001*. 23/October 2003, 23/Dec/2003

<ftp://ftp.eia.doe.gov/pub/consumption/residential/2001ce_tables/ac_expend.pdf>.

Table CE3-9e. Electric Air-Conditioning Energy Expenditures in U.S. Households by Northeast Census Region, 2001 - Preliminary Data

Table CE3-12e. Electric Air-Conditioning Energy Expenditures in U.S. Households by West Census Region, 2001 - Preliminary Data

²¹⁵Joe Wiehagen and Craig Drumhelle, *Strategies for Energy Efficient Remodeling | Seer 2003 | Case Study Report*, 2004). 30/Mar 2004. *National Renewable Energy Laboratory*, 1/Oct/2005

<http://www.toolbase.org/docs/MainNav/Remodeling/4564_SEERCaseStudyReport.pdf>.

²¹⁶Agence France-Presse, *Thai Architect Hits on Blueprint for Sustainable Living in the Tropics*. 28/September 2003, *Terra Daily*, 06/Jul/2005

<<http://www.terradaily.com/2003/030928033742.6azaxajn.html>>.

Maria Cheng and Julian Gearing, "Green Seeds," *Asia Week* 27-18 11/May 2001, *Asia Week*, 05/Jul/2005

<<http://www.asiaweek.com/asiaweek/magazine/nations/0,8782,108626,00.html>>.

²¹⁷And according to Amory Lovins this was larger than he needed.

Paul Hawken, Amory Lovins, and L.Hunter Lovins, *Natural Capitalism: Creating the Next Industrial Revolution* (Boston: Little, Brown and Company/Back Bay, 2000).

Chapter 5:Building Blocks. p103.

²¹⁸U.S. Department of Energy - Energy Information Administration, "2001 Consumption and Expenditures Tables - Total Energy Consumption," *A Look at Residential Energy Consumption in 2001*. 23/October 2003, 23/Dec/2003

<ftp://ftp.eia.doe.gov/pub/consumption/residential/2001ce_tables/enduse_consump.pdf>.

Table CE1-9c. Total Energy Consumption in U.S. Households by Northeast Census Region, 2001 - Preliminary Data

U.S. Department of Energy - Energy Information Administration, "2001 Consumption and Expenditures Tables - Water-Heating Consumption Tables," *A Look at Residential Energy Consumption in 2001*. 23/October 2003, 23/Dec/2003

<ftp://ftp.eia.doe.gov/pub/consumption/residential/2001ce_tables/waterheat_consump.pdf>.

Table CE4-9c. Water-Heating Energy Consumption in U.S. Households by Northeast Census Region, 2001 - Preliminary

²¹⁹U.S. Department of Energy - Energy Information Administration, "2001 Consumption and Expenditures Tables - Water-Heating Expenditures," *A Look at Residential Energy Consumption in 2001*. 23/October

2003, 23/Dec/2003

<ftp://ftp.eia.doe.gov/pub/consumption/residential/2001ce_tables/waterheat_expend.pdf>

Table CE4-9e. Water-Heating Energy Expenditures in U.S. Households by Northeast Census Region, 2001 - Preliminary Data

Table CE4-10e. Water-Heating Energy Expenditures in U.S. Households by Midwest Census Region, 2001 - Preliminary Data

²²⁰U.S. Department of Labor Bureau of Labor Statistics, "Table 8. Region of Residence: Average Annual Expenditures and Characteristics," *Consumer Expenditure Survey 2002*. 13/Nov 2003. U.S. Department of Labor Bureau of Labor Statistics, 06/Jul/2005 <<http://www.bls.gov/cex/2002/Standard/region.pdf>>.

Table 8. Region of residence: Average annual expenditures and characteristics, Consumer Expenditure Survey, 2002

²²¹Whedon 0.5 GPM Ultra SaverAerator - US\$3.50

Energy Federation Incorporated, *EFI Internet Division Residential Catalogue | Bath Faucet Aerators*. July 2005, Energy Federation Incorporated, 13/Jul/2005 <http://www.energyfederation.org/consumer/default.php/cPath/27_52>.

similar product to above for \$2.15

Conserv-A-Store, *Conserv-A-Store :: Recycling Supplies, Solar Lighting, Electrical, Plumbing & Water Conservation Products-Economical & Eco-Friendly! Part Number: 01-0104*. July 2005, Conserv-A-Store, 13/Jul/2005 <<http://www.conservastore.com/productdetail.php?p=23>>.

²²²Conserv-A-Store, *Conserv-A-Store :: Recycling Supplies, Solar Lighting, Electrical, Plumbing & Water Conservation Products-Economical & Eco-Friendly!*. July 2005, Conserv-A-Store, 13/Jul/2005 <http://www.conservastore.com/index_plumbing.htm>.

²²³According to the Handyman Club the Stepflow Kick Pedal should be discounted to \$129

Tom Sweeney, *Handyman Club of America - Hands Free - Pedal Valve Makes Sink Faucets Convenient and Clean*. February 1999, Handyman Club of America (Publishers of Handy Magazine), 13/Jul/2005 <<http://www.handymanclub.com/document.asp?cID=57&dID=777>>.

And here it is on-line for \$120.00 with shipping and such probably around \$129 .

Professional Piercing Information Systems, *Products: Step-Flow Operated Sink Valve*. 16/June 2005, Professional Piercing Information Systems, 13/Jul/2005 <<http://www.propiercing.com/products.html>>.

²²⁴Priced at \$27.00 without shipping at sustainable village. Assuming six bucks in shipping charges total of \$60. Since sustainable village ships this only to developing nations, I've given the URL of manufacturer who should be able to tell where we in the U.S. can actually buy it.

Sustainable Village, *Sustainable Village - Products - Aqua Helix*. 2005, Sustainable Village, 13/Jul/2005 <<http://www.thesustainablevillage.com/servlet/display/product/detail/22602>>.

Jet Blast Industrial Services, *Aqua Helix Home*. 18/Feb 1999, Jet Blast Industrial Services, 13/Jul/2005 <<http://www.jetblast.net/ahhome.html>>.

²²⁵Microphor LF-210 \$539.00

Dean Petrich, *Toilet Prices*. 16/July 2005, Ultra-Low Water-Flush toilets, Aqua Alternatives, 20/Jul/2005 <<http://www.enviroalternatives.com/toiletprices.html#ULTRA-LOW%20WATER-FLUSH>>.

²²⁶WaterFilm Energy Inc., *GFX 40% Off. GFX Heat Exchanger*, 25/May 2005, WaterFilm Energy Inc., 20/Jul/2005 <<http://www.gfxtechnology.com/sale.html>>.

Carmine Dr. Vasile, *International Data on Successfully Demonstrated Energy Efficiency Projects - Residential Waste Water Heat-Recovery System: GFX*. April 2000, Centre for the Analysis and Dissemination of Demonstrated Energy Technologies, 20/Jul/2005 <<http://gfxtechnology.com/CADDET.PDF>>.

Note where showers are not the main hot water consumer in the household storage recovery systems are available in the same price range:

National Association of Home Builders Research Center, *Drainwater Heat Recovery*. 2004, National Association of Home Builders Research Center, 08/Aug/2005 <<http://www.toolbase.org/tertiaryT.asp?DocumentID=2134&CategoryID=1402>>.

²²⁷EnergyStar Dishwasher product rating - in this case 85% better than average new model (so divide by 185).

