

A decorative graphic in the top right corner consisting of two overlapping squares. The front square is a vibrant green, and the back square is a light blue-grey. Both squares have a white fill and a thin border.

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Paper Recycling Energy Savings and GHG Reduction - Myth or Reality?

By Subhash Deodhar, Senior Consultant, Fisher International

A large number of paper mills use recovered paper as a major source for fibers. It's generally assumed that making paper using recycled fibers saves energy compared to using virgin fibers, and various companies report energy savings anywhere from 30% to 50% or more. Given Society's growing focus on issues of energy and climate change, which kind of paper manufacturing is preferable – virgin or recycling?

With the current spotlight on climate change, saving energy is assumed to result in reduction in greenhouse gas emissions. Greenhouse gas emissions (GHG) are closely linked to overall energy usage, but also depend upon types of fuels used. This article compares energy usage and GHG emissions at a select group of paper mills worldwide. Note, this analysis is within the mill only and does not consider the GHG associated with collection and processing of recycled fibers.

The analysis is based on insights from Fisher International's FisherSo/ve Next™ platform. Fisher International maintains a comprehensive database of paper mills across the globe producing more than 50 tons of paper per day. FisherSo/ve Next contains detailed process-equipment and production data for about 3500 paper mills around the world. The grade of paper manufactured dictates manufacturing process and overall energy usage. So, any valid comparison must be made between mills making similar grades of paper.

Total energy usage in this article is calculated by combining energy in fuels used for combustion and purchased electricity. For comparing mill sites, total energy usage is expressed in gigajoules (GJ) per finished metric ton (FMT).

Types of grades selected for comparison:

- Printing and Writing – Uncoated Freesheet (Fine Paper) mills using virgin pulp and/or recycled fiber
- Packaging – Linerboard mills using virgin pulp and/or recycled fiber
- Packaging – Corrugated Medium mills using virgin pulp and/or recycled fiber
- Newsprint mills using virgin pulp and/or recycled fiber

Uncoated Freesheet (Fine Paper) Mills:

There are 466 mills worldwide in this category. 285 mills are virgin integrated and do not use recycled fiber, and 94 mills rely on 100% recycled fibers. The remainder use a combination of virgin and recycled fibers. Energy usage for all fine paper mill sites is shown in Figure 1. (The energy efficiency is plotted against percentage of recycled fiber in the furnish.)

The overall trend is energy savings with the increase in recycled content, and the average energy savings worldwide for fine paper mills is 28% (Table 1). There are a large number of virgin integrated mills that are as energy efficient as 100% recycled fiber mills. Energy efficiency variation is high for virgin mills and variation is narrow for fully recycled mills.

Total energy usage by region for virgin (no recycled furnish) vs. recycled mills (100% recycled furnish) is in Figure 2. The energy savings are highest for North American mills and lowest for mills in Asia Pacific.

