"The Best Energy is Not consumed"
A project for the development of Micro-generation Plants in Agriculture

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Key words: Capacity building, land management, land readjustment, renewable energy, environmental impact, energy production.

SUMMARY

Project: biomass **micro-generation** plants with a nominal power of less than 200 kW/h (25-100 kW/h), fuelled by waste from farm produce, as a resource for the production of electrical and thermal energy.

Objectives: The *first Objective* is to contribute towards achievement of the result passed by EU resolution "*Energy-Climate Package"*, the so-called "20-20-20", by reducing indiscriminate use of conventional energies, by means of a change which is sustainable with a new lifestyle: creating value by innovation (WASTE = RESOURCE). Do not speculate on farmland to the detriment of cultivation for food purposes, to set up plants handed over in management to other economies (growing sugar cane or maize to produce fuel). This objective strengthens the **ethical choice** for land management by developing the concept of *"the fundamental link between sustainable farming, food security, territorial equilibrium, landscape and environmental protection, as well as guaranteeing food supply"*. It gives **added value** to the farming enterprise which may have an essential role for production of renewable energies.

The *second Objective* concerns our professional category, by strengthening and reinforcing the role of **Building Surveyors** in the **Farming** sector; who have always played an important part in the development of farming enterprise plans. The aim is to implement the role of the building surveyor as the reference technician for continuity in land management, by means of specific professional training, and considering this as a new employment opportunity with qualified professional services. This should be the category which carefully collaborates with other stakeholders to design with long sightedness and respect for one's own country. *The culture of the building surveyor to create beauty*.

Conclusions and Significance: One of the most highly debated aspects from a cultural/legal point of view when speaking of renewable energy in the farming sector concerns the location of plants for energy production from renewable sources. Creating energy from agricultural waste within a farm production cycle (if necessary, and as required, with the support of nearby farming enterprises, too) highlights the need to construct plants (*micro-generation 25-100 kW/h*) with very small boiler and chimney sizes, thereby avoiding confrontation with local communities, if installations with a high-environmental impact are located in their area (the so-called NIMBY, *"Not In My Back Yard"*, syndrome). The global decision not to exploit conventional energy supplies (oil, gas …) is aimed at restoring the carbon cycle in the planet (which is currently critical), by returning it into the soil and water. Energy production

with these types of plants favours this requirement, by setting up the *investment*, *research* and a ***stable equilibrium***, and reducing the problem of waste disposal (landfill or incinerators) which is very costly.

"THE BEST ENERGY IS NOT CONSUMED"

A PROJECT FOR THE DEVELOPMENT OF MICRO-GENERATION PLANTS IN AGRICULTURE

Massimiliano DE MARTIN, Italy

In our time it has become indispensable to assertively express, with all our acumen, the knowledge we have acquired from studies on renewable energy sources and the best way to use them. By the same token we absolutely must analyze whether this counter-trend is compatible and sustainable over time, with the aim to determine and represent, by appropriate studies and precise analyses, the most important factors of the energy problem today and the all related phenomena (the energy cycle from source to recycling).
Since the 18th century and for almost all of the 19th century, first coal, then oil, fed the process of the industrial revolution worldwide.
The human effect -- seemingly haphazard, frantic and uneven, on the earth's crust through the excavation of mines and drilling -- has provided and still provides ***fossil fuels*** (coal, oil, natural gas) to power stations and propeller mechanisms which daily maintain and meet the needs of everything we have created.
The interests of industry, always satisfied by fossil fuels, determined global geopolitical events in the 20th century, sometimes very tragic (WWI and WWII, the wars in Southeast Asia and the Middle East), periodically shifting the economic and productive centers of gravity of "global finance" to *developing countries* having little knowledge and no political strategy for land use and management of the environment.
If we fail to criticize this situation, on no uncertain terms, the random development of many *towns* in the world designed to meet the needs of the few who, afraid to respond to the needs of the public, have exploited without measure not only the people who live and work there, but the soil, subsoil and groundwater sources.
The choices and decisions of the global finance strategists have often invested in the search for new deposits of oil, coal or gas, and explore the entire planet, beyond all borders, even sea beds to achieve their ends. We know that nature gives us many gifts; but we must give respect and balance back to the environment, in the knowledge that everything comes to an end.
As early as 1897 the well-known Italian economist Vilfredo PARETO[1] sustained and demonstrated the **Pareto principle** according to which *most effects come from few causes*.

