The Feasibility of Implementing Bio Economy in Kosovo

HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

Bachelor's thesis

HAMK University of Applied Sciences
International Business

Autumn Semester, 2020

Arber Dallku

HAMK
HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

International Business
HAMK Valkeakoski

Author Arber Dallku **Year** 2020

Title The Feasibility of Implementing Bio Economy in Kosovo

Supervisor(s) Dr. Sajal Kabiraj

ABSTRACT

Kosovo is facing many problems and among the largest are environmental issues. Amid the polluters, waste management is not dealt with even though it is very hazardous to the environment. The main source of energy is produced from an old coal plant, and is not considered an efficient from EU Regulations. Currently, the waste management and biomass waste is done on a municipal level where the contracted companies collect the waste from households and dump it into certain landfill sites. An incineration plant is a facility that produces energy through burning waste. Solar energy is considered as one of the most necessary project to be implemented in Kosovo, since it will bring a new efficient source of energy in the country. Kosovo have more than 270 days of sun light and solar plant would be a viable and profitable project to be built.

In this thesis, the author has explained how inefficient waste management and not efficient source of energy can be hazardous to the environment, how the incineration and solar energy plant could improve the environment and economic sector in Kosovo and what are the main risks, budget and costs for building such plants.
This thesis also considers the funding method for the project. The legal framework in Kosovo would make it possible for an incineration and solar energy plant to be built as it is mainly based on EU directives. Building those plants in Kosovo would be a viable projects from an environmental as well as economical perspective. The plants will allow for the employment of many individuals, production of electricity and heat in sustainable manners as well as reduce the landfills and improve the environment in Kosovo, thus making for a better life for Kosovars.

Keywords: Bio Economy, Bioenergy, Incineration Plant, Solar Energy, Kosovo.
Pages: 44 pages including 5 pages of Appendices

CONTENTS

1 INTRODUCTION

Waste generation and efficient energy have become an alarming environmental issue not only in Kosovo but worldwide. At the core, the two main factors that are inseparably linked to this phenomenon are economic development and industrialization. As people start earning more and better their standards of living, they consume increasing amounts of goods and services which ultimately leads to higher amounts of waste generated and more energy consuming.
Furthermore, the World Bank has published statistics that estimate the global municipal solid waste levels to be about 1. 3 billion tons per year or 1.2 kg per capita per day. The amount of waste generation, globally, is expected to be doubled by 2050. (The World Bank, 2020)

Different practices have been implemented to deal with the issue of waste collection and management problems. The most commonly used is the 3Rs Strategy or Reduce, Reuse, and Recycle. As the amount of waste generated keeps increasing, this strategy has become less and less significant as it only diversifies waste but does not reduce it in volume. More advanced technologies such as incineration plants have thus been introduced and these plants are able to decrease the volume of waste to 10% of its original volume while still being environmentally friendly and sustainable. (The World Bank, 2020)

When it comes to bioenergy, the solar plant is considered as the cleanest energy for the moment. Even though the price for building the solar plant is criticized to be expensive, the plant has proven its efficiency and benefits to the environment as well to the economy in general. (Afox & BMG, 2019)

In this thesis, the author has analysed the economic feasibility of building an incineration and solar plant in Kosovo, which would be used to treat the waste and make the energy more efficient and cleaner in Kosovo. Apart from that, those plants would provide job vacancies for numerous families which would be very helpful considering that unemployment is a huge problem in Kosovo. (Green, 2020). Because of this, the author is going to answer the research question: What are the benefits of implementing the Bio Economy in Kosovo?

Electricity and heat production in Kosovo, as processes, largely pollute the environment since it is achieved through the burning of coal. An incineration and solar plant would solve the landfill problem while at the same time producing electricity and heat in a sustainable way which could then be sold to the electricity grid and the neighbouring households respectively. (Green, 2020)

Sustainable ways of managing waste and creating environmentally friendly energy are getting more and more attention globally. There are two reasons for this: 1) There is an increase in demand for electricity and 2) a decrease in the

availability of sources such as fossil fuels. When considering the case of Kosovo, these considerations become even more important. (Beqiraj, 2012)

There is no sustainable waste management system in place and all the waste is essentially dumped in landfills. There are many obstacles to building an incineration plant where one of the biggest among them is the cost.
Moreover, as mentioned above the main energy producer in Kosovo is an old plant that burns coal for creating electricity as such it is considered the first major pollutant in Kosovo. The solar plant would be a viable plant in removing and reducing the air pollution in Kosovo as well as creating a new sustainable source of energy. (Green, 2020)

This thesis focuses on the economic side and to find out that if such projects were agreed upon, would they be able to run and be profitable. The author has taken into consideration also the pros and cons of both projects and what obstacles plants might face during the building and operating processes.
The thesis considers also the budget and funding methods for the projects. The legal framework in Kosovo would make it possible for an incineration plant and solar energy plant to be built, as it is mainly based on EU directives.
The plants will allow for the employment of many individuals, production of electricity and heat in sustainable manners as well as reduce the landfills and energy created by coal plant thus make a better environment to live in for Kosovars.

1.1 **Purpose of the Thesis**

Kosovo generates the main source of energy from coal plants. A coal plant produces energy through burning coal which is considered to be a not environmentally friendly process. To implement Bio economy in Kosovo and improve energy production with Bioenergy, the author found the most appropriate project alternatives such as an incineration plant and solar energy. Solar energy is a profitable and adequate option for the country of Kosovo because it is a country that has good exposure to sunlight throughout the year with two hundred seventy eight days. (Energy, 2020)

An incineration plant is a facility that produces energy through burning waste. The incineration plant in Kosovo would mostly be focused on burning biomass waste as well as other waste. Solar energy is an energy plant where it takes the radiant light and heat from the sun that creates energy and solar heating.

The purpose of this paper is to demonstrate how Kosovo will benefit from the environmental and economic aspects of implementing an incineration and solar energy plant, what are the main obstacles for implementing those plants, what risks should be taken into consideration, and what are the costs and profits.
Moreover, the author has explained how landfills and coal plant are hazardous to the environment and, how an incineration plant and solar energy would sustainably solve these problems.

1.2 **Research Question**

The main research question for this paper is: What are the benefits of implementing the Bio Economy in Kosovo but, for making this paper more significant, the author has taken into consideration other question as well such as: What are the risks for implementing Bio Economy projects in Kosovo and, what are the costs and budget and how these projects work.
The research question has helped the author better analysis of the objectives regarding the implementation of Bio Economy in Kosovo and tackle the main obstacles that both projects (incineration plant and solar energy) might face.

1.3 **Methodology**

Incineration Plants and Solar Energy projects have been built in the neighbouring countries of Kosovo thus the author used in this paper different reliable sources that explained in detail such projects and, the prices used are similar, the differences neglect able.
Disadvantages and advantages, risks, EU regulations and Legal Framework have been analysed in this thesis.
Moreover, the author introduces a useful and valid source for the incineration plant built in Croatia that has been used as a relevant source. The details and numbers will be written in smaller scale because Kosovo does not have a capacity for building a large incineration plant.
As for the solar energy plant, the author explains an under construction solar plant again in the same country Croatia, also another project in Montenegro and Gambia as an example of implementing the solar plant in Kosovo. The profits and costs will be showed in the thesis.
The sources are considered reliable and reputable. The information provided in the thesis will offer a realistic view of the main problem of waste management and lack of bioenergy used in Kosovo together with the possible alternatives of solution of using bio economy.
The author choose to collect qualitative data for this paper because of the thesis structure, also the author decided to do the paper in the form of a business plan.

2 THEORETICAL FRAMEWORK

2.1 **What is Bio Economy?**

Bio economy is an economic activity that involves the usage of biotechnology for the production of many goods (such as food, feed, bio-based products), services and bioenergy from biomass or as other called biological material as a primary resource.
Bio economy aims in preventing the deprivation of the ecosystems and it helps in promoting economic development and in creating new jobs.

Bio economy can also be considered as one of the key factors in the transition towards a more sustainable society. Other than the value of producing, converting, and using biological raw materials, bio economy plays a huge role in transport which is a contributor to greenhouse gases.
Electrifying transport with the energy which is produced from bio-based sources would help to reduce not only C02 emissions but also the energy bill and we would not depend on foreign energy sources. (Eur-Lex, 2020)

Bio economy can be divided into three different sectors: the indirect sector, partial bio economy and the core bio economy.
The core bio economy includes forestry, fishing, agriculture, food industry, and bioenergy. In partial bio economy they are classified in the chemical industry, plastic industry, pharmaceutical, and biotechnology. Lastly, the indirect sector has an indirect impact and includes machinery, services, water supply, etc.
Technology and the advances in biological sciences are important drivers of the bio economy. The technological advances would not have been possible if there would be no investment in bio economy since investments are directly related to developments and researches that determine the speed in biological advances and in technology. (Uzunova, Shishkova, & Ivanova, 2019)

2.2 **What is Bioenergy?**

There exist several types of bioenergy such as:

- Biofuel
- Biomass
- Biogas
- Geothermal
- Hydropower
- Solar energy
- Tidal power
- Wave power

Bioenergy is a renewable energy which is created from biological and natural sources. As natural sources can be considered plants, animals and their by-products.
Bioenergy is viewed as essential for the environment due to the fact that the continuous use of fossil fuels has caused many environmental issues by producing greenhouse gasses that directly contribute to global warming. Therefore as the technology advances bioenergy could reduce greenhouse emissions, and the release of the harmful gases which are associated with global warming and climate change. (Orloff, 2020)

Bioenergy is the energy that we get when we burn biomass fuels and biomass fuels come from trees and other organic materials like crops and food waste. Biomass is a renewable energy that comes from plant-based materials and also algae- based materials.

Biomass can also be converted into liquid and be used as a transportation fuel instead of gasoline, diesel fuel, etc. There exist many types of biomass: garbage, crops, alcohol fuels, landfill gas, and wood. (Orloff, 2020)

One of the important steps in the process of converting organic matter into bioenergy is to choose the appropriate technology. The technologies used in order to convert the organic matter into bioenergy are divided into three general categories. These categories are thermochemical technology, biochemical technology and, other processes.
The thermochemical process uses direct combustion and the heat produced from the combustion can be used in thermal applications such as heating a building. The thermochemical process is divided into two processes: pyrolysis and gasification. The biochemical process uses high pressure and also high temperatures or any other treatment in order to get the production of ethanol. Fermentation and anaerobic digestion are processes included in the biochemical technology. Other processes include transesterification. This process which is used to convert the oil into biodiesel. (Energypedia, 2017)

2.3 **Future Bio Economy plants in Kosovo**

2.3.1 Solar energy

This thesis is focused on implementing bio energy in Kosovo. Solar energy is considered one of the cleanest forms of renewable energy that exist among us.
Photovoltaics or as known solar panels use light energy (photons) and they convert sun's rays into electricity. Kosovo would benefit a lot from the solar energy plant if it would be implemented since solar energy is considered as one of the most sufficient source of energy in world and Kosovo have good amount of sun light during the year.
Solar energy is growing substantially as a clean renewable source of energy among people because people are well informed that solar energy is beneficial to the environment as well as to economic sector. (NWWindandSolar, 2015)

2.3.2 How does solar energy plant work?

In order to understand the process of solar energy, it is necessary to know all the important components that are used for solar power system for it to be complete. The four components that make up a solar system are the roof system, solar panels (photovoltaics), the inverter and, the net meter.
In solar systems, the solar panels are usually placed on the roof. It is important and ideal to not have any shade on the solar panel since even the smallest amount of shade could impact and reduce the power production of the solar panel. As important as it is to have the appropriate angle of the solar panel, still not every roof has it. (NWWindandSolar, 2015)

