

Biomass EuVET 2012.

# BIOMASS IN CROATIA

Report on the situation of biomass (production, supply, use) as fuel in Croatia, and RES in education as an answer to renewable market demands

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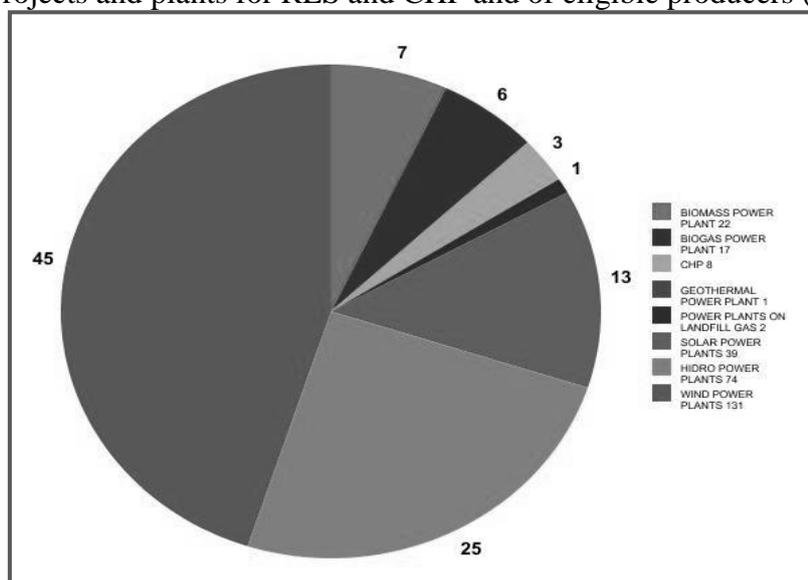
## 1. General situation of RES in Croatia

Electricity generation from RES in Croatia for 2010.

Type of renewable energy source	Electricity generation
Solar	120 MWh
Wind	139,1 GWh
Biomass	33 GWh
Small hydro power plants	124,1 GWh
Geothermal	0
<b>TOTAL</b>	<b>296,32 GWh</b>

source: EIHP, HEP

Registry of projects and plants for RES and CHP and of eligible producers (in percentages)



Over 300 projects, 40 energy approvals and 13 built (2010.)

One of three basic objectives of the Energy Strategy of the Republic of Croatia, that was adopted by the Croatian Parliament in 2009. for the period until 2020., is renewable energy sector development.

Concerning renewable energy sources, the target share in gross final energy consumption in 2020. is 20% of the renewable energy sources. This prediction implies development of RES energy sector, especially utilization of biomass potential with planned biomass fired power plants of total 85 MW power, production of around 340 000 tons of bio fuels in 2020., governmental stimulation of wind power plants construction, construction of at least 100 MW of small hydropower plants, construction of 20 MW capacity in geothermal power and installation of 0.225 m<sup>2</sup> of heat collectors per capita by 2020.

## NEW INSTALLED PRODUCTION CAPACITIES FROM RES TILL 2020

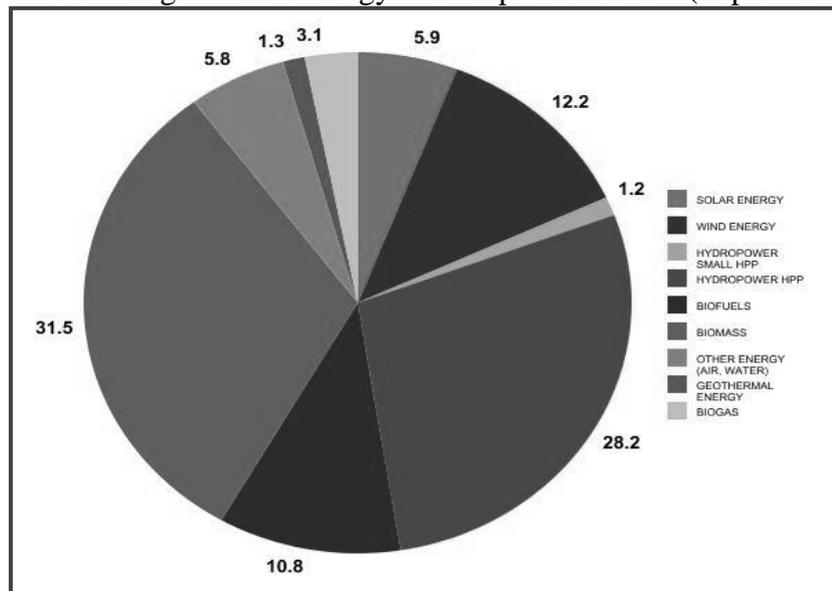
At least 300 MW hydro power plants until year 2020. (including the additional power of revitalization, but without the small hydro) – ENCOURAGE CONSTRUCTION OF PUMP HYDRO POWER PLANTS (increase the competitiveness of the electricity market).

The dynamic depends on mature of technology, electrical grid capabilities and initiatives:

- 140 MW in the biomass power plants (420 MW till year 2030.)
- 40 MW u TPP on on municipal waste (60 MW till year 2030.)
- 20 MW in geothermal power (30 MW till year 2030.)
- 1200 MW in wind farms (2000 MW till year 2030.)
- 45 MW in solar power (250 MW till year 2030.)
- 100 MW small hydro power plants (140 MW till year 2030.)

Usage of renewable energy sources shall be stimulated by electricity consumers funds and it is necessary to ensure that such sources are directly in function of development of the Croatian economy.

RES shares in gross final energy consumption in 2020. (in percentages)



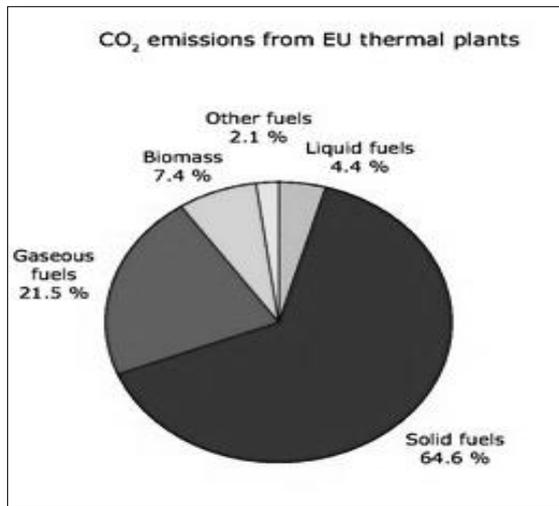
### Sector objectives of RES

The goal is to use around 84 PJ of RES in 2020.

