



## Scientific Facts on Forests & Energy

**Source document:**  
FAO (2008)  
**Summary & Details:**  
GreenFacts

**Context** - In coming years, the world's energy consumption is expected to increase dramatically. While fossil fuels will remain an important source of energy, renewable energies will also gain importance, as a result of concerns over high fossil fuel prices, increasing greenhouse gas emissions and energy import dependence.

Could biofuels derived from forestry products and residues help meet the energy demand?

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This Digest is a faithful summary of the leading scientific consensus report produced in 2008 by the Food & Agriculture Organization (FAO):  
*"Forests and Energy, Key Issues"*

The full Digest is available at: <https://www.greenfacts.org/en/forests-energy/>

**i** This PDF Document is the Level 1 of a GreenFacts Digest. GreenFacts Digests are published in several languages as questions and answers, in a copyrighted user-friendly Three-Level Structure of increasing detail:

- Each question is answered in Level 1 with a short summary.
- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific consensus report which is faithfully summarised in Level 2 and further in Level 1.

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## 1. Introduction – What role can forestry and agriculture play in energy production?

While the global demand for energy is soaring, the sources from which energy is derived are changing. This change is induced primarily by concerns over high fossil fuel prices, greenhouse gas emissions and fossil fuel import dependence.



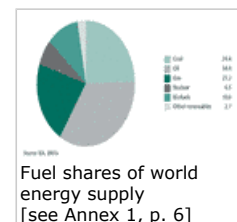
See also our Forest 's Digest [see <https://www.greenfacts.org/en/forests/index.htm>]

Alternative forms of energy have gained popularity as a way to address these concerns. For instance, bioenergy derived from biological materials such as wood, agricultural crops and wastes, or dung is used. If sustainably managed, bioenergy derived from plants can be considered renewable because new trees or other plants can replace those that have been converted to energy. Its net benefit in terms of climate change mitigation depends on the balance between carbon dioxide (CO<sub>2</sub>) captured during plant growth and CO<sub>2</sub> released when producing, processing, transporting and burning the fuel.

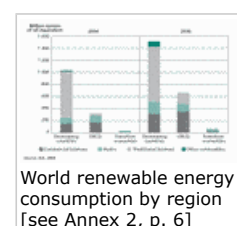
Increasingly, agricultural crops such as oil palm, sugar cane, maize, rapeseed, soybeans and wheat, are being used to produce liquid biofuels, mainly to power vehicles. But the increased use of agricultural lands for growing energy crops may compete with food production, causing increased food prices and deforestation. This has raised questions about the true role of such biofuels in mitigating climate change. A new generation of biofuels derived from wood, agricultural and forestry residues, and certain grasses is being developed. It is expected to be more energy efficient and to generate less greenhouse gases than current generation biofuels (i.e. made from agricultural crops), without competing with food supply. If sustainably managed, large forested areas could serve as a source for these second-generation biofuels.

## 2. What are the trends and prospects of energy supply and demand?

In coming years, the world's demand for energy is expected to increase considerably as a result of population growth and economic development, mostly in Asian countries. Although fossil fuels will play a major role in meeting that increased energy demand over the next 20 years, policy decisions will heavily influence the types of energy sources that will be used.



2.1 The share of renewable energy on the global energy market is expected to increase slightly until 2030. The biggest growth in renewable energy production will likely occur in North America, developing countries in Asia and Central and South America. The United States, China and India will remain the top three consumers of liquid biofuels. Overall, renewable energy sources will continue to be used primarily for heating and cooking, but their contribution to power generation and transport will increase.



2.2 Wood-based energy is used both for domestic and industrial purposes. Countries such as the United States, Canada, Sweden and Finland often use by-products of wood processing to produce electricity. Developing countries mainly use fuelwood and charcoal for domestic heating and cooking, but increasingly also for commercial activities such as fish drying, tobacco curing and brick baking. Their consumption is growing due to population growth, particularly in African and South American countries.

2.3 Future energy choices will primarily depend on the price of fossil fuels, on the availability of alternatives and on political priorities such as mitigating climate change or reducing dependence on fuel imports.

### 3. How is bioenergy produced?

Bioenergy can, for instance, be derived from solid woodfuels, such as fuelwood and charcoal or from liquid biofuels, such as black liquor (a by-product from the paper industry) and ethanol obtained from wood. Energy from woodfuels can be produced through various processes that differ in terms of energy efficiency, installation cost, carbon dioxide emissions and amount of work needed.



Open fires convert only 5% of the wood's potential energy  
Credit: Roberto Faidutti

3.1 Burning solid woodfuel in an open fire only converts about 5% of the wood's potential energy, but technologies exist that can increase efficiency up to 80%. Such efficiency is achieved by combined heat and power systems, which use wood to produce both heat and electricity, and by some modern furnaces that burn wood pellets made of dried, ground and pressed wood residues.

Other technologies include power boilers which burn wood wastes from sawmills to generate electricity and gasification, which is the process of heating wood residues to a very high temperature to produce gas that can in turn be burned very efficiently to produce heat and power.