Photovoltaic cells which contain positive and negative films of silicon are a part of a solar panel which transform the sunlight into electricity.
The hardest and most crucial component of the solar panels are the solar inverters. A solar inverter plays many different roles in the solar panel. Inverters convert the direct power into alternating power, they maximize power output, they report on power productions which is very practical because it makes it easier for solar owners to keep a track of the power production and, they ensure safe system operation.
Net metering or as some refer to it, energy metering is a mechanism and a utility rate structure. Net metering is beneficial since solar panels usually produce more power/electricity than homes or business needs and the excess power will be directly sent to the power grid and, the user will be paid for each kilowatt hour (kWh) of the electricity that they have sent back to the grid. (NWWindandSolar, 2015)

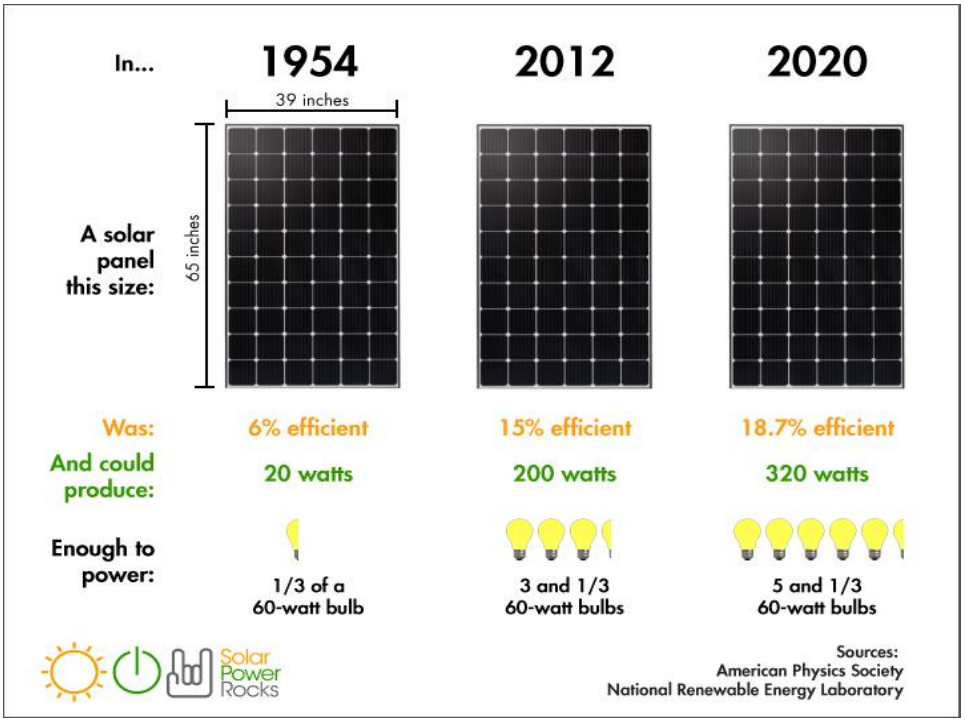


Figure 1. Size of solar panels throughout the years (Sendy, 2012)

In the figure above solar panels are shown throughout the years, how the form and how the size has been changed, how the production of energy has been increased. Nowadays, the solar panels have increased its efficiency by 18.7%, also the cells in tandem has been increased recently which leads on increasing the production of energy. (Sendy, 2012)

2.3.3 Treatment process

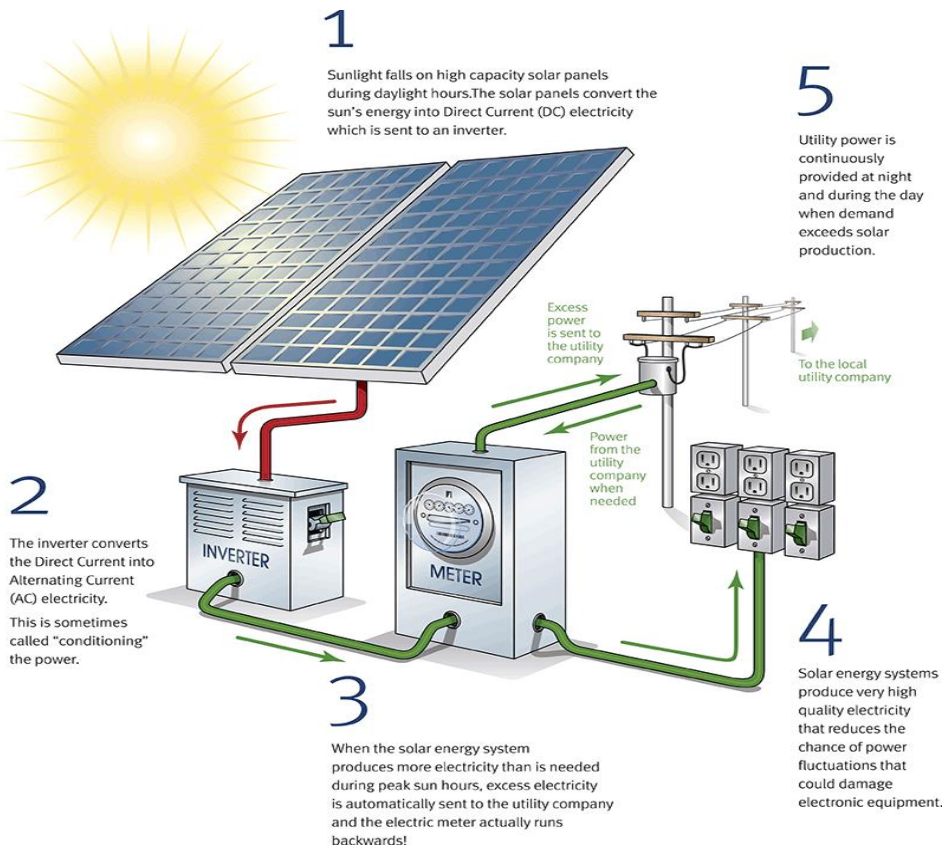


Figure 2. 5 steps of the overall process of Solar Energy. (SuperGreen Solutions, 2020)

2.3.4 Advantages of solar energy plant:

Apart from many financial benefits, there are also other reasons why people should start using solar power. Since Kosovo is facing many environmental problems and having only one source of energy "coal plant", solar plant would be beneficial in every aspect for Kosovo.
A solar plant would clean the air pollution in Kosovo, open new vacancies for people living there, would reduce the energy created through burning coal and reduce the waste created from the coal plant since the coal plant would reduce its capacity by implementing the solar energy in Kosovo.

Solar energy is good for the environment
Relying on fossil fuels is not in favour of the environment, therefore converting to solar power is crucial and beneficial for the environment. Converting to solar power helps in reducing air pollution, water usage, as well as our dependence on non-renewable energy sources. Solar power can improve humanity's health and also help in fighting climate change.
By implementing the solar energy plant as an efficient source of energy in Kosovo would help on reducing the carbon footprint because it does not release any toxic chemicals and gases as the coal plant do. (Afox & BMG, 2019)

Solar energy causes less electricity loss

Since electricity needs to be transported from power plants through cables network also through power lines that can result in electricity loss because of the resistance that lines causes during the transmission of the electricity.
Therefore, using solar power as home individual but also as a huge corporation plant is the best alternative in order to minimize the electricity loss and create efficient and environmental friendly energy. (Afox & BMG, 2019)

Solar energy creates jobs

If more people start choosing solar power instead of fossil fuels then companies would need to hire more workers for installing the solar panels to its consumers. Other than that, by using solar power we could help the economy and make it grow. (Afox & BMG, 2019)

Solar energy is a free source energy

Being that the sun is the biggest free source of energy, it can provide enough power and even more than we need.
Solar energy occurs naturally just like other renewable resources as biomass, wind, etc. Besides electricity you can use solar energy also for heating purposes in your home by using solar thermals and it can provide heated water. (Afox & BMG, 2019)

2.3.5 Disadvantages of solar energy plant:

Besides its advantages, solar energy also has its drawbacks. Therefore, before switching to solar energy it is necessary to discuss and take into consideration the disadvantages of solar energy. Those disadvantages will clarify if the risk would be taken for building the solar energy in Kosovo.

Sunlight availability and location

Not all locations can get the same amount of sunlight since solar power drops dramatically the farther you get from the equator. For example, residents of Russia and Canada are at a solar disadvantage. However, in places like Hawaii, the location is irrelevant to the equator because they do not have unclouded sunlight as much as needed, since the average is 277 days per year of rain and clouds.
Solar effectiveness depends also on the season. During the summer season, the sun is closer to your location, so you can generate more electricity. Whereas during winter, it is not possible to generate sufficient electricity because the earth's tilt moves your location further from the sun. (Ecavo, 2020)

The figure below (Figure 3) shows the sun's path during two seasons and it's visible that when oriented true south in the Northern Hemisphere during summer, solar panels are able to capture more sunlight. (Ecavo, 2020)

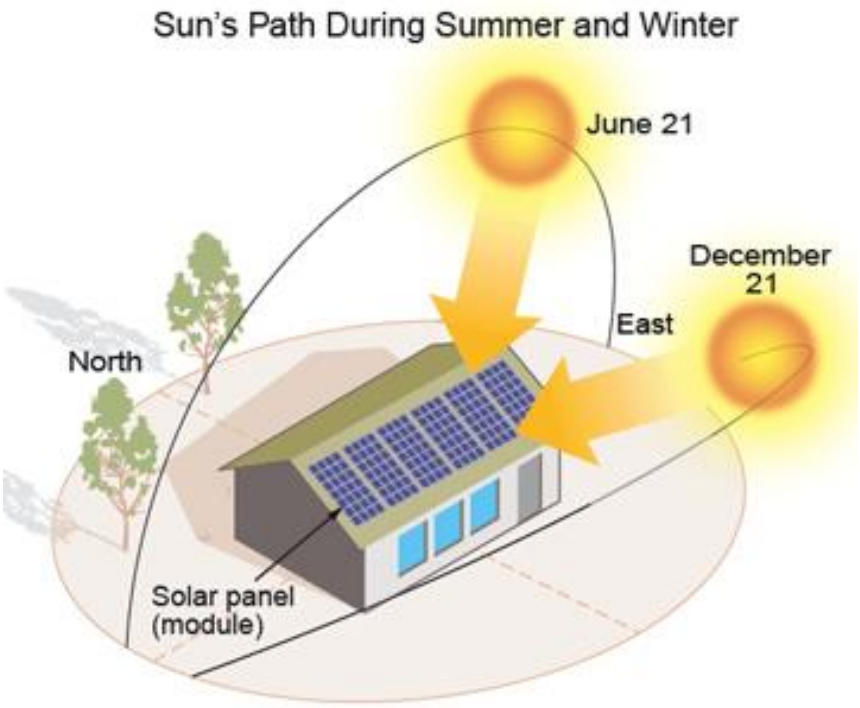


Figure 3. Sun's Path During Summer and Winter (Krishnamurthy, 2015)

Inefficiency

The highest efficiency that could be reached is 85% and never 100% according to the second law of thermodynamics. However, generally these days most solar panels convert only 22% of their energy into power. (Ecavo, 2020)

Pollution and environmental impact

Land, water use, pollution are some of the environmental impacts that are related to solar power. Sharing the land for agriculture uses is not possible and ideal because the lands used by solar fields are massive. Solar power affects lands by the components that are in solar panels such as cadmium, lead, and other toxic metals.

