

Wood – a substitute or a raw material substituted for

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Abstract: *Wood – a substitute or a raw material substituted for.* For over a hundred years recurrent wood revivals can be observed in the world economy. For a few years now we have witnessed yet another increase in interest in this raw material. Therefore, a question arises if wood is a substitute or a raw material substituted for such energy-intensive raw materials as: iron, plastics, concrete and others. This paper presents different aspects of this issue.

Keywords: substitutes, promotion, energy consumption

INTRODUCTION

The aim of this paper is to answer a question whether in the conditions of technique and technology advancement in a more and more global world, wood is a substitute for many raw materials or a raw material substituted for. The latter can be to some extent indicated by wood being pushed out of the markets that can be observed in the EU and other countries.

WOOD SUBSTITUTION VALUE IN REGARD TO HIGH-CARBON RAW MATERIALS (ALUMINUM, CONCRETE, BRICK, PLASTIC, AND STEEL).

The substitution is a phenomenon in which one product is used by the buyer to perform specific functions instead of another, as a rule more expensive, in short supply, or for other reasons¹. This definition, despite its simplicity seems to be universal – although different versions can be found in many textbooks on materials management.

The threat from the substitute products exists in most industries, however substitution is one of the five forces of competition, defining the profitability level of the industry. On one hand, the threat from the substitute products determines the stability of the prices' upper limit of products substituted for; on the other hand, the phenomenon of substitution has a decisive impact on the demand level for both the products from specific companies and the industry.

WOOD SUBSTITUTION VALUE

Wood is the most environmentally friendly material received from nature. This fact causes certain effects throughout the life cycle of this material and its derivatives.

Renewable but limited wood resources, in recent years, have been subject to growing substitution processes by carbon-intensive materials such as: steel, concrete, plastic, aluminum and others. This process leads to the displacement of wood from the market. The developed countries are trying to oppose these processes and the poor countries do not have a chance in this area.

It should be stressed that the wood used in thousands of different applications, at the end of the first life-cycle might be:

- recovered
- re-used
- used as carbon-neutral source of energy.

¹ Porter M.E.: Przewaga konkurencyjna. Osiągnięcie i utrzymywanie lepszych wyników ekonomicznych. New Media, Warszawa 2010, p. 417-420

Wood substitutes replace wood for many reasons, the most important ones being:

- great potential in shaping the production scale, and thus the costs and prices,
- compared with wood, some of the wood substitutes properties have superior characteristics.

So far, the most substitutes on the global scale are being consumed in construction. The energy used in the building industry, including the production, transportation and the building formation is considerably lower for the wood materials system in comparison to other materials (Figure 1). So far, appropriate standards by which the value of a substitute against the replaced material such as wood could be compared, have not been developed, but the significance and strength of industries producing substitution materials is being compared. However, this has not a lot to do with the promotion of wood as a raw material. The results of such comparisons rather inform about the strengths and weaknesses of individual industries. In fact, to a large extent the promotion strength affects their market position, which is the greatest in the richest industries (steel, aluminum, concrete) and weakest for wood producers.

