# INTERNATIONAL ENERGY SYSTEMS AND BUSINESS STRUCTURES

## PAPER 2 – FINAL PAPER

# PROJECT REPORT - ROTARY BOOKS FOR THE WORLD

Carbon calculations and marketing recommendations for the Rotary Books for the World Initiative

School of International and Public Affairs / Columbia University
Professor David Nissen

Fall Term 2008
Fabian Kreuzer

*Word count: 2924 words without title page, annex, references, graphs, tables and footnotes.*

## 1. Introduction: "Rotary Books for the World" – A CO2 positive initiative?

At the Rotary UN Day at the United Nations that took place November 8th, Rotarian Charles Clemmons presented to the audience his initiative tackling illiteracy in Africa. In his opinion, his project should be carbon positive and he asked for people able to perform a proper carbon evaluation.

The author of this paper did perform an evaluation and the result is what you are holding on hand. The paper is a pure consulting product; no field experiments and examinations took place. The evaluation is entirely based on publicly available data. The key questions identified by the author are:

1. What is the carbon dioxide footprint of the Rotary Books for the World Initiative?
2. What is the footprint of the alternatives?
3. How should a positive CO2 evaluation result be marketed?

First, a short project description is given. Second, a what-if-analysis of the flows is performed to construct scenarios, followed by the actual emissions calculation. In the end, a short discussion of the possible markets takes place before the concluding remarks give recommendations for the initiative.

## 2. Project description – Rotary Books for the World in a nutshell

Rotary Books for the World is a not-for-profit project initiated by two Rotarians, Barbara and Charles Clemmons, who have decided to tackle illiteracy in Africa. For seven years, starting in 2001, volunteers have been collecting (text-)books from schools in the US that are replaced by newer versions (law requires to use the new version) and would be shred and burned in many cases (Rotary Books for the World, 2008, pp. 2-3).

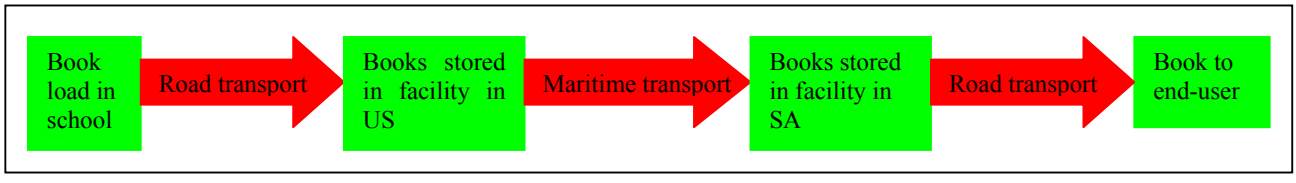
Those books are obtained without charge and transported to a storage facility run by the Books for the World Initiative. These storages are established in Houston (TX), Marietta (GA), Madison (WI), Dixon (CA), Beaumont (TX) and Abilene (TX). Volunteers with pick-ups provide the travel from the school to the storage facilities. If the load is too big for several pick-ups, a truck is hired. The books have to be boxed and palletized before being shelved until a container, which is purchased by the related foundation, can be filled to ship a load of books to South Africa. As containers cannot be filled entirely with books (weight limitations) other useful supplies are added on top (wheelchairs, school desks, etc., Rotary Books for the World, 2008, p. 7). For shipment, the initiative uses empty cargo ships on the way back to South Africa after delivering freight to the US. These ships would go empty otherwise.

Books are distributed to South African schools and, after further road transportation, to schools in Zimbabwe, Zambia, Swaziland, Lesotho and Malawi. These journeys are made by the books on trucks on their way to their home countries after delivering freight (mostly copper and other raw material) to South Africa (Rotary Books for the World, 2008, p. 3). These trucks would either be on their way and adding the books gives them a purpose. The shipping containers are donated to local Rotary clubs that transform them in useful facilities such as school kitchens, orphan day centres, etc. (Rotary Books for the World, 2008, p. 5).

Please note that providing access to Internet instead of shipping textbooks would not help. First, the target population is illiterate, second electricity supply is not reliable and third theft may be a problem (Clemmons, 2008).