The pollution in the air and water comes from many other hazardous materials used in the process of the production of solar panels that are disposed of in fields. (Ecavo, 2020)

High cost

One of the drawbacks of solar energy is the high initial cost of solar panels, which cost approximately $15,000 and $29,000. These systems produce between 4kW-8kW power and the cost includes a solar panel, inverter, wiring, installation, repairs, monitoring, and additional operations.

As for the battery storage system, that is and additional cost since they're not required. However, if you want to add the battery storage system then the total cost would be $33,000 to $47,300. (Ecavo, 2020)

2.3.6 Incineration Plant

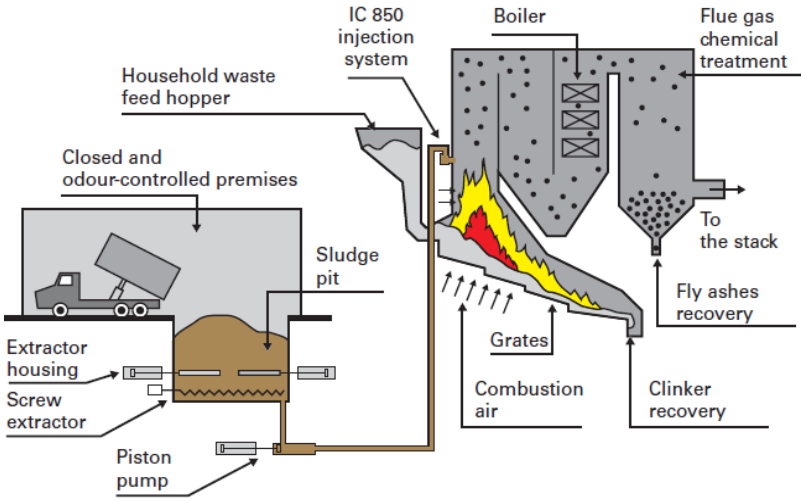
2.3.7 How does incineration plant work?

Incineration is used to define the waste treatment process of solid organic substances such as waste products through combustion. It is described as a thermal treatment due to the usage of high temperatures during the process and is the most commonly used waste-to-energy procedure. The incineration plants convert the waste materials into heat, flue gas, electricity, and ash. (Green, 2020)

The heat, depending on the type of the plant, is generally used for the superheated steam boilers filled with water that generate steam which drives turbo generators to finally produce electricity. The flue gas is dispersed into the atmosphere after treatment through special particle filtering cleaners. The ash is mostly composed of the inorganic leftover from the combustion process. After the separation of the ferrous incombustible materials such as Iron and aluminium, which are sold to interested third-parties for recycling, the ash is depleted into landfills or sold as construction aggregate. (Green, 2020)
At temperatures of 1000 degrees Celsius, the process of incineration vitrifies hazardous components in the waste reducing the leach-ability and toxicity of the residue material. In addition, it decreases the waste volume to 10% and reducing the need to construct new sites. This incineration treatment is particularly prominent in countries such as the Netherland, Denmark, Germany, and Japan where land resources are very scarce thus implying the need to use as little as possible for landfilling purposes. (Green, 2020)

The number of such plants has increased considerably in the last decade following the ban on landfilling untreated waste products in Europe. In addition, the energy produced by incinerators is deemed as renewable thus, if privately owned, investors benefit from the tax credits.
A great example of incineration plant usage in Europe is Sweden. The country recycles 50% of its generated waste annually and treats the other 49% in incineration facilities thus producing electricity and supplying local region heating systems. In addition, Sweden imports almost 3 million tons of waste per year to supply its incineration plants. (European Union , 2014)

Figure 4. Treatment Process of the Incineration Plant (Suez, 2020)



The waste is first brought at the discharge area (1) by the contracted waste collection companies. The plants generally have a waste burning capacity of 150 000 tons translating to roughly 65 trucks a day. The trucks will be weighted at the reception yard (1) and afterwards, they will dump the waste into the waste bunker (2). As a means of preventing odours escaping into the environment, the air in the waste bunker is kept at levels of lower atmospheric pressure. (Liu, Nishiyama, Kawamoto, & Sasaki, 2020)

The role of the crane (3) is to mix up the waste in uniform quality before continually transferring it to the furnace. Homogeneity of the waste is important for the quality of the incineration process. The incinerator is usually operated at temperatures between 850 and 1000 degrees Celsius. The walls of the incinerator need to have a lining of refractory material to protect it from corrosion and high temperatures. (Liu, Nishiyama, Kawamoto, & Sasaki, 2020)

After the incineration process, the waste is reduced to ash in about 10% of its original volume. This will be collected into the Bottom ash bunker (6). After ferrous scrap (Fe and Al) have been recovered from the ash and sold to third parties for recycling, the ash is then sent to specific stations for disposal at different offshore points or depleted in special landfills. (Liu, Nishiyama, Kawamoto, & Sasaki, 2020)

The flue gas cleaner (7) is an efficient gas cleaning system that is comprised of:
1) Electrostatic Precipitators, 2) Lime powder dosing equipment, and 3) Catalytic bag filters.
They are used in combination to remove the dust and pollutants from the flue gas before it is released into the atmosphere. Usually, the length of the chimneys for the releasing of the residue gas is around 150m tall. (Liu, Nishiyama, Kawamoto, & Sasaki, 2020)

2.3.8 Advantages of Incineration Plant

Reducing the volume of the waste

As mentioned, after the waste has been processed through the incineration plant only 10% of its original volume will be left as residue ash. Recently, engineers have even found a use for the residue ash in the construction industry as an aggregate material. (Junkwize, 2015)
Land is a scarce resource and many developed countries are in a frantic need to find means of waste management other than landfilling. Incinerating waste would solve these problems and free millions of hectares to be allocated for much more productive and efficient uses in Kosovo. (Miller, 2019)
Non-combustible ferrous metals such as Iron and aluminium are recovered from the residue ash and, they are sold to third-parties that recycle them for further usage. (Junkwize, 2015)

Making waste harmless
During the process of incineration, waste undergoes detoxification and nitrification thus eliminating:

- Organic compounds that are toxic
- Hazardous properties of carcinogens that are combustible
- Biologically active materials
- Materials that are pathologically contaminated (Junkwize, 2015)

Incineration leaves very little residue by destroying gaseous and liquid waste streams. It sterilizes and destroys putrescible matter and destroys pathogenic organisms. In addition, it decreases the concentration of radioactive isotopes in low-level radioactive waste. (Junkwize, 2015)

Recovering energy from waste
When waste is incinerated in large quantities, the amount of thermal energy created can be captured and converted to electrical energy through steam-based electro generators and can be used to provide heat to the local district heating systems. (Junkwize, 2015)

Environmental Impact
Incineration significantly mitigates the impact of waste in the environment as compared to landfilling. According to analysis from the Harvard School of Public Health, by eliminating biodegradation, the amount of CO2 generated through incineration is negligible compared to the amount of CO2 and methane generated from the landfilling operations. (Green, 2020)

In addition, an incineration plant can be placed near cities or towns. Notably, they can operate under any type of weather as well. This will allow for saving on transportation of waste thus the money can be spent elsewhere. In addition, the overall carbon footprint will be reduced drastically as there will be less

harmful gases emitted by the vehicles during the transportation of such waste (Green, 2020)

2.3.9 Disadvantages of Incineration Plant

Cost

Installing an incineration plant is incredibly costly. Particularly, the price of building it and also the cost of operating. Besides, it requires highly trained professionals and devoted staff to manage the operations. Incineration plants also require regular maintenance. (Miller, 2019)

Strategy

The problem with incineration is that it does not provide a long-term strategy for any society. It does not encourage recycling and waste reduction where the entire point of focus should be. It is only to be used in combination with other strategies as merely burning the waste without recycling will only further encourage more waste production thus potential environmental damage. (Green, 2020)

Potential Risk

After the incineration process, the ash that remains as residue even though small in quantity is toxic. If not for correct disposal, the ash can potentially cause serious harm to the environment and the public. (Green, 2020)

2.4 **Legal Framework in Kosovo**

The legislation of Kosovo`s waste and energy sector is within the process of harmonizing and elaborating with the EU directives. It is worth mentioning that building an incineration and solar energy plant would be possible even in Kosovo considering that the legal framework is essentially built on the EU framework. The Law of Waste (No. 2012/04-L-060) and Law of Energy Efficiency (04/L-016) serves as a benchmark for the responsibilities that lie ahead and introduces the EU standards for Kosovo. (KEPA, 2018)
The main objectives of the laws are:

Waste Sector:

i) Preventing and reducing the number of waste generated
ii) Re-usage of various components from waste
iii) Sustainable Development. The idea is to preserve and protect resources while developing.
iv) Preventing the waste from negatively affecting the environment and people
v) Storing the waste in acceptable environmental methods (KEPA, 2018)

Efficient Energy Sector:

vi) Removing barriers for promoting energy efficiency
vii) Commissioning of high energy efficiency, systems modern metering and control and energy management systems

viii) Application of contemporary energy management methods
ix) Using efficient equipment and machinery for creating renewable energy
x) Promoting financial mechanism and instruments for providing financial measurements and fiscal incentives
xi) Mobilization of investments within the renovation of the plant (Kuvendi i Republikes se Kosoves, 2018)

In order to implement the laws, there are many administrative instructions that are approved. A number of them among all are as follow:

For Waste Sector:
1. AI No 08/2017 on landfill management, abrogates the: AI No.15/2012, on landfill management;
2. AI No.02/2017 list of hazardous waste in line with the origin;
3. AI No.07/2016 for an environmental information system;
4. AI No. 06/2016, on conditions for choosing the location of the waste landfill construction;
5. AI No.29/2014, on sludge management by treatment of polluted waters;
6. AI No.27/2014, for waste management by packaging and wrapping;" (KEPA, 2018)

For Efficient Energy Sector:
1. AI No 01/2018 Purpose of promoting and improvement of Energy Efficiency;
2. Al No 04/2018 National objectives, targets and policy measures in the field of energy efficiency;
3. Al No 06/2019 Municipal Energy Efficiency action plans, implementation and reporting;
4. Al No 10/2018 Obligatory energy efficiency scheme;
5. Al No 15/2018 Energy Services;
6. Al No 20/2018 Transformation, transmission, and distribution of energy. (Kuvendi i Republikes se Kosoves, 2018)

Even though Kosovo has already extensive administrative instructions to base its waste management strategy and efficient energy, there have been problems implementing them. This is a complete issue in itself and the Ministry of Environment and Spatial Planning has to do a better work overseeing and supervising that these instructions are actually implemented.