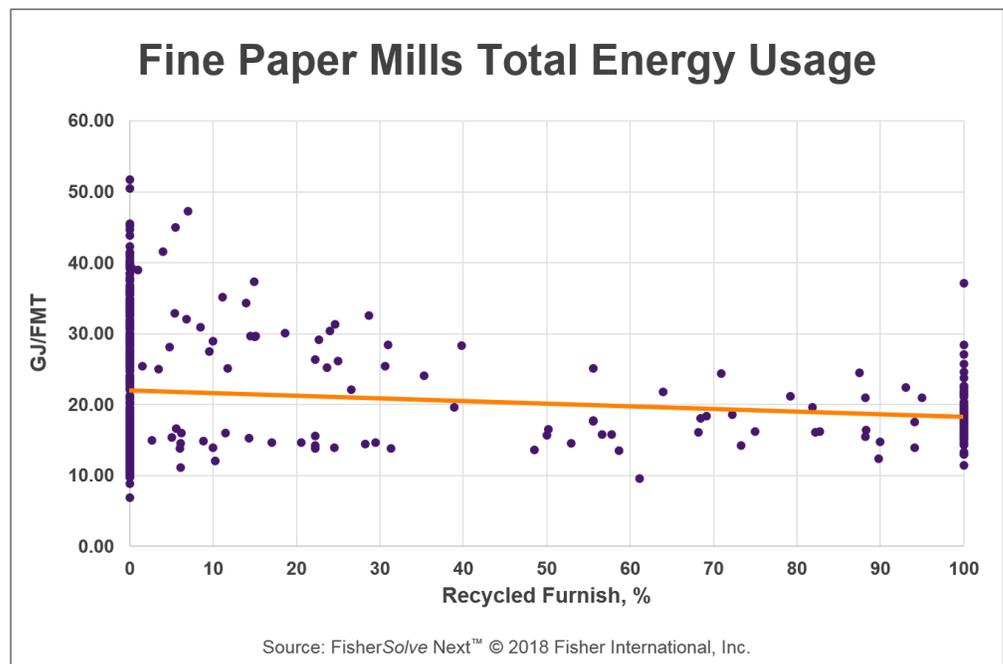


Figure 1

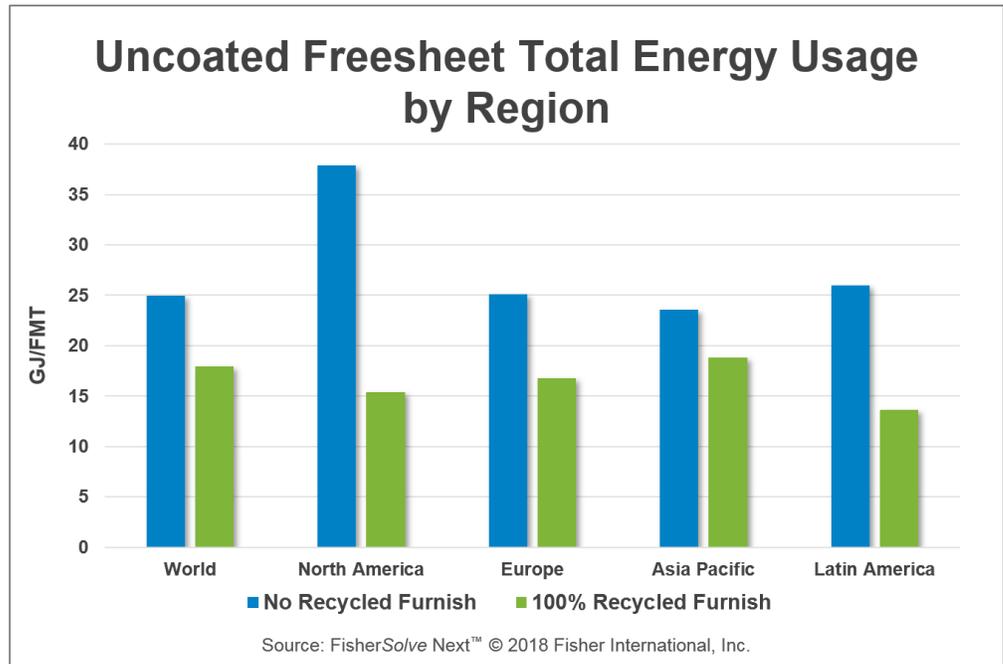


Figure 2

Uncoated Freesheet (Fine Paper) Mills by Region

	Number of Sites		Total Energy Usage GJ/FMT		GHG from Fuel Combustion MT CO ₂ eq/FMT			
	No Recycled Fiber	100% Recycled Fiber	No Recycled Fiber	100% Recycled Fiber	No Recycled Fiber	100% Recycled Fiber	Energy Savings %	GHG Reduction %
World	285	94	24.99	17.91	0.84	1.02	28.33	-21.43
North America	16	2	37.9	15.41	0.78	0.61	59.34	21.79
Europe	69	9	25.13	16.81	0.49	0.98	33.11	-100.00
Asia Pacific	159	74	23.58	18.81	1.1	1.1	20.23	0.00
Latin America	25	4	26.01	13.67	0.45	0.66	47.44	-46.67

Source: FisherSolve Next™ © 2018 Fisher International, Inc.

Table 1

Linerboard Mills:

There are 740 mills worldwide in this category. 25 mills are virgin integrated and do not use recycled fiber, and 532 mills use 100% recycled fibers. The remainder use a combination of virgin and recycled fibers. Energy usage for all linerboard mill sites is shown in Figure 3.

The trend in energy savings is obvious with increase in recycled content. The average energy savings worldwide for linerboard mills is 60% (Table 2). Energy efficiency variation is similar for virgin and 100% recycled mills.

Total energy usage by region for virgin vs. recycled mills is in Figure 4. The energy savings are similar in all regions.

