cifal Jeju

unitar
United Nations Institute for Training and Research

Articles on Renewable Energy and Transport Policy Portfolio

Bangladesh, Cambodia, Indonesia, India, Nigeria,
Nepal, Sri Lanka, and the Philippines

2021. May

Table of Contents

Articles on Renewable Energy
and Transport Policy Portfolio

Workshop Overview

Scaling-up Renewable Energy Ambition in Future Transport

6 – 11 May 2021

Background

Transport sector has highest energy demand compared to other sectors such as heating/cooling and power, while still relying heavily on fossil fuels. Its share of renewable energy among end-use sectors stands at by far the lowest at 3.7%.[1] Therefore, in view of the transport sector's importance for a global energy transition to a sustainable energy system and to be on track to meet global climate goals for 2030 and 2050, renewables uptake in the transport sector is called for.

The energy transition to renewables in transport is predominantly going to be through electrification for zero emissions, especially when it comes to road transport. For instance, electrically charged passenger vehicle will account for 31% of global vehicle fleet.[2]

As such, manufacturers are increasingly under pressure to produce low or zero emission vehicles. On the political side, when expanding the use of renewables in the transport sector, the primary focuses of policy makers have been to improve local air pollution and to meet greenhouse gas emissions targets. In this context, a wide range of policy measures are being taken place: Design ambitious transport targets, support charging infrastructure, introduce financial incentives for electric vehicles, adjust regulation and standardization, reform public procurements.[3]

Yet, it has been pointed out that many countries lack a holistic strategy for decarbonizing transport. The rail, aviation and maritime transport sectors continued to receive less policy attention than the road transport sector[4]. Other barriers to mass adoption of environmentally friendly vehicles include lack of infrastructure (charging station) and public support (regulatory incentives, setting ambitious policy targets, etc.). In addition, for an expected acceleration of electrification of the transport sector, technology innovation and price competitiveness that support energy transition in transport should be expected.

However, the responsibility of adopting sustainable energy system in the transport sector does not and cannot fall on one country or one government alone. A global energy shift towards renewables needs holistic, innovative, sustainable, and responsive policies that can only be implemented effectively with international cooperation.

In this regard, this online event will help participants to raise awareness on the current status of renewable energy portfolio in the transport sector and the potential of energy transition to achieve sustainable development goals. The workshop will also provide a platform for participants to share and exchange their good practices and challenges regarding the renewable energy and transport policy.

1. Global Status Report, REN21 (2019), https://www.ren21.net/wp-content/uploads/2019/05/gsr_2020_full_report_en.pdf

2. https://about.bnef.com/electric-vehicle-outlook/

3. Innovation Outlook: Smart charging for electric vehicles, IRENA (2019)

4. Global Status Report, REN21 (2019), https://www.ren21.net/wp-content/uploads/2019/05/gsr_2020_full_report_en.pdf

Articles on Renewable Energy
and Transport Policy Portfolio

Best Article

Renewable Energy Portfolio in Sri Lanka

By Pubudu Piumal Kalinga, Project Manager, Strategic Cities Development Project
Ministry of Urban Development and Housing

Vehicle emissions contribute more than 60% of ambient air pollution in Sri Lanka. This is mainly due to combustion of combustion of fossil fuels in the vehicles. In Sri Lanka, more than 99.9% vehicles are conventional vehicles powered by either petrol or diesel. As per the study conducted by the ADB, in 2015, about 7,000 electrically powered vehicles were running on roads, meaning only 0.11% of country's vehicle fleet converted to environmental friendly electric vehicles (EV). Further, the ADB report indicated that in year 2000, 26% of total national energy used for transport sector in Sri Lanka and per capita transport energy consumption is 91 ktoe/person. Out of fossil fuel use in the country, 45% of fossil fuel used for transport sector.

The fingers indicated that the impact of transport sector on total energy demand in the country, which is dominated by non-renewable fossil fuel energy supply. Still, the transport sector entirely depends on petroleum in Sri Lanka (figure 1: Energy balance for year 2018 published by the SEASL). On the other hand, trend of energy usage by sectors clearly indicated (see figure 2: Energy use by sectors in Sri Lanka published by SEASL), energy demand for transport sector is increasing along with increasing transport needs and vehicle population with time. Therefore, Sri Lanka does not have any other option, they should reduce combustion of fossil fuel in transport sector and find alternative sustainable transport mechanisms in order to reduce air pollution and safeguard the environment.

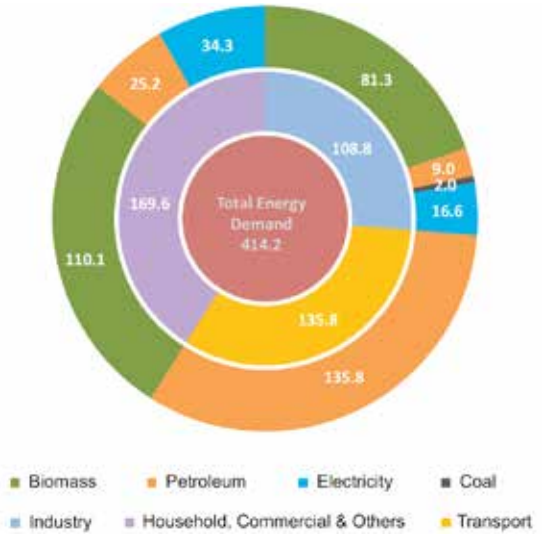


Figure 1: Energy balance for year 2018 (in PJ)

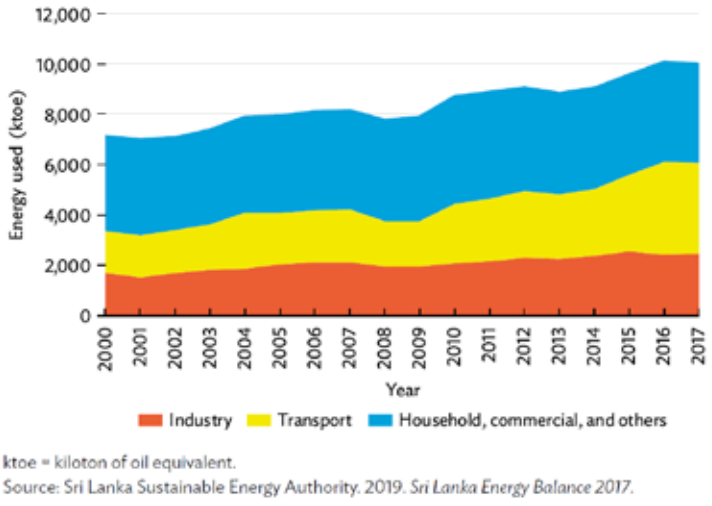


Figure 2: Energy use by sectors in SL (2000 to 2017)

Vehicle population has been grammatically increased with the time due in-efficient public transport facilities (figure 4: Vehicle Population curve published by the Ceylon Chamber of Commerce in 2016). As per the statistics of Ceylon chamber of commerce, annual vehicle population growth is 7.1% in Sri Lanka, which is mainly due to incremental of private conventional fossil fuel powered vehicles. Accordingly, demand for the fossil fuel in the transport sector has grown up (See figure 3: Fuel Demand in transport sector published by the SEASL)

Figure 3: Vehicle Population Growth

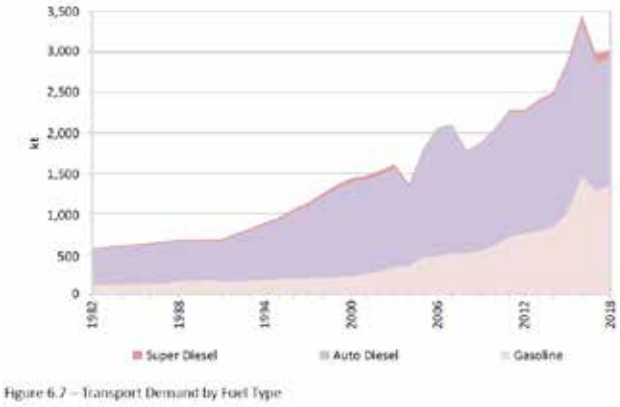


Figure 4: Fuel Demand in Transport Sector

Since year 2013, Government of Sri Lanka (GoSL) tried hard to promote importing EVs by changing their taxation policies. In 2017, GoSL released their “Blue-Green-Budget” targeting sustainable environment friendly economic establishment. As per the Blue-Green-Budget, importation tax for EVs were reduced considerable rate compare to conventional fossil fuel powered vehicles to encourage importation of EVs and GoSL exposed Carbon Tax on motor vehicles based on the engine capacity of fuel powered vehicle, other than electric vehicles to discourage usage of fuel powered vehicle. However, still the government failed get booster in e-mobility sector in Sri Lanka due to varies seasons such as lack of appropriate and affordable technology, lack of investments on research and development and facilitation infrastructure and instability of government policies.