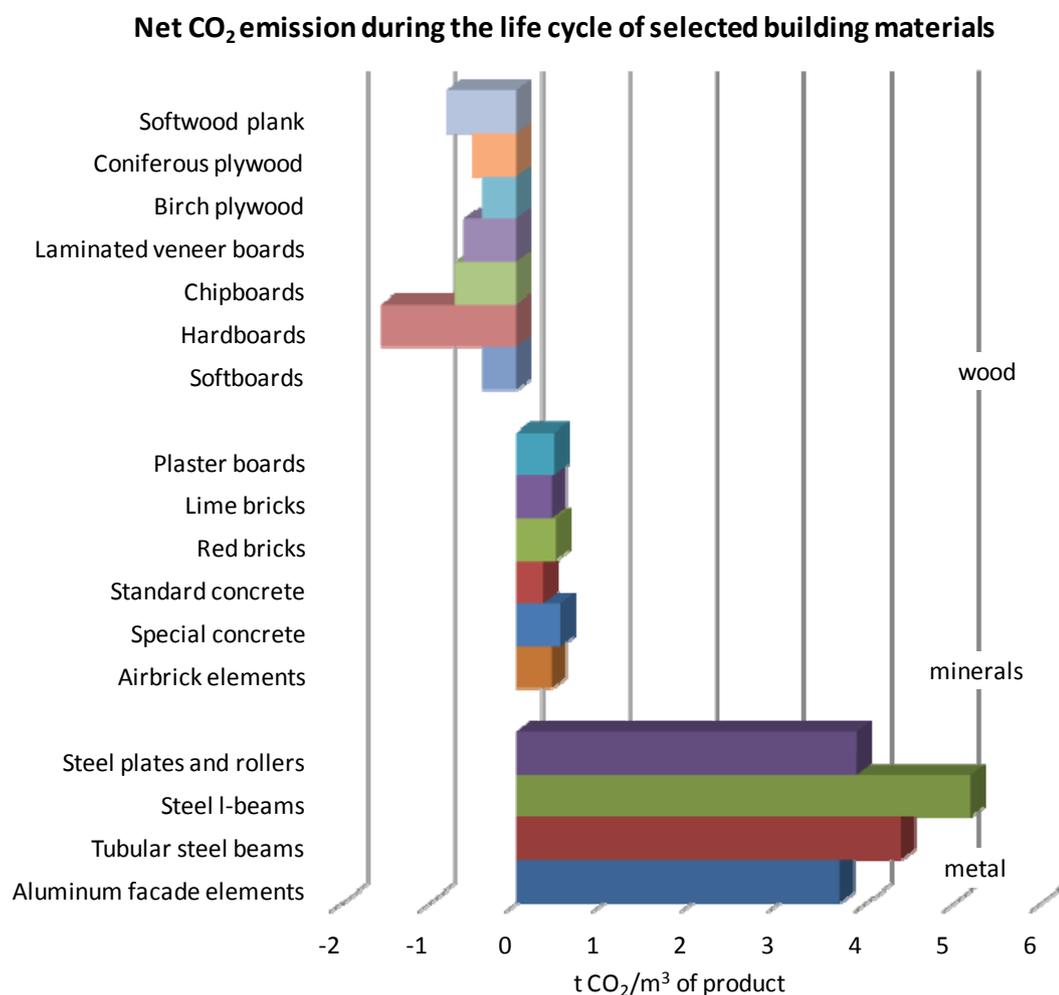


Figure 1. Net CO₂ emission during the life cycle of selected building materials
Source: Tackle Climate Change: Use Wood 2004.

Considering the tasks that lie ahead of wood in the process of global warming and the need to reduce greenhouse gases (CO₂ capture and storage), its role continues to grow. There is no doubt that in the process of global climate change only forests and wood-based products are able to neutralize these dangerous effects.

Another important direction of counter measuring such phenomena includes projects aimed at reducing the demand for energy by:

- change in consumer behavior,
- technological change (improvement of technological efficiency).

Increasing the supply of wood by:

- increase in supply from existing sources,
- new supply sources,
- wood imports increase.

In the event of a maladjustment of the wood demand and supply.

- The wood-based industries will not be able to continue to develop and will be forced to reduce production, or expand the import of raw materials.

MINIMIZING THE WASTE FROM WOOD PRODUCTS

There is very little, if not none at all, waste generated during the manufacturing of wood products and wood products used as an energy source.

During the production of wood products, chips, sawdust, bark are consumed on-site for the production of heat used for drying and other operations and often for the production of wood-based panels or cellulose. Also, the growing interest in this source of energy is indicated by biomass burning companies, especially the power industry.

SUBSTITUTE FOR OTHER MATERIALS

As a substitute for other materials, such as: aluminum, concrete, steel and others, wood shows that the use of energy necessary for processing is lower than the energy stored in that wood during photosynthesis. In the case of the substitutes, the amount of energy is a few times or even several dozen times higher, as shown by the data presented in Table 1.

Table 1. Energy required to produce wood-based and nonwood materials

Commodity	Energy (GJ t ⁻¹)			Potential residual fuel recovery
	Harvesting	Manufacture	Total	
Softwood lumber	1.0	5.6	6.6	9.6
Oak flooring	1.3	6.6	7.9	13.2
Laminated veneer lumber	0.8	7.7	8.5	4.1
Softwood plywood	0.8	8.0	8.8	4.3
Structural flakeboard	1.2	8.7	9.9	10.0
Medium-density fiberboard	0.9	10.8	11.7	3.1
Insulation board	0.7	12.2	12.9	0.8
Hardwood plywood	1.2	11.8	13.0	12.3
Underlayment particleboard	5.3	9.4	14.7	1.7
Wet-process hardboard	0.8	22.8	23.6	0.9
Gypsum board	0.1	3.1	3.2	0.0
Asphalt shingles	0.0	6.6	6.6	0.0
Concrete	0.6	8.8	9.4	0.0
Concrete Block	0.6	8.8	9.4	0.0
Clay brick	0.7	8.9	9.6	0.0
Carpet and pad	7.7	33.3	40.9	0.0
Steel Wall studs	2.9	53.6	56.5	0.0
Steel floor joists	2.9	53.6	56.5	0.0
Aluminum siding	31.1	199.4	230.5	0.0