SECTOR	SHARE OF RES %
ELECTRICITY	9.2
TRANSPORT	2.2
HEATING AND COOLING	8.6

The present approach to energy is unsustainable. Fossil fuels are getting ever so more expensive and hard to get, importing them gets countries into unenviable situations where they get dependant on others, not to mention the pollution they cause.

## CO2 COMPARISON



PRICE COMPARISON	Kn/kWh
Electricity	0.83
Oil	0.74
Pellets	0.40
(1EUR=7.52kn)	

Department of Environmental Governance UNDP conducted a survey on the state of the Croatian market of solar thermal systems, which represents a pioneering effort to collect relevant data and assessing the current state of renewable energy market, since this is the first such survey ever conducted in Croatia. What was clear from that survey was the need for upgrading the secondary education system and the creation of educational programs for adults, because without a sufficient number of qualified installers it is impossible to expect a larger number of installed systems, as well as its quality functioning.

## 2. Current status of the biomass sector and employment opportunities

Economic benefits from forestry biomass as reducing imports of fossil fuels and the balance of payments deficit, increase energy independence and security of energy supply, which is one of the strategic issues of each country. According to the predictions of the dependence of the Croatian energy, imports will rise from the current 50% to over 70% in 2030. year. Since the EU and the developed world is growing tendency of using renewable energy as an energy source, Croatia should work on that too.

Social benefits of using biomass as the possibility of opening a number of new jobs, which brings the rural and local development, and it is imperative for Croatian economic and social policy.

Biomass in Croatia:

- forest biomass
- agricultural biomass
- waste.

## Quantities of wood waste in disposal in the wood industry

ASSORTMENT(m <sup>3</sup> )	2000	2005
Bark, sawdust and solid waste	585.000	787.500
Final waste	295.750	398.125
Cord wood	228.800	288.600
Boughs	192.800	243.200
TOTAL	1.302.350	1.717.425

source: MAFWM, 200

## Theoretical power potential of usable biomass as a result of forest management

ASSORTMENT	Energy utilization factor ( $\mu$ )	Available biomass (m <sup>3</sup> /year)	Energy potential, 40% of moist (PJ)	Energy potential, 10% of moist (PJ)
Logs	0,50	1.837.881,4	12.115	14.771
Firewood	0,60	825.054,9	6.089	7.425
Waste	0,45	458.043,9	2.004	2.324
TOTAL		3.120.980,2	20.208	24.520

source: MAFWM, 200

Targeted growth in the use of forest chips from 1 million tonnes per year from 2010. was achieved by:

1. the increase of forestry income by selling forest chips for about 35 million € per year
2. reduced use of fossil fuels by about 0.36 million tonnes of oil equivalent per year
3. reduced fossil CO<sub>2</sub> emissions by approximately 1.05 million tons per year
4. increase employment by more than 1,000 jobs in forestry.

About 97 % of forests in Croatia are of natural origin, they have been developing for ages in their habitats, which makes them one of the most natural, the most stable and the most productive ones in Europe.

Wood has always been significant energy source throughout the development of human society. Around 1850s wood ensured about 90% of energy needs, only to fall under 5% in the last decade of 20th century. But since the energy crisis has emerged, the contribution of wood for energy balance is rising on daily basis.

Exploitation of forest and wood biomass for energy has a long tradition in Croatia especially when we are talking about fire wood and wood residue. In 1960s almost ¼ of energy needs was being covered by biomass. Today, the situation is significantly different. The use of biomass has diminished, people use natural gas and fuel oil rather, because they are easier to use, more comfortable to use. Also, the problem is low ecological awareness that prevails among Croatian population that gives advantage to fossil fuels regardless to obvious advantages of the biomass.

Vast forest areas in Croatia extends to about 2.580 million hectares, of which the afforested area makes 2.377 million hectares, accounting for about 42% of the Croatian land surface. The state-owned forests make 77% or nearly 2 million hectares, and private forests 23% or 593 027 hectares. The wood supply in Croatia is estimated at around 555.15 mil. m<sup>3</sup> or

232.22 million m<sup>3</sup>/ha, the national forest share is 225.57 m<sup>3</sup>/ha. Currently available wood biomass utilization for energy purposes can be estimated at approximately 5.59 million m<sup>3</sup> per year, or about 70.56 PJ.

Currently available wood biomass utilization for energy purposes in Croatia

FORM OF WOOD BIOMASS	QUANTITY MIL.M3/YEAR	POTENTIAL ENERGY, PJ
WOOD	1.89	24.33
WOOD RESIDUES	0.7	8.65
BARK	0.21	2.01
RESIDUES FROM WOOD PROCESSING INDUSTRY	1.39	17.89
WOOD-BASED BIOMASS FROM NATIONAL COMPANIES: HRVATSKE VODE, HRVATSKE CESTE I HEP	0.4	4.8
ENERGY CROPS	1.0	12.88
TOTAL	5.59	70.56

By exploitation and maintenance of forests there is a large mass of wood biomass leftover and it can be used for the power production. For thermal usage, wood mass from the cleaning of forests can be used, wood collected after maintenance or from the wind breakage, trees collapsed under mass of ice, ill trees, and wood from the areas taken by fire, etc. In classical exploitation, in the Republic of Croatia wood is obtained from the trunk, crown and boughs, whose diameter with bark in the thinner part (end) is bigger than 7 cm. On this way 60 – 70% of wood mass from the mature stands is being utilized, except on the younger stands where the utilization percentage only reaches 50%. Share of leftovers and waste from the wood cuttings depends on many factors and in average for all stands and tree species during cutting down, one could count on something more than 20% of leftovers. Except large quantities of biomass which are produced as a by product and waste in forestry, there is a great number of species of quick growing trees (e.g. willow, poplar and plane trees), which can be cultivated for the biomass production.

In the wood manufacturing production units, production process is resulting in wood leftovers in the form of wet biomass from the primary production, (bark, wet sawdust, pieces of waste – stubs and pieces of bark) and dry biomass from final wood processing (sawdust, grinding waste, shavings and small and big waste), which usually represent load for the wood industry.

Wood-based fuels:

Pellets - most widespread modern wood fuel formed by pressing or crushing of sawdust coarse wood waste or wood chips. A dozen Croatian pellet manufacturers export up to 97% of their products, around 250.000 tons per year. The Ministry of Economy registry RERCPMP has more than 70 registered projects that are in process of construction on forest or wood biomass.