However, as a most important initiative in Sri Lanka’s RE sector, GoSL has established the Sri Lanka Sustainability Energy Authority (SLSEA) in 2007 with the aim of forming a key institution, which would drive energy efficiency throughout the island by proactively identifying sustainable energy resources, which could generate energy in an effective, efficient and eco-friendly manner. Now, SLSEA facilitates the development of nation’s rich energy resources, including solar, wind, water and bioenergy. Further, Green Building Council of Sri Lanka (GBCSL) was established in 2009, which is the Sri Lanka’s leading authority on implementing green concept and green building practices. Now as a result to the positive side of Sri Lanka’s mobility and transport industry, most of transport infrastructure included Removable Energy as main energy supply source. Most of carparks, walkways and highways are light up with solar energy, which is cost effective in long run and environment friendly. Very recent example is Colombo Municipal Council has established parking meters powered by solar panels.

Figure 4: Solar Powered Street Lamps

Figure 5: Solar Powered Parking Meters

Future of RE in Transport sector of Sri Lanka;

Sustainable Sri Lanka Vision 2030 launched in year 2019 to elaborate the strategic path to achieve UN Stainable Development Goals by year 2030. To meet the targets of Sustainable Development Goals, Sri Lanka intends to reduce GHG emissions unconditionally by 7 percent by 2030 compared to a business-as-usual scenario, and a conditional reduction of 23 percent that would increase reductions from energy to 16 percent and 7 percent from other sectors.

Mainly, it is planned promote e-mobility by encouraging electrically powered personal vehicles and public vehicles. However, the GoSL planned to upgrade railway system by electrifying the suburban railway network, which will increase the energy efficiency in transport sector.

Major Potentials and Challenges when Introducing RE into Transport Sector;

Electric vehicles are highly feasible option in sustainable transport in the country due to geographical nature of the country. The Sri Lanka is small island with maximum distance between two point in Sri Lanka is 530Km. Therefore, available energy storage technology can be cater such range of transport easily.

However, still there are a lot of technology gaps need to be addressed to ensure the sustainability of e-mobility. For example; most of storage technologies developed by countries like Japan, Korea, Germany and China is not suitable for Sri Lankan hot climate. Further, cost of energy storage or battery replacement cost is still unbearable to the country like Sri Lanka. Again, the still Sri Lanka could find best disposal methods or recycling technologies for used batteries and solar panels…etc in order to avoid the environment pollution due to disposal of batteries.

Therefore, Sri Lanka should encourage private and public investments on research and development for RE usage in transport sector. Finding an appropriate and affordable technology which is suitable to the county will be a turning point of scaling up RE in transport sector in Sri Lanka. However, future of RE is the bright because cost of RE technology is getting cheaper with time.

Articles on Renewable Energy
and Transport Policy Portfolio

Bangladesh

Renewable Energy Scenario in Bangladesh: Assessing the Prospect in Transportation Sector

Hridita Ferdous, M.S (Petroleum Geology)
Environment and Social Development Organization - ESDO

Author Note
This paper was submitted as a requisite of the UNITAR CIFAL Jeju's Online Workshop on Scaling-up Renewable Energy Ambition in Future Transport held on May 6th and 11th 2021.

Introduction

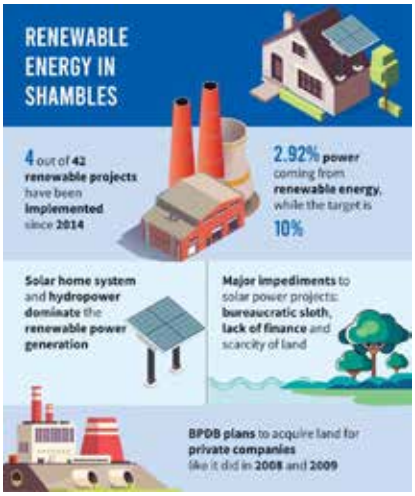
Bangladesh needs to develop and grow its power generation system to increase the energy access rate to 100%. Building new power plants – regardless of what innovation – will require new framework, for example, power grids, spatial arranging, a steady arrangement structure and admittance to fund. With diminished costs for sunlight based photovoltaic and inland wind lately, renewables have gotten a monetary option in contrast to building new gas or coal power plants.

Transport sector is a major consumer of energy in Bangladesh. The share of transport sector in the total consumption of petroleum products is about 54%, which is about 2.5 times higher than the agricultural sector or 18 times higher than the industrial sector (Rahman, 2009). Therefore, if this sector is addressed with renewable energy so huge change can be made in terms of reducing fossil fuel dependency and carbon emissions.

Keywords: Bangladesh, Transport, Renewable Energy, Biofuel, Biomethane

Present Scenario of Bangladesh and Possible Assessments

The government's goal to significantly increase renewable power generation within this year has gone miserably off track as only four out of 42 renewable power projects have been implemented in the last six years. To ensure national energy security where power would be supplied from multiple sources, the government a decade ago planned to have at least 10 percent of total electricity from renewable sources within 2020. However, the real number is less than 3 percent. In Bangladesh, all the renewable energy projects have been designed to enhance power sector rather than addressing transportation sector. Biofuel can be introduced to address our transport sector. Bio fuels can be produced from a variety of plants like rapeseed, mustard, corn, sunflower, canola algae, soybean, pulses, sugarcane, wheat, maize, and palm. The most popular option for producing bio-fuels is from non-edible oilseed bearing trees. The two most suitable species are: Jamal gota (Jatropha curcas) and Verenda (RicinusCommunis). Both of these trees can grow virtually anywhere in any soil and geo- climatic condition. Bio-fuel use is not new in Bangladesh. In the early 20th century, bio-fuel was used for lighting lamps or lanterns. In an agriculturally based country like Bangladesh, bio-fuel can be a better alternative because a 30 percent blend of bio-fuel can be used along with our diesel or petrol. This can also be an excellent fuel to kindle lamps in rural Bangladesh. Biomethane can also be produced by anaerobic digestion of organic waste. In Dhaka City, the capital of Bangladesh around 1.3 kg per capita/day waste were generated and among them 60-70% in organic waste. So, by producing biomethane waste management problem can also be solved.



