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# Biomass energy: new opportunity for agricolture and marginal areas

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# Biomass energy: new opportunity for agriculture and marginal areas?

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**Abstract**
As it is well known, energy is essential for human activities. Despite the high level of technological progress, the increase of energy consumption, satisfied mainly by fossil fuels, raises a series of issues linked to the scarcity of oil reserves, and their growing cost, and to a delicate relationship (and dependence) with a restricted number of world regions and nations. A greater diversification of the energy supply is one of the solutions to solve these problems, especially in the field of renewable resources. Despite the fact that biofuels are still more expensive than fossil fuels, they present many advantages: they are not subject to a progressive exhaustion and their impact on the environment is very low, due to their inclusion in natural cycles. Among biofuels a relevant role is played by the biomass, a renewable resource, that is obtained from the fraction of products, waste and residues from agriculture, forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste. This resource allows a relevant control of the greenhouse gas emission, a minor dependence from oil and gas resources and represents a way for the economic valorisation of local resources and a opportune utilisation of agricultural wastes.
In this context, the aims of the paper are to highlight the opportunities and the bonds that the biomass utilisation involves, to analyse the main public policies adopted to boost a large-scale production and consumption, to measure the different degree of utilisation at national (Italy) and European levels and to draw future scenarios. Particular attention will be paid to the European policies starting from the 1992 reform process until nowadays, having in mind the shortage of cereals in the world market. Where possible and opportune, the situation of Italy and of the European union will be compared with that of India, mainly, as regards public decisions/programmes. The paper concludes with an analysis of the role that the biofuel production is expected to offer in terms of new opportunities to diversify income and employment in rural and marginal areas.

**Keywords**
Biomass energy, rural and marginal areas, energy public policies

**JEL Codes**
O13, P28, Q18, Q41, Q42, Q48

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## 1. Introduction

The increase of world energy consumption satisfied mainly by fossil fuels, raises a series of issues linked to the scarcity of fossil resources, their growing cost, the dependence of Europe and India on imported energy and commitments to reduce greenhouse emissions. In 2005 the European Union-15 imported about 57% (1995, 47%) of its energy needs and India 27% (1995, 17%) of its consumption. When considering the risks of climate change and guaranteeing energy supplies, the development of renewable energy remains one of the best solutions for solving these problems. Despite the fact that bio fuels are still more expensive than fossil fuels, they present many advantages: they are not subject to progressive depletion and their impact on the environment is very low, as they are the result of a natural cycle. Biomass has an important role within the bio fuel context. It is a renewable resource that is obtained from the fraction of products, waste and residues from agriculture, forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste. This resource allows for significant control of greenhouse gas emissions, a lower dependence on oil and gas resources and represents a means of economic enhancement for local resources and an efficient way of utilising agricultural waste. In fact, biomass production could play an important role in rural areas, protecting jobs and revitalising neglected regions where maintaining productive activities is the only way of eliminating the risk of abandon. With regard to India, since agriculture is the major industry in the villages and the majority of biomass is collected by family workers (especially women) goals related to food security and energy are prominent.
As far as the European union is concerned, the introduction of a carbon credit would offer new opportunities for agricultural producers. It could significantly contribute to higher incomes and support stronger productivity growth in agriculture, with positive implications for renewable energy. However biofuel production poses new food security and environmental risks.

## 2. World production and consumption of energy

In the decade 1995-2005 primary energy production[1] increased by 26.4% and consumption by 26.8% (annual average rate 2.4 %). The largest increase in energy demand was for the non-OECD countries (which include China and India) that have higher economic growth rates and a more rapid population growth than the OECD nations. According to the International Information Administration forecast (EIA-International Energy Outlook, 2007) much of the growth in energy demand among the non-OECD nations occurs in the non-OECD Asia region. In this case energy demand has an average growth rate estimated at 3.2 percent per year[2]. In terms of percentage rate, non-OECD nations increased their weight in total world production from 57.3% in 1995 to 64.6% in 2005. Liquids continue to provide the largest quantity of world supply, but their share fell from 39% in 1995 to 36.8 in 2005. The highest growth concerned coal production and consumption, which rank second as far as total supply is

[1] Primary production/Total production of primary energy: any kind of extraction of energy products from natural sources and conversion to a usable form is known as primary production. Primary production takes place when the natural sources are exploited, for example in coal mines, crude oil fields, hydro power plants or fabrication of biofuels. Transformation of energy from one form to another, such as electricity or heat generation in thermal power plants, or coke production in coke ovens, is not primary production.
[2] Strong increases in energy consumption are predicted for the other non-OECD regions.

concerned. Petroleum and coal are followed by dry natural gas. Related environmental benefits and the efficiency of dry natural gas make it an attractive energy producing fuel choice in many countries, however, higher petroleum and natural gas prices make coal the best choice in those nations where coal resources are available in sizeable quantities. In 2005 petroleum, dry natural gas and coal represented 86.3% and 86.4% of supply and demand respectively. Net nuclear electric power increased by 18%, in the decade being analysed, and an increase in nuclear power production is expected to increase in the near future in many countries (EIA, 2007).[3]
Renewable resources play a marginal role in the supply and demand of energy.