Source: Jim L. Bowyer, Rubin Shmulsky, John G. Haygreen: Forest Products and Wood Science. An Introduction, Fourth Edition 2003. Drawings by Karen Lilley, Iowa State Press A Blackwell Publishing Company, 2003

So far no verified models were developed to allow an objective, multi-factorial assessment of used substitutes². Such efforts have been made for a long time in many countries in Europe and America (Switzerland, Germany, the Netherlands, Sweden and the USA). A more commonly used Life Cycle Analysis (LCA) allows to make some comparisons of wood substitutes to wood in a similar, yet different formula.

Currently, in the forests of the EU countries there is a greater growth of wood than its acquisition, however, in some countries, conflicts occur between the users of wood for production purposes and for growing power industry needs.

The problem of the proper use of wood resources was the subject of discussion by the Timber Committee and the FAO in May 2012, where, as a result of the meeting it was stated that the development and clear definitions of wood for the power industry along the supply chain reduce the risk of unnecessary competition for wood fiber with other industries interested in wood. It is about taking the cascade principle of wood utilization, allowing for its effective use for the material and energy production, burning only the last batch of wood, maximizing the whole value chain. This identification between the various stages of consumption should be based on a full Life Cycle Analysis. It was also stressed that any subsidies and incentives introduced for the lower wood energy use efficiency and the revision of current subsidies for energy wood create inefficient competition in the market.

LCA (LIFE CYCLE ANALYSIS)

Many providers who have direct contact with end customers are aware of the importance of the positive impact of wood-based industries on the environment.

With regard to social and environmental criteria, the role of wood products has a positive effect on the climate, its importance steadily increasing and is appreciated by the government. Thus, it is expected that it is necessary to develop strategies to promote wood-based industries in their operations and development.

Wood products harvested in forests in addition to soothing the climate, create the appropriate coal pool. This is another important climate factor reducing fossil fuel by substituting it with wood biomass. The production and transportation of wood products require less fossil energy sources than high energy building materials such as aluminum, steel and concrete.

WOOD PROMOTION

Wood is a material with properties desirable both from a social point of view as well as individual preferences. Currently, a method that enables to a high degree to get to know the benefits of wood in all its richness is the life cycle analysis (LCA) of wood materials and their substitutes, where the advantage of the former is very visible³. Wood promotion should fulfill the functions assigned to it. The outcome of this promotion is visible in the EU countries, where per capita wood consumption is steadily increasing.

In a free market economy, the needs of the market are the result of personal preferences being revealed (the needs that are disclosed in the individual purchasing decisions). These needs are articulated at the level of wood end user. Therefore, it is necessary that above all the forestry farm, as the first producer in the chain, recognized the end user's

² See: Drewno jako surowiec XXI wieku. W. Gil, Sylwan 2011 No 3.

³ At Wood Technology Institute among others there were papers prepared which present such analysis: Środowiskowa ocena cyklu życia (LCA) wyrobów drzewnych, ITD Poznań 2006.

needs. Currently you can no longer win the fight with plastics, steel, cement, solely with the arguments of pricing, quality and environmental values.

From the perspective of sustainable development and the bio-economy, wood has many desirable characteristics, although public perception of wood products is sometimes unfavorable. There is a popular saying "people love wood but hate chainsaw."

While promoting, wood should be presented not only as a raw material or a product, but also the philosophy behind the production should be shown as well. Then it may be regarded as the best form of production and use. This should be seen as the advantage of wood over the production of steel, concrete, plastic and other substitutes that were factory produced.

Promotion of both primary and secondary production in the forestry and wood economy has so far been poor in means and limited compared to other industries. All the more the philosophy of the product and production should be included in the promotion and it is also necessary to note that wood and wood products show strong environmental benefits on the ecological balance sheets resulting from a small percentage of fossil primary energy carriers in obtaining and processing of wood and closed loop CO₂ (Table 1). The low mass of wooden structures and of waste after heat utilization at the end of use period is an additional advantage of wood in comparison with other materials.