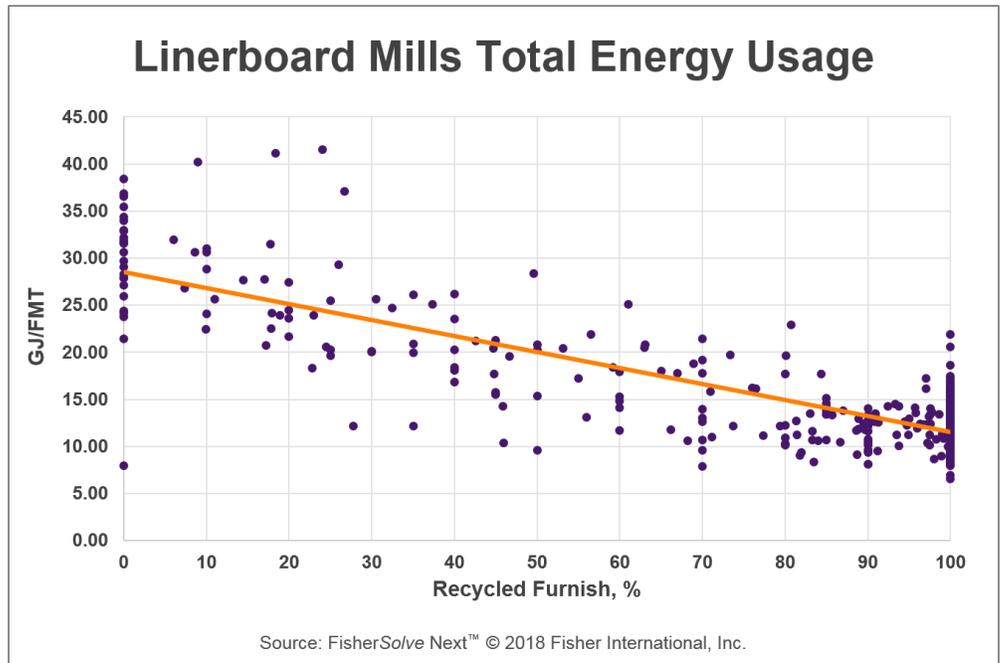


Figure 3

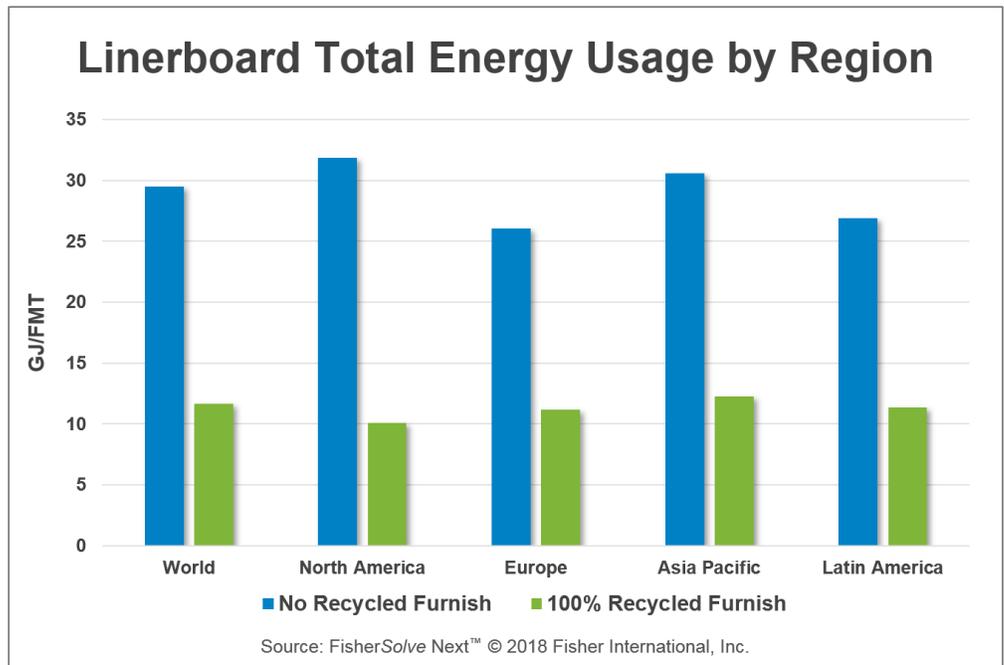


Figure 4

Linerboard Mills by Region

	Number of Sites		Total Energy Usage GJ/FMT		GHG from Fuel Combustion MT CO ₂ eq/FMT			
	No Recycled Fiber	100% Recycled Fiber	No Recycled Fiber	100% Recycled Fiber	No Recycled Fiber	100% Recycled Fiber	Energy Savings %	GHG Reduction %
World	14	758	27.16	11.55	0.37	0.73	57.47	-97.30
North America	1	33	21.95	10.63	0.43	0.48	51.57	-11.63
Europe	5	186	28.54	10.65	0.32	0.56	62.68	-75.00
Asia Pacific	4	392	27.17	11.98	0.74	0.85	55.91	-14.86
Latin America	2	107	24.86	10.89	0.71	0.35	56.19	50.70

Source: FisherSolve Next™ © 2018 Fisher International, Inc.