Briquettes – Fuel that preceded the popular pellets was very widespread in some developed countries. It was used by conscious customers, because in practice it was not too much difference in price compared to traditional wood fuel.

Firewood – historic commercial measures for firewood is a cubic meter, and its made up of logs the length of one meter and the average diameter of eight to fifteen centimeters. Best raw materials for fuel wood is considered hornbeam, followed by beech and other hardwoods.

Wood chips - is used for fuel in large industrial heating or production electricity, and the advantage is that it can be used with a higher percentage of moisture in a specially constructed boiler.

What we also must mention is non-wood based biomass, and of those, in Croatia, the biggest role has corn residue.

For the period from 2006. to 2015. an amount of wood mass foreseen for utilization for energy, is about 2,6 million m<sup>3</sup> (from that amount, 2 million m<sup>3</sup> per year is supposed to be obtained from Hrvatske Šume Ltd, and from the private forests owners 0,6 million m<sup>3</sup>). The large potential of biomass also lies in 42 nursery gardens managed by Croatian forests and numerous private owners.

Available quantity of wood waste from the wood industry in 2005 was 1,7 million m<sup>3</sup>, with remark concerning wood waste quantity to be increased. Beside already mentioned available quantities, wood biomass from horticulture, viticulture, and also from maintenance of areas in close vicinity of roads and watercourses, have a great potential.

The areas of local self government units where the available volume of biomass for 50% of the inhabitants equals or exceeds 0.6 m<sup>3</sup> per capita have high potentials for the use of biomass. These areas cover the following counties: Zagreb, Krapina - Zagorje, Sisak - Moslavina, Karlovac, Varaždin, Koprivnica - Križevci, Bjelovar - Bilogora, Primorje - Gorski Kotar, Lika -Senj, Virovitica - Podravina, Požega - Slavonia, Brod - Posavina, Zadar, Osijek - Baranja, Vukovar - Srijem, Međimurje, Istria and the City of Zagreb.

#### SOLID BIOFUEL PRODUCTION IN REPUBLIC OF CROATIA IN 2010.

SOLID BIOFUELS	PRODUCTION
WOOD PELLETS	62 372 t
WOOD BRIQUETTES	10 227 t
CHARCOAL	4 319 t
WOOD CHOPS	76 410 t
FIREWOOD	1 761 000 t

In 2010. pellets were produced in 9 plants. Total installed capacity for pellet production is more than 205 000 t/yr, out of which only a quarter was utilised during 2010. More than 95% of the total pellets production was exported while little was placed on the domestic market.

Wooden briquettes capacity is estimated at some 60 000 t/yr while its actual production is highly dependent on the feedstock availability – waste from wood processing industry. Briquettes are also mostly exported.

Giving advantage and encouraging the use of biomass as an alternative fuel of the future is recognized by the Croatian Electric company (HEP) and the Hrvatske Šume Ltd. In December

2006. HEP founded a daughter company HEP OIE Renewable Energy, as did the company Hrvatske Šume Ltd that founded a company Forest biomass in March 2007.

The long-term forest management program for the period 2006.-2015. will increase the production of fuel wood, branches, and the remains of the logging and construction of more than 2.6 million cubic meters a year. This material can serve as fuel to produce heat and electricity. Total energy potential of forest biomass for the production of briquettes and pellets is around two million cubic meters, which represents the possibility of producing a million tons of briquettes or pellets per year. It is sufficient to replace about 500 000 liters of fuel oil or 500 000 cubic meters of natural gas.

Over the past few years with the support of the Environmental Protection and Energy Efficiency the timber industry began to replace fossil fuel boilers with biomass boilers. Serious exploitation of biomass as an energy source began in Croatia and is currently associated mostly with the timber industry, which is logical when one considers that they use own by-product, which achieves profitability.

BIOMASS POWER PLANTS	C (kn/kWh)		
	2007.	2009.	2010.
solid biomass from forestry and agriculture (branches, straw, kernels...)	1.2	1,3064	1,3312
solid biomass from wood – processing industry (bark, saw dust, chaff...)	0,95	1,0342	1,0538

Tariff item (C) expressed in kn/kWh for the delivered electricity from plants using renewable energy sources with installed electrical capacity up to and including 1 MW, for initial year 2007 and for 2009 and 2010.

BIOMASS POWER PLANTS	C (kn/kWh)		
	2007.	2009.	2010.
solid biomass from forestry and agriculture (branches, straw, kernels...)	1,04	1,1322	1,1537
solid biomass from wood – processing industry (bark, saw dust, chaff...)	0,83	0,9036	0,9208

Tariff item (C) expressed in kn/kWh for the delivered electricity from plants using renewable energy sources with installed electrical capacity larger than 1 MW.

Biomass for heating (2007. situation)

USE:

- ~1.3 – 1.5 Mm<sup>3</sup> of fuelwood
- rural areas
- traditional low efficient stoves
- Negligibly use of pellets
- Industrial cogeneration – wood processing industry.

#### SUPPLY:

- Pellet production:
  - ~ 150 000 t/yr production capacity
  - ~ 40 000 t produced in 2007.
  - ~ 95% exported
- Briquettes production:
  - ~ 30 000 t in 2007
  - ~ 85% exported.
- Wood chips:
  - Available at 35 €/t from Šumska biomasa d.o.o.
  - Largely exported from woodprocessing industry.

Using renewable energy sources, particularly wind, solar and biomass, is important to expand the number of employees. Government needs to support its development and facilitate the acquisition of local reference and thus become strong export industry. It is therefore reasonable to require the possibility of favoring domestic industry equipment for the use of domestic renewable resources through new laws rely on the fulfillment of the objectives of technological development and new employment referred to by Directive 2009/28/EC.

This would indicate investors to purchase domestic equipment and affect equipment suppliers to organize production in Croatia. The target of this approach is the impact of investors on the manufacturers of equipment and/or services to organize and transfer the production of some of its components precisely in the territory on which to install their equipment. This will form the positive effects for all parties: for the local community that has renewable sources, for investors which are allowed to use these resources, but also for the suppliers of equipment which is given the opportunity to market their products, but perhaps even organize more competitive and organized production of some of its components in Croatia.

