

# SHORT INTROSPECTIONS REGARDING THE SAWDUST BRIQUETTING AS SUSTAINABLE SOLUTION FOR THE ENVIRONMENT

<sup>1</sup>I. Kiss, <sup>2</sup>V. Alexa

<sup>1</sup>Politehnica University Timișoara, Faculty of Engineering Hunedoara, Revoluției 5, 331028, Hunedoara, Romania, e-mail: imre.kiss@fh.upt.ro

<sup>2</sup>Politehnica University Timișoara, Faculty of Engineering Hunedoara, Revoluției 5, 331028, Hunedoara, Romania, e-mail: vasile.alexu@fh.upt.ro

## ABSTRACT

Wood pellets have only become an important part of this boom in the past few years. Owners of large coal-fired power stations in Europe started searching for a way to fulfill the new regulations and to find a solution for the declining economic relevance of traditional coal-fired power stations due to their high carbon dioxide emissions. The answer was to give the old dirty giants a green coat of paint by “co-firing” regular coal power plants with wood pellets. Wood pellets have similar burning qualities to traditional coal and the costs of converting boilers to burn wood pellets are low. The idea of declaring wood pellets as a carbon neutral energy source was based on the assumption that the released emissions of carbon dioxide during the burning process are neutralized by the carbon that is captured and stored in newly growing trees. The idea of using wood as a renewable source was backed by environment organizations. More recent pellet investment projects as well as facilities currently under construction show that the production of wood pellets is being outsourced by the energy firms to companies specialized in wood pellet production. These firms are 100-percent focused on sourcing the raw material, operating the wood pellet production plant and handling the logistics for transporting the renewable resource.

Keywords: biomass, wood pellets, briquetting, sawdust, renewable-energy, environment

## 1. INTRODUCTIVE NOTES

Wood pellets belong to the biomass group of renewable-energies and are gaining in importance to fulfill the European’s renewable-energy targets [1, 2 and 10]. The European Commission decided to reduce Europe’s greenhouse-gas emissions by 2020 to 20 percent below their 1990 level and to set a goal of moving Europe to 20 percent renewable energy by 2020 [4, 5, 7 and 9]. This decision initiated the boom of renewable-energies in Europe [2, 8 and 9].

Biomass energy production is beneficial to the environment preserving ecosystems and assuring sustainable future. We need to make sure biomass energy is produced in sustainable and ecologically safe way, with little or no pollution to air, water or soil. Biomass is a solution to growing pollution problem and can become a significant energy source in the future, being a sustainable and renewable energy source.

Increasing dependence on a worldwide level of energy resources is that the interest for other energy sources to increase. At the present time, biomass seems to be the most affordable and cost-effective source of renewable energy. Unlike wind energy and solar, investments necessary for the exploitation biomass are best. Modern biomass fuel technology means process the biomass matter with a series of advanced transformation technology into the alternative fuel (solid form, liquid form, gas form), those bio-fuels are used in power generation, vehicle fuel, heating stoves, etc. The solidification formation bio-fuel refers to the biomass briquettes products, the briquette industry started in the 1980s, during the last few years, the briquette industry has been developing very fast: the technologies are much mature nowadays, the production and application have formed a certain scale [6, 8].

According to [10], but generally valuable in the literature, the main advantages of biomass energy production are:

- ✓ Sustainable source – Biomass energy uses organic material and waste for its production. Crops and residues in agriculture and forests are sustainable source of biomass. Managing the resources is important to assure sustainability principles.
- ✓ Renewable source – crops, wood, agricultural residue, can be harvested year after year. Unlike fossil fuel reserves biomass reserves will always be available.
- ✓ Reducing pollution – biomass combustion process emits far less greenhouse gasses into the air than in fossil fuel combustion process. In the process of “gasification” no pollution gasses are emitted into the air.