Table 1 World Production and Consumption of Primary Energy

| | **Production (Quadrillion (10 15) Btu)** | | | **Consumption (Quadrillion (10 15) Btu)** | | |
|---|---|---|---|---|---|---|
| **World** | **2005** | **1995** | **Δ % 2005/1995** | **2005** | **1995** | **Δ % 2005/1995** |
| Petroleum | 169.277 | 141.833 | 19.4 | 169.4 | 142.4 | 19.0 |
| Dry Natural Gas | 105.331 | 80.259 | 31.2 | 107.6 | 81.0 | 32.8 |
| Coal | 122.246 | 88.521 | 38.1 | 122.6 | 88.5 | 38.6 |
| Net Hydroelectric Power | 28.997 | 25.340 | 14.4 | 29.0 | 25.3 | 14.4 |
| Net Nuclear Electric Power | 27.473 | 23.260 | 18.1 | 27.5 | 23.3 | 18.1 |
| Net Geothermal. Solar. Wind. and wood and Waste Electric Power | 4.285 | 2.169 | 97.6 | 4.3 | 2.2 | 97.6 |
| Biomass. Geothermal. and Solar Energy Not Used for Electricity Generation | 2.529 | 2.551 | -0.9 | 2.5 | 2.4 | 1.5 |
| ***Total Primary Energy*** | ***460.139*** | ***363.933*** | ***26.4*** | ***462.798*** | ***365.046*** | ***26.8*** |

Source: EIA (Energy Information Administration) – International Energy Annual 2005, our elaboration.

Table 2 Energy Production and Consumption (%) by Region

| | **Energy production: % in different groups of country** | | | **Energy consumption: % in different groups of country** | | |
|---|---|---|---|---|---|---|
| **Energy production: % in different groups of country** | **2005 %** | **1995 %** | **Δ % 2005/1995** | **2005 %** | **1995 %** | **Δ % 2005/1995** |
| **World Total** | **100.0** | **100.0** | **26.4** | 100.0 | 100.0 | 26.8 |
| OECD | 35.4 | 42.7 | 4.8 | 52.4 | 58.4 | 13.6 |
| Non OECD | 64.6 | 57.3 | 42.6 | 47.6 | 41.6 | 45.3 |
| Other Groups | | | | | | |
| OPEC | 21.4 | 20.1 | 34.9 | 6.8 | 5.5 | 56.7 |
| EU | 7.8 | 10.6 | -6.4 | 16.9 | 19.3 | 10.6 |

Source: EIA (Energy Information Administration) – International Energy Annual 2005, our elaboration.

## 3. European Union and Italy

Data related to the supply and demand of energy resources for current EU-27 nations is available for the period from 1990 to 2005. In view of the varying degree with which

[3] Cuts in nuclear power generation are expected only for OECD Europe, where several nations have programmed the elimination and non-replacement of some old reactors and others where nuclear power is forbidden.

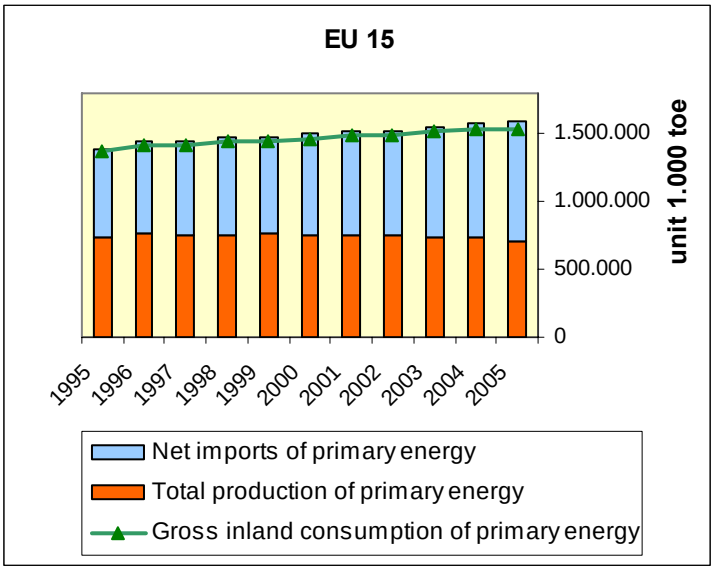
nations contributed, it was decided that we should concentrate on consumption trends from the establishment of EU 15, namely 1995[4].
The EU's energy production and consumption are unsustainable due to their limited resources and their impact on the environment. Europe is in fact a net importer of energy, while internal production levels are decreasing.

Table 3 EU-15 Production, Net Imports and Consumption of Primary Energy

| EU 15 | **2005 (1.000 toe)** | **1995 (1.000 toe)** | **Δ% 2005-1995** |
|---|---|---|---|
| Total production | 711.349 | 738.988 | -3,7 |
| NET imports | 878.330 | 652.393 | 34,6 |
| Gross inland consumption | 1.536.644 | 1.368.697 | 12,3 |

Source: EUROSTAT, our elaboration.