## 3. Carbon analysis

For better understanding the travel path is charted:



Some first reflections give an overview which steps are important for CO2 emissions.

CO2 positive aspects:

1. As books are not burned, landfilled or repulped in the US, no CO2 is emitted.
2. As no new books are printed, deforestation is reduced.
3. As ships are used rather then send back empty CO2 emission is used more efficiently.
4. As trucks are used in Africa rather then send back empty CO2 emission is used more efficiently.

CO2 negative aspects:

1. Road transport of books in the US with pick-ups emits CO2.
2. Moving the container to the warehouse and the port emits CO2.
3. Volunteer travel occurs that burns fossil fuels emitting CO2.

CO2 neutral aspects:

1. Packaging of books as boxes are second use boxes and pallets are second or more use pallets. As this material is second use, it is neutral because it could serve the same purpose previously determined after the material served the initiative.
2. The containers as they serve a new purpose after shipping the book with it. It is true that the initial production of the container emits CO2, but the reuse as a schooling facility, etc. suggests that these buildings would have been constructed in any case. However, this assumption is arguable, especially considering the emissions producing steel and cement for example. The average intensity of carbon dioxide emissions from cement production is 222 kg of C/t of cement (Worrell, Price, Martin, Hendriks, & Meida, 2001). That converts into 222kg*3.67tCO2/tC*0,001 = 0.814 tCO2/t.[1] The containers are probably made of steel of which carbon dioxide emissions per unit mass are 1.75 tCO2/tonne steel (Carbon Trust, 2008).[2] This is roughly twice as much CO2 emitted in the production process. However, constructing a cement house instead of using a container would at least take twice the amount of cement than steel. Therefore, it is arguable how exactly the balance would be, in the following the container will be assumed as carbon neutral.

To prove a positive carbon balance, the condition is
Positive aspects – negative aspects > 0

It is important to note that these possible CO2 spots, however, are highly uncertain as it cannot be proved that every single book would have taken a particular route. Several what-if scenarios can be determined for the books as summarized in the following table, set up by the author, following LaRocco's advice (2008). Please note that we assume that a book is entirely manufactured of paper even tough the cover should be treated differently.

| Part of travel | Possible outcome | CO2 emission | Explicatory remarks | Scenario |
|---|---|---|---|---|
| Books to be disposed | Burn (without energy production) | 2.312 tCO2/t paper | World Wide Found for Nature Switzerland (2006) estimates that 1kg paper needs about 0.7kg cellulose and to produce 1kg cellulose 0.0036$m^3$ wood are needed. Consequently, 0.0025$m^3$ wood are needed to produce 1kg paper. According to Lebensministerium | A |

[1] Conversion factor based on Nissen, 2008.
[2] For comparison: Schmidt, p. 27 calculates slightly lower averages: 1.63 tCO2/t steel and 0.78 tCO2/t cement.