Also, according to [10], the main disadvantages of biomass energy production are:

- ✓ Resource management – If not managed correctly, forests and land can be used to grow energy crops instead for food production.

- ✓ Direct and indirect CO<sub>2</sub> emission – combustion of biomass can contribute to higher carbon concentration in the air.

Biomass refers to substances which occur organically and can be used to generate energy. There are a variety of types of biomass, the most popular being wood. A Biomass system uses the energy generated when burning wood pellets, wood chips or logs in a biomass boiler to generate heat and/or energy. This can be used to power hot water systems, central heating or to heat spaces [10, 11 and 12].

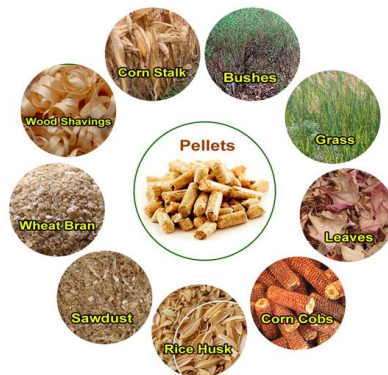
Sawdust is by-product from wood sawing process. Actually, sawdust doesn't have much application because of its low burning efficient. However, by pressing the saw dust into pellets, it becomes a kind of high quality biofuel product – sawdust pellets or wood pellets [8, 10 and 11].

## 2. TYPE BIOMASS FUELS

More and more cities are seeking solutions in order to produce thermal energy from renewable sources. According to a survey conducted by the Ministry of Environment and the Ministry of Economy, biomass (wood waste, pulses and/or livestock) represents the most affordable and durable resource to produce heat and electricity [3, 7 and 8].

Biomass comes from many different sources [3, 7 and 8]. Most common sources of biomass are:

- ✓ Sustainable forest harvesting and residue,
- ✓ Agricultural residue like wheat straw and energy crops,
- ✓ Animal, municipal and industrial waste.



*Figure 1. Biomass sources*

Therefore, type biomass fuels include agricultural waste (straw, animals human dung, husks of all kinds – of grapes, walnut, etc.), wood and wood waste (hubs, sawdust, paddles, chips), energy crops (poplar, willow, willow trees, seed and rape) and solid waste in the municipality [8 and 10]. Organic material, such as crops, agricultural and forest residues and waste are easily obtained and available for biopower production. The briquettable materials are: waste wood, bark, old forest, chips and dusts from the wood and paper working, jute fibers and dust, filter dusts from exhaust air and flue gas dust collection of garbage incineration plants, paper scraps from shredding, hay straw, particle board chips, tobacco dusts, polystyrene, polyurethane foams, cotton stalks, vine cuts, rigid PVC dust, gypsum, spelts, peanut shells, coconut fibers etc.



Wood briquettes



Wood pellets

*Figure 2. Solid fuel by woods*

In this sense, a lot of companies have as object of activity the recycling and the recovery of wastes or scraps. In these circumstances sawdust will represent raw material for the manufacture solid fuel (briquettes, pellets). It has become more and more important for companies to find low-cost methods of recycling their waste materials. This is especially true if these waste materials have high energy content and we want to take them back into the energy cycle. A number of companies have switched from furnace oil to biomass briquettes to save costs on boiler fuels. The use of biomass briquettes is predominant, where coal and furnace oil are being replaced by biomass briquettes. A number of units are also using biomass briquettes as boiler fuel [10, 11 and 12].

### 3. THE WOOD – ONE OF THE MOST IMPORTANT RENEWABLE ENERGY SOURCES

With the world population grows and the modernization of the city and towns, one of the city's problems has become more significant every year-the garbage processing. The garbage has two resources: the domestic garbage and the industry waste. The wood processing plants create large quantities of wood residue waste in the daily production, now a large part of the sawdust are used to make compressed wood board for furniture producing and wood briquette for the heating stoves and fireplaces.