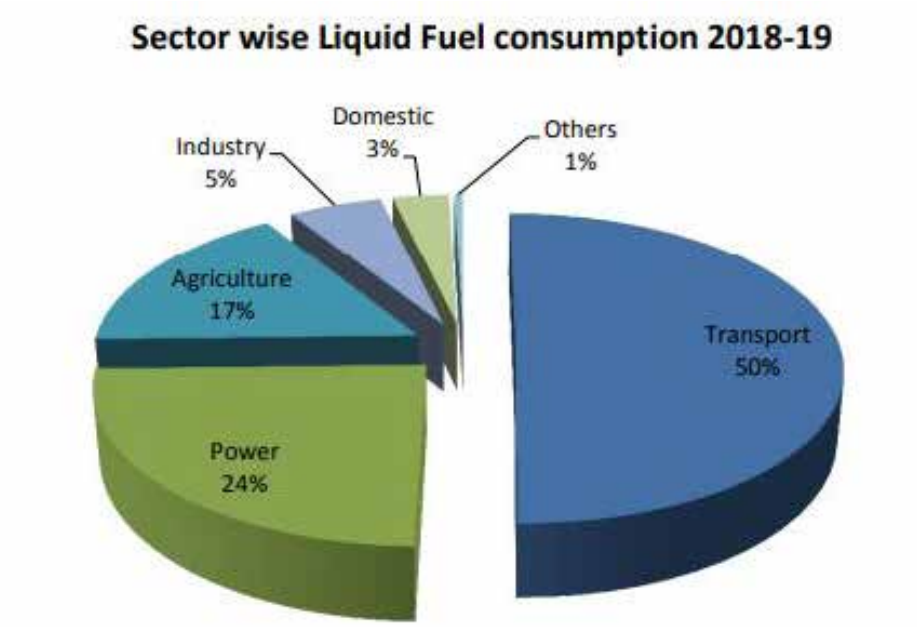


Figure 1: Sector-wise Liquid Fuel Consumption in Bangladesh in Year 2018-19 [Source: (Energy Scenario Bangladesh 2018-19)]

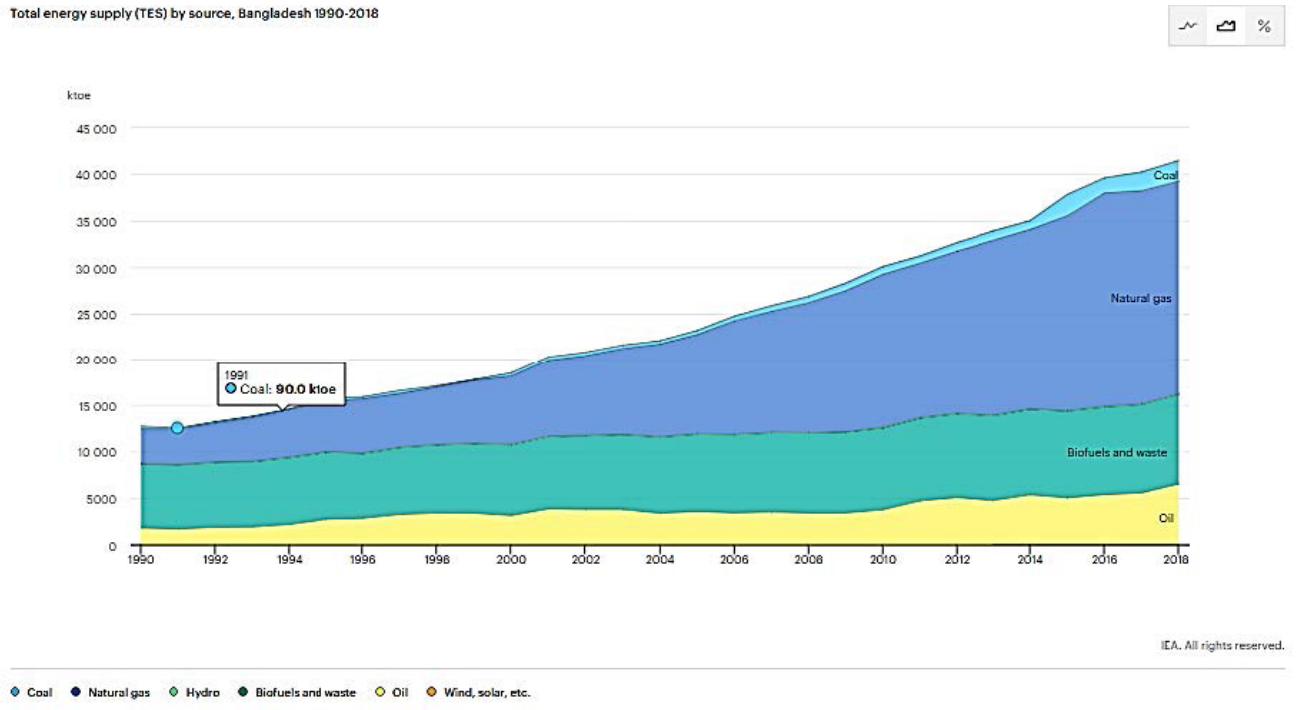


Figure 2: Total energy supply (TES) by source, Bangladesh 1990-2018 [Source: (IEA, n.d.)]

To address the climate change and environmental pollution issues in Bangladesh, one of the way of producing biomethane can be to capture the gas in landfills. Methane in landfills is produced when the organic matter is covered and compressed with the material from above preventing oxygen from reaching the organic material. This creates anaerobic digestion and production of methane which can be captured on site. However, biomethane production in landfills is problematic because methane is explosive in contact with oxygen and because it is difficult

to capture it completely. And since methane is as much as 20 times as potent greenhouse gas as carbon dioxide, production of biomethane in landfills may contribute to global warming. In addition, landfill gas also contains a number of other gases which either pollute the air or increase the greenhouse effect, or both.

Anaerobic digestion is a natural biological process when bacteria break down organic matter in environments with little or no oxygen. A controlled enclosed version of the anaerobic breakdown of organic waste is a landfill process which releases methane as one of end products. Several research groups have shown that the AD process can be split into three main stages: hydrolysis, acidogenesis and methanogenesis as show in Figure-3.

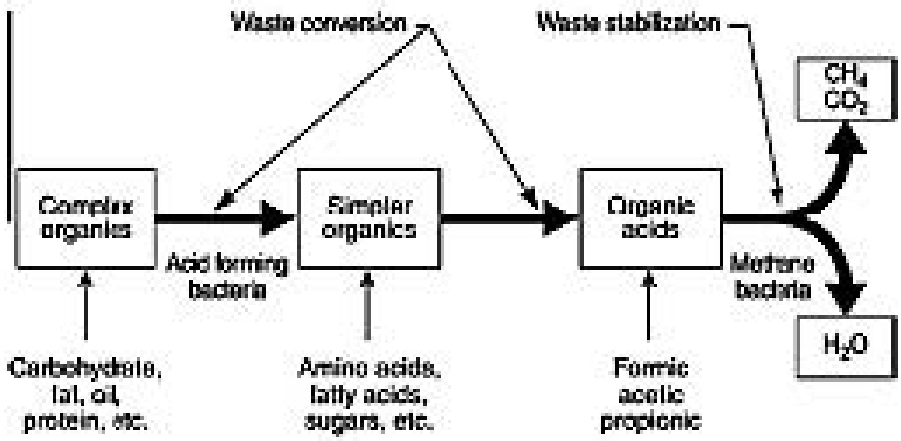


Figure 3: Schematics of anaerobic digestion process

Anaerobic fermentation significantly reduces the total mass of waste, generates solid or liquid fertilizer and yields energy. It can be maintained at psychrophilic conditions (12–16 C, e.g., in landfills, swamps or sediments), mesophilic conditions (35–37 C, e.g., in the rumen and in anaerobic digester) or thermophilic conditions (55–60 C; e.g., in anaerobic digesters or geothermally heated ecosystems).

There are six different city corporations in Bangladesh. In Sylhet City Corporation, Household waste per day was 130-150 tonnes in 2014[1] and among them organic waste is 67% of total waste. So around 94 tonnes organic waste would be generated per day. Some digesters can yield 20 m3 of biogas per tonne of waste while others can yield as much as 800 m3 per tonne. It all depends on waste quality, digester design and proper operation of the system[2].