(Note: this does not quite double efficiency of what is currently for sale, which means it is probably double or better that currently in use - but we will use EnergyStar rating as conservative estimate of savings)

Energy Star Program of the EPA and DOE, *Energy Star Qualified Dishwashers*, List of Energy Star Dishwashers with Efficiency Ratings. 14/June 2004, Energy Star Program of the EPA and DOE, 10/Jul/2005 <http://www.energystar.gov/ia/products/prod_lists/dishwash_prod_list.pdf>.p1

²²⁸Average Energystar & regular appliance prices 2000

The NPD Group, Inc., *NPD INTELECT REPORTS SIGNIFICANT GROWTH FOR ENERGY-EFFICIENT APPLIANCES*. Average Appliance Prices: Energystar Vs. Non-Energystar, 18/October 2000, The NPD Group, Inc., 10/Jul/2005 <http://www.npd.com/press/releases/press_001018.htm>.

(Note: A market survey is a legitimate source for pricing information).

²²⁹ASKO, *D3350*. 204, ASKO, 05/Jul/2005 <<http://www.asko.se/ASKO/brandsite/main.cfm?moduleID=10&productID=2814#>>.

²³⁰Universal Appliance and Kitchen Center, *24" ASKO Dishwasher, D3121*. Quote July 10 for Asko D3121, July 2005, Universal Appliance and Kitchen Center, 10/Jul/2005 <<http://store.universal-akb.net/24asdid3.html>>. (Note this was for a particular day – the key is that you can get a dishwasher that consumes around 250 kWh per year for around \$333 more than a non-Energy Star model.)

²³¹Liz Madison, *Kitchen Tools, Kitchen Electrics, Cookware, Tableware - LizMadison.Com -GWL11*. GWL11 Clothes Washer, July 2005, Liz Madison, 10/Ju <http://www.lizmadison.com/housewares/Product.asp_X_SKU_Y_GWL11_Z_REF_Y_SHLIZ>.

No doubt the particular page will have expired by the time you read this. The main point is that you can get a washing machine that saves nearly 80% of the energy a non-Energy Star model would use for about \$220 more.

²³²Energy Star Program of the EPA and DOE, *ENERGY STAR® Qualified Clothes Washers*, ENERGY STAR® Qualified Clothes Washers with Efficiencies and Projected Yearly KWh Consumption. 21/June 2004. *Energy Star Program of the EPA and DOE*, 11/Jul/2005 <http://www.energystar.gov/ia/products/prod_lists/clotheswash_prod_list.pdf>.

(Again this rates against average new available, so efficiency compared to installed home clothes washers is probably slightly better.)

²³³Mark Hutchinson, *Trickle Irrigation: Using and Conserving Water in the Home Garden - University of Maine Cooperative Extension Bulletin #2280*. April 2005, University of Maine Cooperative Extension, 13/Jul/2005 <<http://www.umext.maine.edu/onlinepubs/htmpubs/2160.htm>>.

²³⁴William B. DeOreo, David M. Lewis, and Peter W. Mayer, *Seattle Home Water Conservation Study: The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes*. December 2000. Aquacraft, Inc. *Water Engineering and Management*, 08/Aug/2005 <<http://www.cuwcc.org/Uploads/product/Seattle-Final-Report.pdf>>.p54.

²³⁵Madison Gas & Electric Company, *Water Heaters*. Feb/25 2005. *Madison Gas and Electric Company*, Madison Gas and Electric Company, 08/Aug/2005 <<http://www.mge.com/images/PDF/Brochures/Residential/WaterHeaters.pdf>>.p3.

²³⁶Low Energy Systems, Inc, *Infinion with Battery Spark Ignition*. August 2005, Low Energy Systems, Inc, 08/Aug/2005 <<http://www.tanklesswaterheaters.com/infinion2.html>>.

²³⁷U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, "Energy Savers: Compact Fluorescent Lamps," *Energy Savers: A Consumer Guide to Renewable Energy and Energy Efficiency*, 21/June 2004, 19/Aug/2005 <<http://www.eere.energy.gov/consumerinfo/factsheets/ef2.html>>.

²³⁸Fisher & Paykel, *Washers*. August 2005, Fisher & Paykel, 19/Aug/2005 <<http://usa.fisherpaykel.com/laundry/washers/washers.cfm>>.

²³⁹Secondary (end use) consumption is 4 kWh per load for the electric dryer, plus .23 kWh per load plus .22 therms per load for the gas dryer. If you convert therms to kWh at 100% efficiency this comes out the gas dryer actually using 67% more energy than an electric dryer.

Energy Star Program of the EPA and DOE, "About the HES Appliance Module," *The Home Energy Saver*, Table 3: Other Appliances and Miscellaneous Energy Usages, 06/June 2001, Energy Star Program of the EPA and DOE, 20/Aug/2005 <<http://homeenergysaver.lbl.gov/hes/aboutapps.html>>.

However, on average heat driven power plants convert only 36.47% of heat energy into electricity.

International Energy Agency, *Electricity Information 2002 Edition*, Electricity Information, vol. 2002 Edition, no. ISBN 9264197931 (Paris: OECD - Organisation for Economic Co-operation and Development, 2002).p.II.706

Part II Table 9 United State Electricity Production From Combustible Fuels in Electricity Plants"

So dividing the electricity consumption in both gas and electric dryers by 36.47, and then converting both to therms or both to kWh as you please, you end up with a 35.47% savings.

²⁴⁰California Energy Commission, "Dryers," *Consumer Energy Center - Inside Your Home*, August 2005, California Energy Commission, 20/Aug/2005 <<http://www.consumerenergycenter.org/homeandwork/homes/inside/appliances/dryers.html>>.

²⁴¹Amory B. Lovins and William D. Browning, *Negawatts for Buildings*, Jul/1992). 15/Nov 2000. *Urban Land Institute*, 21/Jan/2004 <<http://www.rmi.org/images/other/GDS-Negawatts4Bldgs.pdf>>.pp4-5

²⁴²Sarah Goorskey, Andy Smith, and Katherine Wang, *Home Energy Briefs #7 - Electronics*, (2004). 3/Dec 2004. *Rocky Mountain Institute*, 20/Aug/2005 <http://www.rmi.org/images/other/Energy/E04-17_HEB7Electronics.pdf>.p3.

²⁴³Mark Palmer and Alicia Mariscal, *Green Buildings and Worker Productivity: A Review of the Literature*, Aug 2001). Aug 2001. *San Francisco Department of the Environment*, 22/Aug/2005 <http://www.sfenvironment.com/aboutus/innovative/greenbldg/gb_productivity.pdf>.

²⁴⁴Gregory H. Kats, *Green Building Costs and Financial Benefits*. October 2003. *Massachusetts Technology Collaborative State Development Agency for Renewable Energy and the Innovation Economy*, 23/Jan/2004 <http://www.mtpc.org/RenewableEnergy/green_buildings/GreenBuildingspaper.pdf>.p6.

²⁴⁵Gregory H. Kats et al., *The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force*, Oct 2003). Oct 2003. *California Sustainable Building Task Force*, 29/Jan/2004 <<http://www.usgbc.org/Docs/News/News477.pdf>>.p ix.

²⁴⁶William Browning, *NMB Bank Headquarters: The Impressive Performance of a Green Building*, June 1992). 24/Feb 2003. *The Urban Land Institute*, Rocky Mountain Institute, 22/Aug/2005 <http://www.rmi.org/images/other/GDS/D92-21_NMBBankHQ.pdf>.p24.