Wood is a natural product which – highly compacted as a briquette – almost takes on the burning behavior of coal. Owing to their great density wood briquettes has a higher calorific value than the same quantity of firewood. They can be used instead of coal or wood in domestic solid-fuel stoves as well as in industrial furnaces [10, 11 and 12].

Wood, one of the most important renewable energy sources in its possession Romania, it is not operated. The potential of wood is not used in systems thermal power plants in Romania, due to a lack of technology and legislation. Romania has made many steps humble about capitalization of wood and other wood products and pulp for the production of thermal power in both centralized thermal systems, as well as personal. This fuel is ignored despite environmental and economic advantages.

Specialists in the field say that should be reconsidered potential wood and wood pulp, which can be used as a source of real power. Scientists have pulled signals over two major components, namely reducing energy consumption which polluting the atmosphere, on the one hand, and reducing energy consumption due to quick of the reserves of fossil fuels.

Although Romania has the great advantage to hold an important source of renewable raw material, this is which has not previously been used, and we talking about the bulk of lingo-cellulose's biomass, which enables the development of technologies for recouping and national efficiency, directed at converting thermal energy.



*Figure 3. Ligno-cellulose's materials*

Recovery of ligno-cellulose's materials by turning them into microbriquettes is not stimulated at national level. A solution would be constitution of a „green” government for the financing of production and exploitation activities or green fuels.

The bill on „circulation” wood should provide and routing lingo-cellulose's materials, with a view to further binding of the unusable components and waste technologies to woody briquette. What's more, it

was launched even put forward the idea of organizing a national structures for the collection, transport and processing of scraps of wood to their conversion into microbriquettes.

In order to obtain a tones of microbriquettes are necessary 1.45 tones of timber, which must be dry. In Romania, with a view to obtaining microbriquettes would be able to use approximately four million cubic meters, which would mean 2.4 million tones of wood. So, on a yearly basis, it would not be approximately 1.65...1.72 million tones of microbriquettes. Specialists appreciate that, in the case microbriquettes obtained from timber, emission of carbon dioxide resulting from ashing is zero. This calculation takes account of the fact that shaft is retained during his life, through the process of photosynthesis, as much carbon dioxide as released by combustion. Quantity pollutant emissions are diminishing, by replacing fossil fuels with wood.

#### 4. BIOMASS HEATING

Biomass is an emerging renewable fuel that can help to heat homes and buildings at lower impact to the environment and lower costs than fossil fuels. The fuel (usually in the form of biomass pellets) is made from sustainable materials, such as wood, which is easily replaced and in abundance, at a relatively cheap price. As people are becoming more and more conscious about their individual impact on the environment and looking into greener, more efficient alternatives, biomass is slowly becoming one of the nation's favorite renewable heat technologies [4 and 8].

Pellet fuels are heating fuels made from compressed biomass. Wood pellets are the most common type. A form of wood fuel, wood pellets are generally made from compacted sawdust or other wastes from sawmilling and other wood products manufacture. Pellets are manufactured in several types and grades as fuels for electric power plants, homes, and other applications in between. Pellets are extremely dense and can be produced with a low moisture content (below 10%) that allows them to be burned with a very high combustion efficiency.



*Figure 4. Pellet as heating fuels*

Biomass can usually be integrated into a home's existing heating and hot water system and can be an attractive option for households with a reliable wood supply, reasonable storage space and delivery access. Heating a single room using a wood burning stove – or a whole property using a wood-fuelled boiler – is known as biomass heating [10, 11 and 12].

Because the CO<sub>2</sub> absorbed by the trees when they are growing is approximately the same as the CO<sub>2</sub> released when the fuel burns they are considered to be „low carbon”. They are not „carbon neutral” or „zero carbon” because there are still carbon emissions associated with the fuel's extraction, processing and transportation.