So alone from Sylhet City Corporation, minimum 1880 m3 tonnes biogas can be produced per day in Bangladesh.

Conclusions

One of the main pollutants responsible for climate change is carbon dioxide. Because of the excessive use of fossil fuels, climate change is now a burning issue. Humans are responsible for anthropogenic climate change. One of the reasons is the excessive use of cars in our day to day lives, carbon dioxide from the combustion of car fuels is accumulating in the atmosphere. Bangladesh is still a developing country. For this very reason many other alternatives, such as hydrogen fuel cells and electric cars are very difficult to import to Bangladesh. Biofuel can be produced from organic waste centrally as a solution to this particular issue. Until renewable energy is introduced to the transport sector, the most approachable methods for the reduction of car use are carpooling, bicycling and public transport.

---

1. https://www.researchgate.net/publication/328852209_MUNICIPAL_SOLID_WASTE_MANAGEMENT_IN_SYLHET_CITY_CORPORATION

2. https://www.biogasworld.com/biogas-faq/

Articles on Renewable Energy and Transport Policy Portfolio

Cambodia

Cambodia's Renewable Energy Portfolio In Transport Sector

KINGDOM OF CAMBODIA NATION REGOIN KING

MS. TAK KUNTHEA

1. Introduction

1.1 Background

Between 1995 and 2018, Cambodia had one of the fastest-growing economies in the world, with an average annual GDP growth rate of 7.7%. (RGC, 2019; World Bank, 2019). Phnom Penh, Cambodia's capital and most populous city, has a population of more than 2 million people, with a projected increase to 3 million by 2035. Cambodia has experienced rapid economic growth, increased wages, and population growth.

Governments play an important role in speeding up the energy transition. Governments must pass an enabling policy structure that gives the private sector long-term stability and creates a favorable climate for the energy transition. To generate financial incentives for low-carbon energy solutions, market signals must be implemented. This paper is important in a global context.

Currently, only around 60% of the population has access to electricity. To meet the rising demand and to increase the electrification rate, the government has put forward an ambitious plan to boost domestic energy production, mainly through the construction of hydropower and coal power plants.

To overcome its energy challenges, Cambodia needs energy transition strategies. Energy transition policies, if properly implemented, would strengthen Cambodia's energy security by increasing domestic renewable energy production and reducing reliance on imports. The energy transition would also help the government achieve its national target of providing affordable electricity to at least 70% of the population.

Petrol, like gasoline, diesel, heavy fuel, and fuel oil, has historically been the key source of energy for transportation in Cambodia. Caltex, Sokimex Group Co.Ltd, Kampuchea Tela Co.Ltd, PTT (Cambodia), Tota Cambodia, Bright Victor Mekong Petroleum, Savimex, and LHR are the eight largest petroleum distributors in Cambodia. Cambodia has progressed from a low-income nation to a low-middle-income country.

The total primary energy supply in Cambodia was about 4.8 million tons of oil equivalent in 2015.

- Fuel wood and other biomass accounted for an estimated 44.4% of the total.
- Oil and petroleum products for 38.5%.
- coal for 10.7%
- hydropower for 3.6%
- Electricity imports for 2.8%.

The share of coal and electricity in Cambodia's energy supply increased significantly from 2010 to 2015 with the commissioning of new coal and hydropower plants; during this period, the share of coal increased from 0.7% to 10.7%, while the share of hydropower increased from 0.1% to 3.6%.

In 2015, renewable energy accounted for 65% of Cambodia's total energy consumption, according to Tracking SDG7: The Energy Progress Report released in May 2018 of this includes:

- 46% came from traditional biomass such as wood and charcoal
- 15% from modern biomass such as biogas produced from human and animal waste.
- 3% from hydropower.

1.2 Cambodia's transport Sector

In Cambodia, the transportation sector plays a critical role in fostering economic growth and mobility. Rectangular Strategy IV of the Royal Government of Cambodia (RGC) aims to strengthen transportation connectivity and develop effective logistic systems in order to boost economic competitiveness and diversification (RGC, 2018). Cambodia's Industrial Development Policy (2015-2025) has a lot of space for improvement. Agriculture, tourism, manufacturing (primarily garment exports), and construction are the four key sectors that drive Cambodia's economy. For transporting and exporting agricultural products, the agricultural sector needs road transportation, while the tourism sector requires road and water transportation to tourist destinations. The manufacturing and construction sectors depend on road and water transportation as well.

1.3 Cambodia's Energy situation

Cambodia has a significant amount of untapped renewable energy capacity. Cambodia has the second highest hydropower capacity in the lower Mekong basin, thanks to its abundant waterways. Just about a tenth of the estimated 10,000 MW has been used so far. Hydropower produced 929 MW by the end of 2016, accounting for 60% of total installed capacity and 33% of total generation sources. 20 Big dams, on the other

hand, may have negative consequences. For 82 percent of the population, traditional biomass remains the primary source of cooking fuel. In terms of electricity generation, although large hydropower accounted for 52 percent of total national electricity capacity (980 MW out of 1,878 MW total capacity) in 2017, Cambodia's non-large hydrorenewable generation capacity was relatively small, at around 30 MW.

2. Governmental Policy

- Phnom Penh transport master plan is a comprehensive and integrated transport sector master plan with target year 0f 2035 include with the shortlist of recommendation, pre-feasibility study for priority project. The recommendation include a shift of public transport a combination of bus rapid transit, and public buses.
- Encouraging the private sector to invest in electricity generation and transmission and distribution infrastructure by focusing on technical and economic efficiency and minimizing environmental and social impacts.
- Expanding the capacity of low-cost and high-tech electricity production, especially from new and clean energy sources, along with continued development of all levels of the transmission network aimed at strengthening energy security and ensuring efficient, safe, high-quality, reliable, and affordable electricity supply and distribution to respond to development needs.
- Supporting the Renewable to help achieve equitable electricity access for the population through funds from EDC and other government budget allocation, as well as funding support from development partners.
- stepping up the implementation of the electrification strategy (paras. 81–90) to meet the goal that all villages in Cambodia will have access to electricity from the national grid or other sources by 2020
- further strengthening institutional capacity, human resources, and planning and management of the energy sector

- The national strategy plan seeking capacity building and institutional reforms in order to supply efficiency, encourage, and promote efficiency the use of renewable energy.
- Royal government of Cambodia focus on large-scale hydropower and rural electrification.
- Most donor and NGO activities in renewable energy focused on off-grid solution in Cambodia's rural area. These have include small-scale, and pilot program promoting uptake of PV system, biomass gasification, and micro-hydro. Current initiative includes:

- UNDP,
- Global Environmental Facility (GEF)
- Agence Francaise de development (AFD)
- KOICA
- EU
- GERES…..

Nowadays, Ministry of Environment have conduce the strategy plans to educate people, incorporating sustainable transport in the school curriculum. Advertised and promoted environment through social Medias and created Youth on Environmental debate competition, MoE has been contribute with private sector to promote transportation in E-vehicles and integrating EMs into Government fleets, it would also increase public exposure. transportation in Cambodia. Caltex, Sokimex Group Co.Ltd, Kampuchea Tela Co.Ltd, PTT (Cambodia), Tota Cambodia, Bright Victor Mekong Petroleum, Savimex, and LHR are the eight largest petroleum distributors in Cambodia. Cambodia has progressed from a low-income nation to a low-middle-income country.

3. Energy in everyday use

A. Non-renewable energy

Due to the early stages of oil exploration, development, and refining, as well as a shortage of coal for power generation, Cambodia was reliant on imports to meet its energy needs. Oil products, such as diesel, gasoline, and coal, were the most common fuel imports. Road transport accounted for the majority of the share, owing to the high consumption of gasoline and diesel oil. With strong economic growth in recent years, the number of vehicles has been growing rapidly in Cambodia. Motorcycle registration has increase by 10% since 2008 and 2018.