His studies led him to analyze the distribution of income in a given region and he discovered that only a few individuals owned most of the wealth. This treatise inspired the "law of 80/20" which states that 80% of the wealth is owned by 20% of the population.

[1] Vilfredo PARETO (1848-1923) was an engineer, economist and sociologist who became known for the **Pareto Principle** which demonstrates the worldwide distribution of per capita income. This empirical principle has been used in various fields. The statistical study of income distribution had demonstrated for the first time the stability of human nature, even throughout changing historical and geographical situations. This observation of economic behavior, and social behavior in general, led him to see how the social individual rarely acts according to an instrumental rationality whereby the means to an end is appropriate for achieving that end.

While it is true that Pareto's achievements were products of his era, much has changed in the world economy since then. Though in some sectors (IT and copyrights) the new economy is allowing us to experience new economic models, per capita income is still used as a benchmark to measure the wealth of a country's population, compared to others, though we know that a small group of very rich people can significantly increase the average income of the entire population whose majority is extremely poor.
Consequently, throughout the 20th century new needs were met predominantly by processing oil - black gold - and its derivatives.
Often those who have managed this resource, not only for energy purposes, have been the Multinationals. Suffice it to say that the interests of oil companies were directly related to the trend of the automobile market [2], which in turn were often correlated with trends in the cost of crude oil.
Most refining activities produce fuel for many different types of vehicles circulating on the planet today (cars, trucks, ships, trains, airplanes) and take into account the fuel supply systems of these means of transport. The remaining demand for refined oil consists of derivative products for making plastics[3]: *bottles, containers, bags, packaging, pipes, fences, plastics for laboratories, items for the automotive industry, fiber production, office accessories, home furnishings, toys, insulation boards, bollards, sports fields, resins, furniture, televisions, mobile phones, computers, household appliances, sockets, plugs, switches, laminates, paints, adhesive coatings, swimming pools, roofs, boats, tanks, asphalt, bitumen* (list not exhaustive*).* If we read these items all in one breath, it might look like a sterile list of items. But if we try to think about the quantities produced to date worldwide, used, recycled or disposed of as waste, in places where there is a recycling policy (not to mention the places where there is no such policy), we can easily understand that our way of life depends on many everyday objects without which we would have to radically change our lifestyle.
This is not possible. The lifestyle I am referring to is linked to consumption, not to the traditions of cultures or religions. If we observe how and where it is concentrated, we see that, although fortunately it is not a dominant lifestyle (though a select few would like it to gain more ground, logically), it severely compromises the entire ecosystem.

The oligarchic management of a single raw material (petroleum) has affected and continues to influence not only our habits, based on those products and not on others, but instills in us a cultural resistance that hinders a change in our approach to living, preventing us from rationally setting priorities.

2 The oil industry was born in 1850 circa in the United States but it was only at the beginning of the 20th century, with the discovery of the internal combustion engine, that the demand for oil increased to meet the needs of transport by road.

[3] **Plastics** are artificial materials with a macromolecular structure that under certain temperature and pressure conditions undergo permanent changes in shape. They are divided into thermoplastics, thermosetting plastics and elastomers. Rubbers, though having many aspects in common, chemically and technologically, with plastics, they are usually not considered as such.

Thermoplastics: thermoplastics are plastics that acquire malleability, i.e. they soften under the action of heat.
In this phase they can be molded or shaped into finished objects, and then cooled to become rigid again. This process, theoretically, can be repeated several times depending on the qualities of the various types of plastic.

Thermosetting compositions: are a group of plastics that, after an initial softening by heat, become hard by effect of three-dimensional reticulation; in the process of softening by the combined effect of heat and pressure, they become pliable.
If these materials are heated, after hardening they never return to soften, but decompose and become carbonized.

