Energy Management Contribution for Green House Gas Mitigation

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Abstract: Climate change, greenhouse gas emission, and global warming are the biggest challenges on earth nowadays. Mainly, industrialization and informal human activities contribute to this challenge. So it has become a vital need to develop and encourage alternative, renewable, eco-friendly power sources and energy managing practices with low emissions that can lead to sustainability of the power and environment system. Carbon dioxide, methane, nitrous oxide, and ozone gases are the major pollutant gases contributing to the human enhanced greenhouse effect. This paper discusses the potential of mitigating greenhouse gas emissions in various industries and propose some energy management practices for GHG mitigation. Moreover, the study presents the current greenhouse gas emission issues from agriculture, transportation, construction, and residential sectors through sustainable energy management and efficiency-improving measures.

Index Terms: Energy management, greenhouse gas emission, greenhouse gas mitigation, Srilankan Air Pollution, Sustainable development.

1 INTRODUCTION

The ways we choose to develop our cities, grow our food, and live our lives directly impact the number of greenhouse gases we put into the atmosphere. Similarly, the places we choose for our settlements, for our cities, and how we build those settlements directly influences our degree of vulnerability to the impacts of greenhouse gas (GHG) emission. GHG mitigation is another term for dealing with the causes rather than the consequences of the GHG emissions problem. In other words, the goal is to prevent GHG emissions before it starts rather than dealing with the impacts of GHG emissions once they've begun. GHG and climate change mitigation has been the most common policy response to climate change since the evidence for human interference with the planet's climatic balance began to emerge. So just a straightforward definition of mitigation based on what we know about the emission of greenhouse gases into the atmosphere is that mitigation reduces greenhouse gas emissions into the atmosphere or enhances the earth's ability, including oceans and forests, to absorb carbon. When we talk about greenhouse gas emissions, fossil fuel combustion, and organic matter decomposition are the primary anthropogenic or human-caused greenhouse gas sources. And these results from transportation, industrial processes, residential and commercial heating, cooling, waste treatment and disposal, and, of course, agriculture, etc. So implementing proper energy management is an important thing when considering those emissions. Therefore, this paper shows the impact of GHG emissions locally and globally and suggests mitigation measures to prevent it.

2 ENERGY MANAGEMENT

Almost everything we need in our daily lives depends on energy. Energy holds our economics and empowers many of the services we depend on, like our schools, hospitals, transportation, etc. But the critical point is that we have billions of people who still don't have electricity. On the other hand, those who have enjoyed its benefits have relied on sources that are harming the environment. Also, we have consumed

energy in unsustainable ways that are ultimately causing climate change and global warming, which contribute the greenhouse gas emission. Currently, most of the emissions come from the way we generate and use energy. So if we want to address climate change to achieve a green world, we need to change our practices. We need to move away from the sources causing the emissions and transition to cleaner, sustainable, and more efficient options like renewable energy using the power of sun, wind, and hydro. In the early history of human people haven't needed much energy. Then becoming more comfortable with our environment day by day, our need becomes more and more. Nowadays, cars, boats, airplanes, machinery, industry, television, computers, cooking items, and electrical appliances are part of the environment. Therefore power plants supplied boundless energy for the required demand. To produce this power, we need other energy sources such as coal, oil, uranium, wind, water, sun, sea, etc. The more electricity consumption increases more power plants and more pollution. Then we depend more on the primary energy sources. These fossil fuel-based energies pollute our atmosphere, increasing global warming, and emit a lot of greenhouse house gases as well. However, fossil fuel one day becomes too rare and depleting day by day. So energy management comes to the role. Energy management is mainly concerned with saving energy in the area like business, public sector, government sector, and the homes. Saving energy means decreasing the amount of energy use while achieving a similar outcome to the end-user. The use of less energy has lots of benefits. So mainly, energy management required particular tasks such as metering energy consumption, finding opportunities to save energy, and then taking action to target opportunities to save energy. Energy management is the crucial area to minimize environmental effects and improve the quality of the environment. It reduces the load on power plants, so if the power plant burns more and more coal or fuel oil, it contributes to global warming and acid rain because of the emission of flue gases. So less energy consumption means less thermal pollution and a more green world.

