100% BIOENERGY

The era of renewables

Energy – one of today´s most important questions. Will there be enough of it for everyone? How can it be provided in a way that does not further accelerate the climate change? What is the role of bioenergy in tomorrow´s energy mix?

The consumption of energy increases in super-linear ratio to population growth[1]: our lifestyles and living environments are becoming increasingly energy consuming. The energy carrying capacity of our planet may not be enough for the growing population. Not unless we figure out revolutionary new approaches to both energy production, storage and consumption.

All our energy can be traced back to sun. In photosynthesis this energy is converted into biomass, which may be burnt for warmth and light. Already homo erectus, an ancient human ancestor, seems to have used fire for preparing food some 2 million years ago[2]. Ever since then, the use of woody biomass has been the primary way of providing humankind with energy. Even today, wood is an important source of energy.

Renaissance of bioenergy?

But bioenergy is approaching its renaissance as a part of industrial symbiosis. There seem to be significant co-benefits in the joint production of forest-based products and energy.

It does not appear wise to just burn wood for energy. If doing so, much of the potential benefits of wood is lost. But harvesting wood for wood products and producing bioenergy from residues provides an example of balanced co-production of goods and energy.

The joint benefits of producing wood products and energy are multiple. First, harvested wood can be used for manufacturing products that can substitute environmentally more harmful ones. The use of wood-based products may considerably lower the need for non-renewable energy in the production phase and improve the net energy efficiency over the full life cycle, if more energy and greenhouse gas intensive products are substituted[3].

Energy self-sufficient production chain

Production of Kerto laminated veneer lumber (LVL) gives an example of how advanced industrial energy and material symbiosis may operate. As shown in figure 1, one cubic metre of logs from a sustainably managed forest yield some 44% of Kerto LVL. The remaining parts – bark, sawdust and wood chips – may be used for bioenergy. At the Finnish Lohja LVL mill, for example, the production of LVL operates with 100% bioenergy that is recovered from the residues of the manufacturing process. In fact, the residues produce more heat than is needed for the mill´s operation. Remaining energy is sold to the district heating grid of the city. This is a significant support for the city in its low carbon energy goals[4].

Industrial symbioses can indeed lead into efficient utilisation of raw materials. Even though the annual increment of European forests is larger than current harvest, wood needs to be used with careful planning. As our societies struggle hard to phase out fossil fuels, burning wood for bioenergy may seem like an attractive shortcut to lower the greenhouse gas emissions of energy production. If we would convert our coal power plants into wood chip plants, the carbon intensity of producing electricity would indeed decrease[5]. However, the co-benefits of using wood material in a cascade would be lost.

Construction sector uses great amounts of energy being accountable for around 40% of the global consumption[6]. The production of steel and aluminium alone require around 51% and concrete production around 17% of the energy for producing all building materials globally[7]. Wood offers a sustainable alternative to several energy and carbon intensive construction materials. Therefore it is wise to use wood first as a substituting material for concrete and steel in construction and then process it along the waste hierarchy: Reusing reclaimed wood products for other end uses, recycling them into secondary products (e.g. chip board) and finally unleashing its bioenergy potential.

Zero energy buildings are not enough!

One can hardly discuss energy without touching the subject of zero energy buildings. As the European ”Energy Performance of Buildings Directive” (EPBD) requires all new buildings to reach nearly zero energy class by 2020, the role of construction materials seems to start playing an important role across the life cycle of a building.

The ultimate goal of the EPBD is to save energy. Therefore, evaluating the net energy balance over the life cycle is required. Already today the production of construction materials may require significant amounts of energy when compared to the operative energy use of the building. For example, a study from Finland[8] showed that the energy required for the production of construction materials of a wooden houses and operating the energy efficient building for 50 years were on the same level. In addition, the energy recovery potential of the wooden parts of the building were enough for providing bioenergy worth of almost 20 years of residential use. This shows that we need to change our thinking: producing the construction materials may begin to dominate the consumption of energy and release of greenhouse gases over the full life cycle of a building.