We are "forced" to excessively *consume* durable goods made by industry, the vast majority being the oil industry with its products. A production cycle ramified throughout all the industrialized countries of the world, which every day consumes huge amounts of fossil resources for energy production and a good part of it for its derivatives.
From this we can easily arrive at the conclusion that human action has affected the global carbon cycle due to excessive exploitation of traditional energy sources.
Exploitation announced as early as 1972 with the ***"Report on Limits to Growth"***[4] which stated that 25% of world oil reserves would be exhausted in 2000. The report fact pointed out that, though alarming, the percentage has proven to be lower than that observed in the final balance in 2004 during the second update of *Limits to Growth: the 30-year update*.
The estimation of ***oil reserves***, excluding the new deposits that will be discovered in coming years, is that the amount of oil used/consumed is 42% of all available reserves. So we are at the peak of extraction.
According to the study, the remaining available oil would only last for forty years, starting in 2000.
In economic terms one could say that we have reached the Vanishing Point (Break Even or Indifference[5]).
Until now I have dwelt on black gold as a prevalent resource in industrial production, but bear in mind that it is not the only one. Coal remains a major source of energy for humanity.
It has been estimated that 40% of the world's electricity was produced in 2010 by burning coal, and known reserves can supply at least three hundred years of production. According to a study by Nomisma Energy[6] the consumption of coal in the world is growing rapidly because it is a resource extracted at low cost and still of widely used.
The outline report of the International Energy Agency, presented in Venice (Italy) last June at the VI International Green Economy Forum, appears to confirm the supposition that in coming years there will be an increase in fossil fuels, which remain the primary energy source in the world, representing over three-quarters of the growth in global energy consumption between 2007 and 2030.
Coal has the highest growth rate in the projection period, followed by gas and oil. For the same period, oil declines by 4% from 34% to 30% of the total amount of primary fuels.
It is inevitable in such a scenario that there will be a rapid and steady increase in carbon dioxide emissions into the atmosphere by the energy sector due to the increasing global demand for fossil fuels.
One wonders what role gas will play in this scenario. Surely it will play a key role, given the low concentration of carbon it contains compared to that of oil and coal. Therefore providing incentives for the use of gas has a dual purpose: the first is to significantly reduce CO_2 emissions and the second is not to affect the carbon cycle. This rationale is confirmed by the decision to invest in drilling in the Arctic, to show how frozen gases beneath the ice can be

[4] Commissioned by MIT (Massachusetts Institute of Technology) and by the Club of ROMA (a non-governmental and not-for-profit association of scientists, economists, businesspeople, civil rights activists, senior public administrators and international Heads of State from all five continents)
[5]The Break-even Point or Indifference: the break-even point, which corresponds to the level of production required so that total revenues equal total revenues, also called Point of Indifference because at this level of production the company does not operate in either profit or loss.
[6] Nomisma Energy is an Italian company with based in Bologna, independent in its research in energy and the environment, whose goal is to understand and anticipate the basic dynamics of the market and the industry, assisting its clients in defining their strategies.
Its purpose is to be a laboratory of ideas to discuss energy issues, such as rising consumption and the need for sustainability.

considered a new form of energy. The analyses have proven that the amount of CO_2 produced is as low as 40% less than that of fossil fuels.
It becomes vital to verify not only the real situation of the supply of energy resources up to now, but all the dynamics generated by this supply, i.e. the effects that science and our conscience point to, which cannot be denied or avoided.

Biomass micro-generation plants:
Until now the vision of producing energy with traditional resources has left no room for arguments moving us toward the management of new energy sources, i.e. the **renewable ones**.
Among the many renewable energy sources already being produced -- including solar, wind (both on land and at sea), ocean waves, tidal energy, geothermal, as well as the using waste, biogas and biomass -- my focus at this Congress will be on energy generated from biomass[7] taken from farms.
In specific terms, I am referring to projects for biomass micro-generation plants with rated power below 200 kW/h (25-100 kW/h), fed with residues of agricultural products found on farms as a resource for producing electricity and heat.
My interest in this system of energy supply comes from the fact that as a surveyor I have worked and acquired expertise associated with farms.
My passion for the environment, along with a sequence of job opportunities, led me to design my first biomass plant in the province of TREVISO (ITALY).
I believe that by reducing the indiscriminate use of traditional energy and choosing a sustainable lifestyle we can recognize innovations that create value (WASTE = RESOURCE).
Refraining from speculation on agricultural soils at the expense of food crops, to create plants whose management can be outsourced to other economies (that cultivate sugar cane or corn to produce fuel).
This objective supports the **ethical choice** for land management by promoting the concept of *"the fundamental link between sustainable agriculture, food safety, territorial balance, preservation of landscape and environment, and securing food supply."* This clearly provides **added value** to farm estates that play a vital role in the production of renewable energy and waste management and improves waste management all the way to the landfill, reducing or even eliminating the problem of transporting production waste to special waste disposal sites.
The established practice of fertilization on farmland by spreading manure from livestock farms and other small farms is the subject of specific regulations aimed at protecting groundwater and surface water from pollution caused primarily by the nitrates contained in effluent.
Nitrates Directive No. 676 (91/676/EEC) is the measure adopted by the European Union in 1991 with the aim of reducing and preventing water and soil pollution caused by nitrates from agricultural sources. This Directive was transposed at a national level to Italian Legislative Decree No. 152/1999 and Legislative Decree No. 152/2006 and the Decree of the Ministry of Agriculture and Forestry Policies of 7 April 2006.
These laws are designed to protect environmental resources against the pollution of nitrates of agricultural origin and the disposal of sewage sludge in order to ensure safe and sustainable agricultural production.