Figure 1 Production, Net Imports and Consumption of Primary Energy (1.000 toe)




Source: EUROSTAT, our elaboration.

Faced with a 12% increase of Gross inland consumption of primary energy[5] (from 1.37 to 1.54 billion toe) in the years 1995 to 2005, net imports (+35%) rose from[6] from 47.7% gross inland consumption of primary energy in 1995 to 57.2% in 2005. The production of primary energy showed a decrease of almost 4%, shifting from 739 million toe in 1995 to l 711 million toe in 2005.
Energy supplies for EU15 are in the main nuclear energy and natural gas, both of which progressively increased in the decade 1995-2005. The quota represented by nuclear energy rose from 204 to 232 million toe (about +14%). Renewable energy shifted from 73 million to over 100 million toe which represents a 2005/1995 increase of 38% and a 14% share of total primary energy production. The same period showed a sizeable drop in the production of energy derived from coal and lignite (-36%) and crude oil (-25%)

[4] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Republic of Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.
[5]Gross inland consumption represents the quantity of energy necessary to satisfy inland consumption of the geographical entity under consideration. Gross inland consumption is calculated as follows: primary production + recovered products + total imports + variations of stocks - total exports-bunkers. It corresponds to the addition of consumption, distribution losses, transformation losses and statistical differences.
[6]Net imports are calculated as total imports minus total exports.

and which, in 2005, represented 12 and 17% respectively of total primary energy amounts.

Table 4 EU-15 Primary and Renewable Energy Production by Fuel Type

| **EU 15** | **2005 (1.000 toe)** | **1995 (1.000 toe)** | **Δ% 2005-1995** |
|---|---|---|---|
| **Primary production** | | | |
| coal and lignite | 86.453 | 135.778 | -36,3 |
| crude oil | 119.178 | 158.573 | -24,8 |
| natural gas | 171.437 | 167.045 | 2,6 |
| nuclear energy | 232.411 | 204.557 | 13,6 |
| renewable energy | 100.015 | 72.685 | 37,6 |
| **Renewable energy production** | | | |
| Solar | 771 | 242 | 218,6 |
| Biomass and wastes | 65.186 | 43.605 | 49,5 |
| Geothermal | 5.173 | 3.358 | 54,1 |
| Hydro power | 22.849 | 25.130 | -9,1 |
| Wind | 6.037 | 350 | 1.624,9 |

Source: EUROSTAT, our elaboration.

At European level, biomasses/waste top the list of renewable energy production followed by hydroelectric power (65% and 23% respectively). Renewable sources show a steady increase in the ten years from 1995 to 2005, with the exception of hydroelectic power (-9%).

Table 5: EU-15 Composition of Renewable Energy (%)

| | **% in composition of renewable energy** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EU15 | **2005** | **2004** | **2003** | **2002** | **2001** | **2000** | **1999** | **1998** | **1997** | **1996** | **1995** |
| Solar | 0,8 | 0,7 | 0,6 | 0,6 | 0,5 | 0,4 | 0,4 | 0,4 | 0,4 | 0,4 | 0,3 |
| Biomass and wastes | 65,2 | 62,9 | 63,2 | 63,2 | 59,8 | 61,2 | 60,6 | 60,7 | 60,9 | 60,8 | 60,0 |
| Geothermal | 5,2 | 5,5 | 5,7 | 4,5 | 4,0 | 3,9 | 5,2 | 5,0 | 4,9 | 4,9 | 4,6 |
| Hydro power | 22,8 | 25,7 | 26,3 | 28,2 | 33,1 | 32,2 | 32,3 | 32,7 | 33,0 | 33,4 | 34,6 |
| Wind | 6,0 | 5,2 | 4,2 | 3,6 | 2,6 | 2,2 | 1,5 | 1,2 | 0,8 | 0,6 | 0,5 |

Source: EUROSTAT, our elaboration.

At European level, biomasses/waste top the list of renewable energy production followed by hydroelectric power (65% and 23% respectively). Renewable sources show a steady increase in the ten years from 1995 to 2005, with the exception of hydroelectic power (-9%).

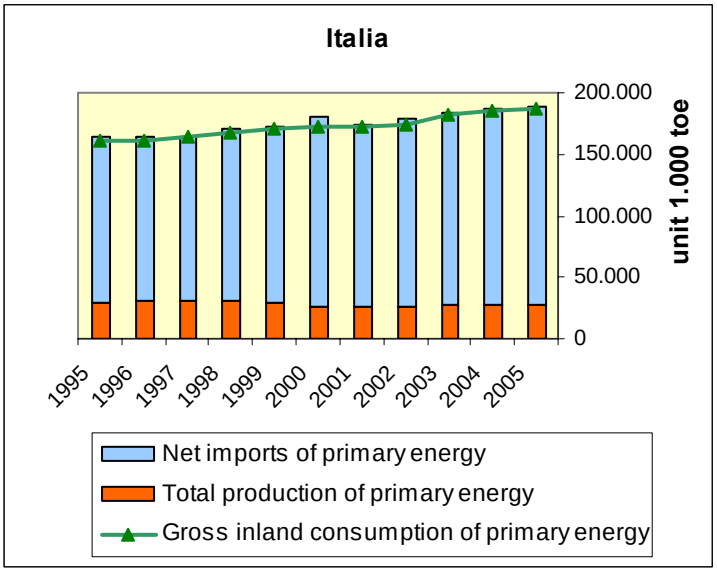
Table 6: Italy Production, Net imports and Consumption

