Recycling – Real or Rationalization

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Recently several different groups in my community of Yellow Springs, Ohio began taking actions concerning climate change. This started around the time of the Pope's visit to the US in September, 2015. An interfaith group was formed of citizens interested in getting the different religions in town to become more aware and more involved in climate change action. As a result of this, a Buddhist group held four meetings (which I attended) to discuss a book on the topic of climate change written by a Buddhist nun. Also the local Quaker community began meeting, starting out by reviewing some of the work they had done to reduce energy use. This work included thickening the walls of their meeting room, increasing the depth of the insulation and replacing the single pane windows with double pane windows. In late October, I attended the first meeting of a third group of citizens commissioned by the Village Council to develop a Climate Action Plan.

At each of these meetings, recycling was discussed. The emphasis varied. In the Quaker meeting an October 3rd New York Times article entitled *The Reign of Recycling* [1] by John Tierney was discussed along with two responses to it – *7 Reasons Why Recycling Is Not a Waste: A Response to 'The Reign of Recycling'* [2] and *Where Our Trash Goes* [3] by Luke Sharret, New York Times, October 11, 2015. There seemed to be some confusion around the effectiveness of recycling. People in each of the two religious groups I have mentioned assumed recycling would make a big impact in mitigating the effects of climate change.

I had disposed of the recycling issue as a key contributor to climate change in my own mind some years back. In my book *Plan C: Community Survival Strategies for Peak Oil and Climate Change* (2008), recycling was dealt with in Chapter 9: "Post – Peak Change Starts with Us". That chapter included a sub section entitled "Pollution Numeracy" which explained the technique of developing per capita numbers and comparing them to alternative approaches. I pointed out in the book that recycling seemed to save very little CO_2 compared to the total yearly CO_2 generated by Americans.

I decided to review the arguments in my book – pro and con – and see if anything had changed since 2008. In the ensuing years I have learned much more about CO_2 emissions and their possible reductions. Reconsidering the question would be worthwhile. I found a myriad of sources that I had not discovered before. One report *Advancing Sustainable Materials Management: Facts and Figures 2013* published in June 2015 [4] contains an amazing amount of data (186 pages worth). A second 22 page report from the EPA is entitled *Advancing Sustainable Materials Management: 2013 Fact Sheet.* [5] A few tables from that report illustrate some key issues of Municipal Solid Waste (MSW).

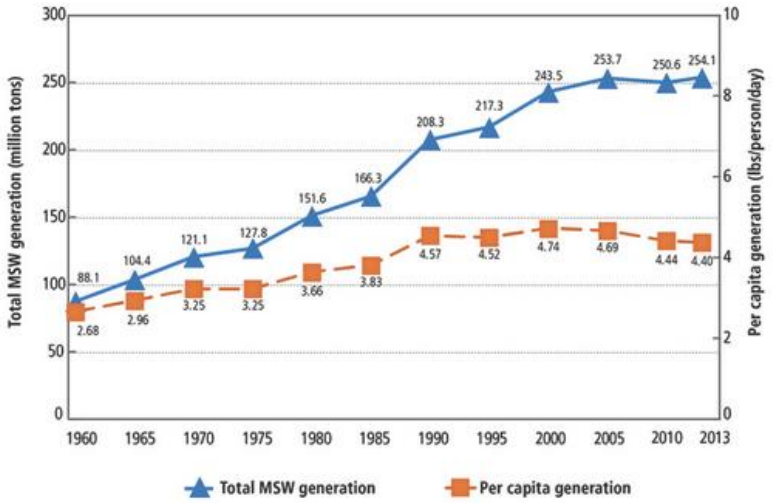

Figure 1: MSW Generation Rates and Per Capita Daily Generation 1960-2013

The rate of waste generation per person is about the same as in 2008. Note that 4.38 pounds per day is about 1,600 pounds per year.