### 3. Professional profiles required in the biomass sector

#### BIOMASS AND EMPLOYMENT

TECHNOLOGY	2005.	2010.	2020.
BIOGAS	37 223	70 168	120 285
COMBUSTION	15 640	27 582	37 271
GASIFICATION	78 524	96 026	117 151
BIOFUELS	10 900	32 369	48 709
ENERGY PLANTATIONS	33 527	56 472	79 223
FOREST RESIDUES	133 291	139 421	147 170
AGRICULTURAL RESIDUES	140 823	220 645	288 971
TOTAL	449 928	642 683	838 780

source: EIHP

Current number of unemployed people in Croatia is around **342 480**

source: Croatian Employment Service

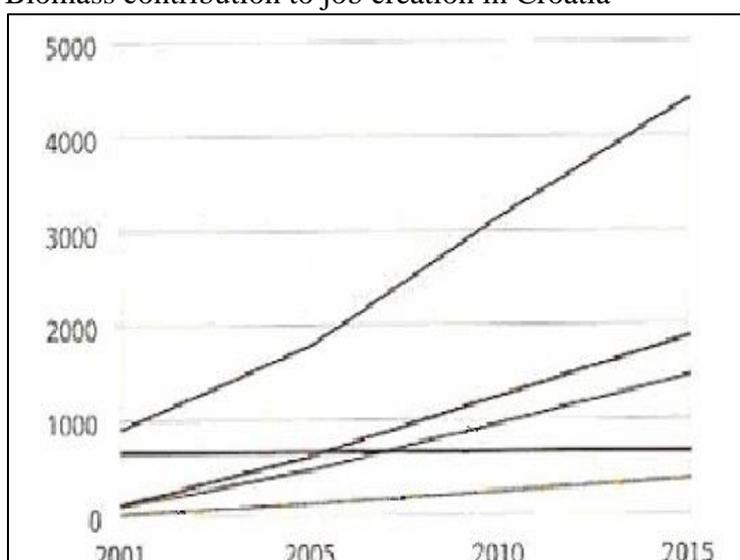
Of all energy sources in Croatia, biomass has the greatest economic potential, offering the greatest opportunity for employment. Estimates of biomass application in Croatia indicate a possibility of opening 5 000 'green jobs' directly with a further 55 000 indirectly and induced 'green jobs'.

Biomass normally results in the substitution of local resources for imported ones, and also creates export opportunities (e.g. pellets). Biomass can provide value-added opportunities for the agriculture and forest sectors as residues from these sectors are used to generate heat and electricity. The prospect long-term stable employment for local residents can also provide social benefits to a community.

Job creation is imperative Croatian economic and social policy. Direct employment results from the use of biomass fuel production due to the construction and management of power plants. Indirect employment includes jobs that appear in the economy due economic activities that use biomass causes. One of the most important difference with regard to development is the cost of investment for each vacancy, which for the biomass is between 15.000 and U.S. \$ 25.000 per job. Such costs of job creation can be compared with the average cost of recruitment per vacancy in industrial projects (40.000 U.S. \$), the petrochemical industry (800.000 U.S. \$), in the production of energy from hydroelectric power plants (over one million U.S. \$).

As mentioned, among all positive effects of using biomass such as effective treatment of wood residues and energy production with the minimum impact on the environment, is the number of jobs – it's about 15 times more, compared to using fossil fuels – which leads to the development of rural areas and creating socially acceptable environment. Improving the efficiency of energy use, while reducing imports, opening new markets and contributing to general development of the country.

Biomass contribution to job creation in Croatia



-Total number of employees

-The production of biomass  
-Serving the facilities

-Manufacturing the facilities  
-Support activities

The exploitation of biomass energy will be one of the most important parameters in the sustainable development of rural areas, waste management and agriculture and forestry. It is therefore necessary to devote adequate attention to the inclusion of energy production from biomass and integrate it into planning of other sectors.

#### GREEN JOBS

SECTOR	GOALS	DIRECT GREEN JOBS	INDIRECT AND INDUCED GREEN JOBS	INVESTMENTS IN TOTAL (USD)
ENERGY EFFICIENCY IN BUILDINGS	APPLICATION OF EE MEASURES IN 20% OF EXISTING HOUSING UNITS IN THE NEXT 10 YEARS	7000	7000	2.8 BILLION
THE USE OF BIOMASS	DURING THE NEXT 10 YEARS TO ACHIEVE GOALS FROM ENERGY STRATEGY FOR THE YEAR 2030	5000	5500	4.6 BILLION
SOLAR HEATING SYSTEMS	DURING THE NEXT 10 YEARS TO ACHIEVE GOALS FROM ENERGY STRATEGY FOR THE YEAR 2030. FOR SOLAR HEATING SYSTEMS	1300	2000	1.9 BILLION
WIND ENERGY	THE PRODUCTION OF 1200 MW WINDMILLS, ANTICIPATED IN ENERGY STRATEGY	1200	1000	2.25 BILLION
TOTAL		14500	6500	11.55 BILLION

Grants and incentives for the installation of energy efficient heating devices  
Ministry of Economy, Labour and Entrepreneurship, 2010.

#### 4. Barriers to the development of biomass sector in Croatia

Unlike other European countries, in Croatia there is still not enough support for the use of biomass in heating and hotwater preparation in private homes, residential, public and commercial buildings, industrial plants. And this situation is in contrast with Croatia's potential for exploitation of biomass.

A complicated administrative procedures at more or less all relevant levels (specific energy permits, environmental impact, access to the network, obtaining construction permits, resolving property issues), disorientation of the administration, sluggishness and inflexibility inhibits the development of biomass sector in Croatia:

- Long process of obtaining positive solutions for environmental impact studies.
- Long and in some elements vague procedure for obtaining the previous approvals for connection to the network.
- Lack of clearly defined requirements for obtaining construction permits, unsteadiness of requirements concerning the place of permit issuance (local offices, county / city offices, the competent Ministry).
- The lack of harmonization of legislation and regulations, especially those in authority of different institutions.

- Too long and non-transparent procedures of listing the new locations for renewable energy in local and county spatial plans (also with large differences from county to county).
- Incompetence of the project leaders ("developers"), usually combined with a lack of financial resources for the serious track and development projects.
- Regulations that permit those 'developers', without any criteria "to occupy" sites for development RES and thereby preventing the entry of serious investors.
- In recent years, the overall global crisis and recession accompanied by greater distrust of banks and funds to invest in riskier projects.
- Also, a great aversion of serious investors to invest in RES in the Croatia.