| | | | | |
|---|---|---|---|---|
| | | | Österreich and Kyoto Forestry Association wood contains about 250kgC/$m^3$, thus, 0.0025$m^3$ contain 0.63kgC=0.00063tC. With the conversion by Nissen (2008), tCO2/tC=3.67, this gives 0.0023 tCO2/kg paper = 2.312 tCO2/t paper. This amount would be released if paper were burned. | |
| | Burn (with energy production) | Less than 2.312 tCO2/t, but more than 0 tCO2/t paper | Estimates of energy out of waste burning include other waste not only paper (according to Environmental Protection Agency, 2008b, p. 6 paper in municipal waste is 32.7%, see annex. How waste is used for energy production can also be found in the annex). If only paper had been burned, the emissions would be the same as for paper burning without energy production. However, some of the emissions are used for energy generation that conserve other energy resources. This part is usefully burned and would have to be deducted. However, generation facilities do not reach 100% efficiency, thus, emissions cannot be zero. This argument is contestable because one could also reason that the same efficiency factor would apply to every electricity production out of fossil fuels, thus, the burning of the books is actually reasonable and should be accounted with zero emissions. That argument is especially powerful considering the fact that energy out of waste is one of the less polluting energy generation resources as can been seen in the annex based on Bilitewski (2006). I will not further engage in this discussion. | B |
| | Recycle/Repulp | 0.849 tCO2/t paper | This is the value the European Commission used for its calculation. The number includes energy used in the recycling process. Please refer to the annex for a comparison table (please note that the other cited values in the table do not include energy use, therefore, I will use the 0.849 value). However, it remains an estimate as the actual number is depending on various variables, e.g. the mix of paper quality in the recycled paper end product and the energy mix of the country that supplies the electricity for the processing stage (See European Commission, 2001). | C |
| | Landfill | No CO2 emission | LaRocco (2008) states that in a typical un-ventilated landfill items like this will never decay. Therefore, this solution is a kind of sequestration with zero CO2 emissions. | D |
| | Reuse the old books | SEE BELOW | Please refer to the shipping evaluation below. | BEST |
| | | | | |
| New Books | Produced with wood from unsustainably managed forests | 1.755 tCO2/t paper + deforestation impact | This is the value from the European Commission study cited above. Same reasoning applies (see European Commission, 2001). An adjustment should be made for the unsustainably managed forests to take into account the deforestation impact. | 1 |
| | Produced with wood from | 1.755 tCO2/t paper. | This is the value from the European Commission study cited above. Same | 2 |

| | | | | |
|---|---|---|---|---|
| | sustainably managed forests | | reasoning applies (see European Commission, 2001). As the forests in this case are managed sustainable, no deforestation surcharge has to be applied. | |
| | Reuse the old books | SEE BELOW | Please refer to the shipping evaluation below. | BEST |
| | | | | |

The above table shows that there are many possible ways an old book can pursue, combined with three possibilities African kids can obtain books for schooling. All scenarios from the first part can be combined with a scenario from the second half, e.g. A1, A2, C1, etc. As these options are numerous, I will only compare the best case for the initiative with the highest emissions (the worst case for the planet) with the initiative case. That means we will look at scenarios A1 and BESTBEST to give a benchmark of what the emission balance of the initiative is and what the emissions would be for the case with the highest emissions.

To proceed, it is important to know the weight of the books collected and shipped by the initiative. In one load, 45,000lbs are shipped and the initiative calculates with a weight of 1lbs per book, according to Clemmons (2008). This means that the initiative handles a total of 45,000 books equalling 45,000*0.000454 = 20.43t (metric tons).[3]

3.1 Case A1 (best case for the initiative, worst case for the planet)

In case A1, books are transported from the school to a waste treatment site where they are burned without electricity generation. At the same time, books in Africa are produced from unsustainably managed forests, causing deforestation and pollution during the production process. Afterwards, books are transported to the schools.

The transport from the school to the waste treatment facility (whatever the treatment should be) is very likely to be conducted by truck. The Environmental Protection Agency (2008a) reports currently 1,754 landfills, 8,660 curbside recycling facilities and 3,510 community composting sites. Therefore, it is not determinable where the books from the schools actually go. Consequently, I will assume that the journey to the waste treatment sites and the storages owned by the initiative are approximately the same. This assumption is reasonable as most of the times the waste will go to the nearest community treatment facility as well as volunteers will not transport the books for hundreds of miles. The initiative probably collects most of the books from nearby schools (unfortunately they to not keep a log book of the travels, Clemmons, 2008).
The same assumption applies to the transport from the production facility in Africa to the schools. As it is not possible to estimate from where to where the books go without purchase orders from the schools and log books from the initiative we will assume roughly the same travel distance from the production site to the schools as from the harbour to the schools.

For the paper burned in the United States emitting CO2 it can be calculated that for each book load shipped the CO2 avoided is:

$$2.312\ tCO_2/t\ paper * 20.43\ t\ paper\ each\ load = 47.23\ tCO_2\ per\ load.$$

Moreover, the books are not reprinted in Africa, cutting down trees from unsustainably managed forests causing deforestation. This is exactly the same amount again as the above calculated factor already takes into account the percentage of wood in each piece of paper.