2.5 **European Union Regulations and Targets for Kosovo**

2.5.1 For Waste Management (Incineration Plant Project)

"When waste cannot be prevented or recycled, recovering its energy content is in most cases preferable to landfilling it, in both environmental and economic terms. 'Waste to energy' can, therefore, play a role and create synergies with EU energy and climate policy, but guided by the principles of the EU waste

hierarchy. To that end, the Commission will adopt a 'waste to energy' initiative in the framework of the Energy Union." (European Union , 2014)

Finding a sustainable means of waste management to landfilling, apart from being important for Kosovo itself, it would also be a significant positive step towards joining the European Union. In December 2015, the European Commission adopted an action plant for a circular economy that aims to make the European economy environmentally friendly by putting more emphasis on conserving the water resources and ecosystems. One of the main legislative proposals is to reduce the total amount of municipal waste that is thrown to landfills down to 10 percent by the year 2030. This and other targets such as increased preparation for reuse and recycling of key waste streams (municipal and packaging waste) are supposed to gradually lead the member states to unite on best practice levels, also encourage their obligatory investment in the sector of managing the waste. (European Union , 2014)

The action calls for the state members to create a framework where closing the loop of the product cycle and achieving a circular economy is possible. This does not only mean that they have to work on finding ways to manage waste. The circular economy starts at the very beginning of a product's life. Designing better products can make them more durable or easier to upgrade, remanufacture and, repair. This will help the recyclers to recover valuable components by disassembling the products. (European Union , 2014)

Current market signals do not appear sufficient to make this happen and this is due to the fact that the interest of producers, consumers and, recyclers are not aligned. Therefore, it is essential that incentives are provided for designing a better products in that aspect, while at the same time preserving competition and enabling innovation. On the other hand, inefficient use of resources during the production of products can lead to more waste generation and lost business opportunities. (European Union , 2014)

Another aspect that can support or hamper the road towards achieving a circular economy is what millions of customers choose to consume. These choices they make based on what information they have access to, the regulatory framework and, the range and prices of the products themselves. This phase of the product life is the most important when it comes to preventing and reducing the generation of waste. In order to solve this, the commission has proposed to improve the labelling system in order to help the customers choose the most efficient products especially when it comes to energy-related products. In addition, a methodology needs to be applied for the approval of the green claim by different brands as it has been found to not always meet the legal requirement for reliability, clarity and, accuracy. (European Union , 2014)

Price is another crucial factor that affects the buying decision in the value chain as well as for the final consumer. For this, the Commission encourages the member states to use economic incentives and instruments such as taxation, in

order to make sure that the prices of the products reflect the environmental cost more realistically. Another aspect of the consumption puzzle is the legal guarantee period.
The commission suggests that, depending on the category of the product, producers must have a set standard for the legal guarantee period that protects the consumers against defective products. This will contribute to the product's reparability and durability and ultimately prevent them from being thrown away during the aforementioned period. In this way, the amount of waste generated will decrease greatly when thinking in terms of the hundreds of millions of consumers that reside in the Union. One such standard of 2 years has already been set for physical goods. There are still problems that have been encountered implementing it. (European Union , 2014)

Other actions such as awareness campaigns have proven particularly operative in reducing the amount of household waste, particularly at the national and local levels. Innovative forms of consumptions such as sharing products or infrastructure, using IT and digital platforms, and consuming services rather than products can also support the development of the circular economy.
Waste management plays a central role in the circular economy by determining the way how the waste hierarchy is put into practice. The hierarchy establishes a priority order starting from prevention and preparation for reuse. After comes recycling and only lastly, landfilling. The aim of the principle is to encourage options that deliver the best overall outcome from an environmental perspective.
Taking into consideration that the EU invests over 100 million EUR annually in Kosovo, making it the largest donor, an incineration plant is not something unrealizable if it was decided to undertake one such project. (European Union , 2014)

2.5.2 For Renewable Energy Source (Solar Energy Project)

The EU regulations and Laws target (2018/2001) is on efficient renewable sources of energy based and, the EU states must produce efficient energy on the rate of 32% as final energy utilization.
In 2009 the EU projected that the final energy utilization to be produced at the rate of 20% for 2020.
Kosovo has not yet accomplished the target of EU regulations of being based on efficient renewable energy at the rate of 32%.
By achieving this goal, Kosovo will have more potential for applying to being an EU member state. (Optima, 2020)

According to the European Commission, Kosovo must invest more in the efficient energy sector for fulfilling the legislations and laws of the European Union.
Even though the demand for electricity is provided by two major coal plants in Kosovo, the EU is asking Kosovo to find other alternative solutions for having more efficient energy production.

According to the Austrian Parliament, the energy created by coal plants in Kosovo does not meet the EU regulations in the energy sector because of its inefficiency and, at the same time does not help Kosovo for becoming an EU member.
Kosovo's plan for implementing more Solar Energy and add efficient electricity in the energy sector market is ten MW from Solar Plant, which is considered not enough in the long term. (Bellini, 2017)

Based on the EU regulations 2009/28/EC in Energy Sector, Kosovo has signed the Energy Community Treaty as such, Kosovo has promised that by 2020 the national renewable energy will be implemented on achieving and over fulfilment the target of twenty five % share of renewable energy.
Back in 2009, Kosovo has announced 18.9 % of the total share from renewable sources of energy consumption, thus Kosovo is improving its total share of renewable sources of energy and accomplishing the EU target. (UNDP, 2012)

EU laws regulations in the energy sector in Kosovo recommend ERO (Energy Regulator Office of Kosovo) as the main operator which gives licenses and makes energy tariffs for energy producers and operators.
Moreover, the land is considered one of the main objectives to accomplish according to the EU for building a profitable solar energy plant in Kosovo and government can provide the investors a state aid. (UNDP, 2012)

The author will mention the main organizations which are directly involved in the production, supplying and management of energy in Kosovo:
(Ministry of Economic development) makes the laws and regulations for the energy and economy in Kosovo, (ERO) its main duty is to create tariffs and make licenses for the energy producers and operators in Kosovo, (KOSTT) is an operator for controlling all transmission systems and market electricity in Kosovo, (KEK) Energy Corporation of Kosovo it is the main energy producer in Kosovo, its energy is created from coal combustion also have the access and licenses for mining of coal, (KEDS) Kosovo Energy for Distribution and Supply is a company under the Energy Corporation of Kosovo which does the distribution of energy to the end consumer, Investment Promotion Agency of Kosovo does the consultation with investors that are interested in investing in different projects in Kosovo. (UNDP, 2012)

2.6 **Profits, Funds, Costs and Opportunities**

Nowadays, the world is seeing bio economy (bio energy) as a priority source of energy that could lead to improving climate change as well as the circular economy. Also, the author found the waste management system and bio economy (bio energy) as an interesting topic that could be implemented in Kosovo in version of incineration plant and solar energy.

Nongovernmental organizations that might be considered a potential investors for the incineration and solar energy plant in Kosovo are USAID and GIZ. The

author will mention some potential organizations that might finance the projects (Incineration Plant and Solar energy) in Kosovo:

Western Balkans Sustainable Energy Direct Financing Facility provides funds to small and medium enterprises that have a project plan and are financially stable on building plants that produce efficient energy can apply for a loan to the organization mentioned above however, this organization is under European Bank for Reconstruction and Development. (UNDP, 2012)

Green Growth Fund is an organization that provides funds to small scale projects for efficient energy production with a capacity of fifty million Euro. (UNDP, 2012)

International Finance Corporation gives funds to the projects that have a mission battling climate change in the energy sector as well as in infrastructure thus, this organization would be the ideal for the projects mentioned in this paper because of both battles and improves climate change in the long term. (UNDP, 2012)

Kosovo Sustainable Energy Projects Framework is a governmental organization that gives 2.5 million Euro loan to the companies that are fifty one % privately owned and the payback period is fifteen years. These companies can create small projects that create efficient energy such as solar panels, small scale hydropower, wind plants, etc. (UNDP, 2012)

2.6.1 Profits, Costs and Opportunities for Incineration Plant

Kosovo is lacking in implementing a sustainable system for waste management and 95% of the total waste as well as the biomass waste is dumped in landfills without meeting the conditions and regulations of the landfill thus, the landfills have created an environmental disaster in Kosovo. (KEPA, 2018)

Building a waste to energy incineration plant in Kosovo is not easily done and, it can face many difficulties during the building process. Price is considered the biggest problem. Moreover, building an incineration plant in Kosovo must have a concrete plan on how the funds will be found, how the investment process is going to be as well as finding the right and considerable investors.
In the past, Kosovo did not have such project so, the author has found a similar project from other countries that can be used as an incineration plant cost analysis for the prices, costs and the labour force. The most comparable project that has been found from the author is a study cost analysis of an incineration plant in Zagreb. (LONČAR & BOGDAN, 2010)

Techno and economic analyses from the case study of the incineration plant in Zagreb have shown positive results on building the incineration plant in Kosovo that would produce heat and electricity. The author, in the case study, has found that technology combustion is advantageous and the capacity of

waste combusted in incineration plant is more than one hundred thousand tons per year. (LONČAR & BOGDAN, 2010)

The capacity of waste that can be combusted in the incineration plant is chosen for the purpose of the thesis. In the case study, the author has noticed the heating system of municipal solid waste is determined by the government for separating the waste from collection waste companies, thus the separation of the waste will lower the combustible waste which will lead to lowering the outputs of the incineration plant.
The geographical location in Kosovo will have a huge impact on the calorific value of MSW (Municipal Solid Waste) because areas in Kosovo produce diverse waste from a calorific point of view also, the seasons throughout the year have an impact on the quantities of the waste produced. Based on these diversities, the author has considered as the most valuable the lower heating system that produces ten MJ (Mega Joule) per kilogram of MSW (Municipal Solid Waste). Moreover, the author has considered using more average values since it can be more beneficial for Kosovo from the incineration plant operations. (LONČAR & BOGDAN, 2010)

Energy balance (2004) of the grate furnace at Indaver

	GJ	MWh
Energy content of waste and auxiliary fuel	4436×10^3	
Energy content of steam produced	3549×10^3	
Electricity produced	537×10^3	150×10^3
Used in installation	127×10^3	36×10^3
Supplied to third parties	410×10^3	114×10^3
Steam supplied for application as heat	1686×10^3	
Used in installation	316×10^3	
Supplied to third parties	1370×10^3	
Total power supplied		
Gross	2227×10^3	
Net	1809×10^3	

Table 1. Energy Balance of an Incineration Plant. (Vandecasteele, Wauters, Arickx, & Jasper, 2007)

In table 1, the author has shown an example of the energy and heat created in form of MWh (Megawatt/Hour) and GJ (Gigajoules) from a medium size incineration plant throughout the year. Moreover, in the figure it is shown the gross and net profit at the end of operations. Based on the research, building an incineration plant in Kosovo would be beneficial for the environment, people, new source of energy and reduce waste in general.

As it was mentioned above, building an incineration plant is not simple when it comes to the price and facility operations. Moreover, it is recommended that the incineration plant must be built not close to the centre of cities because of the air pollution caused from it. (Green, 2020)

Thus, the author has taken into consideration the expenses of building the road which leads to the plant, as well as the waste storage and the area where the waste is going to be weighted. The costs can be around four million and five hundred thousand Euro.
Another cost to be mentioned is the combustion system with a steam generator and it can be around nineteen million and five hundred thousand Euro without the other costs such as construction and controlling the types of machinery. (LONČAR & BOGDAN, 2010)

The system of ignition room contains a system where the waste is brought into the chamber system, ignition room with grate, ignition air supply, removal system of ash, and where it can be stored and, the steam generation which is filled with a supply of water and output of steam. (LONČAR & BOGDAN, 2010)

Another expense to be mentioned is the water and steam system, and it is predicted to be seven million and nine hundred thousand Euro.
Facilities that will be included in heat and water system are the treatment of water, condenser for cooling the air in the systems, controller of the steam output and, contraction turbine. For having an efficient incineration plant in Kosovo, the author must analyse two costs variables. First is, the costs of the components regarding the plant and second, the cleaning system of flue gas emissions. (LONČAR & BOGDAN, 2010)

The cleaning system technology of flue gas emissions consist of the content of the treatment of flue gas, limiting the emissions coming from the stack and, the costs on clean water supply.
Moreover, the mentioned technology is more expensive than the costs of the components in the plant and it can cost around sixty million Euro. The author has chosen as the best alternative to be used in the incineration plant in Kosovo, the cleaning system technology of flue gas emissions. (LONČAR & BOGDAN, 2010)

The costs for the maintenance are calculated annually so, the author took an average cost of 3.2% of the total investment in the incineration plant. In one hundred thousand tons of waste through the year, the costs for CO2 emission fee are estimated to be ten thousand per year, emission fee for SOx two hundred three per year and NOx emission fee one thousand sixteen per year. (LONČAR & BOGDAN, 2010)

Based on the research done by the author, the best option for the incineration plant in Kosovo to be effective is to work twenty four hours every day with three shifts.