The quality of raw material, as well as tradition in wood processing and pronounced trends of increased use of wood residues as a renewable and organic material play an important role in expansion of national pellet industry and market. Although dependent on market demand and economic feasibility in relation to non-renewable energy sources, renewable energy sources can and must be exploited in a better and more effective way.

Example: Critical socio-economic factors for the development of national pellet market:

- Financial incentives for investing in wood pellet heating rapidly increase uptake even when pellets are competitive with alternative fuels;
- The existence of a strong sawmilling industry to provide, at least initially, a low cost and readily available source of raw material;
- Stringent quality and sustainability requirements for pellet boilers with regard to emissions, efficiency and security – poor products can permanently damage the market, trigger serious environmental concerns and cause major functional problems;
- Establishment of effective quality control mechanisms for wood pellets. Establishment of national or international tracking systems that allow identification of the origin of pellets;
- Dedicated educational programs and certification of installers establishing pellet heating systems.;
- Linking of subsidies with quality requirements for boilers and certification of installers;
- Procurement of wood pellet heating in public buildings to provide user confidence and to stimulate the supply chain;
- Development of incentives for energy service companies to enter into the biomass heating market.



Measures needed to fasten development of modern biomass market

- Educational campaigns
- Promotional material
- Subsidized investment / replacement of old, inefficient stoves
- Development of pellet supply network
- Support of modern biomass production to be placed at domestic market
- Development of rational wood waste utilisation.

Barriers for use of modern biomass for heating

- Low competing prices of heat:
  - DH sector has regulated prices of heat sold while it acquires inputs at market prices – low or no profitability
  - Well developed gas pipeline network in areas abundant with forest.

Overlapping barriers in terms of heat prices:

- DH: regulated prices
- Household heating:
  - Natural gas vs. Pellets: pellets equal or a bit less than natural gas prices per MJ (fuel only)
  - Investment:
- Wood stove vs. Pellets stove.

Croatia owns enormous natural potential of renewable resources, especially biomass. However, renewable energy resources do not have an important role in the country power policy and they cover only a small percentage of energy requirements. By development of technology for biomass utilization as energy or raw industrial material, in the future it can be possible to achieve significant benefits in the spirit of sustainable development. Regarding potentials of RER and efforts conducting by the Croatian government on implementing more incentive legislations, efforts on bringing strategic documents, law and sub law acts, and also because of the realization on participating in funds involved in pre accession programs to be expected, conditions are set for faster development of biomass exploitation technology.

## **5. Rules and regulations related to the sector of thermal applications of biomass: National and regional regulations and technical rules and standards about the facilities and installations**

Small thermal systems and systems for areas heating

Category of small thermal systems comprise facilities for households heating or heating intended for public institutions and enterprises with total power of those systems up to 1.000 kW (1 MW). Total power efficiency in these facilities is about 72% do 78%. As a fuel in usage are wood, but also all other types of biomass. First heating plant with total power of 1 MW was opened in 1995 in Forest Directorate, branch – office Ogulin, and another one with same total power was opened in 2005 in Gospić. Future production of thermal energy from biomass is directed towards introduction of advanced technology as centralized thermal systems (systems of local heating units) in the great settlements and cities, and also small automated stoves feeder with split logs, pellets or splinters. Heating systems in local areas are

usually systems for production of thermal power in a range from 1 to 10 MWh, and their construction is often in combination with existing heating systems running on an oil or gas.

Croatia has entered the economic use of renewable energy sources several years ago by making legislative and financial requirements for implementation of government policy in the use of renewable sources. This ranks us among the countries that have a regulated system. The established system is necessary to continually upgrade and increase its mobility, because potential investors have a problem in the process of acquisition the position of eligible producers. In creating the policy of usage of renewable sources, there are controversies, exaggerated marketing messages and sometimes unrealistic expectations.

### **5.1. The legal basis for RES**

- Directive of the European Union: 2001/77/EC- stops importance 2012th all previous directives
- The new Directive 2009/28/EC adopted in the accession negotiations
- The Energy Act (Official Gazette 68/01, 177/04, 76/07, 152/08)
- Law on Electricity Market (177/04 76/07, 152/08)
- Law on Energy Regulation (177/04 and 76/07)

Subordinate legislation (regulations and ordinances):

- Regulations on granting the status of eligible electricity (OG 67/07),
- Regulations on the use of renewable energy sources and CHP (OG 67/07),
- Grid Code (OG 36/06),
- General conditions for supply of electricity (OG 14/06),
- Tariff systems for electricity production from renewable energy sources and CHP (OG 33/07),
- Ordinance on the fee for connection to the electricity network and for connecting force (OG 28/06),
- Technical rules for accounting points in the jurisdiction of the HEP-Transmission system d.o.o. (Bulletin of HEP, no. 175),
- Technical conditions for connection of small power plants in the Croatian power system electric power (HEP Bulletin, No. 66)
- Regulation on the fees to encourage the production of electricity from renewable sources and CHP (OG 33/07)
- Regulation on the minimum share of electricity produced from RES eligible for incentives (OG 33/07)
- Instruction on connection of RES DSO (HEP, September, 2008.).

### **5.2. Law on Production, Distribution and Thermal Energy Supply**

OG 42/05 energy service company which uses energy CHP facility is used and waste, biodegradable parts of the waste or renewable energy for heat energy in an economically viable manner, in accordance with environmental protection measures, can acquire the status PPTTE RULES: the bail on the origin of energy.

PPTE REGULATION: PPTE share in the energy system in Croatia depends on the type, strength and efficiency of the plant, fuel, impact on the environment and the resources; sources and amount of the financial support for PPTE is determined by the Government.

#### Instigated technology

-concerning biomass:

- Small biomass stoves for heating and water heating in households
- District heating systems using biomass in larger buildings and smaller settlements
- Modernization of industrial wood waste boiler
- Use of biomass in driers and other facilities of agricultural and food industry.

### **5.3. Technology and technical criteria**

- Biomass stoves for heating and water heating in households,
  - -Terms: capacity between 5 and 50 kW, the fuel used can be wood chips, pellets, briquettes and logs; boiler efficiency  $\geq 85\%$
- District heating systems to biomass in the smaller settlements,
  - -Terms: capacity of 150 to 5000 kW for heating households, public buildings (schools, hospitals, administrative centers) and office space; used fuel can be wood chips and pellets, the boiler efficiency  $\geq 80\%$
- Industrial wood waste fired boiler
  - -Terms: Capacity 500-10000 kW, the fuel used can be wood waste in all forms that occur in operation wood-processing industry (bark, occasional waste wood chips, sawdust...); boiler efficiency  $\geq 80\%$
- Stoves in biomass driers and other facilities of agricultural and food industry
  - -Terms: a capacity of 100 to 5000 kW, the fuel used can be agricultural biomass in all forms that occur in the production process (straw, corn stalks, seeds, shells, ...); boiler efficiency  $\geq 80\%$ .