Some forms of biomass use material grown especially for the purpose, such as field-scale willow. Two are the main types of biomass heating appliances:

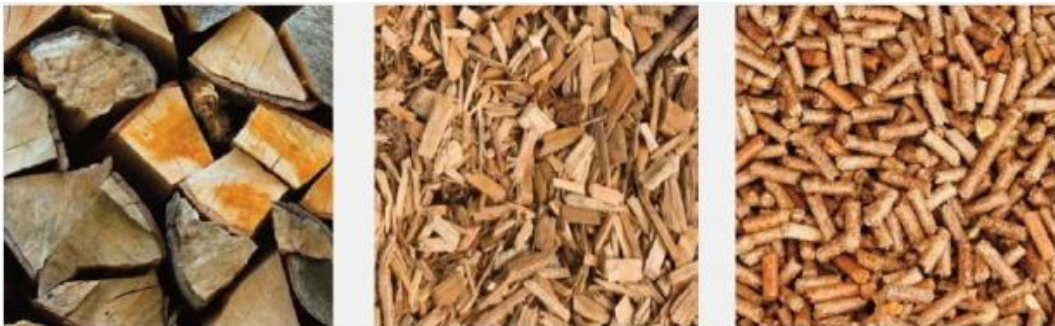
- ✓ Stoves: These burn logs or pellets to provide space heating for individual rooms. Stoves can also be fitted with a back boiler to provide hot water for the kitchen and bathroom. Stoves are usually around 7kW and have an efficiency of between 60-80%.
- ✓ Boilers: Larger and more industrial in design, these provide whole house heating and hot water. Domestic log boilers range from 20-50kW and are stoked by hand. Pellet boilers range from 8-30kW and often incorporate a pellet hopper, which automatically feeds the boiler with fuel.

Chip boilers are most efficient for larger (50kW+) systems so are generally not suitable for individual domestic properties. Some biomass boilers are designed to take a variety of wood fuels, including logs, chips and sawdust, and might be viable if you have access to a range of different wood sources.

Wood-burning stoves are still more popular by far, but sales of the relatively new pellet stoves and fireplace inserts are surging. Instead of logs, pellet stoves burn thin rods made mostly from compressed sawdust or wood shavings. Uncertain energy prices have fueled interest in freestanding stoves and fireplace inserts. These outsized space heaters are designed to supplement your central heating system, generally in a large, frequently used room, or perhaps in a central area of the home. Wood-burning stoves are still more popular by far, but sales of pellet stoves and fireplace inserts have surged as consumers look for ways to slice their energy bills.

Three main types of wood fuel can be used: logs, wood chips and wood pellets, according to [1, 2, 3 and 10], but generally valuable in the literature.

- ✓ Logs require little processing except for seasoning (drying out). This process can take up to 3 years and brings their moisture content down to about 20% meaning the logs burn hotter and produce less smoke. Logs are usually cheaper than other types of wood fuel but need more space for storage and can only be used in manual-feed boilers or stoves.
- ✓ Wood chips are sourced from forestry „thinnings” or made from untreated waste wood. Wood chips are typically used in larger heating systems such as those found in schools or blocks of flats. When they are used in smaller (e.g. domestic) systems the chips must be produced to a standard size and with low moisture content.
- ✓ Wood pellets are made from by-products such as saw dust and have a low moisture content of between 8-10%. As a consequence they are more energy-dense than logs or chips and require about a third of the storage space. The uniform shape makes pellets ideal for automated systems.



*Figure 5. Main types of wood fuel*

Wood fuel is a fuel such as firewood, charcoal, chips, sheets, pellets, and sawdust. The particular form used depends upon factors such as source, quantity, quality and application. In many areas, wood is the most easily available form of fuel, requiring no tools in the case of picking up dead wood, or few tools, although as in any industry, specialized tools, such as skidders and hydraulic wood splitters, have been developed to mechanize production. Sawmill waste and construction industry by-products also include various forms of lumber tailings.