| ITALY | **2005 (1.000 toe)** | **1995 (1.000 toe)** | **Δ% 2005-1995** |
|---|---|---|---|
| Total production of primary energy | 27.597 | 29.219 | -5,6 |
| NET imports of primary energy | 160.475 | 134.651 | 19,2 |
| Gross inland consumption of primary energy | 186.766 | 161.262 | 15,8 |

Source: EUROSTAT, our elaboration.

The gross inland consumption of primary energy in Italy increased by 16% between 1995 and 2005 and resulted higher than that of the other EU nations, rising from 161 million to 187 million toe. Contemporarily, the production quota of primary energy decreased by 5,6%, from 29 million toe in 1995 to 27 million toe in 2005.

Figure 2: Italy Production, Net imports and Consumption (1995-2005)




Source: EUROSTAT, our elaboration.

Furthermore, subsequent to alternating fluctuations in the decade under analysis, Italy's net import quota was noticeably higher than that of the EU15, reaching 86% of gross inland consumption of primary energy in 2005. The dominance of net import quotas is partly attributable to the total absence of nuclear energy production which is not the case for other EU15 nations.

Table 7: Italy Primary and Renewable Energy Production by Fuel Type

| **ITALY –** | **2005 (1.000 toe)** | **1995 (1.000 toe)** | **Δ% 2005-1995** |
|---|---|---|---|
| **Primary production** | | | |
| coal and lignite | 60 | 44 | 36,4 |
| crude oil | 6.146 | 5.289 | 16,2 |
| natural gas | 9.886 | 16.347 | -39,5 |
| nuclear energy | 0 | 0 | |
| renewable energy | 11.504 | 7.540 | 52,6 |
| **Renewable energy production** | | | |
| Solar | 23 | 8 | 187,5 |
| Biomass and wastes | 3.387 | 1.115 | 203,8 |
| Geothermal | 4.791 | 3.167 | 51,3 |
| Hydro power | 3.101 | 3.249 | -4,6 |
| Wind | 202 | 1 | 20.100,0 |

Source: EUROSTAT, our elaboration.

Particularly evident is Italy's reluctance to use coal and its total lack of nuclear power both of which have dominated renewable energy supplies in relation to total energy production over recent years. Furthermore, Italy has a much higher quota of energy imports compared with the rest of the EU15 nations.
Renewable energy quotas show a 53% increase in this decade (from 7.5 to 11.5 million toe) which put them in the lead in 2004 with regard to total product. Natural gas, which is in second place with regard to total product as a whole, has decreased by almost 40% shifting downwards from 16 to 9 million between 1995 and 2005.

Table 8: Italy composition of renewable energy (%)

| | % in composition of renewable energy | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ITALY | **2005** | **2004** | **2003** | **2002** | **2001** | **2000** | **1999** | **1998** | **1997** | **1996** | **1995** |
| Solar | 0,2 | 0,2 | 0,1 | 0,2 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 |
| Biomass and wastes | 29,4 | 26,3 | 19,5 | 19,0 | 18,4 | 18,4 | 17,0 | 15,9 | 14,8 | 13,6 | 14,8 |
| Geothermal | 41,6 | 41,2 | 47,7 | 40,1 | 35,5 | 36,3 | 41,8 | 43,5 | 42,5 | 42,1 | 42,0 |
| Hydro power | 27,0 | 31,0 | 31,5 | 39,4 | 44,8 | 44,6 | 40,8 | 40,2 | 42,5 | 44,2 | 43,1 |
| Wind | 1,8 | 1,3 | 1,2 | 1,4 | 1,1 | 0,6 | 0,4 | 0,2 | 0,1 | 0,0 | 0,0 |

Source: EUROSTAT, our elaboration

Geothermic energy prevails in Italy (around 42% of the total). There has been a progressive downturn in the percentage represented by hydroelectric power in relation to the production of biomass which now ranks second as far as total renewable energy is concerned.