- From 1990 to 2018, approximately 4 million motorcycle. Motorcycle represent around 87% of all vehicle. 422,631 cars and 261,885 minibus, buses, pick-up truck, and truck have been registered.
- Motor transport have been significant role in today transport.

Cambodia's transportation industry consumes all of its energy from imported petroleum products. The country is fully reliant on imports due to the lack of a domestic fuel supply. Given how much petroleum is used in transportation, there is a significant opportunity to reduce GHG emissions by converting from traditional vehicles to greener alternatives. The growing number of imported second-hand vehicles and increase motorizing in Cambodia contribute to air pollution. The transport emission from old and inefficient vehicle are not equipped with polluted mitigation technology will damage air pollution in urban area in the future.

B. Renewable energy in transport

3.1 The Current status of Low Carbon Vehicles in Cambodia

Electric vehicles will contribute to reducing GHG emissions in the congested urban area, together with significant co-benefits such as improvement in air quality, reduction of noise, and positive impacts on public health. Cambodia has potential to promote low Carbon transport toward 2050. Since there have not yet developed strategy and policy the study has proposed low Carbon transport such as: buses, eco-driving, and E-vehicle. Cambodia currently low Carbon vehicle transport include:

- Hybrid Cars
- Electric cars
- E-motorbike, but the number of e-vehicle unknown.

Electric Vehicles (EVs)	Brands
E-passenger Cars	LevDeo Blue Mobility Angkor Car (Make by Cambodian and use in Hotel)
EMs	Thada Oyika Volta Motors Star8

For Cambodia Hybrid car are on secondhand and at least 10 years old. The Cambodia EV, make electric car was launched in 2013. However it not provided popular. And have other companies import electric car to the Cambodia market are: LevDo, Blue Mobility, Angkor Car, Thada, Oyika, Voltra Motors, and Star

While one study proposed a low-carbon development plan for Cambodia by 2050, Cambodia has yet to implement a low-carbon vehicle policy or strategy (Mao et al., 2015). Cambodia has the potential to promote low-carbon transport such as buses, eco-driving, and electric vehicles, according to this report. Hybrid cars, electric cars, and electric vehicles are currently available in Cambodia, but the number of low-carbon vehicles is increasing. Hydrogen vehicles in Cambodia are all secondhand and at least ten years old. In 2013, the Cambodian Angkor EV, a Cambodian-made electric vehicle, was released. Domestically made vehicles, on the other hand, have not proven to be effective. LevDeo and Blue Mobility are two companies that import electric cars into Cambodia. Table 4 summarizes Cambodia's electric vehicle options.

Cambodia's national vehicle market is dominated by motorcycles. Motorcycles, according to the RGC, are a potential entry point for fostering electric mobility in Cambodia. Electric (e-) motorcycles with lithium-ion batteries are currently more costly to buy than ICE motorcycles, but their overall cost of ownership, including lifetime running costs, is also lower. This means that, with the right set of policies in place, consumers' adoption of e-motorcycles could be increased, particularly if incentive mechanisms are given to alleviate the burden of higher purchasing costs and consumers' confusion about the performance of e-motorcycles is alleviated through awareness campaigns.

Renewable energy on transportation

- Promotion of solar tuk-tuk: is the system to low emission vehicle for passenger transport by solar PV integrated into the roof of the vehicle with battery charge and replacing gasoline using.
- Phnom Penh City Bus is a municipal public transportation system that serves Phnom Penh, Cambodia's capital. The system first opened to the public in September 2014, with three lines; additional lines were progressively added over the next few years, and as of 2018, 11 lines operated across the city. The fare for public buses is KHR1,500 (USD0.37) per journey, regardless of distance. Only the local currency, the Riel, is recognized. As of 2018, senior citizens (over the age of 70), small children (under 1 meter), disabled, monks, teachers, students, and factory workers (until September 2019) fly for free, but you must check your identity by wearing your

student card, teacher card, or working card before boarding. (Covid-19 pandemic, city bus has been extend)

3.2 Vehicle Stock

The number of registered vehicles has increased in lockstep with per capita income. Since 2005, motorcycle registration has increased by 10% each year, and in 2018, motorcycles accounted for approximately 87 percent of all vehicle registrations. Between 1990 and 2018, approximately four million motorcycles were made. There have been 422,631 cars registered, as well as 261,885 minibuses, buses, pick-up trucks, and trucks. Motorcycles play an important role in road transport. (Vehicle registration data can be found in Appendix B).

3.3 Cambodia's Transport Plans

The Phnom Penh Urban Transport Master Plan (PPUTMP) is a multi-sectoral, integrated transportation master plan with a 2035 deadline (Figure 6). The PPUTMP ends with a shortlist of project recommendations, pre-feasibility studies for priority projects, and financial and economic analyses of such projects. A transition to public transportation (a mix of rail, bus rapid transit (BRT), and public buses), completion of the radial-ring trunk road network, traffic management upgrades (including new traffic management systems, parking systems, and high-quality pedestrian environments), and institutional capacity building are among the recommendations (JICA, 2014).

The Phnom Penh City Bus began operations in 2014 with the aim of improving public transportation, reducing traffic congestion, and reducing road accidents. It began with three lines and has steadily expanded over the years, with 13 lines in service throughout the city as of 2019. To help alleviate traffic congestion, Phnom Penh introduced a taxi boat in 2017 and an airport shuttle train in 2018. The Agence Française de Développement (AFD) evaluated the feasibility of an urban tram system, while the Japan International Corporation Agency (JICA) conducted a feasibility study for a planned elevated Automated Guideway Transit (AGT) or "sky train" connecting Phnom Penh International Airport to the city center, which would cost an estimated US$800 million to build. Various donors and developers are looking at alternative public transportation solutions. In addition, the MPWT's Department of Urban Transport is undertaking a feasibility study to see whether electric public buses can be introduced in Siem Reap Province. This will be Cambodia's first initiative to use electric buses.

3.4 Market and Technical Assessment

3.4.1 The Asia and Pacific region (APAC) Market

The electric vehicle market in Asia and the Pacific (APAC) is improving. China is the region's and world's EV leader, with 47 percent of the 7.2 million electric vehicles on the road in 2019. (IEA, 2020a). China also had the largest volume of e-scooter and EM sales in the area in 2017 and is expected to maintain its lead in the industry in the coming years, owing to the country's economic growth. While the E2W market in India, the region's second largest EV market, is projected to expand by 25% between 2021 and 2026. (Research and Markets, 2020). A growing population, increased traffic congestion, falling EM rates, a plentiful supply of cheap electricity, and mounting environmental concerns all contribute to the region's market strength..

The APAC EM market is divided into two groups based on battery type: lead-acid and LIB. In 2017, the lead-acid segment had the largest volume of sales in the industry, accounting for more than 80% of total sales. However, due to their lighter weight and longer lifespan, the LIB group is expected to rise at a faster pace during the forecast period (2013-2025).