²⁴⁷U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, *2004 Buildings Energy Databook*, Jan 2005). Jan 2005. *U.S. Department of Energy Office of Energy Efficiency and Renewable Energy*, 22/Aug/2005 <<http://buildingsdatabook.eren.doe.gov/docs/2004bedb-0105.pdf>>.p1-9. Table 1.3.4 - Commercial Delivered and Primary Energy Consumption Intensities, by Year

²⁴⁸http://erg.ucd.ie/EC2000/EC2000_PDFs/dossier_1011.pdf
Commission of the European Communities, *Energy Consumption and Cost Effectiveness of EC2000 Buildings*, Jan 2000). *Energy Comfort 2000*, European Commission Thermie Project to Reduce Energy and Improve Comfort and Environment, Information Dossier Number 10/11. January 2004. *Commission of the European Communities*, Energy Research Group - University College, 22/Aug/2005 <http://erg.ucd.ie/EC2000/EC2000_PDFs/dossier_1011.pdf>.pp1-2.

²⁴⁹

Ibid 248 pp2-3.

²⁵⁰Ibid 248 pp3-4.

²⁵¹Energy Research Group - University College, *Case Study Module C - Sukkertoppen - Copenhagen DK. Mid Career Education: Solar Energy in European Office Buildings*. Nov 1997. *Energy Research Group - University College*, 22/Aug/2005 <http://erg.ucd.ie/mid_career/pdfs/case_study_C.pdf>.p15.

²⁵²Joseph J. Romm, *Cool Companies: How the Best Businesses Boost Profits and Productivity by Cutting Greenhouse Gas Emissions* (Washington D.C. & Covelo CA: Island Press, 1999).p51. Chapter 3: Buildings.

²⁵³Joseph J. Romm, *Cool Companies: Proven Results - Cool Buildings*. 2005, Romm,Joseph J., 22/Aug/2005 <<http://www.cool-companies.com/proven/buildings.cfm>>.

²⁵⁴Green Building Council, *USGBC - LEED Case Study - Energy - DEP Cambria*. 2003, Green Building Council, 22/Aug/2005 <<http://leedcasestudies.usgbc.org/energy.cfm?ProjectID=47>>.

²⁵⁵Green Building Council, *USGBC - LEED Case Study - Finance - DEP Cambria*. 2003, Green Building Council, 22/Aug/2005 <<http://leedcasestudies.usgbc.org/finance.cfm?ProjectID=47>>.

²⁵⁶U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, *Department of Environmental Protection, Cambria Office Building, Ebensburg Pennsylvania - Highlighting High Performance*, Nov 2001), DOE/GO-102001-1353. Jan 2002. *U.S. Department of Energy Office of Energy Efficiency and Renewable Energy*, 22/Aug/2005 <<http://www.eere.energy.gov/buildings/info/documents/pdfs/29941.pdf>>.p3.

²⁵⁷Buy Recycled Business Alliance, *Natural Resources Defense Council*, 2004). 17/Sep 2004. *Buy Recycled Business Alliance*, 22/Aug/2005 <<http://www.brba-epp.org/brba-epp.org/pdfs/Natural%20Resou%E2%80%A6ces%20Defense%20C.pdf>>.p2.

²⁵⁸United States Department of Energy, Energy Information Administration, "Table 2.1a Energy Consumption by Sector, 1949-2002," *Annual Energy Review*, 2004, United States Department of Energy, Energy Information Administration, 20/Aug/2004 <<http://www.eia.doe.gov/emeu/aer/txt/ptb0201a.html>>. Table 2.1a Energy Consumption by Sector, 1949-2002 (Trillion Btu)

²⁵⁹States Census Bureau, "Section 19 - Energy and Utilities," *Statistical Abstract of the United States 2002*. December 2002. *United States Census Bureau* <<http://www.census.gov/prod/2003pubs/02statab/energy.pdf>>.p572. Energy and Utilities - Table No.892. Electric Power Industry Capability,and Consumption of Fuels:1990 to 2000 [Net generation for calendar years; capability as of December 31]

²⁶⁰Los Alamos National Laboratory, *Los Alamos--Energy Security Overview*. 2003, Los Alamos National Laboratory, 31/Aug/2004 <<http://www.lanl.gov/energy/overview.html>>.

²⁶¹United States Department of Energy, Energy Information Administration, *Annual Energy Outlook 2004 with Projections to 2025*, DOE/EIA-0383(2004. January 2004, Table 2. Energy Consumption by Sector and Source, United States Department of Energy, Energy Information Administration, 21/Aug/2004 <http://www.eia.doe.gov/oiaf/aeo/excel/aeotab_2.xls>.

Table 2. Energy Consumption by Sector and Source (Quadrillion Btu per Year, Unless Otherwise Noted)

²⁶² U.S. Census Bureau, *Table 1a. Projected Population of the United States, by Race and Hispanic Origin: 2000 to 2050*. 18/March 2004, 16/March/2005 <<http://www.census.gov/ipc/www/usinterimproj/>>.

²⁶³ Brian A. Toal, "Renewables:Future Shock," *Oil & Gas Investor* October 2001, Chemical Week Associates Inc., *National Renewable Energy Laboratory*, 2/Jul/2005 <<http://www.nrel.gov/docs/gen/fy02/31353.pdf>>. p2

²⁶⁴ *U.S. Bureau of Labor Statistics Series Reports*. 2/Jul/2005 <<http://data.bls.gov/cgi-bin/srgate>>. Series CEU0500000049 [Employment, Hours, and Earnings from the Current Employment Statistics survey (National)] All Years, Not Seasonally Adjusted, Super Sector - Total Private, Industry -Total Private, Data Type - AVERAGE HOURLY EARNINGS, 1982 DOLLARS

“Production and nonsupervisory workers account for about 80 percent of all employment measured by the CES survey.”

Bureau of Labor Statistics, "Planned Changes to the Current Employment Survey," *Employment, Hours, and Earnings from the Current Employment Statistics Survey (National)*, 18/April 2005, 12/06/2005 <<http://www.bls.gov/ces/cesww.htm>>.

²⁶⁵ Stacey C. Davis and Susan W. Diegel, *TRANSPORTATION ENERGY DATA BOOK: - Edition 22*, ORNL-6967 (Edition 22 of ORNL-5198). Sep 2002. *Center for Transportation Analysis Science and Technology Division of the Oak Ridge National Laboratory for the U.S. DOE*, 23/Sep/2005 <<http://www.cta.ornl.gov/cta/Publications/pdf/ORNL-6967.pdf>>. p563. Energy and Utilities - Table No. 877. Energy Supply and Disposition by Type of Fuel: 1960 to 2000 [In quadrillion British thermal units (Btu). For Btu conversion factors, see source]

²⁶⁶Hydroelectricity:

United States Department of Energy, Energy Information Administration, *Table E2. Existing Capacity at U.S. Electric Utilities by Census Division, State, and Prime Mover, 2000*. 24/Sep 2002, United States Department of Energy, Energy Information Administration, 22/Aug/2004
<<http://www.eia.doe.gov/cneaf/electricity/ipp/html1/ippv1te2p1.html>>.