Table 2

Corrugated Medium Mills:

There are 839 mills worldwide in this category. 14 mills are virgin integrated and do not use recycled fiber, while 758 mills are based on 100% recycled fibers. The remainder use a combination of virgin and recycled fibers. Energy usage for all corrugated medium mill sites is in Figure 5.

The trend in energy savings is obvious with increase in recycled content. The average energy savings worldwide is 57% for corrugated medium mills (Table 3). Energy efficiency variation is similar for virgin and fully recycled mills.

Total energy usage by region for virgin vs. recycled mills is in Figure 6. The energy savings are similar in all regions.

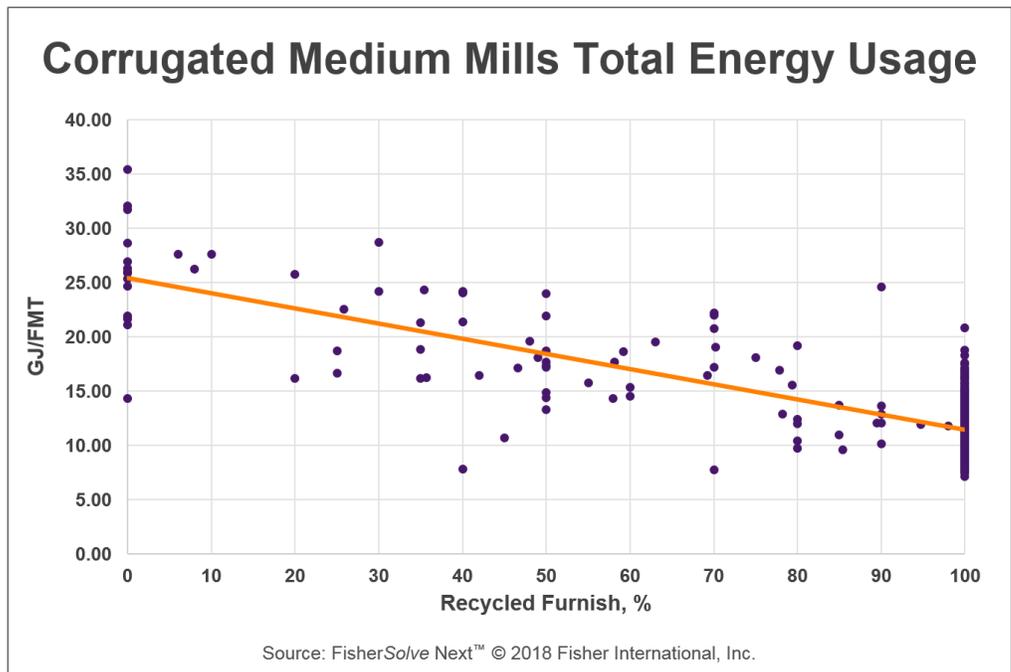


Figure 5

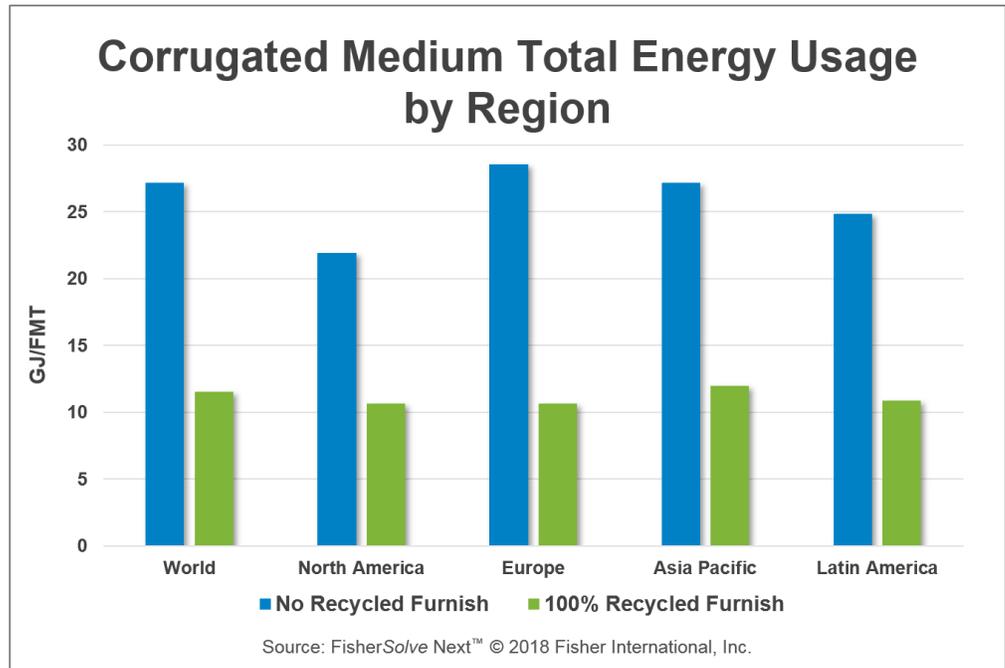


Figure 6

	Number of Sites		Total Energy Usage GJ/FMT		GHG from Fuel Combustion MT CO ₂ eq/FMT			
	No Recycled Fiber	100% Recycled Fiber	No Recycled Fiber	100% Recycled Fiber	No Recycled Fiber	100% Recycled Fiber	Energy Savings %	GHG Reduction %
World	25	532	29.5	11.65	0.39	0.7	60.51	-79.49
North America	9	31	31.83	10.08	0.36	0.39	68.33	-8.33
Europe	8	154	26.06	11.18	0.5	0.81	57.10	-62.00
Asia Pacific	2	207	30.56	12.25	0.37	0.86	59.91	-132.43
Latin America	4	88	26.9	11.34	0.14	0.44	57.84	-214.29

Source: FisherSolve Next™ © 2018 Fisher International, Inc.

Table 3

Newsprint Mills:

There are 161 mills worldwide in this category. 36 mills are virgin integrated and do not use recycled fiber and 92 mills use 100% recycled fibers. The remainder use a combination of virgin and recycled fibers. Energy usage for all Newsprint mill sites is in Figure 7.

The overall trend is energy savings with increase in recycled content. The average energy savings worldwide is 25% (Table 4). There are a number of virgin integrated mill sites that are as energy efficient as 100% recycled mills. Energy efficiency variation is high for virgin mills and variation is narrow for fully recycled mills.

Total energy usage by region for virgin vs. recycled mills is in Figure 8. Energy savings is high in Europe and low in Asia Pacific.