## 4. India

In the decade 1995-2005 energy production increased by 23.7% in India and consumption by 41.6%.
Despite the fact that India is the world's eleventh greatest energy producer and the world's sixth greatest energy consumer, it is in fact a net energy importer, mainly because of the large imbalance between oil production and consumption.
Due to the vast availability of coal reserves (about 10% of the world's total) more than half of India's energy needs are met by coal. During the decade 1995-2005, demand exceeded production.
About 30% of India's energy demand is satisfied by petroleum; more than 60% of that oil is imported. At present India is the world's sixth greatest oil consumer. In the period 1995-2005 petroleum production fell by 5.5% while demand increased by 52.0%.
Natural gas has shown the fastest growth rate of any fossil fuel with regard to India's energy. In the decade 1995-2005 consumption increased by 81.7 and production by 51.2%.
Production and consumption of Hydroelectric Power also increased by about 34%, in the last decade.

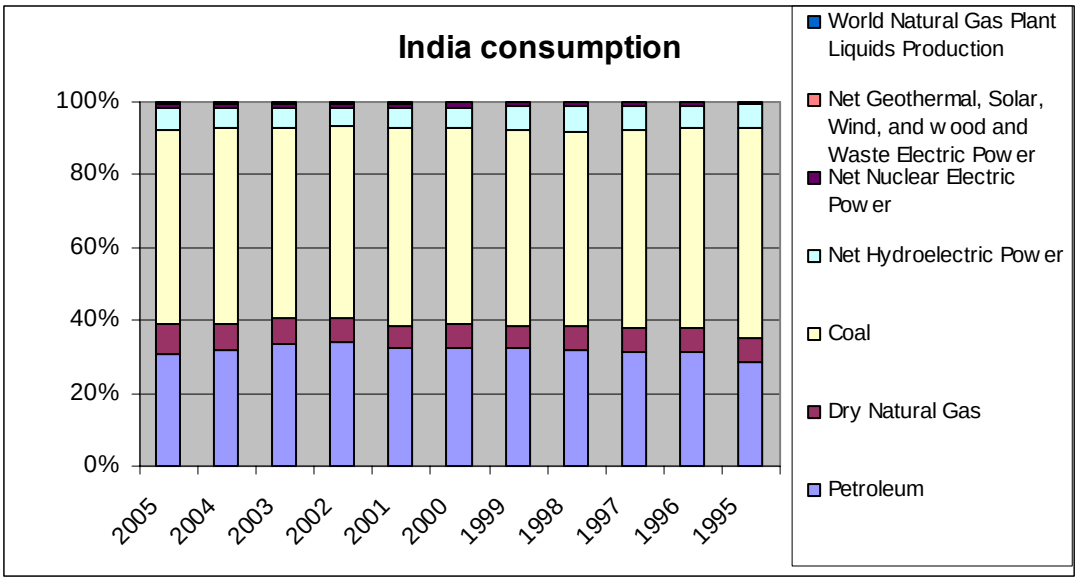
Table 9 India Production and Consumption of Primary Energy

| | **Production** (Quadrillion (10 15) Btu) | | | **Consumption** (Quadrillion (10 15) Btu) | | |
|---|---|---|---|---|---|---|
| | **2005** | **1995** | **Δ % 2005/1995** | **2005** | **1995** | **Δ % 2005/1995** |
| Petroleum | 1.390 | 1.471 | -5.5 | 4.983 | 3.278 | 52.0 |
| Dry Natural Gas | 1.092 | 0.722 | 51.2 | 1.312 | 0.722 | 81.7 |
| Coal | 7.774 | 6.388 | 21.7 | 8.646 | 6.613 | 30.7 |
| Net Hydroelectric Power | 0.990 | 0.741 | 33.6 | 0.990 | 0.741 | 33.6 |
| Net Nuclear Electric Power | 0.190 | 0.078 | 145.8 | 0.190 | 0.078 | 145.8 |
| Net Geothermal. Solar. Wind. and wood and Waste Electric Power | 0.077 | 0.005 | 1.480.5 | 0.077 | 0.005 | 1480.5 |
| World Natural Gas Plant Liquids Production | 0.218 | 0.079 | 176.6 | 0.006 | 0.005 | 9.8 |
| ***Total Primary Energy*** | 11.731 | 9.484 | 23.7 | 16.205 | 11.442 | 41.6 |

Source : EIA (Energy Information Administration) – International Energy Annual 2005), our elaboration.

With regard to India's renewable energy supplies, we can identify three traditional biomass fuel types (wood-fuel, crop residues and dry dung). Generally they are home grown or collected by household labour.

Figure 3 India Consumption by fuel type




Source: EIA (Energy Information Administration) – International Energy Annual 2005), our elaboration.

Quantities and incidence have not been officially estimated and have no direct economic value. According to accepted estimates (Shuka, 2007), about a quarter of the primary energy consumed in India in 2004 was obtained from biomass: 58% from fuel wood, 33% from crop residues and 9% from dry dung.

