

Electricity from Waste –Bibliographic Survey

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Abstract Presented here is a bibliographic survey, which covers the work done in the period ranging from 1913 to 2013; towards realization of feasible methods of electricity generation using waste materials. This paper is the outcome of thorough analysis of various literatures available from the earlier research. This paper would be a great source of literature summarized in one paper. This paper would be helpful as a one stop guide, it will introduce the subject to the reviewer, give him an idea of all the previous work done in this field, the chronological research done by some scientist as well as the development in technology/methodology all along the period.

Keywords: *bio energy, thermal energy, energy from waste*

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1. Introduction

The feasting habits of modern consumer routines are causing a huge worldwide waste problem. Having crowded local landfill volumes, many first world countries are now transferring their refuse to third world countries. This is having a disturbing impact on ecosystems and cultures throughout the world. Some substitute energy companies are emerging new ways to recycle waste by generating electricity from landfill wastes, waste heat from industries and nuclear power plants, bio-energy and many other miscellaneous sources. In count to wind and solar energy, the purported bio-fuels are becoming progressively common. Breeding energy through burning, vaporizing, or fermenting biomass such as waste plant material, vegetable waste, and manure are well-founded methods. Microbial fuel cell is also a new concept which is accomplished of directly generating energy from materials such as waste water.

The bibliography has been divided into the following sections.

1. Electricity from Bio-Energy.
2. Electricity from Thermal-Energy.
3. Electricity from other Miscellaneous Sources of Energy.

2. Electricity from Bio-Energy

Peters [1] mentioned that millions of tons of municipal solid waste (MSW) and disposing it are serious problem in many countries. So an alternative to this has found by recovering energy from waste and thus generating 1.5 quad million Btu of electricity in United States. Disposal problems are reduced and amount of municipal solid waste in landfills are also less toxic now.

Porteous [2], reported that based on the non fossil fuel obligation (NFFO) allocations, energy generation from

MSW and landfill gas combustion have been inspected. Emphasis has been given on energy recycling, waste management. Further he re-examined MSW waste for extracting energy by incineration process and concluded increment in energy generating capacity and reduction in volume of disposed waste.

Zahedi [3], presented the paper on waste to energy technology in Australia. House hold waste which is organic has been examined in five different cities of Australia with accurate amount. So estimation of electricity production is also given in accurate units. Waste to energy conversion has been done by incineration process which involves burning of waste, this adding a benefit of waste disposal in less quantity.

Maunder et. al. [4], described the extraction of bio fuel from biomass and waste material. Former one included agricultural residues and forestry operations. Later one includes Municipal solid waste, human waste, and industrial waste. Bio fuel leads to production of electricity by transformation of all waste. Research was going through advanced technologies for conversion of biomass and waste into better efficient electrical energy.

Walker [5], presented the establishment of thames water services as provider of water and sewerage services in london. Covering the wide perimeter among different cities, the anaerobic absorption of sewage sludge produces methane which acts as energy source producing 8 m of electricity. The spark ignited engines were implemented which improved the power output capacity.

Chakravarthi [6], emphasized on the treatment of cattle waste and thus generated energy and biogas can be utilized in respective ways. Energy from waste using anaerobic digestion process reduces environmental pollution thus generating a low budget energy source for farms. Similarly, biogas can be used for indoor usage like lightening, water heating, and grain drying. Overall cattle waste is utilized thus providing suitable benefits with

generation of fertilizer for crops and plants and cleaning of lands.

Kishinevsky and Zelingher [7], emphasized the use of first fuel cells that harnessed anaerobic digester gas energy by producing medium electricity and heat thereby absorbing the harmful pollutants that can cause green house effect. Anaerobic digester process is used in many wastewater treatment plants where anaerobic digester gas (ADG) is generated as by product and is a mixture of methane and carbon dioxide.

Tomberlin & Moorman [8], represented the benefits of energy generation from municipal solid waste. A thorough power output details are discussed in this paper. The harms and benefits of using combustion of waste have been elaborated.

Justin, et. al. [9], design of bio fuel cells could extract electricity from *Escherichia Coli* and human white blood cells. This bio fuel cell can be used as an energy source for implantable electronic device. The current obtained from both of these experiments have been discussed along with appropriate proportions taken.

Varadi et al [10], drew the attention towards accumulation of Municipal solid waste into enormous heaps. This problem was dealt by setting up waste to energy plant at high temperature which generates steam and thus generates electricity. Heat can also be used in distillation of portable water and industrial hot water requirements. 144 MWh of electricity was generated with new waste to energy systems in addition to more electricity from recovered heat from furnace flue gases.