Given the fact that forest areas in Croatia have growing tendency, the production potential for biomass is large. A considerable part of that potential can be used as energy resource. Apart from the great quantity of these resources there is a large amount of wood residue generated through wood processing plants, which very often represents a burden to the business.

Application of new technologies can directly turn the residue in one of the useful forms of energy or can produce a high quality source of energy, which at the same time deals with the problem of wood residue and makes additional profit. The arriving trends tend to substitute boiler-houses that use fossil fuels with boiler-houses that use wood residue, the number of installed lines for briquettes is rising and considerable investments are planned for realization of technologies for pallet production and CHP plants.

The importance of the “moment” was recognized by the Government of the Republic of Croatia which is responsible for the strategic frame for the development of stimulative legislation in compliance with the EU acquis. On the basis of the guidelines for the development, the Republic of Croatia made an Operational programme for the development of the wood processing industry. According to it a considerable part of funding designated for development and competitiveness of wood-processing sector is redirected for projects dealing with usage of residues for energy. This is supposed to bring on greater competitiveness of the sector, greater economic stability and positive effects on the environment.

## 6. Level of qualification required by the regulations

Within the tasks stipulated by the Law on Trades and Crafts, Croatian Chamber of Trades and Crafts pays special attention to the education of its human resources, particularly by conducting regular education on the secondary school level and retraining and upgrading of tradesmen and potential tradesmen in the form of lifelong education. The Education Department is organized into teams in order to provide educational services on the whole territory of Croatia.

In cooperation with vocational schools and the ministries responsible for vocational education, the Department organizes activities specified by laws and regulations which define its scope of work in the first place within regular school system for the needs of tradesmanship. It is involved in crafts licensing, admission of pupils, practical part of apprenticeship training and it organizes and conducts control and apprenticeship exams. In order to increase the number of pupils enrolled in trades and crafts' programs as much as possible, special attention by the Department is paid to promotional activities. The most significant event among them is "I want to be a master craftsman", promotion of trade and craft professions traditionally taking place every year.

Within further education for the needs of trades and crafts the Education Department conducts master craftsman's exams (names the members of the exam boards, supervises the exam procedure and issues master craftsman's diplomas), conducts vocational competence exams and is involved in all forms of retraining into trade and craft professions.

In order to enable high quality education in craft workshops, the Education Department organizes courses in work didactics for master craftsmen - vocational teachers with the recognized status of master craftsman and provides the necessary textbooks and manuals within its "Master" edition for modern and efficient teaching.

Significant activities of the Education Department are connected to cooperation with the competent bodies of state authorities, institutions, and associations in Croatia and abroad to the aim of mutual exchange of experiences and further support of vocational education.

### 6.1. Vocational education for trades

This education is in accordance with European aspirations to acquire jobs in demand on the labor market and opportunities for advancement in the profession. Education takes place according to the program drawn up by the general part, professional and theoretical part and practical part (apprenticeships), and optional content, lasts three years and provides:

- Law on Trades and Crafts (OG 79/93, 90/96, 102/98, 64/01, 71/01, 68/07, 79/07)
- Ordinance on referential and related crafts and manner of issuing licenses (OG 42/08)
- Regulations on Procedure and Manner of issuing permit (license) and the conditions for the practical part of apprenticeship (OG 2/08)
- Regulations on Eligibility for apprenticeship programs and vocational training for the crafts and the rights, obligations, monitoring, evaluation and assessment apprentice (OG 69/04)
- Rules of Procedure and manner of an apprenticeship examination (OG 116/02),
- Rules of Procedure and manner of taking the master's examination and qualification (OG 88/02),
- Appropriate curricula.

This education helps increase the number of employees in trades, small and medium enterprises and raise the quality of work.

The problem is the lack of defined vocational education for RES trades.

- Pursuant to Article 17 and Article 31 Energy Act ("Official Gazette" No. 68/2001, 177/2004, 76/2007 and 152/2008) Minister of Economy, Labour and Entrepreneurship adopted Ordinance on professional training and knowledge testing for management and operation on power plants.

These Regulations are due to meet requirements for safety and quality of supply and energy use, prescribe qualifications and work experience needed for workers who perform tasks of management and operation of energy facilities, and a program of training and assessment, which must be done in conjunction with a safe and effective control and management of power plants, with the goal of safety of energy facilities and installations, as well as ensuring security of energy facilities, and enabling their maintenance and inspection and testing.

The activities and tasks of management and operation of energy facilities which these Regulations prescribed qualifications and assessment, allowed workers to perform independently after vocational training and passed state examinations pursuant to this Ordinance.

Workers who handle and manage power plants or power machinery and equipment for which this Ordinance does not provide vocational training and assessment, may perform the duties and tasks after they study the technical instructions for the proper and safe operation, technical regulations and guidelines for effective energy use, and conducted an internal assessment (internal examination).

The workers positions (the ones that are of interest here) in this Ordinance include the following duties and tasks:

Plant manager of renewable resources - self-management of renewable sources of energy involved in the power system, whose power exceeds 500 kW;

CHP plant operator - independent performance of duties and responsibilities of management CHP plants, with total power exceeding 500 kW

Boiler operator - independently and perform management tasks and hot water boilers with all kinds of mechanized burning (solid fuel) or with oil and gas burners, with output exceeding 1 MW;

Industrial furnace operator - operating independently from the furnace in the industry, with gas or oil burners - burners, furnaces, solid fuel or coal dust, with a rated capacity exceeding 300 kW;

Boiler handler - heating and handling and hot water boilers fired with solid fuel burners or with all kinds of liquid or gaseous fuel, whose rated output exceeding 100 kW.

Educational background and other conditions for performing on the specific workplace

Renewable energy plant manager

The activities and tasks manager drive renewables can perform:

-workers with university degrees, Bachelor (baccalaureus) Engineering - undergraduate studies lasting three (four) years (VI degree) in Electrical or mechanical engineering with a

minimum of two years work experience in jobs related to producing, transporting or distributing electricity, if the training successfully completed exams (Professional exam) pursuant to this Ordinance, or

-worker with secondary education - (fourth degree), four-year curriculum, Secondary Technical School of Mechanical and Electrical directions with at least five years of professional experience, if the training is successfully completed exams (Professional exam) pursuant to this Ordinance.