## 5. Biomass policies: India and European Union compared

Biomass resources are the total amount of organic materials (wood, agricultural crops, manure or waste and municipal waste) that can be used as a source of fuel or energy[7].
If the vegetable biomass is the result of the photosynthesis process of plants, it can be equally applied both to animal and vegetable derived material[8]. Burning biomass (biopower[9]) is not the only way to release its energy. It can be converted into other typologies such as biofuels[10] and bioproducts[11].
The most common form of biomass is wood. Another source of biomass is garbage (municipal solid waste). In addition to the utilisation of wastes and residues, biomass can be produced by growing crops which are dedicated to energy production.
The main advantages can be summarised in the following:

- Biomass fuels are, in many ways, more environmentally friendly than most fossil fuels.
- It is an inexhaustible fuel force;

[7] Biomass excludes organic material which has been transformed by biological processes into substances such as coal or petroleum.
[8] Although fossil fuels originate from ancient biomasses, they are not considered to be biomasses because they contain carbon that has been out of the carbon cycle for a very long time.
[9] They can satisfy three areas of energy demand : domestic use for the production of heat, industrial use (fire wood and agrifood for the production of electricity and heat) whole local authorities and districts.
[10] Production of fuel for means of transport
[11] They belong to the bio products for everyday use such as plastics, glue etc.

- It cuts back on waste and supports agricultural products. In fact biomass fuel from agricultural waste could be a byproduct which adds value to agricultural crops;
- It uses locally produced biomass instead of imported fossil fuels which provides an economic income for local activities and would increase income and jobs in rural areas;
- Less money is spent on fossil resources.

The disadvantages:

- Economic performance is low;
- It is still an expensive source, both in terms of producing biomass and converting it into alcohols, on a small scale there is more likely to be a net loss of energy;
- It could significantly contribute to global warming and pollution if burned;
- It is not economically viable to transport biomass fuels over long distances, therefore power plants are usually located near biomass sources;
- There is a lack of technologies able to ensure high energy performance during the conversion processes; some biomass conversion projects concern animals and are relatively small and therefore limited;
- Research and public support are needed to reduce production costs;
- Low levels of public awareness;
- The land used for energy crops may be in demand for other purposes, such as faming, conservation, housing, resorts or agricultural use (mainly for food)

In this context the support of the public authorities is essential (Menanteau, Finon, Lamy, 2003). Without such aid, market forces would result in the limited diffusion of renewable energy in limited niche markets. Public involvement can be justified as a means for correcting negative external effects, which result from the use of fossil fuels, and an increase in efficiency by stimulating technical changes. Renewable energy contributes to the preservation of a public good. Due to the non-excludable and non competitive characteristics of air and climate stability as a public good, private actors are not interested in investing in something which everyone can acquire free of charge (market failure).

*5.1 The European union situation*

Unmistakeably, the European Union is a group of European countries which participates in the world economy as a single economic unit. The EU's goal is to create a barrier-free-trade-zone and to enhance economic wealth by creating a more efficient market place. The functions and power of the European institutions do not cover all the issues. With regard to energy the role of the European Union is to drive sustainable processes, leaving the single Member States to deal with specific areas of intervention[12]. The European guidelines and support are more complex and articulated, yet at the same time more lenient, than those of a nation where all the functions are centralised. In 2004 the Commission concluded that with the measures and policies currently in force in the EU-15 countries, it was not likely that they would meet the overall target of 22% renewable energy[13]. Thus, there was an urgent need to implement new measures in the EU-15 countries in order to reach the target, and thus contribute towards satisfying the objectives concerning overall renewable energy the climate. The 10 new EU member countries included national renewable electricity targets as part of their accession

[12] The paper does not consider the national energy policy of each member state.

[13] This is part of the communication from the Commission "*The share of renewable energy in the EU*", May 2004, where it stated that there will be only an increase from 14% in 2000 to 18-19% in 2010.

agreements, but the likelihood that they will reach their targets is limited, particularly due to the fact that most of them have not introduced adequate measures to support renewable energy in the electricity sector. It is crucial that more efforts be made and that effective support systems be introduced at adequate levels, such as feed-in tariffs. The renegotiation of targets should be accompanied by the introduction of efficient support systems to facilitate their development.

Currently, the main EU guidelines and regulations concerning renewable energy and energy saving are to be found in the following documents:

- Commission of the European Communities, Communication from the Commission to the European Council and the European Parliament: "An energy policy for Europe, Brussels 10.1.2007;
- Commission of the European Communities, Intelligent Energy Programmes
- Commission of the European Communities, Communication from the Commission Action Plan for Energy Efficiency: Realising the Potential. Saving 20% by 2020; Brussels October, 2006
- Commission of the European Communities, Green Paper on Energy Efficiency or Doing More with Less, 22 June 2005;
- Directive 2001/77/CE on Electricity Production from Renewable Energy Sources