[7] Biomass is defined as any substance of organic origin, plant or animal, for use as fuel or the production of agricultural fertilizer, and is a sophisticated form of solar energy accumulation.

One of the major debates regarding doctrine and jurisprudence when it comes to renewable energy in agriculture is the where to set up the plants for the production of energy using renewable sources. Creating energy with agricultural waste in the production cycle of the farm (if necessary and according to demand, sometimes with the assistance of the neighboring farms) sheds light on the need to build systems (*micro-generation 25-100 kW/h*) with much ***smaller boilers and flues in order to avoid the resistance of the local communities*** who are not in favor of having installations with a high environmental impact placed on their territory (the NIMBY syndrome, *"Not In My Back Yard"*).
In fact the global decision not to exploit -- with the same ferocity as before -- traditional energy sources (oil, coal and gas) converges in the pursuit to restore the carbon cycle (now in a very critical stage) throughout the world, by putting it back into the ground and water; the production of energy with this type of plant meets these needs by *orienting research toward a* ***stable equilibrium***, and minimizing the problem of disposal (landfill or bonfire) against exorbitant costs.
Each region of Italy has identified areas, some vulnerable and some not, and has established the outline for the operational plans which all companies must present to demonstrate that they are making the proper agronomic use of livestock manure and nitrogen fertilizers.
Dimensioning the biomass plant according to the needs of the farm is strategic as much as it demonstrates the feasibility and sustainability of the energy production weighed against the farm's actual waste products in the annual production cycles for all the days of the year.
It is important that this consideration differs from the large biomass production plants that must collect waste products from several farms. It would seem that agreeing to the creation of a large plant is advantageous because it provides many opportunities, because it harmonizes the needs of the businesses of a certain territory, on the basis of a local survey to quantify and make synergistic the availability of residual biomass that can be used in the agri-energy supply chain efficiency.
At the same time, these opportunities can become a liability and undermine the production of energy, if for any reason a stakeholder should decide to suddenly stop the supply.
The search for waste is vital because the investment in equipment depreciates during its ongoing operation throughout the year (24 hours a day for 365 days, excluding days of maintenance).
Currently, specific knowledge about waste from farms is lacking. First of all, there is no significant ***background*** information about the individual production of waste in a data base. Such an instrument would be needed when dimensioning the plant to obtain precise data for all the farm products surface area involved.
The variables of geographic position, morphology of the terrain, climate, and human impact on the soil, all affect yields per hectare, and it is different from year to year. The comparison of historical data will reduce the mean square deviation (dispersion index), which is also useful for subsequently dimensioning the reserves, in case of a reduction in the supply of waste material to be desiccated and put into the energy production cycle.
Certainly in the next few years, we must analyze a set of records to more precisely quantify the fuel generated by farm waste to be used in the burners. At this time, during the study and analysis of the business plan, we are using the historical data provided by the individual companies. From this data we can find out the amount of waste based on the net yield of the processed product.

Though insurance policies are taken out for down-time at energy production plants, it is true that such events should only be occasional and possibly non-repetitive, because insurance costs could affect the economic and financial management of the system.