#### CHP Plant operator

The activities and tasks CHP plant operator can perform:

-worker with secondary education - (fourth degree), four-year curriculum, Secondary Technical School of Mechanical and Electrical directions with at least two years of professional experience, if the training is successfully completed exams (Professional exam) pursuant to this Ordinance, or

-worker with secondary education - (third degree), three-year program of industrial technical schools, the educational program of mechanical or electrical engineering orientation with at least five years of professional experience, if successfully carried out after training assessment (expert examination) pursuant to this Ordinance.

#### Boiler operator

The activities and tasks of the boiler operator can perform:

-worker with secondary education - (fourth degree), four-year curriculum, Secondary Technical School of Mechanical and Electrical directions with at least two years of professional experience, if the training is successfully completed exams (Professional exam) pursuant to this Ordinance, or

-worker with secondary education - (third degree), three-year program of industrial technical schools, the educational program of mechanical or electrical engineering orientation with at least five years of professional experience, if successfully carried out after training assessment (expert examination) pursuant to this Ordinance.

#### Industrial furnaces operator

The activities and tasks of industrial furnace operators can perform:

-worker with secondary education - (fourth degree), four-year curriculum, Secondary Technical School of Mechanical and Electrical directions with at least two years of professional experience, if the training is successfully completed exams (Professional exam) pursuant to this Ordinance, or

-worker with secondary education - (third degree), three-year program of industrial technical schools, the educational program of mechanical or electrical engineering orientation with at least five years of professional experience, if successfully carried out after training assessment (expert examination) pursuant to this Ordinance.

#### Boiler handler

The activities and tasks firemen - boiler operator can perform:

-worker with secondary education - (third degree), three-year program of industrial technical school with at least two years of professional experience, if successfully carried out after training assessment (expert examination) pursuant to this Ordinance.

-workers with low skill levels - (II degree) with at least five years of professional experience, if the training is successfully completed exams (Professional exam) pursuant to this Ordinance.

### Professional training

Professional training includes theoretical and practical part.

Theoretical part of vocational training is conducted under the "Programme for training of workers who perform duties and tasks of handling energy systems, plants, machinery and equipment" issued by the President of the Examination Board on a proposal from the Commission regional testing. Professional training - theoretical part, performed in the scope and content of which depends on the type of energy positions and jobs or tasks for which the candidate is registered and the required qualifications and work experience.

The workers who directly handled (control), power plants, machines and these devices are being trained in the practical operation of the owner or user of the energy facility, if such facilities or have the same equipment and facilities for other users or owners of power plants.

Practical training for the occupation lasts at least 3 months.

### Test of knowledge

Qualifications of workers who perform duties and tasks covered by this Ordinance, shall be determined by tests of knowledge - Professional exam.

A worker who passes an examination shall be issued a certificate of qualification for the management of power plants.

Professional exams are:

- First test of knowledge
- Periodic testing, which workers must be repeated every five years

The first test of knowledge comprises theoretical and practical part. The theoretical part covers the assessment, the basics of training programs listed in the "Program of vocational training of workers who perform duties and tasks of handling energy systems, plants, machinery and equipment" and is conducted orally.

The practical part of examinations for workers includes serving and a good knowledge of each power plant, machinery and equipment in power plants. Serving involves handling the commissioning, maintenance, operation, cessation of operation of certain machinery and equipment in the power plant, and coping in emergency situations (blocking operation, malfunction, damage, explosions ...).

The practical knowledge examines the mentor, who gives an assessment of practical training when completed.

## **6.2. RES education**

### Incorporating energy efficiency into the curricula of the educational system

It serves two key objectives:

1. It raises the awareness of the benefits of energy efficiency with current and future energy users.
2. It secures that future decision-makers and professionals will take due account of energy efficiency in their future professions.

For the concepts of energy efficiency to be fully integrated into a country it is important that it is included in curricula at all levels.

Actions for introducing energy efficiency in education system:

1. 2008: MoESS and the educational sector assess the current curricula in primary schools and secondary schools regarding energy efficiency, renewables and climate change.
  2. 2009: The new to be established Agency for EE and RES sets up a programme supporting the MoESS in integrating energy efficiency, renewable energy and climate change issues into the curricula of the relevant levels of education. The envisaged budget for this activity is 50,000 €.
  3. 2008 and afterwards: the Agency for EE and RES cooperates with relevant ministries and civil sector (NGOs) in ensuring sufficiency of educational activities.
- (ENERGY EFFICIENCY MASTER PLAN FOR CROATIA 2008-2016)

### The AWERES Project

The overall goal of the AWERES (AWareness and Education in Renewable Energy Sources) project is improvement of environmental protection and sustainable development by enhancing renewable energy sources use in Croatia, through improving renewable energy market functioning.

The renewable market demand side will be promoted by rising awareness in local community on RES issues, through project public events and other visibility actions, while the renewable market supply side will be stimulated by enhancing vocational education in the field of RES, enabling graduates' involvement in RES field and creating a path to be followed by other vocational schools.

Main activities are

- RES training for schools' and civil society organizations (CSO) representatives
- RES inclusion in vocational education
- Public awareness rising
- Wide information dissemination

It is expected that partner schools and CSO's representatives will be fully trained in RES, a new course on RES will be developed and proposed to educational authorities, and local population awareness on energy issues will be raised. Based on the experience gained in the project implementation, a novel model for local RES market enhancement will be developed and acknowledged.

RES training in schools is taking more and more momentum concerning vocational education, but we are still talking about elective courses. Or parts of compulsory courses for vocations such as technician for energetics or installers of heating and air conditioning. Some schools are discussing on the need for new vocations such as technicians for sustainable construction but that idea is yet to be developed.

There are schools that educate their students on RES through educational centers such as Renewable energy educational center in Varaždin or Regional center for vocational education in sustainable building and renewable energy in Čakovec.

The importance of biomass is taught through various seminars at several faculties such as the Faculty of Mechanical Engineering and Naval Architecture in the University of Zagreb and Faculty of Electrical Engineering in University of Osijek, at the undergraduate study.