With regard to the long-term roadmap concerning renewable energy, the EU is committed to a general objective where 20% of total EU energy consumption must be renewable energy, and where a minimum of 10% of total fuel consumption must be represented by biofuels. Both objectives must be reached by 2020. The Commission has also set out proposals for integrating renewable energy into the following sectors; transport, electricity, heating and cooling.
The proposed chronography package includes legally binding objectives which will, however, allow the individual states the freedom to come up with their own personalised combination of renewable energy solutions. Contemporarily, and in order to implement the general objectives on a national scale, the Member States will need to define both the specific and sectoral objectives for each of the sectors concerned by renewable energy, namely electricity, biofuels, heating and cooling.
The schedule also emphasises the need for the development of biofuels to be coordinated at EU level; by so doing the Commission hopes that the minimum biofuel quotas now fixed at 5.75% of total fuel consumption by 2010, will eventually increase to 10% by 2020. In order to more rapidly satisfy these renewable energy goals, the framework programme for innovation and competitiveness (CIP) (2007-2013), the European Union decided to present an “Intelligent Energy- Europe” programme. This programme supports energy enhancement and efficiency, the use of new and renewable energy sources; their more widespread penetration into the market, the diversification of energy and fuels; increased renewable energy quotas (based on the EU’s objective these energy sources should represent 12% of the total by 2010) and a reduction of energy consumption, with particular emphasis on the transport sector[14].
At the end of 2006, the European Commission adopted the 2007-2012 plan of action aimed at promoting energy efficiency with a view to reducing consumption by 20% by 2020. The plan of action includes measures aimed at promoting more energy efficient

[14] The programme guarantees continuity for the “Intelligent Energy – Europe” programme which expired on 31 December 2006.

products, buildings and services; making energy more effective and improving its distribution; reducing the impact that transport has on energy consumption; promoting funding and investment in the sector; promoting and strengthening rational behaviour with regard to energy consumption and encouraging the spread of efficient energy initiatives at an international level.

The Green Paper on Energy Efficiency is the Commission's means for promoting energy saving in the European Union; on the basis that increases in current energy consumption damage both the environment and the EU's economic growth, public authorities are being urged to make the general public and industry make more responsible, energy saving decisions. The green paper targets the transport, energy production and the construction sectors as being the main areas to work on with a view to reducing energy consumption. As far as the regulations are concerned, Directive 2001/77/CE of 27 September 2001 established indicative objectives for the production of electricity from renewable energy sources, which by 2010 should amount to 22% of total electricity consumption within the EU, with 25% and 78% of total consumption in Italy and Austria respectively.

With regard to biomasses, the following must not be overlooked:

– Commission of the European Communities, Biomass Action Plan (December 2005)
– Commission of the European Communities, An EU Strategy for biofuels (February 2006)

The biomass action plan presents measures aimed at intensifying energy production from wood and agricultural waste by offering incentives based on market mechanisms and the elimination of barriers that hinder the development of the market. These incentives will enable Europe to reduce its dependence on fossil fuels, curb greenhouse gas emissions and stimulate economic growth in rural areas.

The EU's strategy on biofuels has three main aims:

- to promote the more widespread use of biofuels within EU states and in developing countries, and to guarantee that their use is compatible with the environment, respecting the Lisbon objectives while addressing the issue of competitiveness.
- providing conditions for the wide-scale use of biofuels and enhancing their competitiveness with regard to cost, optimising the production of the raw materials, encouraging research into "second generation" biofuels by promoting them on the market and consequently increasing the number of demonstration projects and eliminating non-technical barriers;
- examining the opportunities available to developing countries – including those affected by the EU's CAP sugar reform – thanks to the production of raw biofuel materials and the biofuels themselves, as well as defining the EU's potential role in the development of sustainable biofuel production.

As far as European Union policies are concerned, the mid-term reform of the CAP (Common Agricultural Policy) has introduced income aid support for farmers which is no longer linked to the production of crops. This reform also introduced aid for energy crops and within the instrument set aside for this purpose, it maintained the opportunity to grow non food crops. In general, due to the high costs of both land and labour (relatively expensive production factors in Europe) dedicated biomass production is actually more expensive per unit of energy produced than that produced by available residues and wastes.

5.2 *India framework*

India's energy policies are influenced by the following factors:

1. Growing economy and limited domestic reserves, with dependence on the supply of energy resources;

2. Rising household incomes, with a need for an adequate supply of electricity and clean cooking fuels;
3. Indoor, urban and regional environmental impact, calling for the adoption of cleaner fuels and cleaner technologies.

Published literature on the matter has established the relationship between energy consumption and economic growth, even if the direction of its causation remains controversial (Antle, Heiderbtink, 1995; Suri, Chapman, 1998; Aqell, Butt, 2001). Unlinked to this relationship, the availability of fossil energy sources in India is limited and may not be sufficient in the long-term to sustain its rapid economic development. In fact, the Indian economy is forecast to undergo high growth levels over the following years. It is predicted that the demand for energy will increase and will have to cope with growing costs because of the limited supply of fossil fuels.

India has a strong tradition of energy planning and intervention programmes. Programmes for promoting renewable energy and for improving energy efficiency date back to the 1940s. Nevertheless, oil imports are currently the major reason for the increasing trade deficit in the balance of payment.