3.2 'First generation' liquid biofuels include biodiesel and bioethanol and are derived from various food crops that vary by geographical location, for instance cereals, rapeseed and sugar cane. These biofuels have attracted a lot of attention because of their relatively low prices and advanced state of development. However, the increasing use of certain food crops for biofuel production can in some cases significantly raise global greenhouse gas emissions as a result of deforestation and land degradation. Recently, new plant species have been tested that grow well on marginal lands and could therefore produce biofuels without directly competing with valuable lands.

In addition, technological developments are expected to increase future interest in more efficient 'second generation' liquid biofuels, which are not derived from food crops, but from plant materials such as agricultural residues, forestry residues, and wood from forest plantations.

### 4. How much can forestry contribute to future energy demand?

4.1 To what extent forestry will contribute to future energy production will depend on a series of factors: the ability of wood-based energy to meet the recent energy policy objectives, the socioeconomic and environmental costs and benefits of wood energy production, and the policies and institutions that determine forestry practices. Developing countries often tend to have small budgets and will therefore need to carefully assess the risks and benefits of investing in bioenergy technologies.



Energy generated from the residues of forestry operations could be considerable

4.2 The amount of energy that can be generated from the residues of forestry operations is considerable. Efficient methods of harvesting and transportation could further reduce the cost and environmental impacts of producing such energy. Most of the wood for future bioenergy production will likely come from existing forestry operations unless economically

competitive technologies for the production of second-generation biofuels become available. Forest plantations are another major source of wood energy that will likely increase in the future. To be economically viable, such plantations will require efficient harvesting, good logistics, and high-productivity.

4.3 The efficiency of liquid biofuels in terms of greenhouse gas emissions compared to petroleum motor fuels varies from one type of biofuel to the other. The greatest decreases in greenhouse emissions result from the conversion of whole plants to liquid biofuels. In terms of cost efficiency, sugar cane is currently the most economically attractive option for liquid biofuel, but future technological developments could make wood-based second-generation biofuels competitive.

## 5. What are the implications of increased use of bioenergy?

Bioenergy has the potential to promote economic well-being, allow better use of unproductive land, increase energy security and reduce greenhouse gas emissions. However, this potential can only be realised by also addressing problems associated with the large-scale production of biofuels, such as poverty, impacts on biodiversity and climate change, and water scarcity.



Growing demand for bioenergy could result in deforestation  
Credit: Masakazu Kashio

5.1 The expansion of bioenergy can have both positive and negative impacts on livelihoods. It may create more jobs and improve energy security. However, it may also lead to land disputes and human rights abuses, particularly when large energy plantations are involved. Competition for land and agricultural products may raise farmers' incomes but also food prices.

5.2 A growing demand for bioenergy could result in deforestation to make way for agricultural land, but on the contrary agricultural land could be converted into wood plantations if wood becomes the main resource for bioenergy. Depending on how it is done, using degraded lands for the expansion of bioenergy plantations could have either positive or negative effects on soil fertility, erosion, ecosystems, biodiversity, water flow and food availability. Given the many advantages and drawbacks to bioenergy development, countries must consider the long-term environmental, social and economic impacts of various energy alternatives.

## 6. How should bioenergy policies be developed?

To counteract the potentially adverse socio-economic and environmental impacts of large bioenergy projects, effective land-use planning is needed. In addition, information transfer from developed to developing countries should be encouraged.



Sustainable management and development should be part of forest and energy policies  
Credit: Masakazu Kashio

National forestry and energy goals should reflect the principles of sustainable development and sustainable forest management. In particular, forestry and energy policies should:

- integrate bioenergy issues into forestry, agricultural and other land-use policies;
- consider environmental, economic and social impacts;
- ensure information is readily available to anyone involved in the management of forest resources;
- consider areas such as land-use management, rural employment, and environmental protection to seek synergies and avoid negative impacts;

- facilitate bioenergy development through research, education and training, and through transport and infrastructure measures;
- find a balance between agriculture and forestry, as well as between domestic and imported sources of biomass;
- consider the impacts of bioenergy on other economic sectors;
- undergo regular monitoring to avoid negative environmental and social impacts; and
- prevent the destruction of natural resources and the loss of biodiversity.

The current situation represents a major opportunity for the forestry sector to contribute to increasing energy security and mitigating climate change by reducing dependence on fossil fuels.

## 7. Conclusions

In coming years, the world's energy consumption is expected to increase dramatically, particularly in Asia. While fossil fuels will account for most of the increased energy supply, renewable sources of energy will also gain importance, as a result of concerns over high fossil fuel prices, increasing greenhouse gas emissions and energy import dependence.

Bioenergy, including energy derived from wood and other plant materials, accounts for a significant proportion of the current energy supply from renewable sources. In many of the world's developing countries, fuelwood and charcoal (traditional bioenergy) remain the primary source of energy. In industrialized countries and particularly countries with large wood processing industries, wood energy is used for both domestic and industrial purposes.