I carry at a glance a schedule of biomass plant designed for a poultry farm and the single crop of wine grapes,:

Considerations: Many farms have the problem of disposing of excrement, particularly after the Nitrates Directive came into force to protect against groundwater pollution. This precludes spreading it in the fields.

Proposal to use the excrement as fuel to produce 50 kW/hours of electricity and 120 kW of heat to be used to desiccate the bedding and heating water.

The Plant model is particularly suitable for farms with waste from processing: it will certainly arouse much interest and it is intended to use the plant as a "public educational center for the proper appreciation of production waste on farms".

Strengths

- Uses only waste from their own agricultural activities as fuel without outside input;
- Energy efficiency of the system is high: 26% electrical efficiency and 56% thermal output;
- Proven technology: it is based on a moving-grate combustion chamber, an air-to-air heat exchanger and a turbine;
- analyses have been conducted (attached) of excrement and the combustion tests to verify both the functional aspects and the environmental ones;
- All the environmental aspects are managed better:

Environmental aspects

- Emissions are well below the legal limits thanks to the active guarantees of the plant
- No use of water
- Land use: extremely limited: 80 square meters including the manure heap which becomes storage and desiccation of the biomass;
- Easy to run, it is all automatic; the manure is just stored directly in the farms spaces allocated for desiccation thereby avoiding the need for transport on wheeled vehicles to special landfills.

The analyses of the project express the proper verification of the data measured for a balance in both the environmental and business management; in short, it is a plant that reconciles the environment and supplements farm revenues.

The plant is remarkable: it compact size allows the use of heat. The size (50 kW net) allows it to be realized on single farms. The profitability is good and the income from it remains available to the farmer.
In summary: a model of micro-cogeneration to properly value and manage agricultural waste.

Entrepreneur:	Company name
Location:	Geographic position
Action	Process
Type of plant	– Process: Biomass fuel plant – droppings from poultry farms; – Electric power output: 50 kW of electricity. All the energy produced will be sold to the GSE under the "all-inclusive fee"; – Thermal power available: 120kW of heat in the form of hot water used by the air-air heat exchanger to desiccate the biomass; – Consumption of biomass fed into the furnace: 300 kW/h – Heat power: 2.1 kW/kg of dry matter; – Burned excrement: 145 kg/h of bedding “as is” which for 8.000 hours per year means 11.600 quintals per year; – Hours of operation expected: 8.000 hours per year – Mobile grate combustor with automatic unloading of ash, lined with high-strength refractory material; – Heat exchanger air/air (no water consumption) in special steel with high resistance to corrosion at high temperatures; – Turbine and induction motor; – Inverter to stabilize the frequency; – Combustion and operation control panel with connection for remote control; – Connection to network via inverter – Network protection system; – Fully automated continuous operation; – Plant dimensions: 2.75 x 3.75 x 3.95 (height) – Storage dimensions: the company already has the manure heap; – Transport from manure heap to desiccation/burner unit: as per the maneuver spaces shown in the drawings.
Biomass used:	– droppings from poultry farms possibly supplemented with other biomass available on the farm, prune cuttings; – The main purpose of the plant is to dispose of biomass.

<table>
<tr><td></td><td>– For this reason we have chosen a micro- cogeneration plant - only 50kW/h - dimensioned for the production of the single farm.
– No need to travel (0 kilometer) to get the supply of biomass to burn.</td></tr>
<tr><td>Action</td><td>Process</td></tr>
<tr><td>Description of intervention:</td><td>– Permissions and technical documentation for compliance with legal standards (opinion of the Town Council, the Local Health Unit and the Fire Brigade);
– Construction works: plant protection canopy, plant positioning platform, handling areas;
– REI 120 wall separating the storage/desiccation area from the combustion plant (Fire Brigade requirement);
– Installation and testing of cogeneration plant and biomass storage/desiccation plant;
– Verification of compliance with legislation, correspondence of certification (emissions, noise) to real conditions;
– Decommissioning and restoration of the area create no problem since it consists of parts made of iron and a pit in reinforced concrete</td></tr>
<tr><td>Emissions</td><td>Compliance with the parameters of Legislative Decree 152 "Environmental Code" is guaranteed and monitored continuously.
Although low power, the high temperature combustion of biomass can achieve a high combustion efficiency with low emissions of dust particles, SOx, NOx and CO.