Monier et. al. [11], presented microbial Fuel Cell (MFC) technology for electricity generation from the organic matter. The metabolic activity of bacteria on the biodegradable substrates converts the chemical energy stored in substrates to the electrical energy. The operation and current developments in MFC are presented in detail.

Varadi and Takacs [12], described a new plant module supporting combustion at 1150 degree Celsius temperature, 180 metric tons of municipal solid waste and generating a minimum of 144 MWh of electricity, as well as 912,000 litres of potable water a day. The other specifications of plant were also discussed.

Zhi et al. [13], analyzed the effect of suspended sludge on power production to improve the designs of Microbial Fuel Cells (MFCs). Two parallel single-chambered MFCs with or without suspended sludge, operated in fed-batch mode was investigated to study the effect of suspended sludge on electricity generation.

Kayes and Tehzeeb [14], discussed Waste-to-Energy(WTE) technologies in detail. WTE involves converting various elements of municipal solid waste such as paper, plastics and food wastes to generate energy by either thermo chemical or biochemical processes. The thermo chemical techniques like combustion, gasification, thermal de-polymerization, plasma arc gasification or pyrolysis and the biochemical processes including anaerobic digestion, hydrolysis, Mechanical Biological Treatment (MBT) were illustrated.

Amin et. al. [15], suggested the use of waste materials for the generation of electricity instead of conventional fuels, in developing countries like Bangladesh. A brief account of waste-to-energy projects in some parts of the world was presented. The future of waste-to-energy systems in Bangladesh was outlined.

Sarker et. al. [16], proposed alternative fuel created from domestic sources on account of rising prices of fossil fuels and the increasing environmental and health problems. The outlines contained descriptions of a new alternative hydrocarbon fuel which is produced from abundant waste plastic materials and discovered by Natural State Research Inc. (NSR). NSR fuel has the potential to generate electricity as well.

Curry and Pillay [17], emphasized on the application of anaerobic digestion to the organic wastes produced in urban environments. A case study from the downtown campus of Concordia University in Montreal, Canada is also included. Thus, anaerobic digestion is viewed as a critical solution to growing garbage problems and simultaneously providing valuable energy in urban areas.

Baidoo et. al. [18], focused on three major problems of pending energy crisis, the environmental degradation due to waste and the environmental degradation due to greenhouse emissions. Efficient plasma gasification technology can be the solution of the above three problems. A closed loop renewable power generation system was being developed that can be integrated into local communities. A model of energy and economic analysis of the system was presented using visual basic in the form of graphical user interface (GUI). Incineration and micro-turbine models were also discussed.

Baidoo et. al. [19], presented the energy analysis of a plasma gasification system. Plasma furnace modelling was also outlined on the basis of data obtained from the Technical University of Lodz, Poland.

Nikolaeva et. al. [20], concentrated on the adequate management and treatment of piggery and dairy wastes. The authors figured out anaerobic technology ('AFBRs') as a solution to the environmental problems derived from intensive animal breeding. The successful application of anaerobic technology (AFBRs) to treat the waste water of dairy milk with the utilization of biogas in order to produce electricity for the dairy equipment in the milk farm located in the province of Cartago, Costa Rica was also outlined.

Tang et. al. [21], described a RF (radio frequency) Plasma Pyrolysis reactor. The outlines revealed that the reactor could be utilized for the pyrolysis treatment of biomass at different input powers and operating pressures.

Kallimanni, et. al. [22], presented the waste food can be used in biogas generation by anaerobic digestion. At temperature 4° Celsius, waste stored. auto-mixing anaerobic reactor technology (AART) was improved digester with rapid rate of biomethanation compared to conventional digester. It would act as boon responsible for producing cooking gas manure and renewable energy. Wilfried Ngyz Mbav et. al. [23], presented the population energy harnessing from gases emitted from land fill. This source of energy is viable and clean, mitigate green house gas emission and manage the rampant waste production proved as remedy for power shortage.

Cuijie et. al. [24], presented MSWI bottom ash used or road base construction with reduction in resource consumption. Compared to the conventional road saved electricity 51% and 41% diesel. Due to heavy metal as content enhances toxicity via water acts as disadvantage and need for research.

Bardi and Astoefi [25], presented conversation from waste – bed temp. to specified referenced value for

maximize steam production, reference temperature has chosen. Waste incineration process described with control methodologies and new approach.