[3] Conversion factor by Nissen, 2008, p. 10.

Consequently, the avoided reprinting of the books saves 2.312 tCO2/t of paper that means each load avoids additionally 47.23 tCO2 in deforestation.

Furthermore, processing is avoided what has been calculated in the above table to 1.755 tCO2/t paper produced, equalling for the books shipped:

1.755 tCO2/t paper*20.43 t paper each load = 35.85 tCO2 per load.

Adding up these pieces gives the total in CO2 emissions caused by the A1 case:

(47.23+47.23+35.85) tCO2 per load = 130.31 tCO2 per load.

These are the CO2 emissions combined with destroyed CO2 sequestration capacity from burning the paper and reprinting the books.

3.2 Case BESTBEST (the initiative case)

In the initiative case, volunteers travel to the schools, collect books and bring them to the storage facilities owned by the initiative where a container is ready. The books are packaged into the container, which then travels on an otherwise empty ship back to Africa where the books are unloaded and transported to local schools on an otherwise empty truck. For simplicity and lack of information we will not take into account any heating in the warehouse that causes CO2 emission.

The travel of volunteers to the school and the transport to the storage facility will not be taken into account as this is considered to be the same as a possible collection and transport to burning facilities as mentioned above. The same applies to the end of the journey when books are transported to the end user. However, this part of the travel uses trucks that would be on the way in any case as they are on their way back. That is probably not the case if the school bought new books. Therefore, the solution of the initiative is in a certain way more efficient, although it is hard to quantify an exact amount. We will keep this efficiency gain in mind as a slight plus in terms of carbon positivity.

A step in the journey of the books that has to be considered carbon negative, however, and would not have occurred without the initiative is the travel of the books from the storage facilities to the port in Houston, where the actual shipping takes place. Moreover, the container has to be transported to the warehouse and from the warehouse to the port. The following distances apply. The travel will be accounted for with the return as the transporting pick-ups will have to go back after the delivery.

| **Departure** | **Arrival** | **One Way** | **Return** | **Source** |
|---|---|---|---|---|
| Marietta (storage) | Houston (warehouse) | 805 miles | 1,610 miles | Google Maps |
| Houston (storage) | Houston (warehouse) | Approx. 0 miles | 0 miles | Google Maps |
| Madison (storage) | Houston (warehouse) | 1,226 miles | 2,452 miles | Google Maps |
| Dixon (storage) | Houston (warehouse) | 1,947 miles | 3,894 miles | Google Maps |
| Beaumont (storage) | Houston (warehouse) | 87 miles | 174 miles | Google Maps |
| Abilene (storage) | Houston (warehouse) | 423 miles | 846 miles | Google Maps |

| | | | | |
|---|---|---|---|---|
| Houston (container manufacturer) | Houston (warehouse) | 10 miles | 20 miles | Clemmons, 2008 |
| Houston (warehouse) | Houston (port) | 5 miles | 10 miles | Clemmons, 2008 |
| **Total** | | | **9006 miles** | |

For the emissions calculation, it is assumed that on average for one load, one pick-up full of books from every storage facility comes to the warehouse in Houston where the container is filled and then transported to the port. We will assume transportation on pick-ups, as on average this should be a roughly good estimate (although the container travel should be accounted for with a truck). As an example we take the Ford Ranger Pickup 2WD or the Mazda B2300 2WD, which are ranked on 29 miles-per-gallon by EPA (the most efficient pick-ups in the 4,500-8,500 pounds category in 2007, both fuelled with gasoline, Environmental Protection Agency, 2007, p. 4). The Environmental Protection Agency (2005) calculates the CO2 emissions per gallon for gasoline to 8.8kgCO2/gallon, based on the standards set by the Intergovernmental Panel for Climate Change. That means that the emissions from transportation add to:

(9,006 miles*8.8tCO2/gallon)/(29 miles/gallon*1,000) = 2.7 tCO2 per load.

It is obvious that even assuming higher numbers of $CO_2$ emission would not change a lot, as this number is just about 2% of the total emissions in the A1 case.