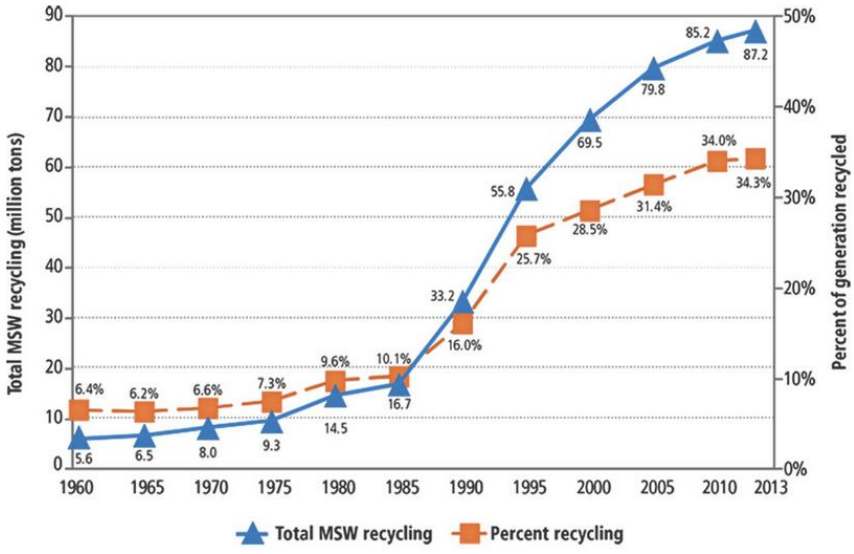

Figure 2: MSW Recycling Rates and Per Cent Recycled 1960-2013

Figure 2 shows the total MSW recycled as well as the percent of the total non-recycled waste. The curve with triangles shows the rapid growth in recycling, the result of a national effort. The curve with squares shows a rapidly increasing percentage of recycled MSW.

For my work on climate change, the most important number is the CO_2 saved per person. The EPA report *Facts and Figures* notes: "Nationally, Americans recycled and composted almost 87 million tons of municipal solid waste. This provides an annual benefit of more than 168 million metric tons of carbon dioxide equivalent emissions reduced, comparable to the annual GHG emissions from over 33 million passenger vehicles." It further states "Recycling and composting almost 87 million tons of MSW saved more than 1.1 quadrillion Btu of energy; that's the same amount of energy consumed by almost 10 million U.S. households in a year."

Although this sounds impressive I decided to verify some of the numbers and put them in perspective by comparing them to total U.S. CO_2 emissions. The first number I chose to analyze came from the statement that 168 million metric tons of CO_2 is equivalent to the CO_2 of 33 million passenger vehicles. Since most people have a car, I concluded that the CO_2 generated per car would be useful. To determine this number, I simply divided the 168 million metric tons by the 33 million passenger vehicles and obtained the number of 5.1 metric tons per year per vehicle. This is quite close to a measure for car emissions of 4.75 metric tons of CO_2 per year found on the EPA web site under the GHG Equivalencies Calculator section. [6] To complete this analysis I note there are about 256 million passenger vehicles in the country.

Then I looked at how the 168 million metric tons compared to total emissions. The total emissions are documented in the annual U.S. Greenhouse Gas Inventory Report. [7] The 2014 report states that the total CO_2 generated in 2014 was 6**,**870 million tons. 168 million tons is 2.4% of that total.

I next compared the 168 million metric tons is to the current personal CO_2 generated by the average American. This number is available from the International Energy Agency (IEA) Key World Energy Statistics report. [8] The 2015 World Energy Statistics shows that the most recent number for an American's annual CO_2 generation is 16.2 metric tons per person per year. The 168 million metric tons saved by recycling divided by the population in 2014 of 319 million people gives a number of about 0.5 metric tons per person per year. Dividing this number by the total number of 16. metric tons per person per year gives a 3.0% reduction. This is very close to the 2.6% percent resulting from the calculation using the Greenhouse Gas Inventory Report noted above.

I wondered how the potential savings of 0.5 metric tons of CO_2 per person per year related to a breakdown of a person's yearly CO_2 emissions divided into categories. This breakdown is shown in Figure 3, available from the Cool Climate Website. [9]

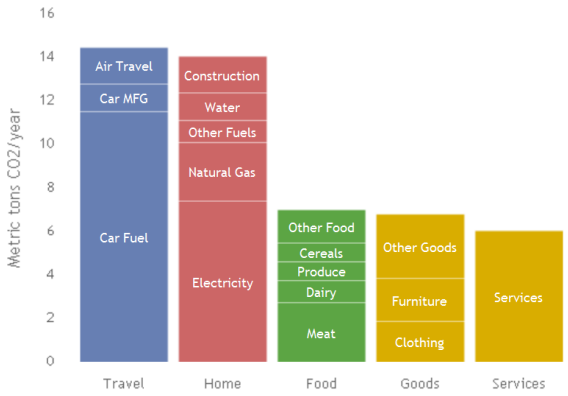

Figure 3: Average U.S. Household CO_2 Budget

The accompanying data for Figure 3 is available from the same website and obtained by running your cursor over different parts of the figure. Table 1 shows the specific values for the different categories shown in figure 3.