Nan et al. [26], presented an energy recyclable burn in technology for electronic ballast for HPS lamps. It simulated transitive characteristic of HID lamps worked at high frequency, processed frequency ballast output power and recycle power back to grid discussed working principle and mathematical analysis.

Khan [27], studied and explored the potential of thermoelectric power from bagasse by sugar mills. Eight mills are used as a model and took interview of officials. Total production of bagasse in recent years will provide 478 mW/hr when averaged from models. It would be boon for power crisis area. It acts as a fuel comes under biomass energy source.

Paurali [28], discussed basics of plasma gasification technology, reviews challenges and opportunities for implementation of it. He showed it is one of the best methods to get rid from landfills, emission of green house gases and save underground water.

Rafi et al. [29], presented a real study of Faridabad area on the basis of power generation by IRES (Integrated Renewable Energy Source). For reducing burden on land fill, MSD is converted to biomass which could be used as bio fertilizers have cost of Rs. 3-5 per kg. Power generation by IRES considered three sources solar, wind and biomass. Potential of solar, wind and biomass energy calculated organic fractions of MSW conversion reduced emission of green house gases.

Kramer et. al. [30], discussed how to regulate the organic waste such as food, animal and human waste converted by anaerobic process with production of hydrogen. Hydrogen production influenced because of some advantages like reduce green house emission, fuel cells and in reciprocating engine. Solar thermal system and its process overviewed and showed produced electricity, heated building and obtain portable water. H production graph showed relation between temperature vs initial pH and substrate concentration Vs pH.

Bin Jobli et. al., [31] presented a main objective to analyze the potential of designed heat pump system when banana peels act as source of energy by recovered heat from it. For make this experiment more fruitful, heat pump applied to heat exchanger. Maintain temperature difference and amount of energy extracted, 3-4 watt heat produced 1 kg dry matter. Data record from data logger and monitored during experimental setup. Evaluation of moisture content and heat recovery from decomposition system was done. A graph showed heat extraction analysis with power output and temperature profile.

Curry and Pillay [33], presented the MSD or any kind of waste has become major global issue which will soon be uncontrollable. Pie chart represented annual MSW composition in US. Anaerobic digestion and incineration methods for reducing waste. But generation of green house gas due to land fill after incineration proved it would not suitable technology. Small scale anaerobic digestion and plasma gasification justified as best method for disposal. Plasma gasification alone produced 1.5-1 MWh energy.

Sayed Kamran foadMarashi and Karimina [34], discussed the application of petrochemical wastewater in generation of electricity by using a membrane -less

microbial fuel cell. It is renewable energy produced from organic and inorganic material using microorganisms. Fuel and micro-organism engaged are PTA waste water and sludge of anaerobic contact filter.

Ahiduzzam and Islam [35], discussed the use of surplus rice husk in production of green power. A survey was done on four major rice processing zones in Bangladesh to estimate potential husk available for generation electricity.

Ahsan and Chowdhury [36], identified the application of house hold produced biomass as a source of green electricity using a biogas digester. It is economically and technically viable for operation of appliances such as biogas light bulb, stove and dual fuel hybrid generator when compared with appliances using conventional energy sources.

Khan and Chowdhury [37], presented treatment of tannery waste fulfills to aim i.e. waste treatment and harness energy from it. Pie chart showed percentage of animal hides and skin in tanneries. Tannery water treated in both manners by gasification and anaerobic digestion. Annual energy yield from both mesophilic and thermophilic methods was compared Government regulatory framework and tanner's owner's support in mitigating pollution and harness electricity from tannery waste.

Lohani et. al. [38], presented two methods incineration and anaerobic digestion compared which proved better results from anaerobic digestion technology by installing a 200 litres capacity of 60 US\$ digesters in homes. By product of digester used as bio fuel and bio-fertilizer. At homes waste can treated and useful tool for energy harness.

Belonio et al. [39], discussed about the rice husk as a fuel for cooking and rural electrification. Stove operation based on rice husk fuel during test some parameters considered such as fuel consumption thermal efficiency percentage char produce specific gasification rate with some design tips. Water temperature profile graph showed performance in three different runs. Light has thrown upon some aspects like operating cost analysis and environmental aspect with some trouble shooting guide.

Verma et. al. [40], wrote a paper that revealed that tremendous amount of biogas resources are available on earth. Now it is evident that biogas can be substituted instead of fossil fuels and by investigation all possible generation and utilization are yet to be explored.