The promotion of wood should be a joint action of forestry and wood companies and local industry councils in order to achieve positive effects on the market for the forestry and wood sector⁴.

In western countries, in addition to specialized agencies professionally promoting wood, an important role in this respect is played by research institutions that have the expertise and information, have accredited laboratories and conduct wood products attestation. The participation of these institutions in the promotion of wood affects its credibility in the public eye.

Deeper analyses are necessary in the forest and wood sector aimed at answering the question of why wood is losing its market share to non-wood substitutes, to be able to deal with these processes effectively⁵.

At this point a few words should be said about promoting the use of wood in the economy, not only for the reason of the climate, citing the experience of the leading countries in this field. There are initiatives implemented at national, international and regional level. The examples might be: "Plan Bois-Construction - Environment" and related "Charter" in France, "Wood for good" in the UK, "Centre Hout" in the Netherlands, "Promo legno" in Austria and Italy, the "Centre Interfederal d'Information sur le Bois" in Belgium, in the Nordic countries the "Nordic Timber Council" - in Finland, Norway and Sweden, and in Germany, "German Timber Promotion Fund". Also, in these countries the importance of science in the development of new wood products, increasing the effectiveness and wider use of wood products due to their advantages (high energy insulation, efficiency and minimum emissions, high aesthetics, reuse of wood and many others) is recognized.

In Poland, the need for wood promotion results from:

- observed climate changes and the need for all the available means to be used in order to prevent them,
- no established need of treating wood as a raw material of high performance and unique ecological character,

⁴ Hofer P., Market effects of Wood promotion. In Forest products Annual Market Review 2001-2201, Timber Bulletin vol. 1 LV.

⁵ In the light of the boom for some wood materials such as pellets, floors, and other, this claim may prove to be not true.

– observed renaissance of importance and the subsequent use of wood in the Polish, European and global economy. In Poland, the actual level of wood consumption per capita after subtracting the wood exported in the form of a variety of goods (furniture, wood-based panels, paper and other) is dramatically low, which is expressed by the obtained merchantable volume of 0.68 per m³ in 2000 to 0.91 m³ in 2011. In the years 2000-2011 the level of acquisition increased from 27.7 thousand in 2000 to 37.2 thousand in 201, though⁶. Despite this positive phenomenon, the level of per capita consumption of wood hardly increased during this time.

The practice from recent years of the wood sector actions indicates that the substitution of wood becomes a major threat not only to the creation of added value and thus maintaining a competitive advantage in the particular markets, but also the liquidation of those companies that will not be able to compete with the substitutes.

The necessity of promotion is also due to the current state of the organization of forestry and wood sector - forestry concentration and dispersion of large wood-based industries, particularly the sawmill and furniture industries.

One of the essential conditions for the effective promotion of wood is the close cooperation between wood harvesters, manufacturers and users, while creating a strong lobby in the society in favor of wider and rational wood use in the economy as one of the most attractive materials and components, which mankind currently has available⁷.

CONCLUSIONS

In the analysis of the problem of substitution of wood intended for production purposes by other raw materials, especially energy-intensive, in an era of reducing the use of fossil fuels the increasingly important factors are: rising energy costs and their source (renewable or non-renewable). Wood supply is limited for the reason of nature, because it has many non-productive functions as well. A clear answer to the central question of this paper is impossible. Taking into consideration such factors as the volume of production/acquisition, the possibility of forming the prices of substitutes, the scale of production, the deficit etc., it can be argued that wood should be used mainly where its natural properties are used to the fullest. In consequence, the wood assumes the function of a substituted raw material.

⁶ See: Leśnictwo Rocznik Statystyczny Rzeczypospolitej Polskiej, Warszawa, 2012 GUS.

⁷ Drewno – surowiec strategiczny. V Kongres Gospodarczy, 14-16.V.2012, Katowice, Instytut Technologii Drewna, Centrum Informacyjne Lasów Państwowych.

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Streszczenie: *Drewno – substytut czy surowiec substytuowany* Od ponad stu lat obserwuje się w gospodarce światowej cykliczne renesanse drewna. Od kilku lat jesteśmy świadkami kolejnego wzrostu zainteresowania tym surowcem. W związku z tym powstaje pytanie, czy drewno jest substytutem, czy surowcem substytuowanym w odniesieniu do takich surowców i materiałów energochłonnych, jak: żelazo, tworzywa sztuczne, beton i inne. W referacie przedstawiono różne aspekty tego problemu.

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