3 GLOBAL ENERGY CONSUMPTION

According to the IEA(International Energy Agency) 2018 report, 38% of coal, 23% gas, 15.8% hydro (pumped storage), 10.2% nuclear, 9.3% non-hydro renewables (wind, solar P.V., geothermal), 3% oil, 0.6 % of other sources are produced global electricity demand [1]. World electricity generation in 2018 is shown in Fig. 1, and Fig. 2 represents the global energy consumption in 2018.

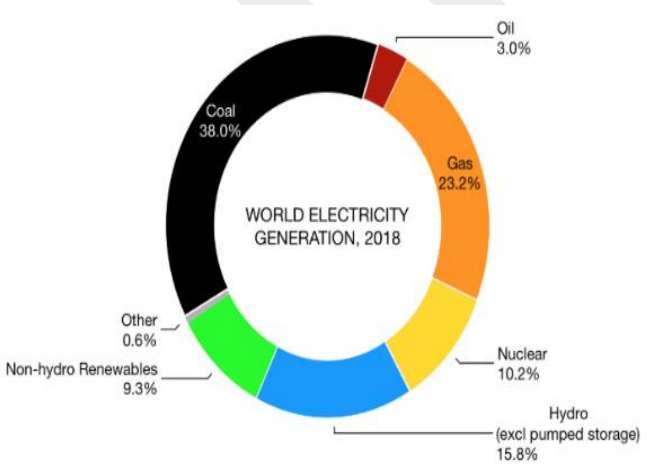

Fig. 1.World electricity generation-2018[1]

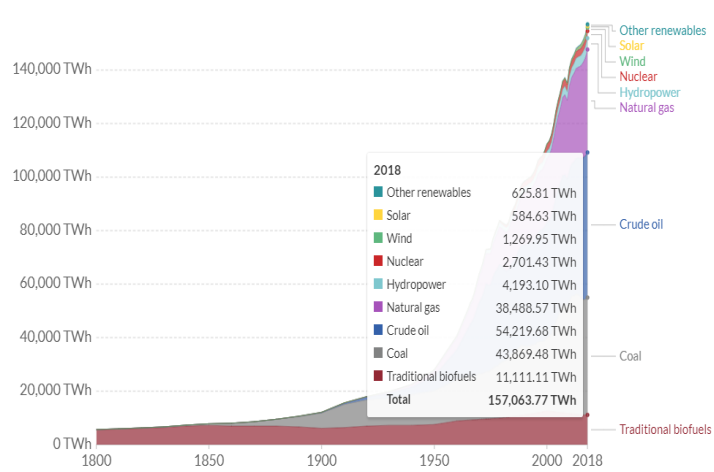

Fig. 2. Global energy consumption [2]

According to that, 54 219.68 TWh((terawatt-hours) of crude oil, 43 869.48 TWh of coal, 38 488.57 TWh

of natural gas, 11 111.11 TWh of traditional biofuels, 4 193.10 TWh of hydropower, 2 701.43 of nuclear, 1 269.95 of wind, 584.63 TWh, 625.81 TWh per year energy was consumed in 2018 [2]. According to the world meteorological organization, globally averaged carbon dioxide concentrations reached 407.8 parts per million in 2018. Fig. 3 represents the CO_2 concentration in 1990-2018 in parts per million [3].

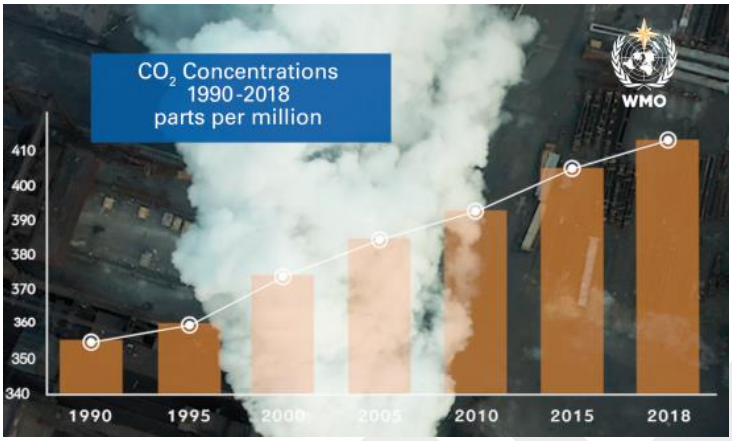

Fig. 3. Global CO_2 concentration 1990-2018 [3]