Maier and Street [41], focused more on environmental, economic, and social areas somewhat than the perception of a public body's requirements and the economic realities of solid waste management. They guarantee investors with satisfied returns and revenues from treatment of stated amounts of solid waste. Finally the findings from the case study provide interesting insights into the conditions under which state of the art MSW incineration plants with energy recovery using the Clean Development Mechanism are competitive with low cost landfills.

Namuli [42], wrote a paper in which rural farms have installed biomass waste to energy conversion systems to solve their manure disposal problems. These systems can however be sources of revenue to the farms, through sale of electricity to the grid. Three biomass wastes to energy conversion systems were optimized with the objective of obtaining maximum revenues. Two of the systems had the right installed generation capacity required to maximize

revenue. These were Emerling farm and Sunny Knoll farm. Emerling farm's system was however not being operated in a way that would maximize revenue. With an improved operational strategy, Emerling farm can increase its cost savings by 18%.

Ushimaru [43], proposed that power plants will deliver much needed power provision increased agricultural productions, help in the access to higher technology and it will also reduce waste for society and local community at a vast scale. This project is actually based on the sound business model so once the operation is underway the project will have many revenue sources from sales of sales of chickens, processing of poultry and meat processing waste from other large farms in the province, sales of electricity to the local utility company, sales of ashes to fertilizer producers, sales of food flavoring pastes to food processors, and sales of feedstock to bio-fuel processors. With the help of external funding this project will proceed much speedy and with a higher probability of confidence for success. The revenue system acquired from this operation will be used to pay back the initial funding investments.

Khelidj et al. [44], carried out a study of viability of a biogas manufacture project and they investigated to prove the important possible of biogas. They started this research by making inventories on different sources of wastes by making a very essential potential of more than 173 billion of cubic meter of biogas in Algeria.

Sulistyo et. al. [45], concluded that the C/N ratio has affected the biogas production. The satisfying results were found when C/N ratio came out to be 20 for white mustard and cow manure, green mustard, rice straw and cow manure and the rate of high production of biogas occurred at 21st day of incubation period. It was observed that methanogenic micro organisms have noticeable effect for manure formation.

3. Electricity from Thermal Energy

Hobson [46], performed in depth study of the various forms of waste energy available and the general conditions governing their employment for the purpose of electrical generation. The considerations involved in the disposal of the power generated were also outlined. The "waste heat" was interpreted in its broader sense as including both waste steam and waste gases.

Crawford [47], discussed the usefulness of the waste heat in both thermal and nuclear power stations in order to improve their thermal efficiency. The author suggested district heating as a way of doing this. The concept of total energy was widely developed.

Palmer [48], represented the loss of significant energy in exhaust systems, cooling water and similar working systems. These losses are recovered to reduce the cost that helps in achieving economic stability. The process of cogeneration has been encouraged for considering the lost energy. In this paper, new technological advancements are described by four systems set up in four different cities in United States.

Haidar and Ghojel [49], the non renewable energy resources must be reduced because of scarcity with more development of renewable sources. They elaborated the recovery of heat from a diesel engine using thermo

electric generators. Waste heat recovery system is mounted on an exhaust pipe and detailed analysis is discussed.

Solbrekken et al. [50], presented the implementation of shunt attach generation (thermoelectric technology) for changing waste heat from microprocessor into electrical energy which is used for driving a cooling fan for cooling the chip. Low voltage fan works in conjunction with heat driven source. Remaining heat is used to keep the temperature of a chip below a critical value.

Othman et al. [51], provided a detailed analysis of the research conducted on electronic plastic waste to determine its potential as a source of energy. Proximate analysis, ultimate analysis and the heavy metal content analysis of the plastic waste sample were covered. The average heat value for an electronic waste was found to be 30,872.42 kJ/kg or 7,375 kcal/kg. Thus, electronic waste can be used as a source of energy in the future.

Deshpande and Pillai [52], give a detailed analysis on green air conditioning technologies in automobiles. The research work supports the use of silica gel-water adsorption system for air conditioners of vehicles. The above technology has been tested using a four stroke diesel engine from Mahindra and results are presented in the paper.

Bornert and Burki [53] presented a technical solution to convert low and medium temperature waste heat into electricity in highly energy intensive industries like cement. Heat conversion into electricity with ORC (Organic Rankine Cycle) power plant was covered in detail. ORC power plants can boost electrical energy efficiency in cement plants by upto 20%, reduce indirect CO₂ emissions considerably and save water at the same time. The outlines revealed the fact that high and rising energy costs and the requirement to reduce CO₂ emissions are the main drivers to invest in heat recovery systems.