Currently most liquid biofuels are produced from food crops and yield low economic and environmental benefits compared to fossil fuels. The increased use of these crops for energy production may even compete with food supply and lead to increased deforestation. However, it is expected that a new generation of liquid biofuels will become available in the next decade using wood as well as agricultural and forestry residues. This technology is expected to become commercially competitive and generate much less greenhouse gases compared to fossil fuels. Such second-generation liquid biofuels produced from woody biomass rather than from food crops would also reduce competition with food production.

Wood-based energy is among the most efficient sources of bioenergy. At present, it is particularly competitive when using wood residues from the wood processing industry.

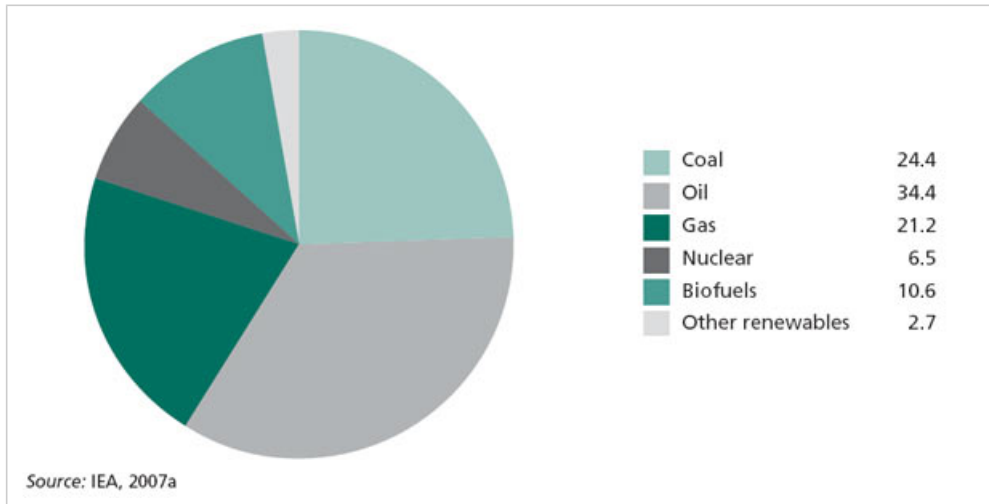
To avoid negative environmental and socioeconomic impacts, the expansion of biofuel production will need to be accompanied by clear and well enforced regulations.

Future demand for bioenergy will depend largely on the policy measures that will be adopted.

## Annex

### Annex 1:

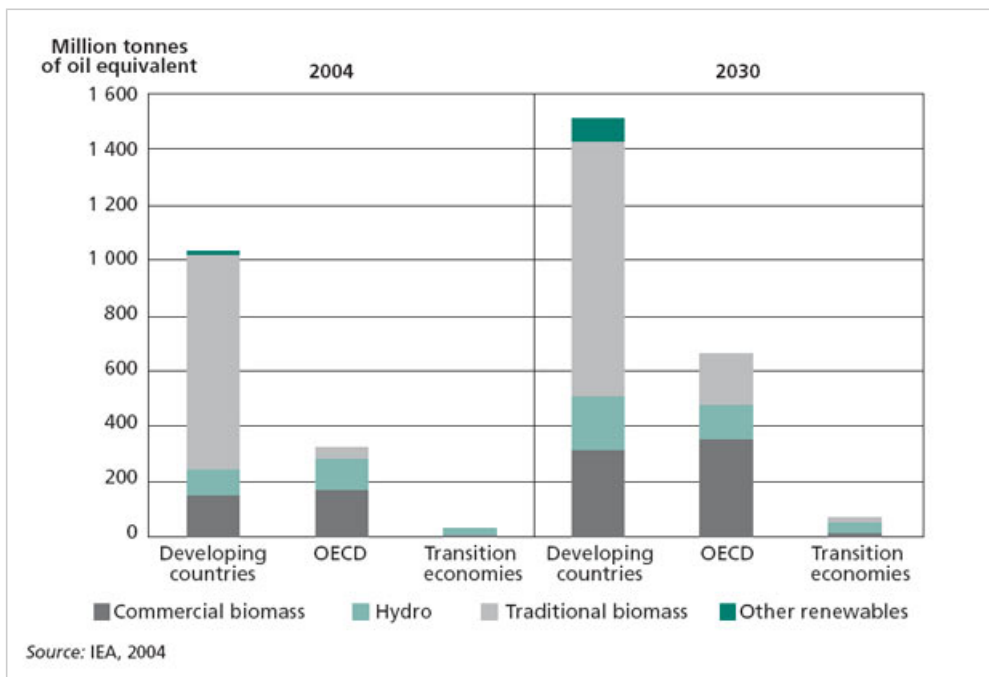
**Figure 2. Fuel shares of world total primary energy supply in 2004(%)**



Source: FAO, *Forests and Energy, Key Issues (2008)* [see <http://www.fao.org/docrep/010/i0139e/i0139e00.htm>], *Energy supply and demand: trends and prospects*, p. 7

### Annex 2:

**Figure 6. World renewable energy consumption by region for 2002 and projected for 2030**



Source: FAO, *Forests and Energy, Key Issues (2008)* [see <http://www.fao.org/docrep/010/i0139e/i0139e00.htm>], *Energy supply and demand: trends and prospects*, p. 11

## Partner for this publication

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