By considering all of these data, we can see that energy production and energy consumption are directly connected and contribute to CO_2 emission. When we look at the level of CO_2 emission in 1990 compare to 2018, CO_2 emission was increased rapidly and still going on. This continuous long-term trend means that future generations will be face up severe impacts.CO_2 is more long-lived greenhouse gas in the atmosphere, which is related to human activities.CH_4 is the second long-lived greenhouse gas methane and reached about 1869 parts per billion (ppb) in 2018. Then N_2O atmospheric concentration in 2018 was 331.1 parts per billion [3]. According to the Environmental Protection Agency 2014 data records, 25% of global greenhouse gas emission is done by way of electricity and heat production; on the other hand, 24% emission due to agriculture, forestry, and other land use, 21% due to industry emission, 14% due to transportation, 6% due to building construction and so on [4].

4 SRILANKA ENERGY CONSUMPTION AND GHG EMISSION

When we move on to the Sri Lankan scenario, According to the Ceylon Electricity board (C.E.B) 2018 statistical report, 41% of energy generation from hydro, on the other hand, 31% from oil, 4% from additional renewable energy such as wind, solar, dendro, biomass except mini-hydro generate the required energy demand for Sri Lanka. From that, 77% of energy supply to grid from Ceylon Electricity board and other 23% supply from private power projects such as mini-hydro, thermal oil, wind, solar, biomass, and rooftop solar. Fig. 4 shows the Srilankan 2017/18 energy generation by source and ownership [5].

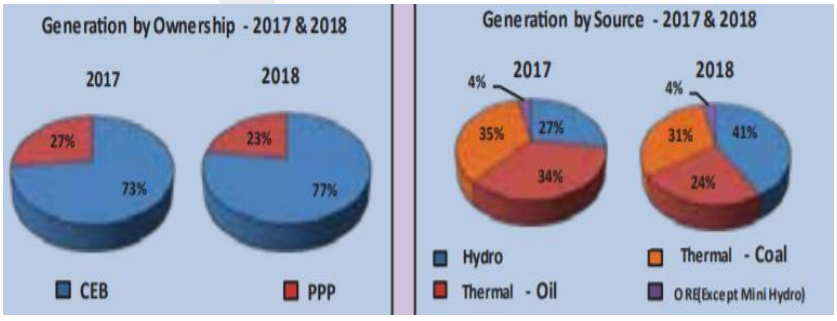

Fig.4. Srilanka energy generation by ownership and source -2017 & 2018 [5]

When we were concerned about the Sri Lankan electricity demand in 2018, 33% came from domestic consumers, 3% from industries, and 22% from government and general-purpose consumers. 13% of the electricity demand comes from bulk consumers and street lighting, and 2% is by the hotel sector [6]. So, more and more energy is generated to supply the required demand in Sri Lanka. As a result of that, GHG emissions also increased at that time and still going on. In 2018, CO_2 emissions per capita for Sri Lanka were 1.14 metric tons, and it was increased from 0.53 metric tons in 1999 to 1.14 metric tons in 2018, growing at an average annual rate of 4.50% [7]. According to the IEA CO_2 Emissions from Fuel Combustion 2018 Edition, 45% of CO_2 emitted by the transport sector, 41% from electricity and heat production, 8% from manufacturing industries and construction, 6% from other sectors [8]. Even though the electricity sector is the major contributor to emissions globally, in Sri Lanka, the transport sector contributes to the most greenhouse gas emissions.

5 GHG MITIGATION THROUGH ENERGY MANAGEMENT PRACTICES

According to the data, GHG emission is the critical area that we need to consider. Apart from that, there are other impacts of the greenhouse gas emissions such as rising sea level and temperatures, global warming, more extreme weather, water stress, disturbing marine ecosystem, and desert area increasing are considered as the some of the impacts that we could be affected due to the GHG emissions. So time is running out. Therefore it needs to optimize each area with low emission. From here, the paper will be discussed solutions for GHG mitigation through sustainable energy management practices.

6 INDUSTRY VICE GHG MITIGATION

6.1 Cement industry

After water, concrete is the most utilized substance on the planet. It's the key ingredient; cement is one of the biggest contributors to our climate crisis. It's responsible for up to 8% of the world's CO_2 emissions. In cement production, it takes a huge amount of fossil fuel energy to produce tons of cement. Cement production emits GHG gases in two ways. The first one is its use of fossil fuel to heat limestone at super-high temperatures. When the limestone chemically transforms, that process releases CO_2 into the atmosphere. In the cement industry, 14-33% of CO_2 contains in the flue gas. Other than that, CO_2 coming from the raw material(calcium carbonate) as well. When $CaCO_3$ goes through the combustion process, $CaCO_3$ is converted to calcium oxide and CO_2. Calcium oxide is the clinker where we grind and convert it as cement, and CO_2 is the byproduct of $CaCO_3$. That's why the cement industry's CO_2 emission much higher than the other industries.