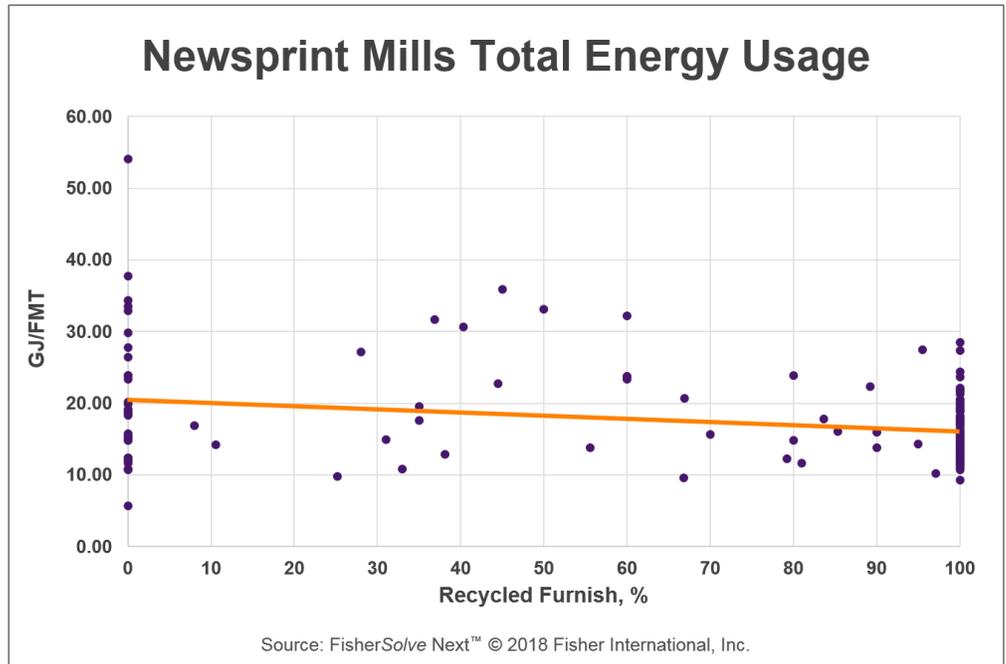


Figure 7

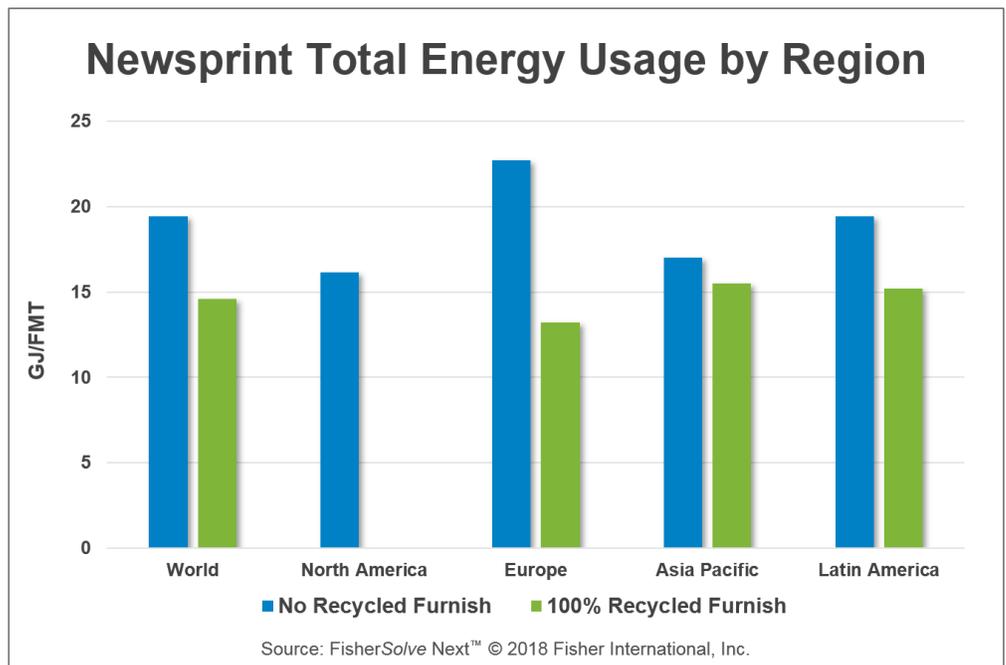


Figure 8

Newsprint Mills by Regions

	Number of Sites		Total Energy Usage GJ/FMT		GHG from Fuel Combustion MT CO ₂ eq/FMT			
	No Recycled Fiber	100% Recycled Fiber	No Recycled Fiber	100% Recycled Fiber	No Recycled Fiber	100% Recycled Fiber	Energy Savings %	GHG Reduction %
World	36	92	19.45	14.61	0.27	0.84	24.88	-211.11
North America	18		16.13		0.17		100.00	100.00
Europe	9	14	22.72	13.21	0.3	0.49	41.86	-63.33
Asia Pacific	3	74	17.03	15.51	0.61	1.07	8.93	-75.41
Latin America	2	3	19.43	15.2	0.02	0.88	21.77	-4300.00

Source: FisherSolve Next™ © 2018 Fisher International, Inc.

Table 4

All Grades – Energy Usage, GHG Emissions and Biomass Fuel Usage

Figure 9 compares total energy usage at virgin integrated mills and 100% recycled mills for all grades. Energy savings are very high for packaging grades such as linerboard and medium. But energy savings are limited for fine paper and newsprint.