Estimates for power consumption by State:
United States Department of Energy, Energy Information Administration, *State Energy Data 2000: Consumption Estimates for Power Consumption by State*. 2003, United States Department of Energy, Energy Information Administration, 22/Aug/2004
<http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_all_btu.csv>.

²⁶⁷ Geothermal Energy Association, *Geothermal Electric Production Potential*. 2004, Geothermal Energy Association, 22/Aug/2004 <<http://www.geo-energy.org/UsResources.htm>>.

²⁶⁸ World Bank, *Geothermal Energy: Assessment*. 7/Sep 2000, World Bank, 22/Aug/2004
<<http://www.worldbank.org/html/fpd/energy/geothermal/assessment.htm>>.

²⁶⁹ Roger Hill, *Public Renewables Partnership, About PRP - Geothermal: Geothermal Costs*. 10/Jun 2004, The Public Renewables Partnership, 22/Aug/2004 <<http://www.repartners.org/geothermal/geocosts.htm>>.

²⁷⁰ California Energy Commission, *Levelized Cost of Electricity Production*. Jan 2004, California Energy Commission, 7/Jun/2004 <http://www.energy.ca.gov/electricity/levelized_cost.html>.

²⁷¹ Federal Energy Regulatory Commission, *Staff Briefing Paper: ASSESSING THE STATE OF WIND ENERGY IN WHOLESALE ELECTRICITY MARKETS*, ADO0 13 000. Nov 2004. *Federal Energy Regulatory Commission*, 1/Oct/2005 <<http://www.ferc.gov/legal/maj-ord-reg/land-docs/11-04-wind-report.pdf>>.p11.

New Mexico Energy, Minerals, and Natural Resources Departments - Energy Conservation and Management Division, *Wind Energy*. 1/Nov 2005, New Mexico Energy, Minerals, and Natural Resources Departments - Energy Conservation and Management Division, 1/Oct/2005
<<http://www.emnrd.state.nm.us/emnrd/ecmd/Wind/wind.htm>>.

U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, *Wind and Hydropower Technologies Program: Wind Energy Research*. 30/Aug 2005, U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, 1/Oct/2005
<http://www.eere.energy.gov/windandhydro/wind_research.html>.

²⁷² Renewable Resource Data Center, *Wind Energy Resource Atlas of the United States - Map 2-14 Summer Wind Resource Estimates in the Contiguous United States*. Feb 2002, U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, 27/Sep/2005 <<http://rredc.nrel.gov/wind/pubs/atlas/maps/chap2/2-14m.html>>.

²⁷³ Cristina L. Archer and Mark Z. Jacobson, "Evaluation of Global Wind Power,". *Journal of Geophysical Research - Atmospheres* 110, no. D12 30-Jun 2005, American Geophysical Union, 20-Jan-2008
<<http://www.stanford.edu/group/efmh/winds/2004jd005462.pdf>>, D12110 DOI:10.1029/2004JD005462.

²⁷⁴ Julie Osborn et al., *A Sensitivity Analysis of the Treatment of Wind Energy in the Aeo99 Version of NEMS*, LBNL-44070 / TP-28529. Jan 2001. *Ernest Orlando Lawrence Berkeley National Laboratory - University of California; National Renewable Energy Laboratory*, 12/Jun/2004
<<http://enduse.lbl.gov/info/LBNL-44070.pdf>>.

²⁷⁵ Cristina L. Archer and Mark Z. Jacobson, "Supplying Baseload Power and Reducing Transmission Requirements by Interconnecting Wind Farms,". *JOURNAL OF APPLIED METEOROLOGY AND CLIMATOLOGY* 46, no. 11 Nov 2007: 1701-17, American Meteorological Society, 18/Jan/2008 <http://www.stanford.edu/group/efmh/winds/aj07_jamc.pdf>.

²⁷⁶Willet Kempton and Amardeep Dhanju, "Electric Vehicles with V2G Storage for Large-Scale Wind Power,". *Windtech International* Mar 2006, (accessed 27/Dec/2004)
<<http://www.udel.edu/V2G/docs/KemptonDhanju06-V2G-Wind.pdf>>. Figure 2.

²⁷⁷]Cristina L. Archer and Mark Z. Jacobson, "Spatial and Temporal Distributions of U.S. Winds and Wind Power at 80 m Derived from Measurements,". *JOURNAL OF GEOPHYSICAL RESEARCH* 108, no. D9 16/May 2003, (accessed 27/Dec/2006)
<<http://www.stanford.edu/group/efmh/winds/2002JD002076.pdf>>. Previously unpublished data in the V2G article had been compiled for this study.

²⁷⁸ Ken Zweibel, James Mason, and Vasilis Fthenakis, "A Solar Grand Plan,". *Scientific American* Jan 2008, By 2050 Solar Power Could End U.S. Dependence on Foreign Oil and Slash Greenhouse Gas Emissions, 18/Jan/2008
<<http://www.sciam.com/article.cfm?id=a-solar-grand-plan>>.

²⁷⁹ Otis Port, "Power From The Sunbaked Desert | Solar Generators May Be a Hot Source of Plentiful Electricity,". *Business Week* 12/Sep 2005: SCIENCE & TECHNOLOGY, The McGraw-Hill Companies Inc, 14/Oct/2005 <http://www.businessweek.com/magazine/content/05_37/b3950067_mz018.htm>.

²⁸⁰ National Renewable Energy Laboratory (NREL), *NREL: Concentrating Solar Power Research - Parabolic-Trough Thermal Energy Storage Technology*. National Renewable Energy Laboratory (NREL), 26/Mar/2005 <http://www.nrel.gov/csp/thermal_storage_tech.html>.

²⁸¹ Gerhard Knies, *Deserts as Sustainable Powerhouses and Inexhaustible Waterworks for the World*, Sep-2006). Sep 2006. *Trans-Mediterranean Renewable Energy Cooperation - (Formed by The Club of Rome, The Hamburg Climate Protection Foundation, and the National Energy Research Center of Jordan)*, 3/Jan/2007 <<http://www.trecers.net/downloads/GCREADER.pdf>>.

²⁸² Electricity Storage Association, *Electricity Storage Association - Technology Comparisons - Capital Cost*. 27-Oct 2005, Electricity Storage Association, 20-Jan-2008
<http://electricitystorage.org/tech/technologies_comparisons_capitalcost.htm>.

²⁸³ Alessandro Clerici and Andrea Longhi, *Competitive Electricity Transmission as an Alternative to Pipeline Gas Transport for Electricity Delivery*. 17th World Energy Council Congress, Houston, Texas, USA, 13-18 September 1998. Sep 1998. *World Energy Council*, 23/Aug/2004
<http://www.worldenergy.org/wec-geis/publications/default/tech_papers/17th_congress/2_2_08.asp>.

Also: American Wind Energy Association, *FAQ: Cost of Wind Energy*. 2000, American Wind Energy Association, 22/Aug/2004 <<http://www.awea.org/faq/cost.html>>.

Also: Shimon Awerbuch, "Determining the Real Cost: Why Renewable Power is More Cost-Competitive Than Previously Believed,". *Renewable Energy World*, no. March-April 2003 Mar 2003, James & James, 27/Sep/2005 <<http://www.earthscan.co.uk/news/article/mps/UAN/71/v/3/sp/332149698573342662256>>.