The last part of the travel that has to be taken into account is the shipping. Even though the ships would be on their way back anyway and Rotary Books for the World increases their efficiency, giving them a purpose to make the tour, the weight of the books may increase their emissions. The Maersk Line for example estimates the emissions from its container ships to 8.36 gCO2/t of freight and kilometre. The distance from Houston to Cape Town according to Convertunits.com (2008) is approximately 14,000km. The resulting CO2 emissions are:

[(8.36 tCO2/t of freight*km)*14,000km*20.43t]/1,000,000 = 2.4 tCO2 per load.

Again, this is relatively small compared to the A1 case.

In total the emissions for the BESTBEST case are about:

(2.7+2.4) tCO2 per load = 5.1 tCO2 per load.

3.3 Comparison A1 case and BESTBEST case

The Rotary Books Initiative is able to save CO2 emissions if one takes the two extreme cases, the most polluting one and the initiative case, as a baseline. In total the savings are:

130.31 tCO2 per load – 5.1 tCO2 per load = 125.21 tCO2 per load ≈ 120 tCO2 per load.

To take into account the rough estimates the evaluation sometimes assumed it is reasonable to take 120 tCO2 per load as the actual savings the initiative is able to perform for the most extreme cases.[4]

[4] This maybe a rough estimate, however, even one of the leading universities of continental Europe, Sciences Po Paris, states for its carbon evaluation an uncertainty of 33%, Sciences Po Paris, 2008. Consequently, the above-presented result is probably not too bad in comparison.

## 4. Marketing of CO2 positivity

Savings of 120 tCO2 per load (not even taking into account several loads per year) is substantial for such a small-scale initiative and should be used in favour of the project. First and foremost, it is a communication and advertising strategy, considering the fact that according to Moore (2004) air contains about $429.39*10^{-9}$ $tCO2/m^3$.[5] This means that the initiative saves about 280 million $m^3$ fresh air per load. That can be a powerful marketing argument.

Moreover, another possibility would be to sell the reduced CO2 to companies that want to buy CO2 emissions (as the European Trading Scheme does). The Clean Development Mechanism (CDM) established under the Kyoto Protocol would technically be the best option as it is integrated in the official United Nations body. However, first obstacle already is that the United States are currently not an active participant of the Kyoto Protocol. Moreover, the methodologies to evaluate a carbon positive project are complex (United Nations Framework Convention on Climate Change, 2008). Two main criteria are that the project definitely improves the CO2 balance (what cannot be determined for the initiative 100% as seen in the what-if-scenarios) and that the project would not be the most cost efficient alternative anyway (what has not been evaluated here but could be the case).[6] It seems more promising to work with the voluntary market, where private organisations do exactly the same as the CDM does just on a voluntary base. However, the methodologies to prove CO2 positivity are almost as strict as under the CDM, limiting the opportunities for the initiative.[7] These two options should be explored with a professional CDM consultant.

The most promising option to benefit financially from the CO2 positivity is to attribute a value to the CO2 emissions and try to find a goodwill sponsor that makes a donation in the same amount of money.[8] The initiative may be especially interesting to other foundations that are engaged in tackling illiteracy and want to become "morally" CO2 neutral. But what should the donation be? The current price as of 12 December 2008 in the European Emission Trading Scheme is about 15€ per tCO2. However, fluctuations are high (30€ in May 2006 and some cents in December 2007) and for a voluntary project the price may be a bite too high. Consequently, a price of about 7€ or $10 may be reasonable. That means that the initiative could sell each load for about $1,200.

## 5. Conclusion and recommendations

The Rotary Books for the World Initiative is carbon positive. Depending on the scenario what can happen to a book if not the initiative takes care of it; CO2 reductions up to 120 tCO2 per load are possible. This CO2 positivity is an additional advantage to the fact that the initiative tackles illiteracy (a social benefit that has not been taken into account). This advantage should be communicated to the public. Furthermore, in attributing a dollar value to the saved emissions, the initiative could raise money up to $1,200 per load in the goodwill market. Accreditation with the CDM or one of the voluntary organisations trading emissions is not

[5] C to CO2 conversion according to Nissen, 2008.