3.4.2 The pricing structure of ICEMs and EMs And Consumer Perceptions Of EMs

Although competing with energy motors like Honda and Yamaha, the current use of e-vehicles is still common in the country, they are not fashionable enough to entice customers. Customers prefer to concentrate on the initial purchase price of a motorcycle and not consider the product's lifetime cost, which includes service and maintenance. Customers also consider EMs to be high-cost, low-capacity, and low-reliability devices.

a. Capital Costs: Cambodia EMs Market price have range from US$890 (Star8-ST-01) to US$1,450 (Star8-M3) (Figure 12). For ICEMs, prices range from US$1,200 to US$4,000 as of January 2020 (Figure 14). On average, an EM costs around US$1,000, which is relatively low in comparison to an ICEM, which costs US$2,000 on average depend on battery capacity.

b. Tax: import tax on EMs and ICMs (≤50cc) is 32.83% and 39.15% for ICEMs (50cc to 150cc) (GDCE, 2017), Road tax (all motorcycles are exempt from paying road tax (MEF,2018), and Value Added Tax (VAT) is 10% for all imported goods, including EMs and ICEMs, according to the General Department of Customs and Excise (GDCE).

c. Quality: Since EMs are new to the Cambodian market, consumer confidence in technology is lower than with ICEM (International combustion Engine Motorcycle). A common misconception is that EMs are not reliable and cannot drive for long distances. Other concerns include the consistency of the battery, how long it takes to charge, and how long it lasts. Customers in Cambodia prefer high-quality vehicles and have a high degree of confidence in Japanese automobiles.

d. The resale market: is critical in order to meet consumer demand for new motorcycle models. Every year, new ICEMs models are released, and many customers sell their current motorcycles in order to upgrade to the new one. However, Ems are not allowed on the resale market, causing customers to be hesitant to buy them.

e. Charging system: There are no charging stations in the country, and it can only travel 50 to 60 kilometers on a full charge, requiring the driver to return home and recharge the battery.

f. Maintain: Customers have access to only one showroom. It is challenging for customers because if their motorcycle breaks down, they must go to a showroom to get it repaired, while ICEMs have maintenance and repair on every lane.

4 Conclusion

a. Evaluation

Cambodia is well positioned to incorporate significant amounts of renewable energy, especially solar, into its generation mix, given the ongoing reduction in renewable energy generation costs globally and abundant renewable energy resources. Diversifying Cambodia's hydropower and coal base load supply with solar will help to lower supply costs while also assisting in the implementation of the emission.

Cambodia's economy expanded rapidly from 2006 to2016, with an average annual growth rate of 7.0 percent, and poverty fell significantly from 47.8% in 2007 to 14.0 percent in 2014. In Cambodia, the transportation sector plays a critical role in fostering economic growth and mobility. Rectangular Strategy IV of the Royal Government of Cambodia (RGC) aims to strengthen transportation connectivity and develop effective logistic systems in order to boost economic competitiveness and diversification (RGC, 2018). Cambodia is a low-emitter of greenhouse gases but is extremely vulnerable to climate change. In the year 2000, per-capita GHG emissions were around 0.23 CO2e. However, by 2030, this number is predicted to grow to around 1.10 tCO2e, and by 2050, it will be

around 5.49 tCO2e. The transportation sector's GHG emissions are increasing in tandem with the growing number of vehicles. The transportation sector is Cambodia's largest source of CO2 emissions, with an estimated rise and share of GHG emissions of 10,816 GgCO2e in 2050, followed by energy industries, manufacturing, and commercial and residential sectors.

b. Concern

- Government promotion: Government not strongly encourage to people to use electronic Vehicles, it is depend on people choice.
- Low salary income: Over the past two decades, Cambodia has undergone a significant transition, reaching lower middle-income status in 2015 and aspiring to attain upper middle-income status by 2030. Driven by garment exports and tourism, Cambodia's economy has sustained an average real growth rate of 7.7 percent between 1998 and 2019, making it one of the fastest-growing economies in the world.
- Market strategy: The Company not widely publicized.
- Reliabilities of quality of vehicles: people think about vehicle quality, charge station, resale market not easy as fuel vehicle, and drive only near direction.
- People behaviors in Public transport: People believe that individual vehicle is easy and don't waste time and not determine everywhere.

※Future Plan

1- Continuing Cooperate with all concerned organization include the private company to develop:

- Solar Energy Project
- Wind Projects and
- Bio-Fuel Projects

There are no sources in the current document.

2- Goal:

To improve the current level of electrification and for the poverty reduction as well as enhancing education and medical treatment in the rural areas.

3. Purpose

- To promote electrification in those areas not serviced yet ,
- Introduction and development of Renewable Energy
- Technologies,

4-Target:

- To achieve 100% Electrification of Rural Villages by the year 2020.
- by 2030, at least 70% of total household in the country should have access to quality grid electricity

C. Opportunity

In 2000, the United Nations Millennium Summit created eight Millennium Development Goals (MDGs), which were intended to better the lives of the world's poorest and most disadvantaged people. At the end of 2015, the

MDG goal date came and went. After examining the MDGs' successes and weaknesses, The UN then issued a collection of 17 Sustainable Development Goals (SDGs) that were agreed to by 193 countries, including Cambodia, to replace and extend the Millennium Development Goals (MDGs) while also highlighting additional global concerns. One of these SDGs is the current aim of providing all nations with "affordable and renewable energy." There are some benefits of using renewable energy instead of fossil fuels. Here are a few of the most important advantages:

a. Renewable energy sources can never run out.

b. Renewable energy's advantages: it is environmentally friendly.

c. There are fewer maintenance needs.

d. Renewable energy is cost-effective.

e. There are many health and environmental advantages of renewable energy.

f. Encouragement for the growth of renewable energy (promote private sector participation)

g. Influence people's behavior

h. A more environmentally friendly future

i. Take advantage of public transportation.

Bibliography

- *Cambodia Green Urban Development program-Phase 1.(May 2016) Phnom Penh Green City strategic plan, prepared for GGGI*

renewable energy in transport policyAppendix-A.pdf

- *Kongchheng Poch, (August 2013), Renewable Energy Development in Cambodia: status, Prospects and Policies, Economic Institute of Cambodia (EIC)*

RPR_FY2012_No.26_chapter_7.pdf

- *ASEAN Centure for Energy Team. (June 2019). Renewable energy assessment in Cambodia. ACE Building, 6th Fl. Jl. HR. Rasuna Said Block X-2, Kav. 07-08, Jakarta 12950 Indonesia Tel: (62-21) 527 8027 I Fax: (62-21) 529 6382*

RE-Assessment-in-Cambodia.pdf

- *Readiness Proposal.(09 September 2019). with Global Green Growth Institute (GGGI) for Kingdom of Cambodia.*

readiness-proposals-cambodia-gggi-strategic-frameworks.pdf

- *Renewable Energy and Energy Efficiency in Developing Countries: Contributions to reducing Global Emissions(2017)*

1_Gigaton_Third Report_EN.pdf

- *Pheakdey, H. (2018). Toward a low carbon energy transition in Cambodia, Phnom Penh: Enrich Institute.*

toward_a_low_carbon_energy_transition_in_cambodia__june_1_.pdf

- *(January 2021).Promoting Green Mobility through Electric Motorcycles in Cambodia. Global Green Growth Institute Jeongdong Building 19F 21-15 Jeongdong-gil Jung-gu, Seoul 04518 Republic of Korea*

Promoting_Green_Mobility_Through_Electric_Motorcycles_in_Cambodia.pdf

Article Template on "Country City's Renewable Energy portfolio in the transport sector in Cambodia"

Patriciate's Name : Thida Miech
Year of participation 2021

My province, Sihanoukville, Kingdom of Cambodia

I. About the city (Geographical location, area size, population, tec)

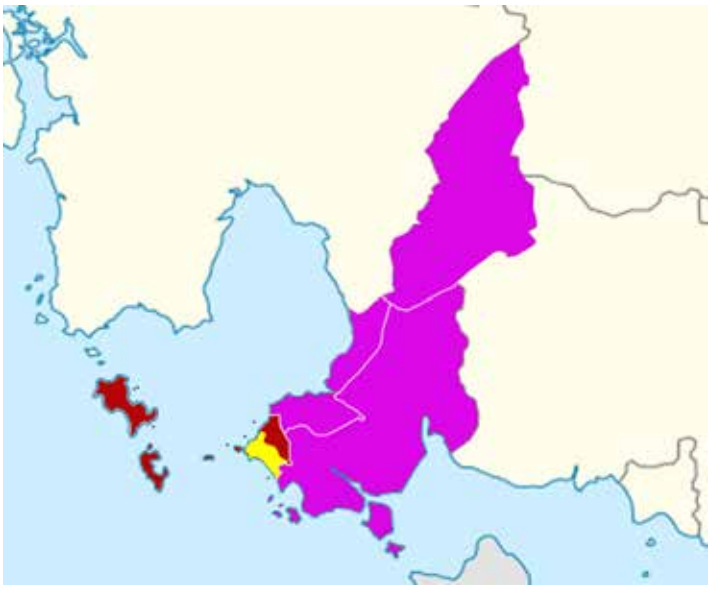
Developed in the 1955 as Cambodia's first and only deep seaport, and with 100 kilometers coastline, the city of Preah Sihanoukville become a tropical charm, and the biggest beach retreat, and resort that offering relaxation for all visitors, especially tourists.