The salaries for employees are calculated and the costs will be around five hundred thousand Euro per year so, the salaries are going to be higher in incineration plant than the average salaries in Kosovo. The total amount of employees will be twenty to twenty five normal workers, five to ten engineers, five maintenance workers and three managers working on three shifts. (LONČAR & BOGDAN, 2010)

The author has focused also on the revenues that could an incineration plant generate by its operations. Gate fee is considered by the author one of the most important revenue that comes from waste collection companies. Gate fee revenues depend on the market price conditions, the overall costs of the plant and the volume of energy sold. As an ideal price for the gate fee would be one hundred Euro per one ton of waste brought from waste collection companies to the plant. Moreover, the plant will generate ten million Euro per year from waste collection companies. (LONČAR & BOGDAN, 2010)

Considering all the costs and budget for building an incineration plant in Kosovo, the best alternative solution is to build the plant with a capacity of one hundred thousand tons per year. Moreover, all the information and details below of the outputs and other materials from the plant will be explained in approximate numbers. The electric power generated from the plant for one hundred thousand ton per year is 6.23 MW and thermal power 10 MW. Incineration plant will consume electricity for one year roughly 1.4 MW and heat 0.6 MW. The lifetime of an incineration plant can last for over twenty years. For building the incineration plant in Kosovo, the author must have taken into consideration on taking a loan as well as finding investors and funds from the EU. The repayment of the loan for building the plant it is estimated to be fifteen years with a five percentage interest rate. (LONČAR & BOGDAN, 2010)

The selling price for the electricity is estimated to be 0.050 Euro per kWh and for the heat 0.027 Euro per kWh. With the selling price of electricity and heat, the plant can generate around three million five hundred fifty thousand and thirty Euro per year. (LONČAR & BOGDAN, 2010)

Moreover, after the incineration process, the ash is created at the bottom which contains Aluminium and Iron. Thus, the ash is predicted to create two thousand three hundred tons of Iron and four hundred and fifty tons of Aluminium. Iron can be sold at the third parties with forty five euro per ton whereas Aluminium five hundred sixty euro per ton. Overall, the beneficial price from the selling product mentioned above will be three hundred fifty five thousand and five hundred Euro per year. (LONČAR & BOGDAN, 2010)

Building and operating successfully the incineration plant in Kosovo, the author thought of doing a 40 year permanent contract with the ministry of energy for not taxing the profits. By taking into account all the costs, revenues

and risks, the Incineration Plant is considered a profitable and valuable project for building it in Kosovo.

2.6.2 Profits, Costs and Opportunities for Solar Energy

The majority of energy in Kosovo is produced from two major coal plants with 1170MW. Only 2% is created from small Hydro Power plants also a small amount of energy is imported from other neighbouring countries.
Since the demand for efficient electricity has been raised among the people and government in Kosovo because of the environmental damages created from coal plants, the solar power plant would be a valuable project in Kosovo because of its efficiency and bio energy. Throughout the year, Kosovo generate more than 270 days of sunlight and is considered a capable and perfect country for harvesting and building solar energy plant. (IRENA, 2017)

Kosovo has received support from EU and non-governmental organizations for building a solar power plant.
When coming to investments, Kosovo is well known for its long administrative procedures because of the corruption thus, long procedure might take approximately one to two years until the investments are given for different projects.
Kosovo has significant potential for building efficient energy plants that could generate more than 436 MW energy throughout the year because of the unused capacity of land and many natural sources of energy that Kosovo has. (IRENA, 2017)

Cost of electricity level (Mega Wat per Hour) created from solar energy depends on many factors such as; the location of the plant, capacity, overall costs of the plant, etc., the author is going to show the costs and profits later in the text. (IRENA, 2017)

Nowadays, exists a global solar atlas that provides information on countries that have the potential on building solar energy plants and can generate energy from it. In the figure below, it is shown the map of Kosovo with the most potential cities and areas where the solar plant could be built and produce more than 1300 (Kilo wat per hour). (Rizvanolli, 2019)

Based on the analysis and research done on finding the most appropriate location in Kosovo for building solar energy plants; Peja and Gjakova districts have been the most potential ones thus, in total, Kosovo could generate more than one hundred MW energy annually from solar plants. (Rizvanolli, 2019)

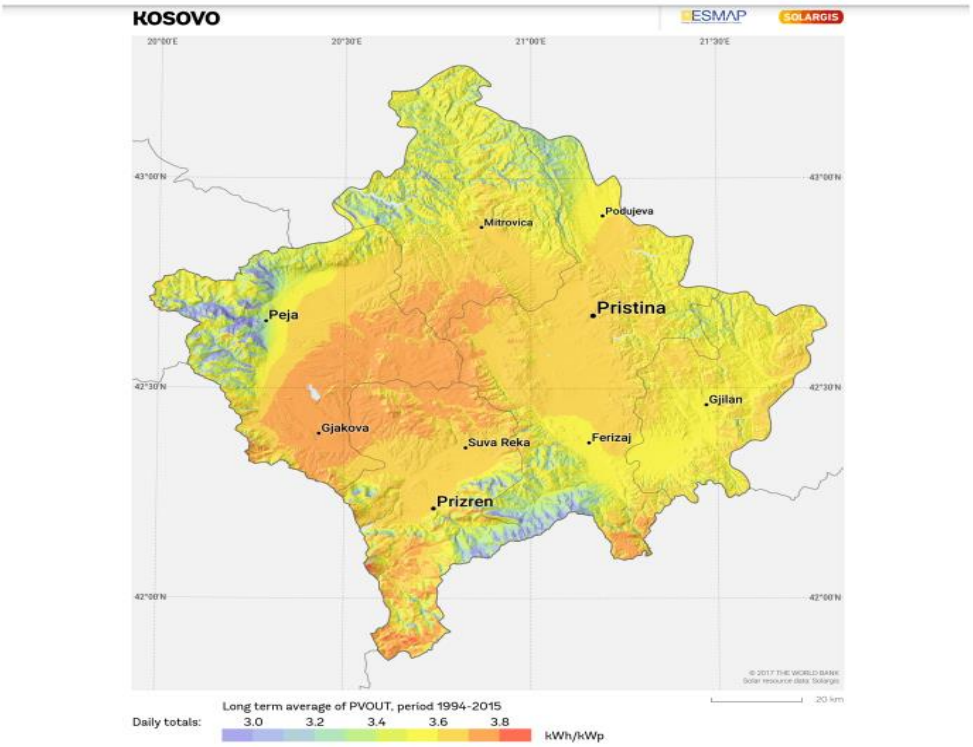


Figure 5. Solar Energy Potential in Kosovo (Rizvanolli, 2019)

Building a solar energy plant in Kosovo is not simple because of the high costs. Such a plant has been built in the neighboring country Croatia thus, the author is going to take it as an example for estimating the costs for building the plant in Kosovo because prices are similar between the two countries. The author will mention other costs based on other solar energy plant findings such as price per kWh, maintenance costs, labour work costs, land costs, and investment costs, profit will be shown in this paper as well. (Pavlova, 2020)

The price for building a solar plant has decreased recently because of the demand for efficient energy and lower price equipment needed for building the plant. The solar panel in Kosovo can be built at the lowest scale with 1 megawatt which can supply energy to more than 200 households. The estimated price for building such a plant with the lowest capacity can cost approximately one million euros to install. (Pavlova, 2020)

Implementing the solar energy plant for the first time in the country is recommended to be no more than 3.5 MW or 3500 kW. The 3.5 MW solar plant will supply energy to more than 700 households. The solar plant releases 50 grams of CO_2 per kWh so, the price for released CO_2 would be around sixty Euro, after the calculations, the overall cost for CO_2 will be two hundred ten thousand Euro. (Pavlova, 2020)

A similar project is going to be built in Croatia thus, the author took it as an example for building it also in Kosovo which will cost around four million Euro. (Pavlova, 2020)

For implementing a bigger scale solar energy plant in Kosovo, the author took an example from the country of Montenegro which have a plan on building a 200 MW solar plant. This project would be possible and profitable in Kosovo as well thus, it will cost around one hundred seventy million Euro. Moreover, forty thousand households will be supplied with efficient energy by implementing the mentioned above plant. (Ralev, 2020)

As for the most suitable and cost competitive solar plant project to be built in Kosovo, the author used a project in the country of Gambia with a capacity of 1 MW. (Sowe, Ketjoy, Thanarak, & Suriwong, 2013)

Parameters	Specifications	
Module type/name	c-Si modules	CdTe modules
Number of modules	4,546	12,528
Module area	5,000-8,000 m^2	9,020-11,000 m^2
Total land area	2.4 ha	3.2 ha
Mounting orientation	Fix mounted module	Fix mounted module
Operating hours & days per year	8 hrs./day or 365 days/year	8 hrs./day or 365 days/year
Module efficiency	12-14% [15]	8-10% [15]
Temperature Coefficient (TCE) of Power loss	-(0.45-0.50)%/°C [14,15]	-0.25%/°C [14,15]
Performance Ratio (PR)	74% [15]	79% [15]
Annual yield	1,593,590 kWh/year	1,701,265 kWh/year
Investment system	3,070,000 US$ [16]	2,640,000US$ [16]
Discount rate	6%	6%
Project lifetime	25 years	25 years

Table 2. Technical and Economical Parametres of Solar Plant (Sowe, Ketjoy, Thanarak, & Suriwong, 2013)

Most commonly, the solar power plant can last up to 25 years until the next rebuilding or renovating process. The module which will be used in the project will be C-SI (Crystalline Silicon), also (Cadmium Telluride Photovoltaics) can be used. The number of modules should be more than 4500 for generating efficient energy from the sun. The author saw it viable for using 2.4 Hectares for the plant in Kosovo since the country has more than 40% of unused land. For having a profitable and efficient plant, the working hours per day should be 8 every day for every year. Making the solar plant more profitable and save

operation costs, employees can shut down the solar plant when there is no sun light during the working hours that could plant generate energy from it. Even though the plant with 1 MW is considered small when comparing to other solar plants in the world, it generates almost 1.6 million kWh per year as such the plant will be profitable in the economical aspect.
The costs for building such a small solar power plant in Kosovo will be around 1 million euros. Choosing the right amount of price for electricity per kWh was not easy because of low standards among the population in Kosovo. As such, 0.24 cents was considered the most appropriate price for making the plant profitable. (Sowe, Ketjoy, Thanarak, & Suriwong, 2013)

Parameters	c-Si modules	CdTe modules
Benefits		
- Electricity cost	9,561,540	10,207,590
- CO_2 emission	434,415	463,767
- Total benefit	9,995,955	10,671,357
- Total benefit at 6% discount rate	5,111,274	5,456,630
Costs		
- Land	40,000	53,333
- Investment cost	3,070,000	2,640,000
- O&M	1,535,000	1,320,000
- Transport and labor	26,800	34,467
- Total cost	4,671,800	4,047,800
- Total cost at 6% discount rate	3,921,698	3,402,761

Table 3. Benefit and Costs Analysis of 1 MW Solar Plant for 25 years. (Sowe, Ketjoy, Thanarak, & Suriwong, 2013)

Bio energy projects have a positive impact on the environmental and economic aspects. As such, bio energy projects are considered the best alternative for investors because of an increased demand for efficient energy and battling climate change. For a 1 MW small scale solar plant in Kosovo, the electricity profit will be around 9.5 Million euros when calculating the price and amount of electricity. The total profit for 25 years will be around 10 million euros if the project will be financed only from investors and non-governmental organizations, but with 6% of bank loan, the profit will change drastically on 5.1 million euro profit. If the project will be funded from NGOs and investors, there would not be any investment costs, but if the project will be funded only from the bank loan then the investment costs will apply. Operation and

maintenance costs will keep in good condition the plant thus, overall costs will be 1.5 million Euros. In the end the total costs for building, maintaining and operating costs are estimated to be around 4.6 million Euros without the discount rate. (Sowe, Ketjoy, Thanarak, & Suriwong, 2013)

2.7 Risks for Incineration Plant

Before starting on investing in any kind of project or business it is recommended to do the risk management as well as to follow the steps for overcoming these risks.
On another hand, risks show the main obstacles that the project could face during the building and operation processes. (Global Infrastructure Hub, 2019)
For the incineration plant, the author has mentioned the main risks that could appear also, risks are not seen as a reason to not implement the project in Kosovo but as obstacles that could appear in any time and be prepared for them.