As a solution for that, we can use the post-combustion carbon capture method to reduce the CO_2 emission into the atmosphere. And also, flue gas recirculation, low NOx burners, and selective catalytic reduction technologies can be used to remove the NOx as well. Attention should be given when capturing the CO_2. Because NOx and SOx should be removed before that. It's mean that dust removal, then NOx removal, SOx removal, and finally, we can remove the CO_2, respectively.

After capturing CO_2, we can store that captured CO_2 underground or ocean permanently. It can be done as geo-sequestration (The idea of this technology is to isolate the CO_2 to avoid its emit into the atmosphere. So the remaining CO_2 can be dehydrated and compressed in a liquid form. It then can be safely injected into a sedimentary basin at the ground with 1000m-3000m of depth), ocean storage, and mineral storage. Another purpose is that we can use it as a chemical feedstock for different industrial purposes. The final

purpose is that we can use it for enhanced oil recovery.

6.2 Boiler energy optimization

Boilers are the common device that every industry uses for generating steam which is used in their production process. So if we optimize the boiler efficiency through proper energy management practices, we can reduce major amounts of GHG emission. Here are some solutions to optimize boiler efficiency,

·Use alternative fuels such as briquette, palm fibers, and shell, urban solid waste, bagasse, rice husk and straw, hydrogen, oily sludge, dendro instead of fossil fuel. So it helps to lower the CO_2 emission by burning fossil fuels.

·Flue gas quantity can be controlled by controlling the excess air level which is provided for the fuel combustion

·Use economizers to preheat makeup water and improve feed water treatment efficiency to minimize the boiler blowdown.

·Make sure that the condensate return is working efficiently because condensate is already hot and needs less heat to produce steam than feed water

·Adding measuring, metering, and monitoring equipment to the boiler to check whether the fuel flow, steam flow, feedwater flow, condensate flow, and blow downflow are in an optimum range.

·Regular inspections, maintenance to ensure optimal heat transfer, and burner adjustment for the complete combustion [9].

6.3 Conducting energy audits

Energy Audit is the systematic key to approach for decision-making in energy management. The primary objective of the Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs in the selected industry. It considers all key areas in industries such as energy management systems&consumption, and flow of energy, statistics, consumption indicators, operating efficiency of equipment, energy consumption during manufacturing, energy savings, energy cost indicators, economic analysis of energy-saving projects, etc. The auditors identify the main energy conservation opportunities, such as fuel substitution, energy generation, energy distribution, energy usage by processes, and so on. At the end of the audit, the auditors able to,

- measure the energy usage by each machine, building, equipment and their wastage, failures
- Check about the actual energy requirement
- Propose how to minimize the wastage, increase the equipment efficiency
- Propose how to reduce fossil fuel requirements and suggest some alternative energies
- Check whether the ways to improve boiler, cooling towers, heating, and cooling systems
- Check green energy replacement and do cleaner production
- Check whether the ways to minimize environmental pollution and flue gas emissions
- Check how to use waste energy efficiently

Therefore, conducting an energy audit at least once per two years will be the best solution to lower the emission.

7 AGRICULTURE ENERGY MANAGEMENT AND GHG MITIGATION

Agriculture emission includes CH_4 and Nitrous Oxide emissions from livestock, manure management, flooded rice cultivation, agricultural soils and fertilizers, and burning of crop residues and savannas, CO_2 from liming, and urea applications, etc. Therefore, farming communities need to build their resilience and ability to adapt to the changing climate. Then, they can feed the growing population without further

depleting our resources, such as soil and water. Therefore we need climate-smart agriculture. At first, we need to identify the production systems, keep efficient production, improve policies and plans for sustainable agriculture, combine financing options in a new way, etc.