But the Faculty of Forestry in the University of Zagreb is the one that, so far, has integrated the biomass study the most, through different studies such as Forestry Graduate Studies:

- a) Cultivation and Forest Management with Wildlife Management,

b) Engineering, Technology and Management in Forestry and Graduate Study of Wood Technology Process and also Professional Studies of Wood Technology in Virovitica. Subject such as Bio-energy Culture and Phytoremediation, Forest Biomass for Energy and Energy in the Timber Industry are offered to students as elective courses.

## STRATEGY DEVELOPMENT IN VOCATIONAL EDUCATION CROATIA 2008 - 2013

### Continuous compliance education and labor market needs

In response to the challenges of rapid emergence of new technologies, demand for new competencies, globalization and an aging population, the system of vocational education plays a central role. There's the need for greater investment in human resources development and seek adjustment of the system of vocational education in response to these challenges.

Vocational education has a key role in developing human resources to achieve economic growth, employment and achieving social goals. Therefore, it must provide a broad base of knowledge, skills and competencies required in the labor market or further education.

To further develop the vocational education system was driven by the needs of individuals and society, it is necessary to define the mechanisms that enable rapid response system to changing market demands, among other things, offer appropriate adjustment of educational programs and learning (curriculum) and alignment with higher education.

Sector analysis and/or sub-sector should provide information on the number of employees, trends in the sector, required competencies, projections of future development of the sector and the necessary personnel, job titles and progression pathways within the industry or economic sector.

Such mechanisms create educational opportunities and educational programs can be realized only through a partnership with all stakeholders in VET (employers, unions, chambers, representatives of local government and all other interested parties).

The function of better meeting the needs of the labor market is necessary to further develop and strengthen lifelong guidance in vocational education as an important policy tool of education and employment, among other things by strengthening the capacity for providing career guidance.

(MINISTRY OF SCIENCE, EDUCATION AND SPORTS)

## **7. Required professional licences related to the rules**

Certification and qualification of installers of small systems on renewable sources is one of the requirements that EU law requires. However, the qualification should not be considered exclusively through the legal framework, but as expected, and the need of the growing market for qualified installers and service quality monitoring system.

Small RES systems such as boilers and furnaces using biomass, solar thermal and photovoltaic systems and heat pumps are commonly used in households and / or small commercial buildings sector, and their customers and investors are mostly laymen in the area of technology, and energy. With such systems are often associated financial incentives, in which case the user and a body that provides incentives need to be sure that funds are properly invested and that the system is installed properly and efficiently. In this sense, the installers have a significant role, since they are in direct contact with customers and assist them in the correct sizing, equipment selection, installation and introduction to using the system.

## Directive 28/2009/EZ

One of the strategic aims of the European Union is the use of all forms of renewable energy sources and increasing energy efficiency. Accordingly, in June 2009, the Directive 28/2009/EZ was adopted to promote the use of energy from renewable sources. It has set an obligation to all Member States to establish a certification or equivalent training schemes for installers of small systems on renewable sources. This term is explicitly stated in the Directive for boilers and furnaces using biomass, PV and solar thermal systems and heat pumps, but are not limited to their size (in any sense). Specifically, Article 14, paragraph 3 of the Directive states: 'Member States shall ensure that certification schemes or equivalent training schemes are available from 31 December 2012, for installers of small boilers and stoves using biomass, PV and solar thermal systems and shallow geothermal systems and heat pumps. Such schemes may take into account existing schemes and appropriate structures and must be based on criteria that are set out in Annex IV. Each Member State shall recognize certification that was obtained in other Member States in accordance with these criteria.'

The criteria on which certification schemes are based, detailed in Annex IV, of the Directive and related to the general requirements of the certification scheme, educational facilities and equipment requirements of the training program and installers, and among them is essential to emphasize the following:

- installer certification process must be transparent and clearly defined
- installers must be certified under an accredited program of education or the educational institution
- educational institutions that are implementing the program training must have adequate technical conditions to maintain it
- the training program must include theory and practice
- a mandatory final exam with a practical part
- certification scheme is intended for installers with working experience and relevant education, depending on the work done
- duration of the certificate should be time limited, and its extension should attend continuous training courses.

Annex IV, defined basic contents of theoretical part of training, depending on the type of RES system and the skills the installers must master in training.

Aligning training installers of small systems on renewable sources in the EU will create conditions for increasing the quality of installation of such systems and the quality guarantee of the installation, but also open new opportunities in the labor market. In some Member States the fact that the system is installed by an authorized installer is a prerequisite for exercising the right of incentives for energy production.

## 7.1. Biomass burners installers – current practice

- example from Istria, Pula (firm Alup d.o.o.)



They school their installers in Italy, four of their installers passed the course so far and have gotten the certificate of qualification. The expense per person was about 3-5000 € including the trip, accomodation and the course . The basic course lasts about 2 to 5 days depending on the manufacturer and later communication concerning problems that might appear, is done by e-mail. In the EU, pellet burners can be put into function only by an authorized personnel with a special licence that validates the installed furnace is in accordance with high safety and technical standards.

Safety standards guarantee the users that CO<sub>2</sub> is not entering the room (it can cause serious health problems to the occupants) and also guarantees the proper outer fresh air supply.

Technical standards guarantee the right way of pellet combustion and it makes the whole proces ecologically friendly because the pellets are CO<sub>2</sub> neutral. Pellets have up to 1% ash what makes them 99% usable.

Safety standards - the furnace has a built in sensor that makes it shut down automatically and sound an alarm in case anything goes wrong.

## 7.2 Licensing

For the practical part of apprenticeship craftsman and legal person must have a permit (license). The permit is issued by the Croatian Chamber of Trades, which also prescribes the procedures and manners of its publication.

This permit (license) can obtain:

- craftsmen who have passed master's examination,
- people with rights that Law on Trades and Crafts recognizes to individuals who have passed the master's examination,
- persons with relevant tertiary or high education that passed the exam proving basic knowledge about teaching apprentices
- individuals, inventors, persons with the appropriate secondary education with trades based in the areas of special national concern, hill and mountain areas or on islands that have at least three years work experience in an occupation for which they perform the practical part of apprenticeship and a certificate proving basic knowledge about teaching apprentices
- persons that had a registered business on the day the Law on Trades and Crafts entered into force, the appropriate secondary education and at least ten years of experience in an occupation for which they perform the practical part of apprenticeship and a certificate proving basic knowledge about teaching apprentices.

If the practical part of apprenticeship training is performed in a legal entity then the entity must employ a person who has passed the master examination or other person with the above conditions.

If all the above subjects want to run a program of practical apprenticeship, they must have equipped workshop to practice in accordance with the curriculum of the certain profession.

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