²⁸⁴ Energy Ideas Clearinghouse, *Product Technology & Review | Home Voltage Regulator (HVR)TM, Enterprise Voltage Regulator (EVR)TM*. 2004. *Washington State University Extension Energy Program (Manages Energy Ideas Clearinghouse for Northwest Energy Efficiency Alliance in Portland Oregon)*, 26/Mar/2005 <http://www.nwalliance.org/resources/documents/PTR/EI_PTR200407Microplanet.pdf>.

²⁸⁵ "The scale of deploying the technology, and doing the detailed systems engineering to make it work as a seamless network, will require significant levels of investment, estimated at \$100 billion over a decade."

T.J. Glauthier, Testimony of T.J. Glauthier President & CEO, Electricity Innovation Institute Affiliate of EPRI (Electric Power Research Institute) House Committee on Energy and Commerce Hearing on

“Blackout 2003: How Did It Happen and Why?” Sep 2003, Electric Power Research Institute (EPRI), 27/Sep/2005 <http://www.epri.com/corporate/discover_epri/news/testimony_TJ-090403.pdf>.p5.

If they really mean what they say in the study, they are talking about a number closer to \$200 billion per decade plus:

“..investment deficit is now on the order of \$20 billion per year and must be accounted for over and above the investment levels of the 1990s if service demands are to be confidently met.”

Electric Power Research Institute (EPRI), *Electricity Sector Framework for the Future | Volume I | Achieving the 21st Century Transformation*. 6/Aug 2003, Electric Power Research Institute (EPRI), 27/Sep/2005 <http://www.epri.com/corporate/esff/ESFF_volume1.pdf>.p16.

So this is \$100 billion every five years, plus however many years of “deficit” they propose to make up for.

²⁸⁶Eric Hirst and Brendan Kirby, *Transmission Planning and the Need for New Capacity. National Transmission Grid Study - Issue Studies*, Issue 4. May 2002, U.S. Department of Energy, 27/Sep/2005 <http://www.eh.doe.gov/ntgs/issuepapers/ISSUE_4.PDF>.pD-19.

Table 3. Typical costs, thermal capacities, and corridor widths of transmission lines

(Note: The table was reformatted by me to fit this document, some of the units converted, and a computed column added to the end.)

Voltage (kV)	Capital cost \$/mile	Capacity (MW)	Cost (Million \$/GW-Mile)	Width (feet)	Cost for 3000 KM (1865 mile) Line
230	480,000	350	1.37	100	895,200,000
345	900,000	900	1	125	1,678,500,000
500	1,200,000	2000	0.6	175	2,238,000,000
765	1,800,000	4000	0.45	200	3,357,000,000

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Generation, Distribution and various administrative, sales and miscellaneous expenses ran around 36.5% of total expenses in 2005.

Energy Information Administration, *Revenue and Expense Statistics for Major U.S. Investor-Owned Electric Utilities* (Electric Power Annual with data for 2005) - Published October 2006. <<http://www.eia.doe.gov/cneaf/electricity/epa/epat8p1.html>>

Electricity costs per kWh in 2005 averaged 8.14 cents per kWh.

Table 7.4. *Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, 1994 through 2005* - (Electric Power Annual with data for 2005) - Published October 2006 <<http://www.eia.doe.gov/cneaf/electricity/epa/epat7p4.html>>

Hence 2.9697 or ~3.0 cents per kWh

²⁸⁸Mick Sagrillo, "Advice from an Expert -Putting Wind Power's Effect on Birds in Perspective," *Frequently Asked Questions*, 2003, American Wind Energy Association, 24/Jun/2005 <<http://www.awea.org/faq/sagrillo/swbirds.html>>.

²⁸⁹John S. Coleman, Stanley A. Temple, and Scott R. Craven, *Cats and Wildlife - A Conservation Dilemma*. 1997, U.S. Department of Agriculture, University of Wisconsin-Extension, Cooperative Extension, 24/Jun/2005 <<http://wildlife.wisc.edu/extension/catfly3.htm>>.

²⁹⁰Power Technology, *Power Technology - Mokai Geothermal Power Plantl, New Zealand*. 26/Aug 2003, SPG Media Limited/SPG Media Group, 23/Aug/2004 <<http://www.power-technology.com/projects/mokai/>>.

²⁹¹ National Park Service - U.S. Department of the Interior - Geologic Resources Division, *Geothermal Energy Overview. NPS Western Energy Summit Jan 21 - 23. Jan 2003*, National Park Service - U.S. Department of the Interior - Geologic Resources Division, 24/Aug/2004
<http://www2.nature.nps.gov/geology/adjacent_minerals/EnergySummit/Geothermal/geothermal%20factsheet.pdf>.p2.

²⁹² Anders Ahlbom et al., "Review of the Epidemiologic Literature on EMF and Health," *Environmental Health Perspectives* 109, no. SUPPLEMENT 6 Dec 2001, ICNIRP (International Commission for Non-Ionizing Radiation Protection) Standing Committee on Epidemiology, National Institute of Environmental Health Sciences of the U.S. Department of Health and Human Services, 24/Aug/2004
<<http://www.icnirp.de/documents/epireview1.pdf> ; <http://ehp.niehs.nih.gov/members/2001/suppl-6/911-933ahlbom/ahlbom-full.html>>.pp911-933.

²⁹³ Ibid 163 p6-2. - Table 6.1

²⁹⁴ Jim Giles, "Methane quashes green credentials of hydropower", *Nature*, November 30 2006,444:7119. p.524

²⁹⁵ American Society of Civil Engineers, *2001 Report Card for America's Infrastructure - Report Card ASCE - Energy*. 2001, American Society of Civil Engineers, 8/May/2003
<<http://www.asce.org/reportcard/index.cfm?reaction=factsheet&page=12>>.

²⁹⁶ Steve Thomas, "Government Needs to Take a Brave Decision Now | Crunch Time for Pebble Bed Plan," *Cape Times* 18/Sep 2003: Insight, The Cape Times & Independent Online (Pty) Ltd, 10/Apr/2005
<<http://www.capetimes.co.za/index.php?fSectionId=332&fArticleId=238104>>.

²⁹⁷ U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, *Combustion Success Story: Solarwall© Air Preheating System | Elegantly Simple System Uses Solar Energy to Heat Ventilation Air or Preheat Combustion Air. Office of Industrial Technology Inventions & Innovations Program, I-CO-563*. December 2001, U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, 5/Sep/2004 <<http://www.eere.energy.gov/inventions/pdfs/conserval.pdf>>.

²⁹⁸ United States Department of Energy, Energy Information Administration, *Preliminary CBECS End-Use Estimates - Preliminary End-Use Energy Consumption Estimates for Commercial Buildings in 1999 Based on Data from the 1999 Commercial Buildings Energy Survey*. 1999, United States Department of Energy, Energy Information Administration, 25/Aug/2004
<http://www.eia.doe.gov/emeu/cbecs/enduse_consumption/intro.html>.
Detailed Tables - Table 1. End-Use Consumption for Natural Gas, Electricity, and Fuel Oil, 1999 (Preliminary Estimates)

²⁹⁹ These are preliminary numbers released in late 2003, and may change slightly by the time you read this.

U.S. Department of Energy - Energy Information Administration, "2001 Consumption and Expenditures Tables - Total Energy Consumption" *A Look at Residential Energy Consumption in 2001*. 23/October 2003, 23/Dec/2003

<ftp://ftp.eia.doe.gov/pub/consumption/residential/2001ce_tables/enduse_consump.pdf>.