7.1 Animal agriculture

On dairy farms, most GHG comes from feed production, enteric methane fermentation, and manure. In pork and poultry production, manure and feed contribute equally to GHG emissions. Other than that sow barn,processing, packaging, finish barn, retail also contributes some amount of GHG emissions. In beef production feed production, cow-calf operation, feedlots are the main contributors for GHG emissions. Following mitigation measures can be suggested,

- For agricultural soil emission- In soils,NOx is formed during the phase of the nitrogen cycle. Therefore proper manure and fertilization practices, replacing commercial fertilizer with manure, reducing tillage contribute to reducing GHG.

- For enteric fermentation emission - In the beef and dairy industry, methane from enteric fermentation is the biggest contributor to GHG emission. It occurs in the rumen on animals. Methane is the byproduct of this fermentation process. Reducing enteric methane includes dietary changes such as feeding higher quality and injecting more digestible forages or a higher percentage of grain. Such feeding and nutrients practices may reduce emissions by 2.5 to 15%. However,the biggest reduction in enteric fermentation is related to gain efficiency per unit of production. For instance, healthy animals produce more product than unhealthy animals. So that should also we have to consider.

- Manure management- This system includes diet and housing, storage, treatment, and spreading. Each part of the system contributors for the emission.Therefore less manure or few nutrients in the manure reduce the emission in each part of the manure management system. Other ways to mitigate manure emissions are, at first, we should focus on animal housing and manure collection systems because they also affect GHG emissions. So mitigation options include move manure to storage sooner and keeping feedlots dry. Manure storage mitigation includes shorter storage times daily, and monthly storing allows less time to gases to form. Smaller storage surface areas, cooler manure temperature, manure covers also can be suggested as solutions for the GHG mitigation[10].

- Livestock methane emission- Supplementation with fodder trees, rice straw, and low-cost concentrate, improves productivity and reduces methane emissions by using of total mixed ration, Supplementation of forage diet with Gliricidia blocks can be accomplished bypromoting high dry matter intake [11].

Apart from animal agriculture, there having plenty of agriculture areas such as rice cultivation, wheat, corn, and so on. When we consider the wheat production, among all energy resources, 48% for fertilizer, 32% for diesel fuel consumption.12.04% for electricity.7.05% for weedicide, 0.12% for machinery contributors to the total amount of GHG emissions. The major reason for this highest CO_2 emission was higher energy use. Therefore, to overcome these issues, it can be suggested to

- use bio-fertilizer for soil fertility

- solar energy for water pumping. Those can be very effective in reducing energy consumption.
- Selecting suitable crop rotation
- modifying the planting date in agreement with rainfall occurrence for irrigation and utilization of the conservation tillage system to decrease the diesel fuel consumption and machinery usage for land preparations[12].

Organic fertilizer usage also contributes to GHG emissions. Instead of using synthetic fertilizers, we can

- Promote slow/controlled N releasing fertilizers and increasing their effectiveness
- Increase the usage of N transformation inhibitors to scale back the hydrolysis of urea to ammonium by soil urease enzyme,
- Increase the usage of compost.It is one of the simplest ways to recycle organic wastes[13].

8 RESIDENTIAL ENERGY MANAGEMENT AND GHG MITIGATION

When it comes to residence energy usages, mainly energy uses for cooking, laundry, water heating, lighting, entertainment devices (T.V., laptop, radio, etc.), refrigeration, cooling, and so on. Inefficient equipment usages,walls, pipes, windows leakages, occupants' behavior, incomplete fuel combustion mainly contribute to this effect. Therefore potential energy management practices and savings should be implemented. Some of the efficient practices can be identified as follows,

- Switching from electric to gas space heating and cooling
- Install or upgrade ceiling & loft insulation
- Insulate walls
- Draught-proof around doors and windows
- Allocate shade windows and glazed areas in summer
- Use L.E.D. efficient bulbs instead from C.F.L. and incandescent bulbs
- Replace old refrigerator with new efficient refrigerators
- Use natural ventilation instead of HVAC systems

8.1. INSTALL DOMESTIC SOLAR P.V.

By considering residents' electricity cost, climate condition, and roof shading pattern, it is better to use'on-grid net accounting solar P.V. systems.It would be suitable to accomplish the required electricity demand. Sri Lankan government launched the Rooftop Solar P.V. Programme under the theme "SooryabalaSangramaya."Under this program, excessenergy can be exported to the national grid. For that,C.E.B.is paying around LKR 22.00 per kWh during the first seven years and LKR 15.50 per kWh during the remaining thirteen years for Sri Lankan customers. To supply electricity from the power plant to our home, C.E.B. spends more than Rs.30.00 per KWh. On the other hand, fromhome itself, we can get electricity using solar P.V. units only for less than Rs. 10.00 per KWh [14].