New energy efficient residential areas need to be planned from materials that carry low amounts of embodied energy within. If this is not ensured, the payback times of energy and greenhouse gas emissions resulting from the production of construction materials may extend over several decades[9].

A pioneering example of a plus energy house – a building that produces more energy than it consumes over a year – is made from Kerto LVL. It is a simple yet elegant wooden experimental house that was presented in the international Solar Decathlon competition 2010. Designed by students of Aalto University, Finland, the ”Luukku” building (figure 2) is mainly built from LVL boards and beams – in fact, 75% of materials are renewable. In addition to making the building robust for taking it across the Europe in a roadshow, LVL also gives the building good level of air-tightness. This is an essential feature when extreme energy efficiency is aimed at.

Turn down the heat

The World Bank has given several important reasons why the mankind should “turn down the heat” and take serious action in combating the climate change. A shift into closed loops of renewable energy seems to be an essential part of this transition that is taking place during our generation. Highly resource efficient production of wooden construction products is an example of how the factories of future should operate. Careful optimisation of the use of raw materials not only substitutes more energy intensive products, but also produces considerable amounts of bioenergy in the end of its lifecycle before returning to the natural carbon cycle of our planet.

FIGURES

Note: these are drafts that need to be re-drawn for publishing.

FIGURE 1. Production flows of Kerto LVL. Surplus bioenergy is used for district heating.

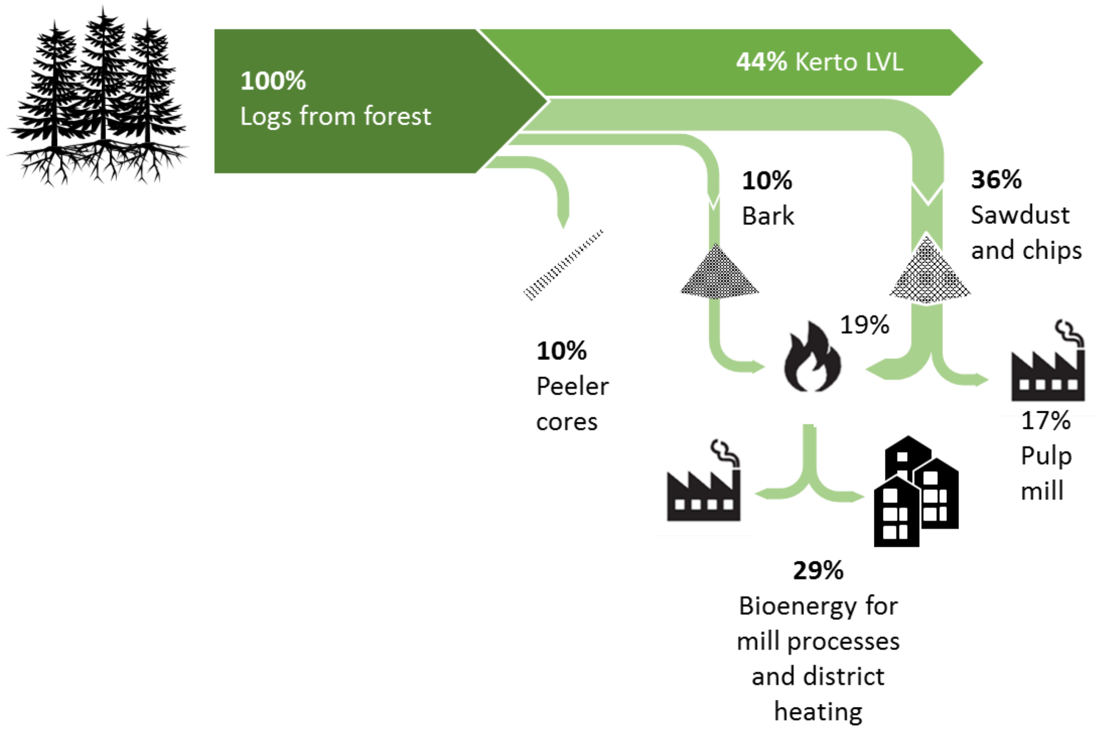

Figure 2. The Luukku house. Photo: Montserrat Zamorano Gañán

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