Table CE1-9c. Total Energy Consumption in U.S. Households by Northeast Census Region, 2001 - Preliminary Data

Table CE1-10c. Total Energy Consumption in U.S. Households by Midwest Census Region, 2001 - Preliminary Data

Table CE1-11c. Total Energy Consumption in U.S. Households by South Census Region, 2001 - Preliminary Data

Table CE1-12c. Total Energy Consumption in U.S. Households by West Census Region, 2001 - Preliminary Data

U.S. Department of Energy - Energy Information Administration, "2001 Consumption and Expenditures Tables - Space-Heating Energy Consumption," *A Look at Residential Energy Consumption in 2001*. 23/October 2003, 23/Dec/2003

<ftp://ftp.eia.doe.gov/pub/consumption/residential/2001ce_tables/spaceheat_consump.pdf>.

Table CE2-9c. Space-Heating Energy Consumption in U.S. Households by Northeast Census Region, 2001 - Preliminary Data

Table CE2-10c. Space-Heating Energy Consumption in U.S. Households by Midwest Census Region, 2001 - Preliminary Data

Table CE2-11c. Space-Heating Energy Consumption in U.S. Households by South Census Region, 2001 - Preliminary Data

Table CE2-12c. Space-Heating Energy Consumption in U.S. Households by West Census Region, 2001 - Preliminary Data

U.S. Department of Energy - Energy Information Administration, "2001 Consumption and Expenditures Tables - Electric Air-Conditioning Consumption Tables," *A Look at Residential Energy Consumption in 2001*. 23/October 2003, 23/Dec/2003

<ftp://ftp.eia.doe.gov/pub/consumption/residential/2001ce_tables/ac_consump.pdf>.

Table CE3-9c. Electric Air-Conditioning Energy Consumption in U.S. Households by Northeast Census Region, 2001 - Preliminary Data

Table CE3-10c. Electric Air-Conditioning Energy Consumption in U.S. Households by Midwest Census Region, 2001 - Preliminary Data

Table CE3-11c. Electric Air-Conditioning Energy Consumption in U.S. Households by South Census Region, - Preliminary Data

Table CE3-12c. Electric Air-Conditioning Energy Consumption in U.S. Households by West Census Region, - Preliminary Data

³⁰⁰Solargenix Energy LLC, *Solargenix Energy - Formerly Duke Solar Energy - The Natural Power For Good*. 2005, Solargenix Energy LLC, 28/Mar/2005 <<http://www.solargenix.com/powerRoof.cfm>>.

³⁰¹Rober C. Brown, Colletti, Joe, and Arne Hallam, "Factors Influencing the Adoption of Biomass Energy Systems: An Evaluation for Iowa," Fifth World Congress of Chemical Engineering, San Diego, CA, July 14-18, 1996 (Ames Iowa USA: Iowa State University, 1996), Obsolete URL (<http://webbook2.ameslab.gov/Summary%20Biomass.doc>).

³⁰²Donal L. Klass, "Biomass for Renewable Energy And Fuels," *Encyclopedia of Energy*. 2004. Elsevier, Inc, Biomass Energy Research Association (BERA) Washington D.C., 28/Sep/2005 <<http://www.bera1.org/cyclopediaofEnergy.pdf>>.p196.

³⁰³David Tilman, Jason Hill, and Clarence Lehman, "Carbon-Negative Biofuels from Low-Input High-Diversity Grassland Biomass," *Science* 314, no. 5805 8/Dec 2006, American Association for the Advancement of Science, 01/01/2007 <http://www.ce.cmu.edu/~gdrgr/readings/2006/12/12/Tilman_CNegativeBiofuelsFromLowInputHighDiversityGrasslandBiomass.pdf>.

³⁰⁴Biopact [Summarizing Report from German Energy Agency], *Bioenergy Pact Between Europe and Africa: German Energy Agency: Biomass-to-Liquids Can Meet up to 35% of Germany's Fuel Needs by 2030*. 15/December 2006, Biopact, 28/Dec/2006 <<http://biopact.com/2006/12/german-energy-agency-biomass-to.html> [summary of original report in German: http://www.dena.de/fileadmin/user_upload/Download/Dokumente/Publikationen/mobilitaet/BtL_Realisierungsstudie.pdf]>.

Note that this price assumes biomass imported by ship or rail into German - so probably more than with biomass grown within 50 miles.. The price given is \$3.98/ gallon, which is for refined product. At the pump price tends to be 42% higher than refined product - so at the pump price of \$5.65 (including taxes), around 2.2 X current price of \$2.50/gallon.

³⁰⁵ Stefan Unnasch and Louis Browning, *Fuel Cycle Energy Conversion Efficiency Analysis Status Report*. 25/May 2000. California Energy Commission Transportation Technology and Fuels Office ARCADIS Geraghty & Miller, Inc, 01/03/2007
<<http://www.arb.ca.gov/msprog/zevprog/2000review/efficiency.doc>>.p7.Table 6.

three specific cases:

It was considered feasible to produce Methanol with nearly 53% thermal efficiency back in 1981: L.K. Mudge et al., *Investigations on Catalyzed Steam Gasification of Biomass. Appendix B: Feasibility Study of Methanol Production Via Catalytic Gasification of 2000 Tons of Wood Per Day*, Jan-1981), On-Line Abstract. 2001. U.S. Department of Energy, 03-Jan-2007
<http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=6711590>.

More recently, non-bleeding-edge technology was considered able to convert biomass into methanol which had 57% of the original BTU content. If the plant generated its own electricity that would reduce thermal efficiency to 475-49%. However, this is not the proper accounting of net energy, because even with combined heat and power, methanol combustion is not an efficient way to generate electricity. If efficiently generated electricity had been used, provided by (say) a 55% efficient combined cycle turbine that managed to place some waste heat, the range would have more like 50% - 52%, even more if the electricity was provided by wind.

Nycomb Synergetics and Ecotraffic R&D AB, *Biomass-Derived Alcohols for Automotive and Industrial Uses*, Apr 1999). May 1999, European Union Program Altener and the Swedish National Board for Industrial and Technical Development, Jan-03-2007 <<http://www.nykomb.se/pdf/methanol.pdf>>.

Lastly, Mitsubishi recently demonstrated bleeding edge technology extracted 65% of energy from biomass in the form of methanol in a pilot project. They claim that, on a large scale, 75% would be possible. Obviously this should be taken with great circulatory system threatening sacks of salt. Also, Mitsubishi says nothing about cost. But it certainly is indicative that Methanol conversion efficiency limit is well above 50%.

Mitsubishi Power Systems, *New Product New Technology: Biomass Gasification Methanol Synthesis System*. 29/Sep 2005, Mitsubishi Power Systems, Jan-03-2007
<http://www.mhi.co.jp/power/e_power/techno/biomass/index.html>.

³⁰⁶ Doctor L. Fishbein, *ENVIRONMENTAL HEALTH CRITERIA 196: Methanol*, 1997). *INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY*. 1997. *UNITED NATIONS ENVIRONMENT PROGRAMME; INTERNATIONAL LABOUR ORGANISATION; WORLD HEALTH ORGANIZATION*, 03/Jan/2007
<<http://www.inchem.org/documents/ehc/ehc/ehc196.htm>>.