Planning and Permitting Risk:

Getting the permitting decision from the government on building the incineration plant in Kosovo can be questionable because the plant can have a negative impact on the environment for its smell and released emissions in the air as well as for the high costs of building it.
The key plans and environmental legislation and regulation must be taken into consideration before applying for permission on building the plant. Commonly public agencies fail to build the plant and get the government credits because of not fulfilling and following the legislations and rules in the concession contract. (Global Infrastructure Hub, 2019)

Technology Risk:

Waste to energy plants can have three different technology solutions which are; non incineration solution, incineration solution and advanced thermal treatment solution thus, author will choose the thermal treatment solution as the main technology for the incineration plant.
The thermal treatment converts the waste to energy through combustion which releases gas into atmosphere after the combustion process is done. The technology solutions mentioned above have various alternative suppliers in their technology. For choosing the right technology solution, author must contact the authorities and partners who are involved in the project and decide with them the most appropriate solution. During the building process of the plant, delays and increases in costs must be taken into consideration. Moreover, different projects of the incineration plants in the past have experienced and failed during the building process because of the delays and increases in costs.

Another point to be mentioned is advanced technologies. Those technologies can be beneficial to the plant because of its advanced innovation but also, the huge costs from them do not provide cost efficiency and environmentally friendly management. (Global Infrastructure Hub, 2019)

Waste Composition Risk:

The differentiation of the waste brought to the incineration plant can have a huge impact on the operations and the profit generated by the plant. In general, the plant can process a huge amount of different waste in a short period of time but, the waste with low calories can have an impact on the reduction of the energy produced whereas waste with high calories can have an impact on lowering the waste output.
Therefore, based on the research analysis, the author found out that differentiation of waste brought to an incineration plant can have a negative role in the outputs of the plant because the plant can be more biodegradable waste focus or not recyclable waste focus thus, the plant must classify the waste brought from the collection waste companies.
However, the incineration plant in Kosovo at the beginning of the operations must use the majority of the waste for combustion to be profitable. (Global Infrastructure Hub, 2019)

Environmental and Social Risk:

Nowadays, waste management at the municipal level is not done in the appropriate way and it is considered a major problem for the people. Also, this applies to Kosovo where waste management does not meet the EU regulations. It is recommended by the authorities that the incineration plant must provide environmental friendly and safe operation technologies because it is well known from the past that, different technologies used for incineration plants have failed during the operations and have created a negative impact on the environment.
The plant must take into consideration how the waste is going to be managed under any circumstances and who is going to be in charge of any additional costs. An overview of the overall costs must be taken from the plant and if the costs are higher than the plant can handle, the contracting authorities will share its help towards the plant for not damaging the private partners. (Global Infrastructure Hub, 2019)

Revenue Risks:

Different factors can have a negative or positive impact on the total revenues from the incineration plant in Kosovo.
The author saw it valuable to mention the main factors such as; decreased or increased price of electricity and heat, transportation costs of the waste, the

maintenance costs of the plant and the costs for maintaining the waste brought to plant from collection waste companies.
Decreasing the gate fee for the waste collection company would have a negative impact on revenues because it is seen from the author as not viable to have the gate fee less than one hundred euro per ton.
Another point that could have a negative impact on the revenues is not creating an agreement with government of Kosovo to have tax free for 40 years. The technology used in the plant is projected to be the most advanced which will meet the EU regulations and conditions but, the breakdown of the equipment's might happen in the beginning of the operations and later on, thus could create another major cost for the plant and have a negative impact on the revenues. (Song, Song, Zhang, & Sun, 2013)

2.8 **Risks for Solar Energy**

As with many other modern appliances, solar panels have systems that can fail and are considered as risks. These risks can appear anytime during the entire project lifetime, but of course they differ from each other. Author will explain the main risks that solar energy plant in Kosovo might face during the building and operation process. (Simpson, 2020)

Construction Risk:

During the process of building the project there should be proper specific plans for the installation process. Therefore, in order to avoid any possible construction risk these plans should include the necessary equipment for handling and lifting the solar panels and the protection for fall (for rooftop work). Considering that workers in the solar industry usually have to work on the rooftops every installer should have its own protective equipment and should be protected by the device for fall protection because they are exposed to fall hazards.
There are three different methods that are used for the protection of construction workers in solar industry. These methods are guardrail systems, safety net systems and, personal fall arrest systems. (Simpson, 2020)

Environmental Risk:

Even though solar energy is considered more efficient and safer form of renewable energy, still solar panels are made from different chemicals and toxic materials which some of them contain a risk for the environment where we live.
In the field of environmental impacts of solar energy take part also land use and water use. Since there's not so much opportunity to share land of solar projects for agricultural uses then there can be built smaller scale solar that could have less impact on the land use. (Worren, 2012)

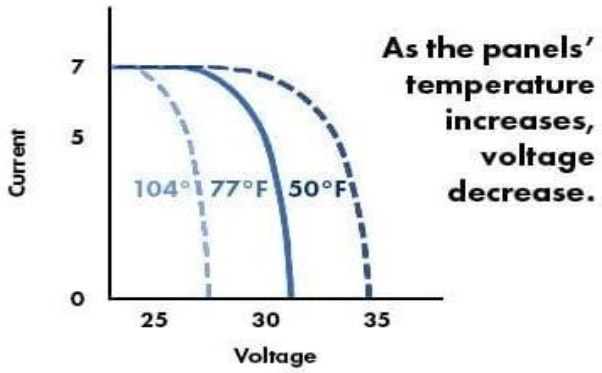
Financial Risk:

There are a number of key risks related to the financial part that could be considered as barriers that can threaten the solar industry.
Some of the financial risks are the high financial cost, uncertain project development costs, and high operational risk.
As mentioned also above, the components of solar panels and process of the instalment of solar panels is expensive. Therefore it is necessary to calculate all the costs and even the uncertain costs that may arise during or after the process of the project. (Energypedia, 2017)

Climate and weather risk:

Climate and weather are also important factors that have an impact and may be seen as risks for solar energy. As known, solar panels work more efficiently when there are more cold temperatures and this is also explained in the figure shown below, that as the panels' temperature increases, the voltage decreases. (Figure No. 4)
Another factor that could affect the electricity production, is any cloud or other shadow that may stand between the sky and the solar panel.
When the weather is cloudy the production can fall up to 25%. So it is important to always take into account the weather, when calculating the electricity production.
During rainy days, the rain does not have any impact on the panels, but the rain clouds have and this can result in the decrease of production.
Whereas during snowfall, the snow will definitely have an impact on the solar panels since it blocks the panels from the sunlight. (Gambone, 2020)

Figure 6. How weather affect solar panels production. (Gambone, 2020)



3 ANALYSIS ON FINDINGS

The problems that Kosovo is facing in the environmental and economic sector made the author to choose Bio Economy as a topic for this thesis.
The projects chosen by the author have been seen as the most appropriate ones for improving the waste management and creating new efficient source of energy.
Detailed steps for both incineration and solar energy plants has been analyzed and showed in this paper thus, steps of the projects will make the readers to understand better how the plants works.
The main advantages and disadvantages has been analyzed for having a better view on how the plants will contribute or harm the environment. Moreover, based on the pros and cons, projects will improve the environment compare to coal plant, and waste management in general in Kosovo.
For implementing successfully the Bio Economy in Kosovo, the projects must meet the conditions of legal framework in Kosovo as well the EU Regulations and Laws. Even though Kosovo has not met the overall EU Regulations in energy sector but is moving towards achieving them. The Legal framework and EU Regulations will make it easier for implementing the projects mentioned in this paper.
The funding part of the projects has been analyzed and research from the author. Moreover, the main possible investors are considered NGOs, Government of Kosovo, private investors and EU.
Both of the projects are seen to be profitable when the overall costs and profits has been analyzed from the author. Based on analysis, in the beginning of operations, the Incineration plant is going to be more profitable because of higher price for electricity and more energy produced compare to solar energy plant.
Building a successful Incineration and solar energy plant, risks must be taken into account. The two major risks that the plants might face during the building and operating process are environmental and financial risk. Financial risk has been mentioned because of the high costs for building the plants and environmental risk because of the CO2 and other emissions released from both plants, especially Incineration Plant.

4 CONCLUSION

As has been noted above, this paper is mainly focused on implementing Bio Economy in Kosovo, improving the energy production with bioenergy, improving the waste management and reducing the environmental issues that exist. Given these points, the author has explained two main projects which would help in achieving the mentioned implementation and improvements.

Considering that Kosovo faces many environmental problems due to the lack of efficient sources for energy, the most beneficial source would be the solar energy plant. Solar energy plant would be advantageous for Kosovo in many aspects such as, for the environment by reducing air pollution and water usage. It would help in minimizing the electricity loss and it would create more efficient energy. Since Kosovo's unemployment rate is high, switching to solar energy and choosing solar power instead of fossil fuels, companies would need to hire more employees. Therefore, by hiring more employees, solar energy would help in reducing the unemployment rate.

The other project is the incineration plant which converts waste materials into heat, electricity, flue gas and, ash. After this process, the waste would not be dumped into landfills, hence it would help in waste management. Another benefit would be the fact that during the process of incineration the waste goes through detoxification and nitrification, thus it would make waste harmless.

Risks, budget and costs has been taken into account from the author for both projects thus, projects would be viable to be built in Kosovo from an environmental and economical perspective.
Funds are expected to be granted from EU but also, from private investors and non-governmental organizations.

5 RECOMMENDATIONS

As a thesis, it has mainly been focused on the economic and environmental feasibility and as such has dealt more superficially with the specifics of the plants.
The author has used relevant data research from neighbouring countries of Croatia and Montenegro but also from the country of Gambia in Africa and it would be fair to assume that the prices and other parameters reflected in those papers are quite similar to the ones in Kosovo such as the price of electricity per kWh and cost of labour. Future in depth research could make a cost analysis using the parameters and costs pertaining to the Kosovar standard.
Future research could focus on finding a favourable place for building the plants in Kosovo and, taking into consideration all the important factors such as close distance from the cities in order to save for the transportation cost, proximity to a water stream and proximity to an electrical generator for electricity supply, proximity to the local heating system so that heat is not lost getting transported to large distances, land for solar energy especially must be more visible to sun.
In addition, further research could focus on surveying people about the incineration plant and solar energy projects. Some questions could be similar to whether they would agree to live close to a plant considering these plants

are built in proximity to the city or where do they stand on the issue of burning waste to make energy and creating energy through solar panels. From the answers, the researcher could understand whether people think that is a good idea and deciding on whether a campaign is needed in order to change people's ideas about the plants if such projects were to be built.
By the author point of view, government of Kosovo needs to make a renewable energy source target for producing 30-35 % efficient energy from bio energy projects and not depend all in coal combustion plant. By achieving that target mentioned above, the incineration and solar energy plant can have a positive chance to be implemented in Kosovo.