9 TRANSPORT SECTOR ENERGY MANAGEMENT AND GHG MITIGATION

As mentioned earlier, transportation contributed to the GHG effect by 14% globally and 45% locally. It is the largest sector that emits CO_2. Therefore it is better to introduce and implement energy management by identifying eachof the factors that contributed to this disaster. So this can be a huge challenge. The use of petroleum fuelis one of the major reasons for this emission. It creates more carbon intense in the

atmosphere.

According to the data from the Economic and social statistics of Sri Lanka 2018 report,the total number of vehicles registered in 2012 is 397,295. Thatwas increased up to 451,653 in 2017. From that majority of vehicles are used petrol as fuel and others are used diesel and both. The least number of people are using electric vehicles [15]. Many actions can be taken to reduce GHG emissions from the transport sector. Rather than cutting carbon, it is better to decrease fuel consumption, and our dependence on foreign oil can save consumers money and environment as well. Following energy management practices can be implemented.

9.1. Switching from fossil fuel to alternative energy

Compresses natural gas,biodiesel,ethanol,electricity,hydrogen,renewable natural gas can be identified as alternative energies for transportation.For example, we cannot say that electric vehicles have zero emissions, those are completely eco friendly, and so on. When we consider the entire lifecycle CO_2 analysis of vehicles, it reveals that conventional vehicle(CV) produces 62,866 kg CO_2 equivalents, hybrid produce 40,733 kg CO_2 equivalents, and battery electric vehicle(BEV) produces 31,821 kg CO_2 equivalents. So the lifecycle emissions result, revealing that the BEV is the most efficient compared to the hybrid and CV [16]. The government of Srilanka provides lots of facilities to people who are using electric vehicles. They located the E.V. charging stations all over the country and provided adequate charging facilities at a low rate. The problem is people still fearusing E.V. vehicles as they didn't much awareness about that. Fig.5 shows the E.V. charging stations, and Table 1 shows that the available tariffs for E.V. charging at Srilanka, respectively.

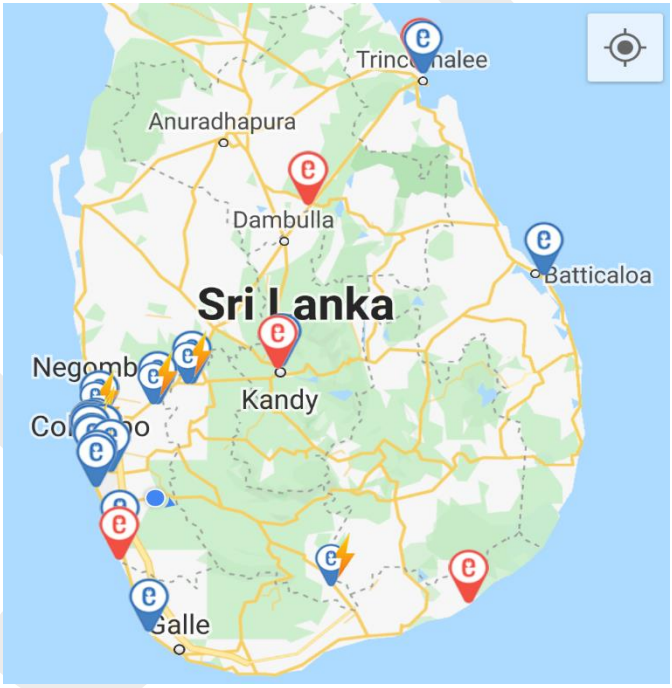

Fig.5. BEV Charging station at Srilanka[18]

For example, Nissan leaf electric car requires 9KWh to charge the car up to 150 Km. So it only requires Rs. 450.00 to travel up to 150 Km distance. If it is used petrol or diesel car it requires more than Rs. 1000.00. So time to change now.

Table.1. S.L. E.V. charging tariff[17]

Time of Use	**DC fast charging Rs./KWh**
Transportation with C.E.B. E.V. charging	
Day time(5.30 am to 6.30 pm)	50.00
Peak time (6.30 pm to 10.30 pm)	70.00
Off peak Time(10.30pm to 5.30am)	30.00
Transportation with ChargeNet charging	
24 hours	70.00

One the other hand we can use solar power to charge our electric car instead of using electricity. It will be a greater solution rather than using electricity.