Preah Sihanouk Province has been upgraded from Sihanoukville municipality to provincial level through sub-degree no. 07 dated 09 January 2009. Administrative management has been changed from Khan to districts and municipality. Sihanoukville was only a municipality comprised of three Khans. Being the provincial level, Preah Sihanouk Province has expanded its administrative boundary and covers two municipalities and three districts.

The Province, locally known as Kampong Som and could be reached through various means including national road 4 with 230km, national road number 3 with 260km, and also a railway directly from the capital city of Phnom Penh. Preah Sihanouk Province has a border with Koh Kong Province to the north, Kampot and Kampong Speu Provinces to the east, and the Gulf of Thailand to the south and west.

Sihanoukville Municipality is the capital city of Preah Sihanouk Province. The city has been chosen to be a Multi-purpose Special Economic Zone in the country by the Royal Government of Cambodia due to the advantages of its unique geographical location and seawater port serving as a commercial gate way for international trade and tourist destinations in Cambodia.

This city covering a total area of 84,364 Km2 with 24.5 km long of coastline and 5 islands. The city consists of 4 Sangkat with a total population of 83,610 (42,364 are women) which it is excluded foreign residents from 54 different nationalities with 16,874 people.



Sihanoukville city's urban area (Yellow)

In Sihanoukville municipality (Red)

Sihanouk province (purple)


Picture of Sihanoukville Port Special Economic Zone

II. Renewable energy on transport sector (Road construction and using solar lights along the road in the city)

Tree plantation programs were included in our 34 road construction projects. Different tree species have been planted along the sidewalk on both sides of the road. The tree will add beauty to the city, provide shade for walkers, and will also help to capture carbon emission from the atmosphere back to the ground through the carbon sequestration process. A total of 75,850 trees were planted in this program. The tree will give flowers seasonally to add beauty and show the national identity at its respective road lines.

To reduce carbon emission and save for energy use, solar lights were introduced to all constructed roads. A total of 5,300 units being installed. The lights were equipped with smart technology to provide lighter while objects are present and lower light while the street is empty. Attention to maintenance support will be needed to ensure sustainable result.




III. Experiences from participation with UNITA CIFAL Jeju in May 6th and May 11th

It was the first time for me to participate the online workshop with UNITA CIFAL on Scaling-up Renewable Energy in transportation portfolio. It' quite new topic to me. The workshop gave me more knowledge and experience from the speakers on Global GHG emissions cause by transport, the current status of transport, key opportunities for renewables in transport, international cooperation opportunities and also getting to know more on analysis of current policy measure to scale up renewable in transport. On the other hand, participates can sharing the situation of their own country on renewable energy in transportation sector to found out the challenges and then we tried to discuss in order to get the better or suitable solution. This workshop is short time but it's meaningful to me, I'm glad to join with the program and thanks again for invited me to participated in the workshop.

IV. Expectation

For my expectation I hope in my whole province is using solar light system along the road and our citizen will know or getting more knowledge on renewable energy and it's useful to the earth.

Renewable Energy Portfolio and How to Raise the Ambition to Increase Renewables in Transport in Cambodia

Tha Pon

1. Background of the Kingdom of Cambodia

- Country: Area 181,035 sq km, water 2.5%. Population 15.1 million (2014) base on growth rate projection 1.48% (NIS, 2008)
- GDP growth rate 7.4% (2013), GDP growth rate 7.2% (2014)
- GDP by sectors: agriculture 31%, industry 26%, service 43%.
- Hydro power potential about 10,000 MW, at present the capacity < 13% used

2. Energy Policy

- To provide an adequate supply of energy throughout Cambodia at reasonable and affordable price,
- To ensure a reliable and secured electricity supply at reasons price, which facilitates investment in Cambodia and development of national economy,
- To encourage exploration and environmentally and socially acceptable development of energy resources needed for supply to all sectors of Cambodia economy,
- To encourage the efficient use of energy and to minimize the detrimental environmental affects resulted from energy supply and consumption.

National Policy on Rural Electrification by Renewable Energy

- Provide access to reliable, safe electricity services, with insignificant impact on the environment,
- Encourage the private sector to participate in providing electricity services by renewable energy in the rural areas;
- Act as a market enabler, through various incentives,
- Encourage of using the renewable energy technologies,
- Promote electricity systems by renewable energy at least cost for rural communities, through research and pilot development,
- Empower to the poor involving in rural electrification to participate.

3. Renewable Energy Potential

- Solar Energy: the average sunshine duration of 6-9 hours per day, giving an average of 5kWh/day. thus, considerable potential of solar energy.
- Wind Energy: The southern part of the great lake Tonle Sap, the mountainous districts and the coastal regions,

such as Sihanoukville, Kampot,Kep and Koh Kong have the annual average wind speed of 5m/s or greater.

- Hydro: The potential is about 10.000 MW by desk study.
- Biomass: The report prepared by NEDO on “the Assistance Project for the Establishment of an Energy Master Plan” identified significant biomass energy resources from a variety of agricultural residues such as rice husk, acacia , Luscenia tree, ect.
- Biogas: The effectiveness of small scale biogas has been demonstrated in Cambodia by a number of different projects. The use of animal wastes to generate high quality gas for cooking has significant economic, health, social and environment benefits for poor rural households.
- Biofuel: Jatropha – 200 ha (Fencing)

4. Completed Projects

- Solar Photovoltaic: Project with NEDO (130kWp), JICA Japan (777kWp), WB (12,000 SHS), UNIDO (30kWp), KOICA (110kWp) other international and national institutions including Prime Minister project, which we had installed around 2 MW in the country.
- Biomass Gasification: Project with UNDP in Battambang (7kw + 20kw) and with DEDE Thailand in Kompong Cham (20kw), in Sambour District, Kompong Thom Province with the capacity 30kw by FONDEM France and a number of biomass gasifiers developed by local investors.
- Micro-hydro: With Grant from JICA, 2 micro hydropower plants with capacity of 370 kw already put in operation since November 2008.
- Bio-fuel: Have more than 10 companies doing with Jatropha, planting around 1,000 ha, no once do with big scale yet.

5. On Going Projects

Solar Photovoltaic Study Projects:

- Korea Company with the capacity of 500 MW
- US Company with the capacity of 200 MW
- apanese Company with the capacity of 30 MW.

Solar Battery Charging System

- UNIDO: Study for establishment of SBCS in two provinces Battambang and Pursat provinces.

Bio-fuel: Bio-Diesel Based on community

- MME cooperate with DEDE, Thailand to study for establishment of small Scale Bio-diesel System for the rural community in Battambang province.

Projects under Study and Negotiation

- 108 MW Stung Cheay Areng Hydropower Project, under negotiation IA, LA, PPA by Sinohydro Resources Ltd. (China), (2017).
- MOU for 90 MW Lower Se San I Hydropower Project, PF/S & F/S by EVNI (Vietnam), (2018).
- MOU for 2,600 MW Sambor Hydropower Project, PF/S & F/S by CGDC (China), (2019).