<table><tr><td></td><td></td><td colspan="2">EMISSIONS</td></tr><tr><td></td><td></td><td>Limit as per Legislative Decree 152/2006</td><td>Guaranteed values</td></tr><tr><td>Total dust</td><td>mg/Nm3</td><td>100</td><td>30</td></tr><tr><td>CO</td><td>mg/Nm4</td><td>350</td><td>300</td></tr><tr><td>NO2</td><td>mg/Nm5</td><td>500</td><td>400</td></tr><tr><td>SO2</td><td>mg/Nm6</td><td>200</td><td>200</td></tr></table></td></tr>
<tr><td>Fine dust</td><td>This subject is extremely complex and meant for experts.
We emphasize that:
– the proposed system reduces the production of other systems with much higher flow rates and pollutant values;
– the amount of emissions is very limited, slightly higher</td></tr>
</table>

	than that of methane, particularly when compared to fossil fuels.

Action	Process
Pollution from transportation of biomass	Absent
Noise pollution	Complies with the limit < 55dB. It is in the interest of the company, considering the activity it carries out and the visitors at the stables. For this reason - as well as for loading - it was decided to locate the plant partially underground.
Water consumption	None
Ash	Approximately 25%. After analysis and authorization, we believe the ash can be scattered on the land.
Conclusions	– Biomass understood as waste from farms and agriculture-related activities is one of the most important (and underappreciated) energy sources available to us; – It is a renewable resource and is available on site; – It reduces the importation of fossil fuels. – **EROEI** more than 60, so significantly higher than all fossil fuels and photovoltaic sources

This experience has allowed us to calibrate a model (simplified here) for analyzing the energy needs of a farm. The metric calculation was developed to define costs in order to analyze in detail the single items for the supply of the plant, transport and construction permits.
If we consider how much is produced by rural areas throughout the world daily, we see that even just the cycle of plant and animal waste can contribute right away to the production of energy, especially for residential areas still under urban development that are not provided with electricity because they are still far away from the grids of large cities. Therefore this type of system cannot be deemed unworkable.
Consider the possibility of building small clinics and medical centers in remote areas that run on energy from biomass: reducing infant mortality and death during childbirth, the ability to power a UPS in order to safely perform surgery.
It would allow us to illuminate public spaces to fight crime which festers unseen in the darkness. We could operate pumps in wells to supply water for drinking and irrigation.
Another important factor is the opportunity to create jobs in small towns.
This type of policy, like others, in order to be successful and earn a social consensus should have substantial support from local politicians, the scientific community, but most of all economic and tax incentives. It is my hope that individual countries will pool their expertise in order to accelerate the exchange of experiences and facilitate the declared changes.

The Italian Association of Surveyors is oriented strongly toward the environmental sector, and it sets out to combine its focus on the environment and the landscape with a focus on

energy in the design phase of a building. The 80 year history of the Italian Association of Surveyors has always been involved in rural areas. Italy has always believed in the importance of having surveyors present with their expertise and particular skills.
Today, it has becomes imperative to develop knowledge through specialized and targeted training, as our President Fausto SAVOLDI often points out, not only at the national but also at the European and international level, on issues related to environmental impact, the need to enhance parks as elements of climate stabilization, alternative energies and energy conservation, river reclamation, the stabilization of slopes, water treatment.
Our profession, with its competence and sensitivity, can consolidate the role of **Surveyor** with the world of **Agriculture**: we have always had a deep understanding and appreciation of the development of agricultural business plans.
Implementing, through specific training, the surveyor's role as a technical reference for continuity in land management is considered a new opportunity for jobs that provide qualified professional services.
The Association of Surveyors aims to collaborate closely with other stakeholders to plan with foresight and respect for the good of our country.
I believe that the discovery of renewable energy that provides coolness, heat and light, which generates motive-power, which makes it possible for mankind to gather in residential complexes, which allows us to manufacture products and machines useful for human existence, which favors medical discoveries and allows human beings to be treated in hospitals, which preserves food for the medium-long term so it can be distributed around the globe, has to be stimulated, managed and maintained with due consideration. The respect for the common good, which is our land, is essential for living in harmony.
Now it has become our ethical duty to return, if possible, everything we have taken from nature and its rules: its balance.

The culture of the surveyor to create beauty.

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