Xie et al. [54], discussed the various aspects of CMOS Micro-electromechanical systems-based thermoelectric power generators (TPGs) for conversion of waste heat into electrical power. The design, modeling, characterization and fabrication steps of TPGs were covered in detail.

Razak et al. [55], high-lighted harnessing electricity from heat energy harvesting using thermo couple concept. Bismuth Telluride (Bi₂Te₃) material produced power and convert heat energy to electrical energy with having temperature differences between two sides.

Megha Tak [56], concluded that the Thermoelectric Generator or TEG waste heat recovery system could potentially offer significant fuel economy improvements. If this is achieved successfully on large scale applications such as automotive, a noticeable saving in fuel consumption can be achieved by using it in automobile sector. They have proved that it is possible to use thermoelectric convertors to light up the car headlights for large SUV cars using 80 Amp-hr on higher batteries. There is also potential to increase the conversion rate from heat to electrical energy, by using materials with better Seebeck coefficient difference and increasing efficiency of TEG's. This application, on a real scale would help in prevention of large amount of heat, preventing the environment also from damage.

Derakhshandeh et al. [57], elaborated a new generation method coordinated with PEV's charging based on DOPF for an IMG consisting of 12 factories with CHP systems,

PV generation systems coupled with PV storages and 6 types of PEVs. Both the network security and factories constraints are added in DOPF formulation. It decreases the cost of IMG by optimizing the hourly heat and electricity generation schedules for individual factories. The problem of optimization is subjected to both electric and thermal needs keeping in mind the possibilities of heat transfer between relative factories. It manages the factories such that part of required electricity is purchased from the upstream network when the price of electricity is lower than the generation cost. Otherwise, the IMG will sell electricity to increase the overall profit. It considers PEVs with time and energy related constraints as coordinated loads and optimizes their charging rates in order to minimize the cost associated with vehicle charging and to maintain the voltage profile within the acceptable limits. Finally, based on the analyses of this paper, introduction of PV generation systems coupled with PV storages in IMGs could have positive effects on their scheduling solution and minimizing the overall cost since the peak of most industrial electricity loads occur during daytime and usually coincide with the maximum output of PV generation.

Vineetha V. and Shibu K. [58], studied on single chambered less microbial fuel cell and the effect of using two types of anode on dairy wastewater treatment and electricity production which resulted in maximum electricity and voltage production on day 4th using iron coated carbon anode compared to plain carbon anode. Carole-Jean Wu [59], discussed about harvesting of heat energy of modern computing systems using COTS TEGs. They showed that with a single TEG, they can recover wasted heat from the CPU to significant electrical energy on a real-system.

4. Electricity from Miscellaneous Sources of Energy

Charles P. Steinmetz [60], demonstrated that the efficient utilization of the America's energy supply requires generating electric power where on earth hydraulic or fuel energy is available, and collecting the power electrically, just as we distribute it electrically. Richard L. Nailen [62], illustrates the use of induction generators for the process industries as a key to energy conservation. Emphasis is given to the induction generators producing "free" electric power from process energy that would otherwise be wasted. The operating principles, design and performance using performance curves, protection and control measures, along with application considerations of induction generators in waste heat applications are outlined. Examples of industrial use and the utility rates are also covered in brief.

Hammons and Geddes [63], illustrated the implication of alternative energy sources for energy generation which can replace conventional energy sources in United kingdom. Several energy sources are examined in this paper which includes, tidal power, wind power, small scale hydro turbine, use of natural gas coming out from land, wave power, municipal solid waste, biogas conversion, geothermal power which could generate an ample amount of water.

Palanichamy et al. [64] illustrated the support of government of India in saving non-renewable resources by developing more efficient energy sources. Here new technological advancements about extraction of energy from waste are discussed and comparisons of new developments have been done with old technologies.

Leung and Hui [65] reviewed the adoption of renewable energy developments in HONGKONG. Technological trends are reviewed in two stages. First stage included use of solar power, wind power and energy from waste. Second stage was to implement a building integrated photovoltaic system which gives output of 55 KW.

Tompros [66], focused on reduction of energy cost in cement industry by taking benefits of energy conservation devices. Exhaust gases and clinker coolers are utilized for generation of electricity. The comparison of heat source in cement industry with heat sources in kalina cycle power plant is shown. Thus purchase cost of power has been cutoff to some extent.