³⁰⁷ John A. Volpe National Transportation Systems Center of the U.S. Department of Transportation Research and Special Programs Administration, *CLEAN AIR PROGRAM SUMMARY OF ASSESSMENT OF THE SAFETY, HEALTH, ENVIRONMENTAL AND SYSTEM RISKS OF ALTERNATIVE FUELS - Aug 1995 Final Report*, Aug 1995), FTA-MA-90-7007-95-1 ;DOT-VNTSC-FTA-95-5. Mar 1999. *Federal Transit Administration*, 01/03/2007 <http://transit-safety.volpe.dot.gov/Publications/CleanAir/Alt_Fuel/alt_fuel.pdf>.p3-5.

³⁰⁸B.H. West et al., *Federal Methanol Fleet Project Final Report*, Mar-1993), ORNL/TM -12278. 2003. *Oak Ridge National Laboratory; U.S. Department of Energy Office of Transportation Systems*, Jan-03-2007
<<http://www.ornl.gov/info/reports/1993/3445603700029.pdf>>.

An important note on maintenance: if you look at the chapter on this subject, especially the summary tables on page 21, you will see that engine wear, and maintenance were if fact worse than with gasoline, but not a great deal worse. Given that these were retrofits rather than designed from scratch for M85, had original parts ripped out and replaced, there is little doubt that a built-from-scratch methanol car would have had reliability comparable to gasoline.

³⁰⁹ Howard ED Lentzner, "Glow-Plug-Assisted Ignition and Combustion of Methanol Studied in a Direct-Injection Diesel Engine," *Combustion Research Facility News* 23, no. No 1 Jan/Feb 2001, Sandia National Laboratories, 03-Jan-2007 <http://www.ca.sandia.gov/crf/newspubs/CRFnews/news_pdf/CRFV23N1.pdf>.

³¹⁰ Biomass Energy Research Association (BERA), *Additional Commentary Submitted by D.L. Klass for the Record: Los Angeles Evaluation of Methanol- and Ethanol-Fueled Buses*. 29/May 1998, Biomass Energy Research Association (BERA), Jan-03-2007 <<http://www.bera1.org/LA-buses.html>>.

³¹¹ R. Lal, R. F. Follett, and J. M. Kimble, "ACHIEVING SOIL CARBON SEQUESTRATION IN THE UNITED STATES: A CHALLENGE TO THE POLICY MAKERS.," *Soil Science: An Interdisciplinary Approach to Soil Resarch* 168, no. 12 Dec 2003, Walters Kluwer | Lippincott Williams & Wilkins, 01-Jan-2007 <<http://cat.inist.fr/?aModele=afficheN&cpsid=15361224>>.

³¹² Jim Dryden, "Does Too Much Protein in the Diet Increase Cancer Risk?" *School of Medicine News & Information*, 7/Dec 2006, Washington Univeristy in St. Louis School of Medicine, Jan-03-2007 <<http://mednews.wustl.edu/news/page/normal/8388.html>>.

³¹³ Nathanael Greene et al., *Growing Energy: How Biofuels Can Help End America's Oil Dependence*, Dec-2004). Dec 2004. *Natural Resources Defense Council*, 01-Jan-2007 <<http://www.nrdc.org/air/energy/biofuels/biofuels.pdf>>.p5.

³¹⁴ Burton C. English et al., *25% Renewable Energy for the United States By 2025: Agricultural and Economic Impacts*, Nov 2006). Nov 2006, 4.1 Renewable Production. *The University of Tennessee Department of Agricultural Economics Biobased Energy Economics Analysis Group*, 03/Jan/2007 <<http://www.agpolicy.org/ppap/REPORT%2025x25.pdf>>. p31.Table 11.

³¹⁵ KPMG Bureau voor Economische Argumentatie; Steins Bisschop Meijburg & Co Advocaten, *Solar Energy: From Perennial Promise to Competitive Alternative - Final Report*, Project Number: 2562. Aug 1999. *Greenpeace - Nederlands*, 24/Sep/2004 <<http://archive.greenpeace.org/~climate/renewables/reports/kpmg8.pdf>>.

³¹⁶ European Commission, *EUROPA - Research - Energy - - R&D Topics*. Jul 2005, European Commission, 28/Sep/2005 <http://europa.eu.int/comm/research/energy/nn/nn_rt/nn_rt_pv/article_1108_en.htm>.

³¹⁷ Doug Selsam, *The Selsam SUPERTURBINE*. Sep 2005, Superturbine Inc., 28/Sep/2005 <<http://www.speakerfactory.net/wind.htm>>.

California Energy Commission, *Notice of Awards EISG Program, Solicitation 02-01*. 19/Feb 2003, California Energy Commission, 18/Sep/2004 <http://www.energy.ca.gov/contracts/smallgrant/2003-02-21_awards_02-02.html>.

³¹⁸ Sky WindPower Corporation, *Sky WindPower Corporation*. 6/June 2005, Sky WindPower Corporation, 123/Feb/2006 <<http://www.skywindpower.com/ww/index.htm>>.

³¹⁹(For example wheat accounted for 20 times the acreage harvested compared to coffee worldwide in 2004)

United Nations Food and Agriculture Organization of the United Nations Statistical Service, *FAOSTAT Database Results*. 2004, United Nations Food and Agriculture Organization of the United Nations Statistical Service, 13/Jul/2005 <<http://faostat.fao.org/faostat/servlet/XteServlet3?Areas=862&Items=656&Items=15&Elements=31&Year>>

s=2004&Format=Table&Xaxis=Years&Yaxis=Countries&Aggregate=&Calculate=&Domain=SUA&Item Types=Production.Crops.Primary&language=EN>.

³²⁰U.S. Department of Energy - Energy Efficiency and Renewable Energy, *Solar FAQs — Concentrating Solar Power — ALL*. 8/Feb 2007, 18/Jan/2008
http://www.eere.energy.gov/solar/cfm/faqs/third_level.cfm/name=Concentrating%20Solar%20Power/cat=ALL#Q84

³²¹ According to the DOE, coal plants consume slightly more land than CSP.
Ibid 320

According to an in depth 1984 study, CSP uses slightly more land than coa.
Byron A. Miller and Martin J. Pasqualetti, "Land Requirements for the Solar and Coal Options," *The Geographical Journal* 150, no. 2 (Jul 1984): 192-212.

Given that solar energy has made a lot of progress since 1984, it seems likely that Miller and Pasqualetti were right when their study was complete, and the DOE is correct today.

³²² U.S. Army Corps of Engineers, "National Inventory of Dams", Feb 2005, 27-Jun-2007
<<http://edcftp.cr.usgs.gov/pub/data/nationalatlas/dams00x020.tar.gz>>.

³²³ Michael Shellenberger and Ted Nordhaus, "The Death of Environmentalism: Global Warming Politics in a Post-Environmental World,". *Grist Magazine* 13/Jan 2005: Main Dish, Grist Magazine - Seattle, 15/Oct/2005 <<http://grist.org/news/maindish/2005/01/13/doe-reprint/>>.

³²⁴ John Weir, *Global Warming*. 8/Apr 2002, NASA Earth Observatory, 10/Jun/2005 <<http://earthobservatory.nasa.gov/Library/GlobalWarming/printall.php>>.

³²⁵ Naomi Oreskes, "Beyond the Ivory Tower: The Scientific Consensus on Climate Change,". *Science* 306, no. Issue 5702, 1686 ; 3/Dec 2004: Essays on Science and Society, The American Association for the Advancement of Science (AAAS), 30/Dec/2004
<<http://www.sciencemag.org/cgi/content/full/306/5702/1686>>.