Biomass, the product of recycling, is a man-made renewable resource that contributes to a large portion of recyclable materials. These can include plastics and papers, lumbers, textiles, farming material and fertilizer, to name a few. Because biomass is made from organic products such as animal waste or subsidiaries from agriculture, lumber industries and food industries, biomass has unlimited resources. Recycling and biomass help sustainability throughout the world's industries.

Pellet fuels are heating fuels made from compressed biomass. Wood pellets are the most common type. A form of wood fuel, wood pellets are generally made from compacted sawdust or other wastes from sawmilling and other wood products manufacture. Pellets are manufactured in several types and grades as fuels for electric power plants, homes, and other applications in between. Pellets are extremely dense and can be produced with a low moisture content (below 10%) that allows them to be burned with a very high combustion efficiency.

## 5. BIOMASS BRIQUETTE EMERGING

A popular biomass briquette emerging in developed countries takes a waste produce such as sawdust, compresses it and then extrudes it to make a reconsituted log that can replace firewood. It is a similar process to forming a wood pellet but on a larger scale. There are no binders involved in this process. The natural lignin in the wood binds the particles of wood together to form a solid. Burning a wood briquette is far more efficient than burning firewood. Moisture content of a briquette can be as low as 4%, whereas green firewood may be as high as 65%.

The extrusion production technology of briquettes is the process of extrusion screw wastes (straw, sunflower husks, buckwheat, etc.) or finely shredded wood waste (sawdust) under high pressure when heated from 160 to 350°C. The quality of such briquets, especially heat content, is much higher comparing with other methods like using piston presses.

Sawdust briquettes have developed over time with two distinct types: those with holes through the centre, and those that are solid. Both types are classified as briquettes but are formed using different techniques. A solid briquette is manufactured using a piston press that compresses sandwiched layers of sawdust together. Briquettes with a hole are produced with a screw press. The hole is from the screw thread passing through the centre, but it also increases the surface area of the log and aids efficient combustion.

Biomass briquettes are a biofuel substitute to coal and charcoal. Briquettes are mostly used in the developing world, where cooking fuels are not as easily available. There has been a move to the use of briquettes in the developed world, where they are used to heat industrial boilers in order to produce electricity from steam. The briquettes are cofired with coal in order to create the heat supplied to the boiler. Biomass briquettes, mostly made of green waste and other organic materials, are commonly used for electricity generation, heat and cooking fuel. These compressed compounds contain various organic materials, including rice husk, bagasse, ground nut shells, municipal solid waste and agricultural waste. The composition of the briquettes varies by area due to the availability of raw materials. The raw materials are gathered and compressed into briquette in order to burn longer and make transportation of the goods easier. These briquettes are very different from charcoal because they do not have large concentrations of carbonaceous substances and added materials.

One of the most common variables of the biomass briquette production process is the way the biomass is dried out. Manufacturers can use torrefaction, carbonization, or varying degrees of pyrolysis. Researchers concluded that torrefaction and carbonization are the most efficient forms of drying out biomass, but the use of the briquette determines which method should be used.

The companies promotes the use of sawdust briquettes for heating. It is a totally organic. Solid fuel with low moisture from waste wood left after processing (sawdust, wood chips or bark), wastes are crushed, dried up at a rate of 10% and then plants with a special presses.

Resins and binders existing naturally in the sawdust briquettes are designed to keep them compact and therefore do not contain additives. Using waste wood left after we obtain a valuable product, respecting nature.