Inamdar et. al. [67], present an energy management architecture that is applicable on domestic appliances. By the effective use of latest information and communication technology, the proposed architecture is concerned about three main functions: real-time estimation of the energy consumption of the home environment; control of domestic appliances energy use; and autonomous identification and management of standby devices.

H.P and R.P. [68], explained IT based Energy Auditing for effective energy management and conservation. Computers and advanced metering technologies can be employed in industrial sector. The IT based Energy Auditing components like data measurement, data analysis program, advanced data management, network communication are also covered in detail. A case study supporting the use of Information Technology in energy management is also mentioned.

Thokair and Mansi [69], discussed application of waste hydrogen in desalination and power plant. Hydrogen calculated from a process and then used in different areas like cooling generators, generating electricity using fuel cell in UPS and source of electrolysis process. Hydrogen enhanced $\frac{1}{2}$ to 1 full load efficiency of generator. Use of recovered hydrogen leads to save money. Jae-Do Park [71], described about an efficient Microbial fuel cells also known as MFC, energy harvesting system using DC/DC converters has been presented. The proposed energy harvesters capture the energy from multiple MFCs at individually controlled operating points and at the same time forms the energy into a usable shape. The proposed parallel operation system consists of multiple harvesting converters for each MFC and a single voltage boost converter. The proposed control scheme has been validated experimentally and a successful result has been shown.

Zhang and Wang [72], told that high-concentration photovoltaic (HCPV) is a highly promising technology to directly convert plentiful solar energy to electricity. However, even for the most advanced HCPVs, about 60% of the concentrated solar energy is rejected as waste heat; therefore, it is desirable to utilize the massive waste heat from HCPV modules. Considering the nature of low-grade waste thermal energy, a micro scale organic cycle (MaRC) offers a promising solution. In a subcritical MaRC, sub cooled refrigerant is usually pumped into a micro channel heat sink of each multi-junction photovoltaic cell. In this

paper, a complete micro channel flow boiling model is developed based on distributed mass, energy and momentum conservation laws. Detailed MaRC thermal-fluid analysis is conducted to evaluate the effects of working fluid, inlet sub cooling, axial fluid/cell temperature distribution and critical heat flux on cogeneration efficiency. The performance analysis indicates that the HCPV/MORC system can achieve a net 8.8% increase of power generation efficiency in comparison to liquid-cooled HCPV at ambient temperature. The proposed HCPV /MaRC configuration shows great promise in large-scale applications of HCPV solar power generation.

Habib et al. [73], promoted closed cycle standalone than other conventional power plants due to its higher efficiency and smaller size. MHD generators also don't consist of any rotating parts. Therefore they don't require much maintenance. But the advantage of MHD are offset by difficulties of high temperature requirement (2500-3000 K) and high magnetic flux densities (5 to 6 Tesla) involving costly superconducting magnet technologies. Swapna kumari B. Patil et. al. [74], dedicated research on nonconventional waste material harvesting model taking into account economy, environmental effects and power generation related to harvesting of various waste samples. In this study several waste management scenes are compared along with the various energy and environmental factors among alternate waste management strategies; the effect of waste diversion through reuse and effective conservation of energy to restore electrical power on environmental releases and economy.

5. Conclusion

The alarming rate of increase in the waste materials around us can no more be acceptable. Hazardous wastes poison our planet and negatively affect the health of millions of people worldwide. Also, conventional sources of energy like fossil fuels are depleting at a faster rate which will lead us to energy crisis. The concept of 'Electricity from wastes' gives us a way to manage energy as well as waste. Conducted literature survey included several research papers and categorized them in 3 areas that are Bio-energy, Thermal Energy and Miscellaneous sources of energy. In bio energy we encountered many methods like incineration, anaerobic digestion, plasma gasification etc. useful in generating electricity by mitigating the bio waste. While in Thermal energy we focused on saving waste heat energy and converting into electricity. Miscellaneous sources of energy consists many waste sources like electronic waste, plastic waste, waste hydrogen in desalination etc. Every energy source has its own indispensability in its area. Hence, we conclude from our work that by effective waste management we can keep earth green forever and save ourselves from energy crisis. Even though a conclusion may review the main results or contributions of the paper, do not duplicate the abstract or the introduction. For a conclusion, you might elaborate on the importance of the work or suggest the potential applications and extensions.

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