Biofuels also used as alternative fuels for the transport section. Wood residues, bagasse, rice husk, agro residues, animal manure, municipal and industrial waste, sugar, starch, vegetable oil, palm oil, coconut oil, wheat straw, corn, algae can be considered as the examples for the biomaterial which are used for biofuel production. Biofuels have near-carbon neutrality,short ignition delay, high ignition temperature, pressure, and peak heat release, as well as low CO_2emissions;therefore, they are considered one of the most promising alternative energy sources for transportation [19].

9.2. Incremental vehicle technologies on-road efficiency improvements

This process includes efficient combustion, fuel direct injection, cylinder deactivation, efficient transmissions, automated manual and continuously variable, increase overall vehicle advance by aerodynamics and light-weighting. From these technologies, GHG emissions rates can be reduced by 20%-30%. On-road efficiency improvements include vehicle maintenance practices with tires, wheels, oil, and air filters, and those arereduced GHG emissions by 20% [20].

9.3. Other suggestions for eco-friendly low emission transportation

- Introducing electronic buses to public transportation and allocating charging stations to charge them
- Introducing a separate lane for the public transport buses on roads which leads to reduce traffic jams
- Introducing a separate line for foot cycle in cities and will turn to improve the health of the people as well
- Introducing electronic trams (Trams are not trains, but they are special transport system which operates only within the cities)
- Introducing particular regulations related to transportation

10. ENERGY STORAGE DEVICES FOR GHG MITIGATION

Making low CO_2 emission resources such as hydro, wind, solar, biomass, marine energy, and geothermal is one of the biggest discovered in this decade. As mentioned earlier, according to the C.E.B. Statistical Digest 2018 report, 41% of our national electricity comes from hydropower. Wind & solar power also continuously growing; on the other hand, water can also play an important role in bringing more resources to the power grid. There are plenty of technologies that have been developed to store these energies and connecting them to the existing transmission network.

10.1 Pump storage hydropower

Oneway is storing energy through a technology known as pump storage hydropower. It's like a big battery which response to various power demand. We can use wind, hydro and solar power as a solution for this technology. Wind power only can be generated when the wind is blowing. Solar power also generated when the sun is shining. Therefore, the variation of climate change should be considered the whole time. So there is a need for backup capacity to generate power on day time with no wind or no solar. Electricity supply is high when the sun is shining and the wind blowing. So, in the pump storage hydropower system, water pumps to a higher elevation reservoir. Then after the sun goes down and wind stop blowing, water release back to the lower reservoir. This process contributes to filling in gaps during peak demand and generate the needed electricity. So rather than using fossil fuel-generated electricity, it's beneficial to use solar or wind power to run those pumps in the day time and generateelectricity. Then that generated electricity we can use in the night time. Pump storage most dominant for energy storage on the electric grid today because it is keeping the grid more reliable and ready to add more renewable electricity mix at low operating cost and without emitting greenhouse gas as well.

10.2 Biomethane

Every year million tons of waste products from agriculture, agri-food sector, animal waste, household waste, agro-industrial, or organic solid waste. These are the raw material from which biomethane is made. It's renewable energy, which is equaled to natural gas. Biologically generated methane is contributing to the green gas emission because methane is the second largest compound that is increasing global warming. The waste is collected at a methanation facility. Then it transformed into the biogas. The biogas produced is purified to ensure the same quality as natural gas. It became biomethane and odorized for safety. Produced biogas can be used as an automotive fuel for transportation, for central heating, for cooking or heat water, produced electricity and powered the energy storage devices as well.

11. CONSTRUCTION SECTOR AND GHG MITIGATION

The construction sector is the largest global consumer of materials, and buildings are responsible for 19% of global greenhouse gas (GHG) emissions.Construction materials have a significant direct impact on greenhouse gasemissions and global warming potential. Some amount of CO_2, CH_4, and N_2O are emitted during production, installation, maintenance, and end-of-life disposal of construction materials. Emissions from the construction equipment and tools are another source of GHG emission. This emission depends on the type of energy used to operateequipment, equipment capacity, and duration of equipment operation. Fossil fuel operated equipment emits relatively higher GHG than tools operated by electricity. Therefore, it needs to develop a proper model for planning construction activities and processes tosupport optimizing the construction plans to minimize global warming potential. This model shouldconsists and capable of,

(1) analyzing the lifecycle global warming potential impacts of construction materials

(2) estimating the global warming impacts expected from the operation of construction equipment

(3) evaluating the impact of construction activities and processes on the total project cost and duration

(4) optimizing the utilization of construction resources (materials and crews) to identify the construction plans that provide optimal tradeoffs between minimizing GWP, construction cost, and duration[21].