Whether we use heat in ovens for pizzerias and bakeries, may use it for central heating and stoves, should we consider a number of factors:

- ✓ A related factor is the environmental aspect. We live where it becomes mandatory, considering that we are responsible for our children's future. Heating by burning briquettes from sawdust ensure no CO<sub>2</sub> emissions, protecting the environment. Briquettes are made from sawdust and waste resulting from processing wood in sawmills and furniture. These wastes, unused sawdust are a source of pollution because it does not degrade over time. A very efficient solution for their elimination as a pollutant is briquetting and use as fuel. Also, avoid using sawdust briquettes from forest destruction to get firewood.
- ✓ A second important factor that should we consider when choosing a fuel is its price and efficiency. Based heating cost sawdust briquette is up to 60% less than the price of oil products and at least 40% less than the price of electricity. Lighters of sawdust have a yield much better than wood because of low water content and density of the material. After firing, in case of sawdust briquettes, be very little ash (approximately 1.5%), while in case of using firewood, remains behind the combustion of a proportion of up to 50% ash. Calorific value of briquettes from sawdust is 4800kcal/kg, while the firewood is only 1800-2000 kcal / kg.
- ✓ Another issue is the one related to storage. If firewood, bring it to court, is split and then finely grind and stored. Use sawdust briquettes to eliminate time and money because they just buy and stored in a place away from moisture.

Being an alternative energy, wood pellets play more and more crucial role in human life. And the influence of them now is beyond the field of green energy. The development of wood pellets will bring us great benefits such as social, environmental and economic benefits. The use of renewable energy has several environmental, economic and societal benefits. Renewable energy sources do not require the use of fossil fuels and, as a result, they do not emit carbon dioxide. By reducing the amount of carbon dioxide that goes into the atmosphere, we are eliminating pollution and increasing our air quality.

- ✓ **Social Benefits:** Slathering wood pellets produces of great assistance to society. Promoting by government authorities all across the globe, wood pellets industry likes great recognition. Not just so, being an emerging industry, wood pellets creating will give you large amounts of jobs, which in certain degree will alleviate the issue of high unemployment, particularly in rural places.
- ✓ **Environmental Benefits:** In recent centuries, the dominance of non-renewable fuels like coal and oil brought serious atmosphere pollution and green house effect. Wood pellets like a eco-friendly resource can improve this case effectively. In other words, wood pellets could possibly be the definite alternative of fossil fuel and do best to atmosphere.
- ✓ **Economic Benefits:** Once we have known clearly, wood is really a alternative energy source. Simultaneously, the distribution of wood is wide around the globe: not just wood, but additionally organic materials like leaves, branches, grass, and lots of many other materials can be found. Only whenever you process these to pellets, moisture contained could be reduced to ensure that to vow our prime efficiency of wood.

Biomass carries the highest potential for green energy production in the country, amounting around 88.33 TWh per year. It is estimated that approx. 36% of this potential is currently used, but so far, biomass usage has mainly focused on household firewood: direct burning, space heating, cooking and water heating account for around 95% of the current biomass exploitation, while industrial biomass use equals only 5%. Carpathians and Sub-Carpathians provide around 66% of the firewood and wood waste, whilst the South Plain, West Plain and Moldova regions provide approximately 58% of the agricultural waste. About 27% of Romania's land is covered by forests, whose exploitable potential is estimated at 20,000 cm.

The wood pellets are clean-burning, carbon-neutral, and locally produced—a renewable resource grown in sustainable forests. That's as green as a fuel can get. Heating the home with pellets offers three ecological advantages: pellets are sourced locally; they're a renewable resource; and they're carbon-neutral.

New wood-pellet home heating technologies allow customers to easily upgrade their existing oil-fired furnaces and boilers to wood pellets simply by swapping out the burner. Now you can choose a central heating system that's completely automated and environmentally friendly while you save on home heating bills year after year.

## 6. CONCLUSIONS

Briquetting is a process that biomass is compressed under high pressure and high temperature. The self bonding of biomass to form a briquette involves the thermo-plastic flow of the biomass. The lignin content that occurs naturally in biomass is liberated under high pressure and temperature. Lignin serves as the glue in the briquetting process, thus binding, compressing the biomass to form into high density briquettes. During this process, no binder needs to be used. So the output briquette is a type of clean and green fuel that is ideal for use in furnaces, boilers and open fires.