³²⁶ Bruce A. Hungate et al., "CO2 Elicits Long-Term Decline in Nitrogen Fixation,". *Science* 304, no. 5675, 1291 28/May 2004, The American Association for the Advancement of Science (AAAS), 1/Sep/2004
<<http://www.sciencemag.org/cgi/content/full/304/5675/1291>>, (Brevia: Requires free registration and Login).
Brevia: Page 1291

³²⁷ National Center for Atmospheric Research, *New Look at Satellite Data Supports Global Warming Trend*. 1/May 2003, National Center for Atmospheric Research, 10/Jun/2004
<<http://www.ucar.edu/communications/newsreleases/2003/wigley2.html>>.

³²⁸ Sydney Levitus et al., "Warming of the World Ocean,". *Science* 287, no. 5461 24/Mar 2000, The American Association for the Advancement of Science (AAAS), 31/Dec/2004
<http://www.atmos.ucla.edu/~gruber/teaching/papers_to_read/levitus_sci_00.pdf>.

³²⁹ Sami K. Solanki, *The Sun is More Active Now Than Over the Last 8000 Years*. 28/Oct 2004, Max Planck Institute for Solar System Research, 1/Oct/2005
<<http://www.mpg.de/english/illustrationsDocumentation/documentation/pressReleases/2004/pressRelease20041028/>>.

³³⁰ National Oceanic and Atmospheric Administration, *NCDC: Global Warming - Frequently Asked Questions - Can the Observed Changes Be Explained by Natural Variability, Including Changes in Solar*

Output? 27/May 2005, National Oceanic and Atmospheric Administration, 1/Oct/2005 <<http://lwf.ncdc.noaa.gov/oa/climate/globalwarming.html#Q10>>.

³³¹Daniel L. Albritton et al., *Summary for Policymakers: A Report of Working Group I of the Intergovernmental Panel on Climate Change*. Jan 2001, Intergovernmental Panel on Climate Change, 31/Dec/2004 <<http://www.ipcc.ch/pub/spm22-01.pdf>>.p13.

³³²Union of Concerned Scientists, *Global Warming FAQ*. 10/Aug 2005, Union of Concerned Scientists, 1/Oct/2005 <http://www.ucsusa.org/global_warming/science/global-warming-faq.html>.

³³³Shaobing Peng et al., "Rice Yields Decline with Higher Night Temperature from Global Warming,". *Journal of the Proceedings of the National Academy of Sciences* 101, no. 7 6/Jul 2004, National Academy of Sciences, 31/Dec/2004 <<http://www.pnas.org/cgi/reprint/101/27/9971.pdf>>.pp9971-9975.

³³⁴Luis Cifuentes et al., "Climate Change: Hidden Health Benefits of Greenhouse Gas Mitigation,". *Science* 293, no. 5533 17/Aug 2001 *When Smoke Ran Like Water*, The American Association for the Advancement of Science (AAAS), 4/Jun/2004 <<http://www.whensmokeranlikewater.com/publications/scientific/Science2.html>>.

³³⁵World Resources Institute, *Greenhouse Gas Emissions Endanger the Public's Health Today*. Nov 1997, World Resources Institute - Citing November 7 1997 Lancet Article, 1/Oct/2005 <http://population.wri.org/newsrelease_text.cfm?NewsReleaseID=104>.

³³⁶David Urbinato, "London's Historic "Pea-Soupers,"". *EPA Journal* Summer 1994, U.S. EPA, 9/Jan/2005 <<http://www.epa.gov/history/topics/perspect/london.htm>>.

³³⁷Chirag Trivedi, "The Great Smog of London,". *BBC News Online* 5/Dec 2002, BBC News Online, 9/Jan/2005 <<http://news.bbc.co.uk/1/hi/england/2545759.stm>>.

Ken Livingstone, *50 Years On: The Struggle for Air Quality in London Since the Great Smog of December 1952*. Dec 2002. *Greater London Authority*, 9/Jan/2005 <http://www.london.gov.uk/mayor/environment/air_quality/docs/50_years_on.pdf>.p1.

Regulatory Services - The Lambeth Council, *Lambeth 2002 Annual Air Quality Report - Active Monitoring Summary*. 2002. *Regulatory Services - The Lambeth Council*, 9/Jan/2005 <<http://www.lambeth.gov.uk/intradoc/groups/public/documents/report/029068.pdf>>.p10.

³³⁸Shaoni Bhattacharya, "Global Warming 'Kills 160,000 a Year,'" . *New Scientist (NewScientist.Com Online News Journal)* Oct 2003, 9/Jan/2005 <<http://www.newscientist.com/article.ns?id=dn4223>>.

³³⁹Dave Frame, Reto Knutti, and Malte Meinshausen, *RealClimate - Can 2°C Warming Be Avoided?* Climate Science from Climate Scientists, 31/Jan 2006, Real Climate, 12/Feb/2006 <<http://www.realclimate.org/index.php?p=246#more-246>>.

³⁴⁰Caroline Dr. Lucas, *The Future of Aviation: The Government's Consultation Document on Air Transport Policy - Submission from Dr Caroline Lucas, MEP, Green Party, and Member of the European Parliament's Transport Committee*. 2001. *European Parliament*, Green Party UK, 23/Sep/2005 <http://archive.greenparty.org.uk/reports/2001/aviation/av_fut_mep_resp.pdf>.

³⁴¹Joe Sharkey, "Rail Projects Are Sign of a Quiet Revolution in Short-Haul Trips," *EcoCity Cleveland - Transportation Choices*, 4/Jun 2002, New York Times Inc., 23/Sep/2005 <http://www.ecocitycleveland.org/transportation/rail/nytimes_rail_article.html>.

³⁴²Ibid 252

Appendix : "There Is No Such Thing As the "Hawthorne Effect"

³⁴³The Impact of the Hawthorne Effect in Experiment Designs in Educational Research, Final Report P1757, U.S. Office of Education
Desmond Cook, 1967 - as cited by Cool Companies (252)

³⁴⁴ Hawthorne Control Procedures in Educational Experiments: A Reconsideration of Their Use and Effectiveness," Review of Educational Research Summer 1989 Vol 59 No 2 pp 215-228
John G. Adair, Donal Sharpe, and Cam-Loi Huynh
as cited in Cool Companies (252)

³⁴⁵B. Douglas Clinton and David E. Keys, "Resource Consumption Accounting: The Next Generation of Cost Management Systems," *Focus Magazine: For the Performance Management Professional* 5, no. 2002 (2002), Focused Management Inc., 2/Apr/2005
<http://www.focusmag.com/back_issues/issue_05/pages/rca.htm>.

³⁴⁶Shane Johnson, *Environmental Management Accounting*. 13/Jan 2004, Association of Chartered Certified Accountants, 2/Apr/2005 <<http://www.acca.co.uk/publications/studentaccountant/1073480>>.

³⁴⁷Peter Dorman, *The Economics of Safety, Health, and Well-Being at Work: An Overview*. In *Focus Program on SafeWork*. May 2000, International Labour Organization (ILO) of the United Nations, 2/Apr/2005 <<http://www.ilo.org/public/english/protection/safework/papers/eoanal/ecoview.pdf>>.p17.