India has significant reserves of coal, but it has scarce oil and gas resources and it is becoming rapidly more dependent on them. With this in mind, India is seeking to diversify its oil suppliers (like other major importing economies outside the Gulf states). The instruments applied are long-term purchase agreements, contracts for exploration, development and production, aid packages and investments. However the diversification of suppliers has problematic consequences due on the one hand to the social, economic and politic instability of the nations with which India is dealing and on the other hand to direct competition with nearby Asian countries. With a view to reducing at least the potential global fluctuation in energy market, India is building strategic facilities for the storage of crude oil reserves on its east and south coasts.

Despite the fact that coal is the most important energy source, India's fuel basket pursues all options of available energy-fuel types (conventional and non conventional).

Other policies implemented by the Indian government may be summarised as follows:

- Creation of markets that promote competition through cuts in state subsides in all petroleum products, bearing in mind social objectives (household demand for kerosene and cooking gas);
- Shift to natural gas and liquefied natural gas. Natural gas, however, is a non-tradable commodity due to the absences of pipelines or liquefied natural gas terminals. The construction of a pipeline from Central Asia would have to cross Pakistan and such a pipeline is not politically feasible. As a consequence, India is seeking new suppliers outside Central Asia (especially Oman and Qatar);
- Raised domestic oil and gas production and the utilisation of clean coal technology. Due to its long-standing experience in promoting renewable energy technologies (notably biogas and wind energy[15]), India is looking to increase the use of renewable energy sources[16].

With regard to renewable resources, it is appropriate to mention that India has a fully fledged ministry dedicated to the production of energy from non-conventional energy sources. Also worthy of note is the fact that large numbers of poor households have insufficient income to buy commercial fuels (MNES, 2006).

Biomass in India is the most important source of energy for over one hundred million households and traditional industries (it represents a quarter of the primary energy

[15] India is emerging as a growing market for solar, wind and hydroelectric power.
[16] India's programme on biomass-based electric power is a recent development.

consumed in India). Biomass is the principle provider of energy for domestic use; wood fuels contribute 56% of total biomass energy.
In India, biomass is traditionally used by rural and semi-rural households to satisfy their domestic energy needs. Most biomass is collected on common land by family labourers who are generally women. With the rise in population and greater competition for the use of available land have increased deforestation and the degradation of common land (Shukla, 2007). One of the main issues for Indian policy makers is to develop the market for biomass energy services by removing tariff distortions which favour fossil fuels, and to supply infrastructure with a view to producing and delivering bio-energy services. India has advanced in this field with its important technological innovations concerning the production of Biomass gasifiers.
However, in absence of a developed market in rural areas, most biomass fuels are not traded and the social costs are associated with pollution (mainly indoor pollution).

## 5. Concluding remarks

Two thirds of the renewable energy in Europe is generated from biomass. Nearly half of the biomass energy used by households is derived from wood.. In rural areas, wood is often a suitable alternative for fossil fuels, because it is amply available and most people are not connected to a natural gas or heat grid.
According to International Fund for Agricultural Development (IFAD, 2008) information, about two thirds of India's more than 1 billion people live in rural areas, and almost 170 million of them are poor. Over 80% of the population in rural areas depends on biomass for meeting its cooking energy needs. Only 44% of rural households have access to electricity. Agriculture and breeding are important sources of food and income for many poor rural people, but their waste and manure contribute to the production of greenhouse gases. Transforming agricultural waste and manure into biogas will; improve the lives of poor rural people by providing energy for cooking and lighting, increase jobs and substitute the time spent collecting fire wood with economic activities and decrease the release of greenhouse gases, mainly in rural areas (World Bank, 2005).
However, the use of cultivable crop land for fuel remains strongly controversial. Biomass production depends on land, water, fertilisers and/or pesticides and energy. The strengthening of biomass production creates competition for land and water, conflicts based on food security or energy security and feasible environmental improvement, when there is an absence of opportune and dedicated policies (Berndes, Hoogwijk, van den Borek, 2003).
Both agricultural commodities and energy prices have increased significantly in recent years. In the past no significant correlation between them appeared to exist, but many authors and researches state the correlation has now strengthened. We would like to conclude by quoting from the FAO 2007 report: *International cereal prices remained high and volatile, however, reflecting sustained demand, particularly from the biodiesel industry, coupled with historically low levels of stocks and insufficient increases in production…. Rises in international prices have translated into higher retail prices of basic food in many countries. Most affected by the food inflation are those developing countries that depend heavily on imports to cover their cereal consumption requirements.*
As far as wood is concerned, it is worth noting that wood has a standing tradition in rural areas due to its availability, sustainability and the fact that it is an environmentally friendly, renewable natural resource. Wood also represents a significant source of income for forest owners in the context of forest restitution processes. In this case, an

increase in demand for forest products could see a decrease in forestation. However a recent study (Foster, Rosenzweig, 2003), which examined the connection between economic growth and the growth of forests in India, concluded that as a result of several of India's policies (economic incentives, conservation methods, trade measures that limited importation of forest products) forest owners have been given an incentive to increase the supply of trees. Furthermore, the researchers do not support the assertion that increased agricultural productivity increases forestation by decreasing the need for expansion of agricultural land, and that the growth in rural employment increases tree area by moving labour out of forest-resource extraction.

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