In our current economic climate we are all looking to make positive changes to the way we live financially. At the same time the pressing topic of climate change means that we also need to make environmental changes, and heating is one of the priorities.

Using briquettes ourselves we noticed a vast difference in the quality of products being supplied. We noticed more and people opening up old fireplaces and installing wood burners in an effort to reduce their energy bills.

Generally the better quality wood is used in the furniture and construction industries leaving very little good quality timber for firewood production. A lot of the time the cost of producing the firewood on a commercial scale is just too high for most to bother with. We found that later in the season that seasoned wood is unavailable due to high demand resulting in the market being flooded with green timber.

As well as seasoned firewood they also supply sawdust briquettes.

Biomass is a renewable energy source because we can always grow more trees and crops, and waste will always exist. When burned, the chemical energy in biomass is released as heat. If we have a fireplace, the wood burn in it is a biomass fuel. Wood waste can be burned to produce steam for making electricity, or to provide heat to industries and homes.

Biomass, unlike any other resource, is available to us in excess. Its abundance is what makes it a useful asset to mankind, and we can never fear its running out. Everywhere has land available for growing biomass. The process of converting biomass into useful energy is a plain process. If biomass is grown on a large scale, it can save tremendous amount of money in importing oil and rural areas become economically more vital and stable. In addition, biomass can be mixed with coal in coal power plants without making any alterations to the plant. Biomass, if used effectively and efficiently, could be a catalyst in the future of earths' renewable energy system. Moreover, it is cheap compared to its rival resources.

Therefore, biomass is seen as an economically viable and environmentally friendly solution to energy generation. Biomass is a financially viable investment as well as being environmentally friendly. Biofuels provide a unique opportunity to address needs ranging from energy independence to environmental sustainability and economic development, with solutions that include the creation of new opportunities and jobs. These demands have led to government initiatives and accelerated research and development at universities and among leaders in the energy industry.

The different countries clearly have chosen very different approaches in developing and deploying various bio-energy options. Partly this is caused by the natural conditions (type of resources and crops, climate) and the structure of the energy system, and also by the specific political priorities linked to the agricultural and forestry sectors in those countries.

## REFERENCES

- [1.] Green Energy in Romania – Current situation and development perspectives (<http://oldrbd.doingbusiness.ro>)
- [2.] A potential renewable energy resource development and utilization of biomass energy, FAO Document Repository (<http://www.fao.org/documents/en/>)
- [3.] Romania Biomass and Biogas Energy Market 2013 – 2018 (<http://renewablemarketwatch.com>)
- [4.] Overview and Status of Renewable Energy Technologies (RET) in Romania, TU Bergakademie Freiberg, 2013
- [5.] Evaluating Renewable Energy Policy: A Review of Criteria and Indicators for Assessment, Report of International Renewable Energy Agency (IRENA), 2014
- [6.] Mario Ragwitz & co.: Shaping an effective and efficient European renewable energy market, European Research Project, Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, 2012
- [7.] Monitoring and Evaluation of the RES directives implementation in EU27 and policy recommendations for 2020, Reference Document on Renewable Energy Sources Policy and Potential, 2009 (<http://www.cres.gr/res2020/>)
- [8.] New Energy Externalities Development for Sustainability (<http://www.needs-project.org/>)
- [9.] Monitoring and Evaluation of the RES directives implementation in the EU27 and policy recommendations for 2020 (<http://www.res2020.eu/>)
- [10.] My wood pellet solution: Wood Pellet Central-Heating Solution for Homeowners and Small Industry (<http://www.mywoodpelletsolution.com/overview/>)
- [11.] What is the Best Home Heating Energy Investment? (<http://www.mywoodpelletsolution.com/category/news/>)
- [12.] Components of Wood Pellet Heating Systems ([http://www.mywoodpelletsolution.com/category/system\\_components/](http://www.mywoodpelletsolution.com/category/system_components/))