To achieve savings from buildings, each of industries should encourage to innovate better designs, better technologies to come together to deliver the same output. Here are some sustainable energy managing solutions to change the building into the green buildings,

- Fixingsolar panels to meets the electricity demand
- Do weatherization for door frames and use operable windows
- Use skylights glass sheet for roof
- Innovative insulation material for walls and roof
- Use thermal insulation concrete
- Design building with more natural ventilation areas then we can reduce our HVAC systems operation
- Automative glasses for buildings

11.1 Introducing sustainable housing apartment

As a first step towards this need, SriLanka established the first fully sustainable apartment in the administrative Capital of Sri Jayawardenepura, Kotte. Fig 6 shows the side view of that housing apartment.

Fig.6. Fully sustainable apartment in Kotte [22]

This amazing develop consist,

- Zero Carbon – A 15,000 sq. Ft. Solar roof generates all the power which need for occupants in the complex needs.
- Local and Sustainable Food is the concept of an urban vertical farm that produces chemical fertilizer-free, pesticide-free, weedicide free fruits, and vegetables within the building.
- Sustainable Transport-free electric vehicles charged with solar renewable energy(Ten free electric vehicles for carpooling).
- Heat and fireproof sustainable materials are used for construction
- Zero Waste – Waste will be recycled, composted, and used in the vertical gardens and farm with excess sold as organic fertilizer.
- Sustainable Water – Harvested rainwater and recycled water are used for the vertical gardens and farm.

- Sustainable Materials – Alternative aggregates to river sand make the walls soundproof, heat, and fire retardant and reduces the carbon emissions of the building further [22].

If we continue this type of constructions in the future then that will be a greater GHG mitigation option from the construction sector.

12 CONCLUSION

Globally, most percentage of CO_2 emissions coming from power generation, agriculture, then transport, industries, and finally from the households, respectively. So this article recognized that how we identified our growing need for electrical energy with a fight against GHG emission and climate change. When electricity production, transportation represent the most CO_2 emissions into the atmosphere, the answer lies in the new society that is emerging more energy-efficient, more digital, with the use of more electrical devices, new technologies, and virtual interactions. As a solution, clean energy sources of power can help to meet the newly emerging needs. With all of that, there is a clear path through the world with better control of low CO_2 emissions. Reducing GHG emissions in the transport sector, industries, agriculture, the construction sector is quite difficult. But there is a need for an active reaction; otherwise, we cannot survive on earth in the future because it's already started to deplete day by day. Power generation also has a set of challenges. So energy management comes to the role and giving solutions as possible. People look through a variety of solutions for their answers. They have identified different mitigation areas to reduce these emissions. In order to be more effective, reduce energy-efficient power plants that use fossil fuel to generate electricity is a big challenge. Because we need to produce the same amount of energy by using less amount of fuel and low GHG emissions. Capture and storage of CO_2 released by power plants involve in all fossil fuel power plants and results in the production of carbon-free energy even in the raw material containing carbon. Throughout the paper, we were able to identify the proper GHG mitigation for the industries,post-combustion carbon capture systems, NO capturing devices, SOx capturing devices, boiler optimization, conducting energy auditing, and so on. Manure management, fertilizer replacement, soil management was identified as the mitigation measure for the agricultural GHG emission. When we consider the residential sector, implementing domestic solar panels and keeping good occupant behaviors were found as solutions. Increasing BEV vehicles, new technologies, developing smart public transport are the key management practices for transportation. Sustainable energy storage devices and introducing smart housing apartments are the other key areas that we should implement.

Not only that but also each one of us can also save the planet and reduce the emission. Every day that lots of waste we produce and that not much think about it. Turn the light off, disconnect the computer, microwave by simply lowering our consumption of energy and direct contributors to change the emission rate. Every one of us has the responsibility of consuming this energy. We need to raise our power, and that means we need to do it better, and we need to do it faster. And the time to act is now. Can we move to the right way to protect our planet?

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