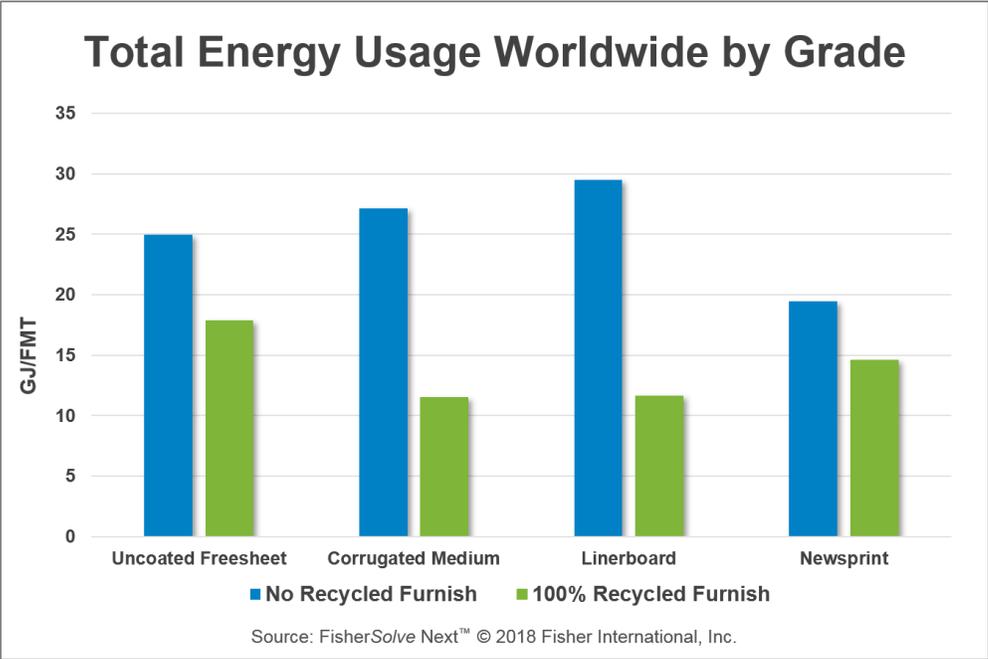


Figure 9

Figure 10 compares GHG from fuel combustion (Scope 1 Emission) at virgin integrated mills and 100% recycled mills for all grades. GHG emissions are higher for recycled mills as compared to virgin integrated mills. This observation is contrary to general assumption that energy savings and GHG emission reduction go hand in hand.

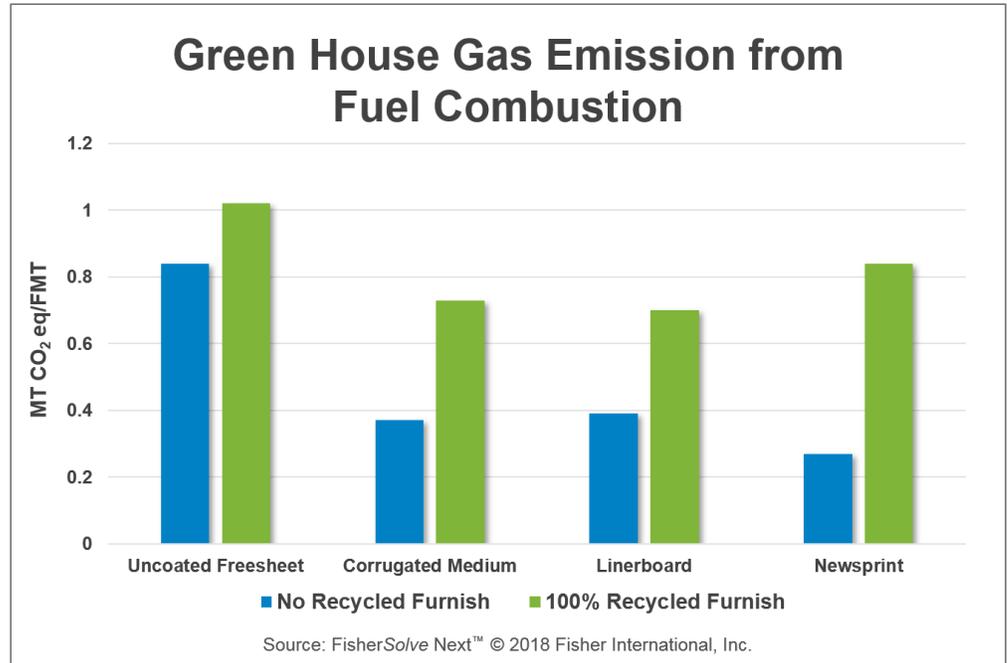


Figure 10

Combustion of fuel releases CO₂ (Carbon Dioxide), CH₄ (Methane) and N₂O (Nitrous Oxide) as Greenhouse gases. CH₄ and N₂O released from combustion of biomass fuels are counted as GHG. But CO₂ released from combustion of biomass fuels is not counted as GHG emission, since biomass fuels are considered carbon neutral.