[6] Several methodologies have been accessed on the website of UNFCCC by the author but no approved methodology seems to be close to the initiative. However, if the executives of Rotary Books for the World want to try to submit a new methodology, the application material is available on the same website.

[7] The two biggest private organisations engaged in this business use also the UNFCCC standards as can been seen on their websites: Voluntary Carbon Standard, 2008 and CDM Goldstandard, 2008. However, Voluntary Carbon Standard may be a bit more promising as it also recognises the California Climate Action Registry Standards (http://www.climateregistry.org/tools/protocols/project-protocols.html) that seem to be more flexible for new projects. Currently there is no similar project.

[8] The term „goodwill market" has been invented by LaRocco, 2008.

recommended. However, the initiative should evaluate this option with professional carbon emissions consultants and lobby for a broader range of accreditation methodologies under the next climate change protocol via its Representation to the United Nations in New York.

Recommendations:
The initiative should

1. Communicate that it reduces CO2 emissions by 120 tCO2 per load equalling 280 million $m^3$ fresh air.
2. Sell its CO2 reduction for about $1,200 per load in the goodwill market to foundations or other organisations.
3. Lobby with the Rotary UN Representatives for more flexible CDM accreditation methodologies under a new climate change protocol.

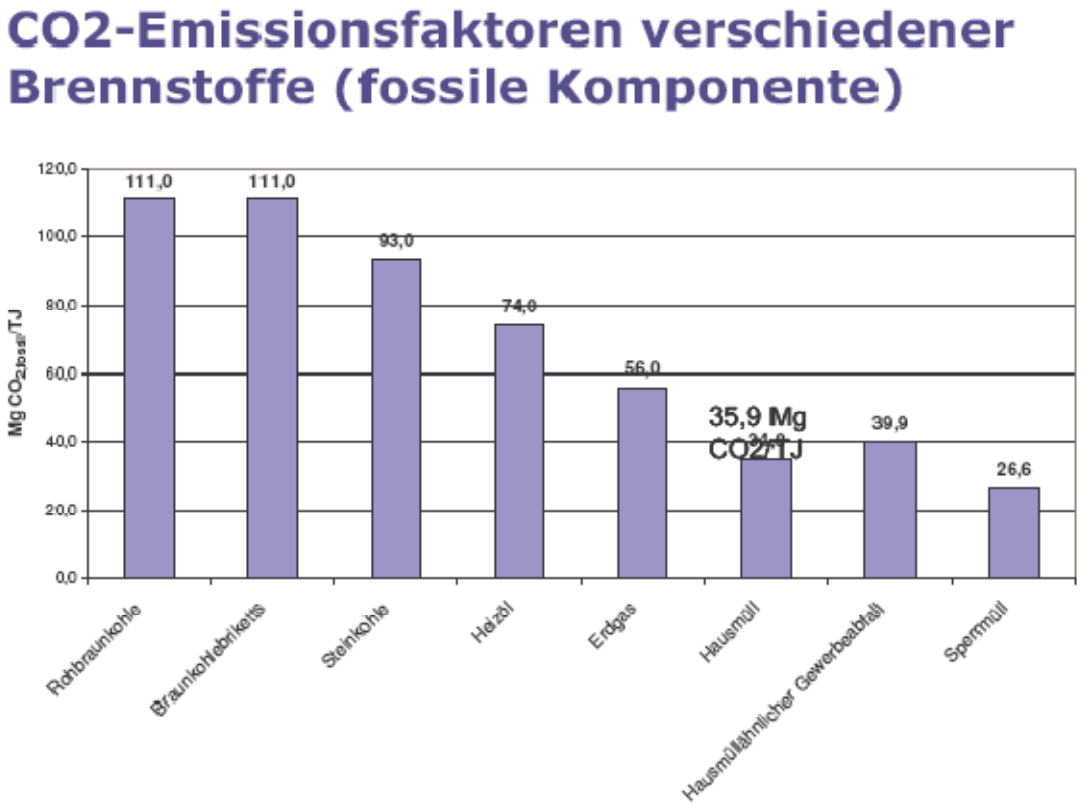
**I. Annex**

Table from the waste management study commissioned by the European Commission that shows values for CO2 emissions in paper production.