The recycling value of 0.5 metric tons per person discussed above must be converted to household numbers. The average household contains 2.54 people.[10] Multiplying the two numbers (0.5 and 2.54) gives 1.27 tons of CO_2 per household. This is placed in the Home column of Table 1.

TRAVEL	TONS CO_2	HOME	TONS CO_2	FOOD	TONS CO_2	GOODS	TONS CO_2	SERVICES	TONS CO_2
Air Travel	1.66	Construction	1.72	Other Food	1.50	Other Goods	2.95	Services	6.02
Car MFG	1.27	Water	1.25	Cereals	0.89	Furniture	1.94		
Car Fuel	11.54	Other Fuels	0.99	Produce	0.83	Clothing	1.90		
		Natural Gas	2.70	Dairy	1.04				
		Electricity	7.43	Meat	2.74				
		Recycling	(1.27)						
Totals	14.47		12.82		7.00		6.79		6.02

Table 1: Carbon Footprint (CO_2 per household per year) for a household

The purpose of this calculation is to show how recycling fits in the overall picture of CO_2 emissions. As a quick verification, I reviewed data maintained by the McAuliffe-Shepard Discovery Center in New Hampshire in a paper entitled Reducing Personal CO_2 Emissions.[11] This report notes that a household that recycles aluminum cans, glass bottles, plastics, cardboard, and newspapers can reduce CO_2 emissions by 850 pounds per year for a household of 2.6 people. This is less than half a ton per household so my 1.27 tons estimate may be optimistic.

Many groups measure savings in terms of “equivalent to X million cars removed from the road”. This does not mean the cars are removed – a better way to say it might be “equivalent to the yearly emissions from X million cars”. Plan Curtail prefers using exact measures rather than equivalent ones as a way of increasing understanding. By seeing the national allocation of CO_2 per person for different classes of energy usage, an individual can more easily evaluate different CO_2 saving strategies. I concluded that our local groups might want to consider some target other than recycling since its savings is such a small percent of total emissions.

[1] The Reign of Recycling by John Tierney, New York Times, October 3, 2015
http://mobile.nytimes.com/2015/10/04/opinion/sunday/the-reign-of-recycling.html?referer=&_r=0
[2] Reasons Why Recycling Is Not a Waste: A Response to 'The Reign of Recycling' by Tom Szaky October 13, 2015,
http://www.sustainablebrands.com/news_and_views/waste_not/tom_szaky/7_reasons_why_recycling_not_waste_response_reign_recycling
[3] Where Our Trash Goes by Luke Sharret, New York Times, October 11, 2015
http://www.nytimes.com/2015/10/11/opinion/sunday/where-our-trash-goes.html
[4] Advancing Sustainable Materials Management: Facts and Figures Full Report
https://www.epa.gov/smm/advancing-sustainable-materials-management-facts-and-figures-report
https://www.epa.gov/sites/production/files/2015-09/documents/2013_advncng_smm_rpt.pdf
[5] Advancing Sustainable Materials Management: 2013 Fact Sheet Materials and Waste Management in the United States Key Facts and Figures 1960-2013 https://www.epa.gov/smm/advancing-sustainable-materials-management-facts-and-figures#Materials
[6] http://www2.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references
[7] Inventory U.S. Greenhouse Gas Inventory Report: 1990-2014
http://www3.epa.gov/climatechange/ghgemissions/usinventoryreport.html
[8] Key World Energy Statistics 2015, page 15
https://www.iea.org/publications/freepublications/publication/KeyWorld_Statistics_2015.pdf
[9] Cool Climate Network, Carbon Footprint http://coolclimate.berkeley.edu/calculator
[10] Number of people per household in the United States from 1960 to 2014
http://www.statista.com/statistics/183648/average-size-of-households-in-the-us
[11] Reducing Personal CO_2 Emissions McAuliffe-Shepard Discovery Center
http://www.starhop.com/library/pdf/studyguide/high/brsp-17ReduceCO2.pdf