6 REFERENCES AND APPENDICES

REFERENCES

Afox, & Bmg. (2019, May 06). 6 Reasons Why Solar Power is an Excellent Alternative Energy Source. Retrieved October 27, 2020, from https://www.astralenergyllc.com/?s=sola+power

Bellini, E. (2017, April 27). Kosovo must do more for renewables, EU says. Retrieved October 30, 2020, from https://www.pv-magazine.com/2017/04/27/kosovo-must-do-more-for-renewables-eu-says/

Beqiraj, A. (2012). Problemet mjedisore në Kosovë në rritje: DW: 05.06.2012. Retrieved November 07, 2020, from https://www.dw.com/sq/problemet-mjedisore-n%C3%AB-kosov%C3%AB-n%C3%AB-rritje/a-15999595.

Ecavo.com, P., Ecavo.com We highlight technology and ideas in energy sustainability, Ecavo.com, We highlight technology and ideas in energy sustainability, & →, V. (2020, October 23). Solar Energy Disadvantages: The Top Drawbacks of Solar Power. Retrieved October 29, 2020, from https://ecavo.com/solar-energy-disadvantages/

Energy, K. (2020, November 03). INDEP: Kosova ka 278 ditë me diell. Retrieved November 06, 2020, from https://kosovo.energy/indep-kosova-ka-278-dite-me-diell/

Energypedia. (2017). Barriers and Risks to Renewable Energy Financing. Retrieved October 27, 2020, from https://energypedia.info/wiki/Barriers_and_Risks_to_Renewable_Energy_Financing

Eur-Lex (2012). Lex Access to European Union law. Retrieved November 06, 2020, from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52012DC0060

European Union, E. (2014). EU support to waste management in Kosovo. Retrieved November 03, 2020, from https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/annexes/ipa_2018_041246.06_eu_support_to_waste_management_in_kosovo.pdf

Gambone, S. (2020). How Does Weather Affect Solar Panels' Production? Retrieved October 27, 2020, from https://www.paradisesolarenergy.com/blog/how-does-weather-affect-solar-panels-production

Global Infrastructure Hub. (2019, August 09). Waste to Energy Plant. Retrieved October 26, 2020, from https://ppp-risk.gihub.org/risk-allocation-matrix/water-waste/waste-to-energy-plant/

Green. (2020, July 05). Various Advantages and Disadvantages of Waste Incineration. Retrieved November 07, 2020, from https://www.conserve-energy-future.com/advantages-and-disadvantages-incineration.php.

IRENA. (2017). COST-COMPETITIVE RENEWABLE POWER GENERATION: Potential across South East Europe. Retrieved November 05, 2020, from https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/IRENA_Cost-competitive_power_potential_SEE_2017.pdf

Junkwize. (2015, June 09). Pros and Cons of Rubbish Incinerators. Retrieved November 07, 2020, from https://junkwize.com/blog/pros-and-cons-of-rubbish-incinerators/.

KEPA. (2018). MUNICIPAL WASTE MANAGEMENT IN KOSOVO. Retrieved November 07, 2020, from https://www.ammk-rks.net/repository/docs/Municipal_Waste_Managment_in_Kosovo_Status_Report_2018.pdf?fbclid=IwAR37zhm8Oe4Vbw2ICeaOtlPdxmB3KdkqhVnvKdoyOVRCsPR9SX6Xs-mNxy0.

Krishnamurthy, R. (2015, October 23). Charting the Sun's Motion In Relation To Your Home and Permaculture Site. Retrieved November 07, 2020, from https://www.permaculturenews.org/2015/10/23/charting-the-suns-motion-in-relation-to-your-home-and-permaculture-site/

Kuvendi i Republikes se Kosoves. (2018, December 05). PËR EFIÇIENCË TË ENERGJISË. Retrieved November 06, 2020, from https://mzhe-ks.net/repository/docs/LIGJI_NR._06_L-079_P%C3%8BR_EFI%C3%87IENC%C3%8B_T%C3%8B_ENERGJIS%C3%8B_(1).pdf

Liu, C., Nishiyama, T., Kawamoto, K., & Sasaki, S. (2020, June). Waste-to-Energy Incineration. Retrieved November 07, 2020, from https://www.iges.or.jp/en/publication_documents/pub/policysubmission/en/10877/WtEI_guideline_web_200615.pdf

LONČAR, D., & BOGDAN, Ž. (2010). Cost Analysis of Waste-to-Energy Plant. Retrieved November 06, 2020, from file:///C:/Users/Admin/Downloads/V52_3_p369_p378.pdf

Miller, B. (2019, December 16). 8 Pros and Cons of Incineration. Retrieved November 02, 2020, from https://www.greengarageblog.org/8-pros-and-cons-of-incineration.

NWWindandSolar. (2015). How do solar systems produce energy? Retrieved October 27, 2020, from https://www.nwwindandsolar.com/solar-power-in-seattle-and-the-northwest/how-do-solar-systems-produce-energy/

Optima (2020). 2030 EU Renewable Target Requirements - Kosovo Position. Retrieved October 30, 2020, from http://www.optima-ec.com/en/new-renewable-target-requirements-which-are-necessary-mechanism-to-adopt-/

Orloff, J. (2020). The Definition of Bioenergy, a Potential Replacement for Fossil Fuels. Retrieved October 27, 2020, from https://www.thoughtco.com/what-is-bioenergy-2941107

Pavlova, I. (2020, September 14). HEP launches Croatia's largest solar power plant. Retrieved November 07, 2020, from https://renewablesnow.com/news/hep-launches-

croatias-largest-solar-power-plant-713462/#:~:text=The%20construction%20of%20several%20solar,MW%20Obrovac%20plant%20(42.6%20million

Ralev, R. (2020, June 08). Construction of 200 MW solar plant in Montenegro to kick off in 2020 - econ min. Retrieved November 07, 2020, from https://renewablesnow.com/news/construction-of-200-mw-solar-plant-in-montenegro-to-kick-off-in-2020-econ-min-701778/

Rizvanolli, D. (2019, August). Kosovo's Potential for Renewable Energy Production: An Analysis. Retrieved November 07, 2020, from http://essay.utwente.nl/79555/1/Rizvanolli_MA_BMS.pdf

Sendy, A. (2020, November 03). How much energy does a solar panel produce? kWh solar production calculator. Retrieved November 07, 2020, from https://www.solarpowerrocks.com/solar-basics/how-much-electricity-does-a-solar-panel-produce/

Simpson, K. (2020). Solar Energy: Safety Risks and How to Prevent Them. Retrieved November 05, 2020, from https://www.thehartford.com/resources/energy/solar-energy-risks

Song, J., Sun, Y., Zhang, X., & Song, D. (2013, June). Risk identification for PPP waste-to-energy incineration projects in China. Retrieved November 04, 2020, from https://www.researchgate.net/publication/266911060_Risk_identification_for_PPP_waste-to-energy_incineration_projects_in_China

Sowe, S., Ketjoy, N., Thanarak, P., & Suriwong, T. (2013, December). Technical and Economic Viability Assessment of PV Power Plants for Rural Electrification in the Gambia. Retrieved November 07, 2020, from file:///C:/Users/Admin/Downloads/TechnicalandEconomicViabilityAssessmentofPVPowerPlantsforRuralElectrificationintheGambia.pdf

Suez. (2020). Organic matter destruction treatment using co-incineration processes. Retrieved November 06, 2020, from https://www.suezwaterhandbook.com/processes-and-technologies/dewatered-sludge-treatment/thermal-processes-used-to-destroy-the-organic-matter-contained-sludge/organic-matter-destruction-treatment-using-co-incineration-processes

SuperGreen Solutions. (2020). How Do Solar Panels Work?: A Step by Step Guide to: How Does Solar Power Work? Retrieved November 07, 2020, from https://supergreensolutions.com.au/faq/solar-power/how-does-solar-power-work/

The World Bank. (2020). Trends in Solid Waste Management. Retrieved November 08, 2020, from https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html

UNDP. (2012). Kosovo General Information. Retrieved November 07, 2020, from file:///C:/Users/Admin/Downloads/Kosovo.pdf

Uzunova, R. B., Shishkova, M., & Ivanova, B. (2019, October). CONCEPTS AND KEY SECTORS OF THE BIOECONOMY. Retrieved November 07, 2020, from https://www.researchgate.net/publication/336846892_CONCEPTS_AND_KEY_SECTORS_OF_THE_BIOECONOMY

Vandecasteele, C. (2007). Integrated municipal solid waste treatment using a grate furnace incinerator: The Indaver case. Retrieved October 25, 2020, from https://www.semanticscholar.org/paper/Integrated-municipal-solid-waste-treatment-using-a-Vandecasteele-Wauters/64976899ba1da148809754790e649ae6f1a0289c

Worren, J. E. (2012, August 02). Assessing the Risks in Solar Project Development. Retrieved November 05, 2020, from https://www.renewableenergyworld.com/2012/02/08/assessing-the-risks-in-solar-project-development/

Appendix 1

FIGURES AND TABLES

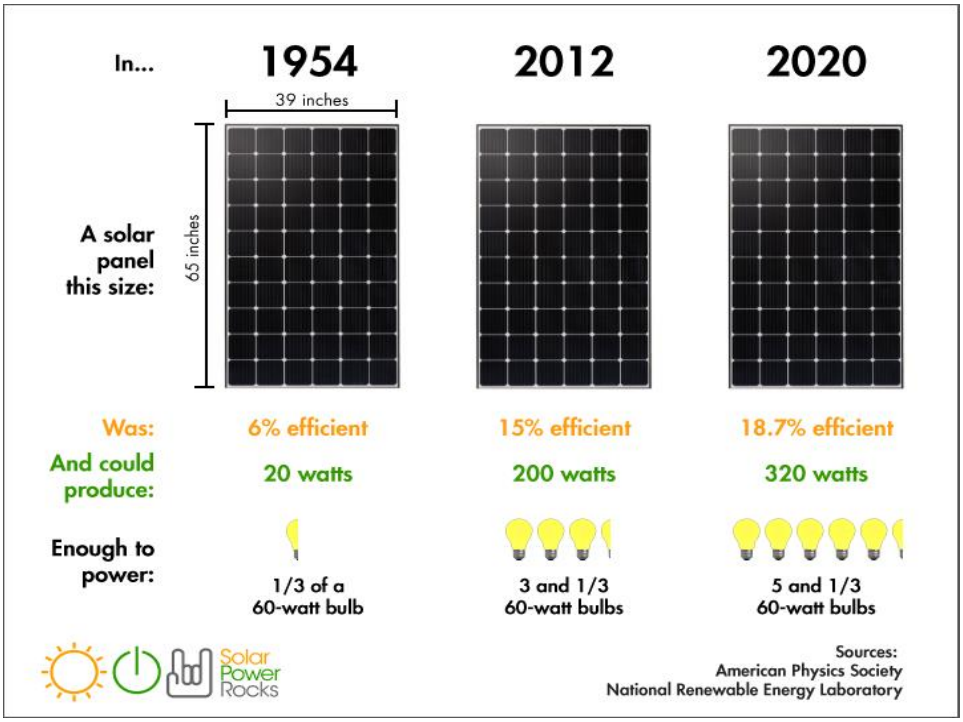


Figure 1. Size of solar panels throughout the years (Sendy, 2012)