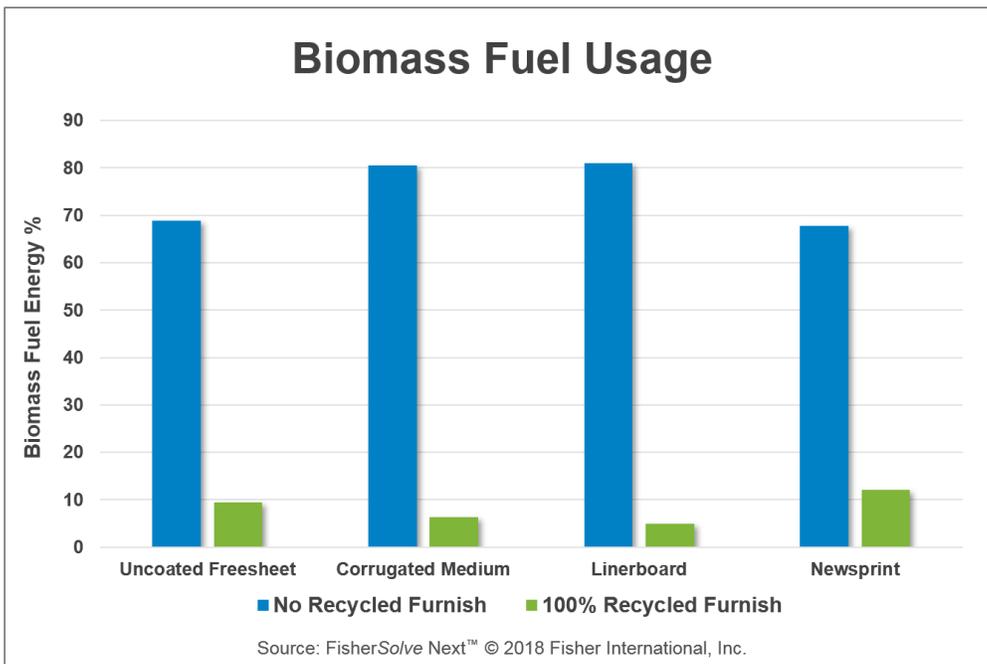


Figure 11 compares biomass fuel usage for virgin versus recycled mills by grade. All virgin integrated mills have biomass readily available to use as fuel, thus their biomass fuel usage is very high. Chemical and semichemical pulp mills burn pulping liquor. Bark and residual wood waste are commonly burned as fuel in virgin mills. Recycled mills obviously do not have pulping liquor to burn. Wood or biomass is not readily available at recycled mills. So recycled mills are mostly reliant on fossil fuels.

Figure 11

Conclusions:

As in much of life, the answer to the question, “Which is better?” is not a simple, “A” or “B.” It is nuanced.

From the standpoint of total energy used, recycled fiber certainly results in energy savings at paper mills. The energy savings are very high (close to 70%) for packaging grades such as linerboard and corrugated medium, but modest (less than 30%) for newsprint and printing grades such as uncoated freesheet (fine paper). Recycled paper collection, sorting and delivery to mill sites does require energy. Similarly harvesting and delivery of wood to virgin integrated mill sites also consumes energy. In both instances, fuel used comes mostly from fossil sources.

However, despite the fact that recycled mills use significantly less energy, *their GHG emissions are higher* compared to virgin integrated mills. The main reason for this is in the fuels used to generate their energy: recycled mills use mainly fossil fuels whereas virgin integrated mills use biomass, which is not readily available at recycled mill sites. Since biomass is generally considered to be “carbon neutral,” virgin paper manufacturing looks more environmentally friendly even though it consumes more energy to make a ton of paper than it does to recycle.

Of course, some virgin manufacturing is required in the economy or there would be no paper to recycle. So, the right question isn’t really “Which is better?”

Better questions might be:

- “How much should society encourage of each?” and,
- “Given all the pressures on a business, such energy costs, potential regulations, investment needs, etc., which is better for my business?”

We at Fisher specialize in addressing the important and complex issues facing managers in the pulp and paper industry today. Give us a call if you’d like to talk.

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About Fisher International, Inc.

Fisher International, by virtue of its deep expertise in the pulp and paper industry, provides insights, intelligence, benchmarking, and modeling across myriad scenarios. By arming companies with the knowledge that will help them gain a better understanding of their strengths and help identify weaknesses, Fisher is helping businesses stave off challenges and better position themselves for long-term growth.

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