| paper type | source | from virgin materials | from recycled materials |
|---|---|---|---|
| newsprint | Swedish study | 1755 | 849 |
| newsprint | US study | 2222 | 1535 |
| newsprint | BUWAL database | | 291 (68% recycled) |
| kraft paper unbleached | BUWAL database | 1080 | 633 (Swiss kraft) |
| graphic paper | BUWAL database | 436 (uncoated) 730 (coated) | 586 with deinking 380 without deinking |
| corrugated board | BUWAL database | 644 (25% recycled) | 522-556 |
| packaging paper | BREF note | | 90 (stock only) |
| newsprint | BREF note | | 215 (stock only) |

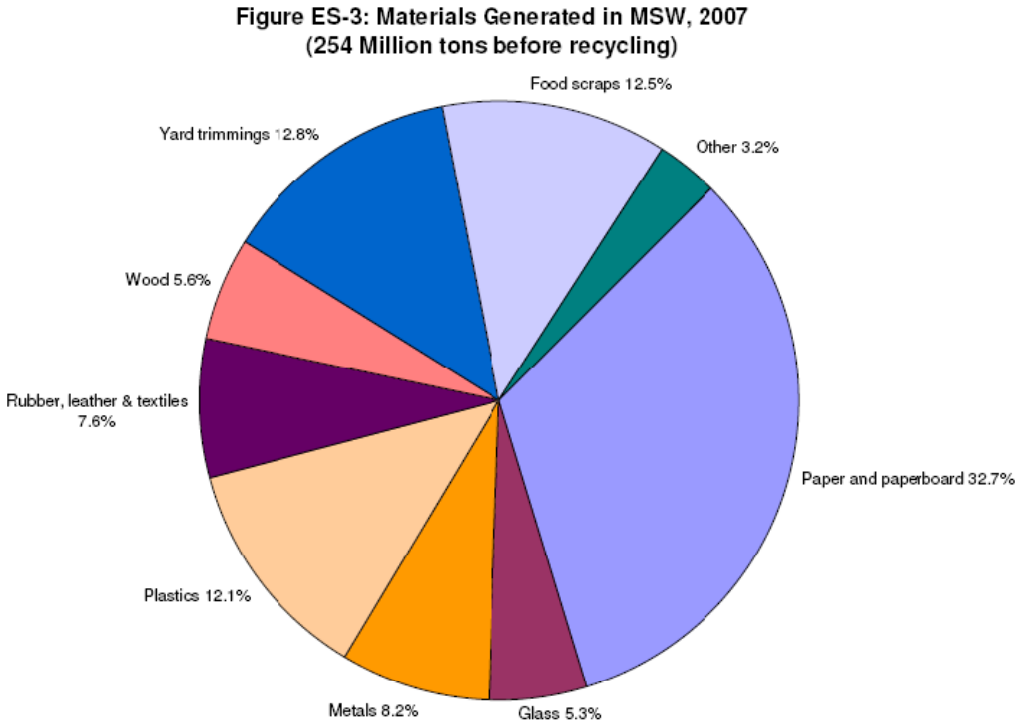
Source: European Commission, 2001.

Chart on CO2 emission from different energy sources. Emissions from burning waste in bold, showing that burning waste is one of the less polluting energy resources (excluding the fact that for producing that waste energy had been used before).