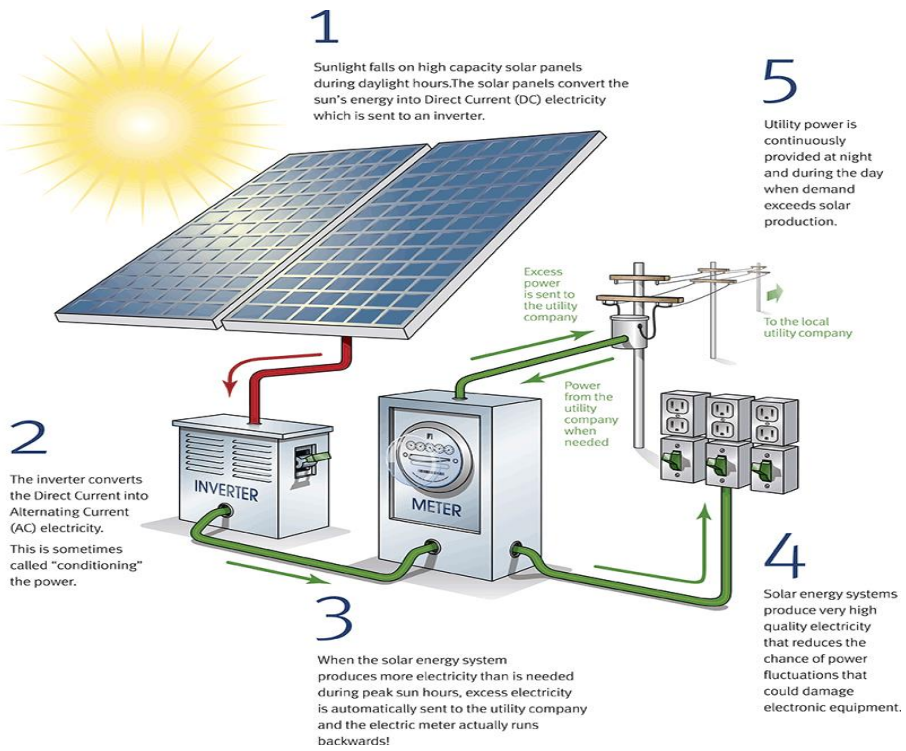


Figure 2. 5 steps of the overall process of Solar Energy. (SuperGreen Solutions, 2020)

Appendix 2

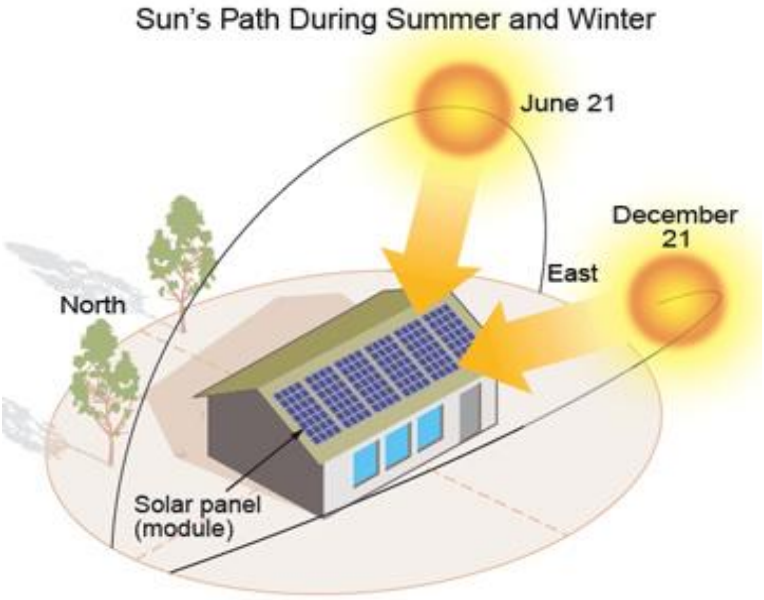


Figure 3. Sun's Path during summer and winter (Krishnamurthy, 2015)

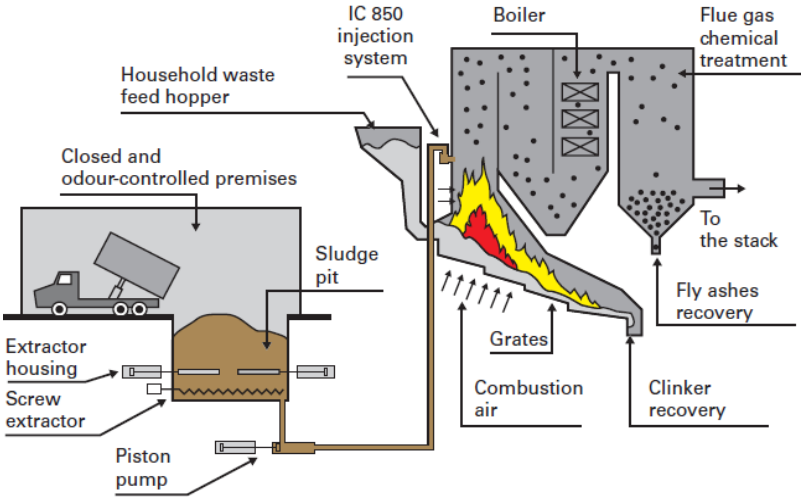


Figure 4. Treatment Process of the Incineration Plant (Suez, 2020)

Appendix 3

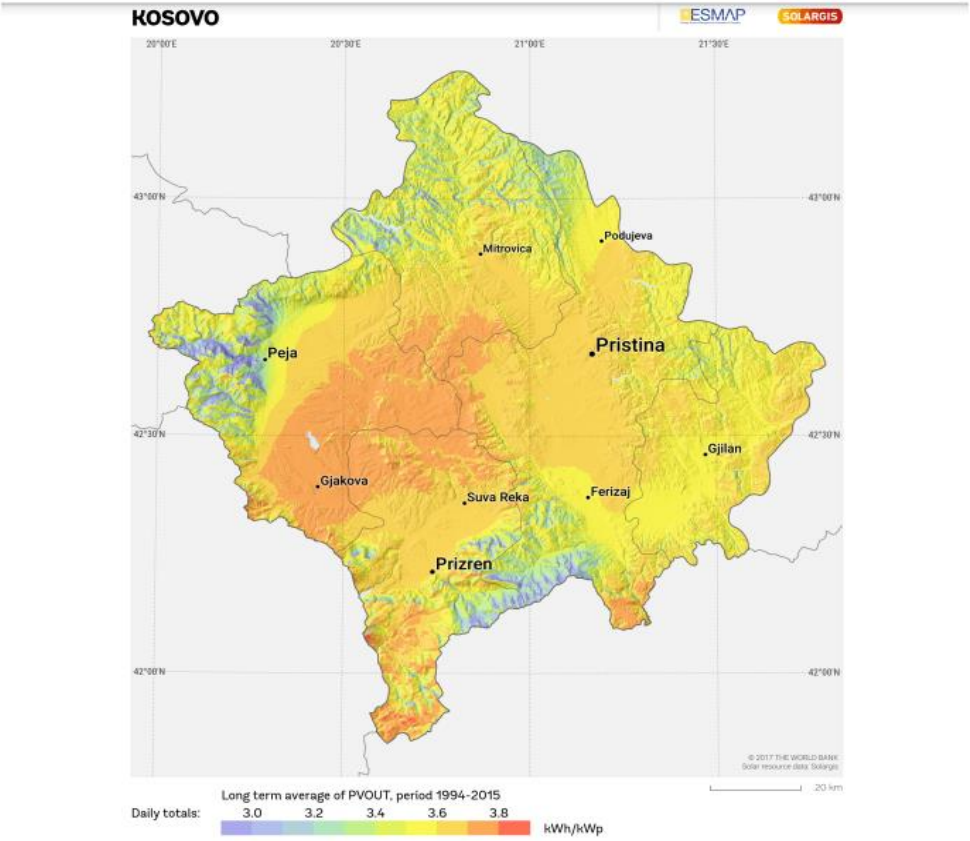


Figure 5. Solar Energy Potential in Kosovo (Rizvanolli, 2019)

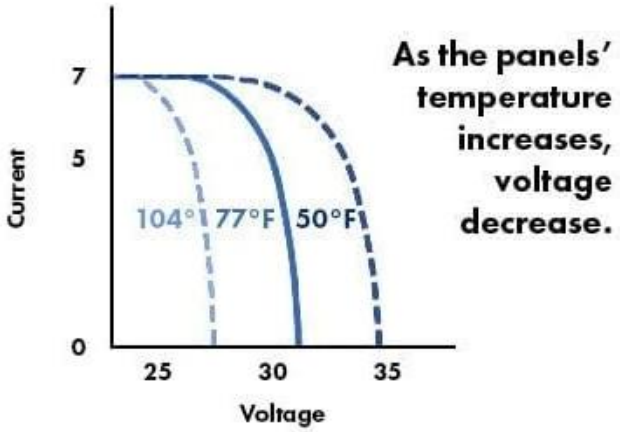


Figure 6. How weather affect solar panels production. (Gambone, 2020)

Appendix 4

Energy balance (2004) of the grate furnace at Indaver

	GJ	MWh
Energy content of waste and auxiliary fuel	4436×10^3	
Energy content of steam produced	3549×10^3	
Electricity produced	537×10^3	150×10^3
Used in installation	127×10^3	36×10^3
Supplied to third parties	410×10^3	114×10^3
Steam supplied for application as heat	1686×10^3	
Used in installation	316×10^3	
Supplied to third parties	1370×10^3	
Total power supplied		
Gross	2227×10^3	
Net	1809×10^3	

Table1. Energy Balance of an Incineration Plant. (Vandecasteele, Wauters, Arickx, & Jasper, 2007)

Parameters	Specifications	
Module type/name	c-Si modules	CdTe modules
Number of modules	4,546	12,528
Module area	5,000-8,000 m^2	9,020-11,000 m^2
Total land area	2.4 ha	3.2 ha
Mounting orientation	Fix mounted module	Fix mounted module
Operating hours & days per year	8 hrs./day or 365 days/year	8 hrs./day or 365 days/year
Module efficiency	12-14% [15]	8-10% [15]
Temperature Coefficient (TCE) of Power loss	-(0.45-0.50)%/°C [14,15]	-0.25%/°C [14,15]
Performance Ratio (PR)	74% [15]	79% [15]
Annual yield	1,593,590 kWh/year	1,701,265 kWh/year
Investment system	3,070,000 US$ [16]	2,640,000US$ [16]
Discount rate	6%	6%
Project lifetime	25 years	25 years

Table 2. Technical and Economical Parametres of Solar Plant (Sowe, Ketjoy, Thanarak, & Suriwong, 2013)

Appendix 5

Parameters	c-Si modules	CdTe modules
Benefits		
- Electricity cost	9,561,540	10,207,590
- CO_2 emission	434,415	463,767
- Total benefit	9,995,955	10,671,357
- Total benefit at 6% discount rate	5,111,274	5,456,630
Costs		
- Land	40,000	53,333
- Investment cost	3,070,000	2,640,000
- O&M	1,535,000	1,320,000
- Transport and labor	26,800	34,467
- Total cost	4,671,800	4,047,800
- Total cost at 6% discount rate	3,921,698	3,402,761

Table 3. Benefit and Costs Analysis of 1 MW Solar Plant for 25 years. (Sowe, Ketjoy, Thanarak, & Suriwong, 2013)