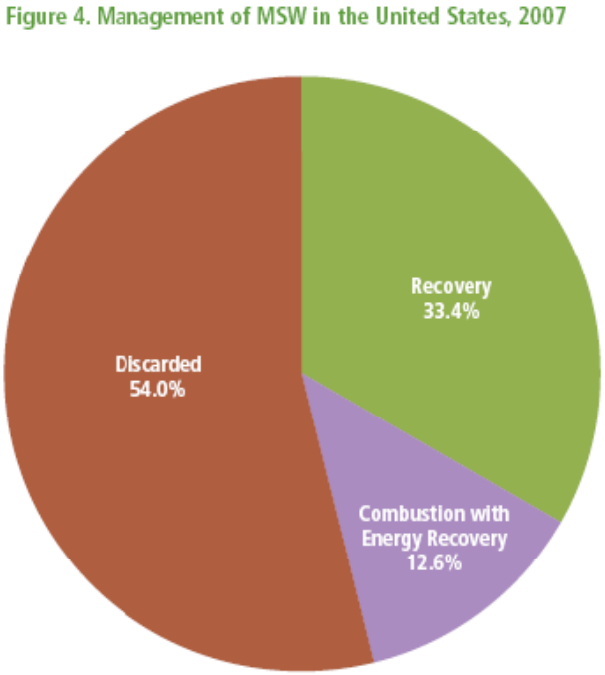

Source: Bilitewski, 2006.

Share of municipal solid waste in the United States, paper is the largest contributor.




Source: Environmental Protection Agency, 2008b, p. 6.

Treatment of waste in the United States.




Source: Environmental Protection Agency, 2008a.

## II. References


Bílitewski, B. (2006). Ökologische Effekte der Müllverbrennung durch Energienutzung. Berlin: Umweltbundesamt.

Carbon Trust. (2008). Life-cycle energy and emissions of marine energy devices. Retrieved 10 December 2008

CDM Goldstandard. (2008). GS Project Database. Retrieved 12 December 2008, from http://www.cdmgoldstandard.org/projects.php

Clemmons, C. (2008). Email.

Convertunits.com. (2008). Flight Houston Cape Town. Retrieved 12 December 2008, from http://www.convertunits.com/distance/from/Houston/to/Cape+Town

Environmental Protection Agency. (2005). Emission facts: Average carbon dioxide emissions resulting from gasoline and diesel fuel. Retrieved 12 December 2008, from http://www.epa.gov/otaq/climate/420f05001.htm

Environmental Protection Agency. (2007). *Fuel economy guide - model year 2007*: EPA.

Environmental Protection Agency. (2008a). Fact Sheet on Municipal Solid Waste: EPA.

Environmental Protection Agency. (2008b). *Municipal Solid Waste in the United States*: EPA.

European Commission. (2001). *Waste management options and climate change*. Luxemburg: EC.

Kyoto Forestry Association. How efficient is a forest in sequestering carbon from the atmosphere? Retrieved 10 December 2008, from http://www.kfoa.co.nz/faqs.htm#4

LaRocco, P. (2008). Email CO2 evaluation project.

Lebensministerium Österreich. The raw material wood is a promising construction material. Retrieved 10 December 2008, from http://forst.lebensministerium.at/article/articleview/70130/1/14174

Maersk Line. Environmentally friendly transportation: Maersk Line.

Moore, P. (2004). The forest and carbon fixing - some stunning figures. Retrieved 10 December 2008, from http://www.greenspiritstrategies.com/D87.cfm

Nissen, D. (2008). Lecture slides "Conversions". New York City: Center for Energy Management Maritime Transportation and Public Policy.

Rotary Books for the World. (2008). *USA and Southern African Rotarians are answering literacy needs*: Rotary International.

Schmidt, J. Slides UNFCCC side event: sector-based approach: Overview and possible proposal: Center for Clean Air Policy.

Sciences Po Paris. (2008). Newsletter n°12. *Newsletter* Retrieved 12 December 2008, from http://www.newsletter.sciences-po.fr/index.html

United Nations Framework Convention on Climate Change. (2008). About the CDM. Retrieved 12 December 2008, from http://cdm.unfccc.int/about/index.html

Voluntary Carbon Standard. (2008). Methodologies. Retrieved 12 December 2008, from http://www.v-c-s.org/methodologies.html

World Wide Found for Nature Switzerland. (2006). Dossier Papier. *Info Schule* Retrieved 10 December 2008, from http://assets.wwf.ch/downloads/dossier_info_schule_1_2006.pdf

Worrell, E., Price, L., Martin, N., Hendriks, C., & Meida, L. O. (2001). Carbon dioxide emissions from the global cement industry, *Annual Reviews* (Vol. 26, pp. 303-329).