- MOU for 900 MW Stung Treng Hydropower Project, PF/S & F/S by IDICO (Viet Nam), (2020). (2), (3) and (4) Should be termination MOU

Existing Hydropower Stations

The total installed capacity of existing hydropower

- Kirirom1= 12 MW
- Kamchay = 194.1 MW,
- Kirirom3= 18MW,
- Stung Atay=120MW,
- Stung Tatay = 246 MW
- Lowe Russei Chrum Kraom 338MW

6. Challenge and Solution

The Challenge

- To meet increasing energy demand of Cambodia.
- To develop affordable localized energy infrastructure that reduce the cost of power to industry and government
- To increase the access to secure and regular electricity supply to all Cambodians
- Develop energy sources that have a positive impact on the Cambodian environment and do not negatively impact on Co2 emissions
- To improve the wellbeing of the broader Cambodian population by increasing the access to reliable electrical energy supplies

The Solution

- Wide spread installation of localized renewable energy systems such as solar PV , biomass …..wind generation.
- Focused energy solutions for Government and industry that reduce or offset consumption and therefore reduce costs
- Introduction of energy efficiency technologies such as low energy and solar lighting
- Establish remote/off grid power generation
- Develop peek storage mechanisms that offset demand and impact positively upon the grid

7. Future Plan

Continuing Cooperate with all concerned organization include the private company to develop:

- Solar Energy Project
- Wind Projects and
- Bio-Fuel Projects

Goal:

- To improve the current level of electrification and for the poverty reduction as well as enhancing education and

medical treatment in the rural areas.

Purpose:

- To promote electrification in those areas not serviced yet ,
- Introduction and development of Renewable Energy Technologies,

Target:

- To achieve 100% Electrification of Rural Villages by the year 2020.

Lessons from Other Countries

Case studies and lessons learned about electric two-wheelers (E2W) focus on the China (e-bike), Taiwan (e-scooter), India (EVs and E2Ws).

- China

The national government has a few key policies that have facilitated the development of the e-bike market, the "1999 National E-bike Standards", the 2004 "Road Transportation Safety Law", and the economic incentives for New Energy Vehicles (NEVs).

- Taiwan

The Taiwan Environmental Protection Administration (TEPA) started to promote and subsidize e-scooters in 1998,but without any restrictions on the use of gasoline-fueled scooters (Lee and Pan, 2003).

The subsidies included

- tax reductions for e-scooter manufacturers
- subsidies for research and development
- promotional activities
- charging facilities, and
- rebates for consumers amounting to nearly half of the scooter retail prices.

The Industrial Development Bureau of Taiwan :drew up

- a subsidization program to reach the goal of one hundred thousand e-scooters 'on-road' in the four years from 2009,
- including the subsidy for consumers,
- the reward for manufacturers,
- and the subsidy for constructing charging facilities.

Conditions for the e-scooter subsidization policy

- Vehicle type approved by MOTC (Ministry of Transportation and Communications).
- Adopt a detachable lithium-ion battery (LIB) pack.
- The nominal voltage of the battery pack is 48V.
- Information on battery management system (BMS) including temperature, voltage, residual capacity, abnormal

signal, recharging cycles, and battery identification should be recorded and can be read out.

- Meet the criteria of performance and safety.
- Issue business operations plan to approve: (1) Projected sales quantity (2) Detailed vehicle performance; (3) Detailed battery specification (including nominal voltage and BMS information); (4) Warranty conditions; (5) Promotion plan and sales channel; (6) After service.
- Quality compliance: (1) Regularly scheduled inspection (2) Scheduled inspections if a customer complains.

● India

The current EV policy framework is a mix of incentive-based policies accompanied by regulatory reforms, and public-private partnerships to encourage EV adoption, expand charging infrastructure and support domestic EVs, and supply equipment manufacturing capacity and battery manufacturing. Energy security and clean air considerations have also prompted the adoption of stricter performance and efficiency standards for the overall vehicle fleet and led to new policies focusing on the development and market adoption of electric and hybrid vehicles.

Current Situation

A study conducted by Clean Air Asia in 2019 on the Development of Standards on the uptake of E2Ws and E3Ws in Cambodia indicated that there are no national standards for EVs in Cambodia. The lack of national standards is a loophole for low-quality EMs flowing into the Cambodian market and could hinder plans to promote low-carbon vehicles.

Cambodia has not yet developed a low carbon vehicle policy or strategy, although one study proposed a low carbon development plan for Cambodia towards 2050 (Mao et al., 2015). Cambodia has the potential to promote low carbon transport such as buses, eco-driving, and EVs. Low carbon vehicles in Cambodia currently include hybrid cars, electric cars, and EMs. In Cambodia, hybrid cars are all secondhand and at least 10-years old.

The growing number of imported, second-hand vehicles and increasing motorization in Cambodia contribute to air pollution. The transport emissions from old and inefficient vehicles, that are not equipped with pollutant mitigation technology, damage air quality in urban areas. No vehicle age limit is imposed on imported second-hand vehicles in Cambodia, and most are at least 10 years old. There are currently no policies or regulations on EM battery standardization in Cambodia, but it could play an important role in stimulating the growth and adoption of EMs. Battery standardization would enable multiple EM companies to utilize the same battery swapping stations; this would increase access to charging stations and therefore reduce users' range anxiety. Standardizing batteries could also be a key factor to improve the quality of EMs in the market. Cambodia does not currently have an established system to collect and recycle batteries and it lacks regulatory controls and oversight of the informal and unregistered recycling facilities.

Lessons from Other Countries: local, regional, and national government policies play a major role in the adoption of EVs

<u>Policy recommendations</u>

● Increase charging infrastructure through incentives.

● Streamline the import tax and registration process.

- Reduce the import tax for EMs.
- Issue inter-ministerial Prakas on battery standardization.
- Reduce battery waste export fees.
- Develop guidelines for the battery disposal and recycling sector.
- Establish battery take back schemes.
- Establish an EV association.
- Establish minimum standards policy for EMs.
- Integrate EMs into Government fleets

EV Charging Station at a parking lot in a mall in Phnom Penh

REFERENCES

APEC (2017). The impact of government policy on promoting new energy vehicles (NEVs) – The evidence in APEC economies. Singapore: APEC.

Center for Global and Regional Environmental Research (2006). Emission data. Available: http://bio.cgrer.uiowa.edu/EMISSION_DATA_new/tables.html

Cherry, C.R., Weinert, J.X., Xinmiao, Y. (2009). Comparative environmental impacts of electric bikes in China. Transp. Res. Part D: Transp. Environ. 14:281–290.

Chiu, Y.-C., & Tzeng, G.-H. (1999). The market acceptance of electric motorcycles in Taiwan experience through a stated preference analysis. Transportation Research Part D: Transport and Environment, 4(2), 127–146.

C. J. Yang (2010). Launching strategy for electric vehicles: Lesson from China and Taiwan. Technological forecasting and social change, 77:831-834.

Clean Air Asia (2019). An Assessment of Regulatory and Fiscal Policies for Road Transport Vehicles in Cambodia.

C. P. Tang, K.-J. Liao (2004). Technology policy and democratization: the political economy of promoting electronic scooter in Taiwan. J. Public Adm, 1–34.

Curriculum Development Department (2018). Climate Change Textbook for Upper Secondary School.

EC, 2013. Regulation (EU) No 168/2013 of the European Parliament and of the Council of 15 January 2013 on the Approval and Market Surveillance of Two- or Three-Wheel Vehicles and Quadricycles. EC – European Commission. Official Journal of the European Union L60, pp. 52–128.

General Department of Customs and Excise (2017). Customs Tariff.

General Secretariat, National Council for Sustainable Development (2015). Cambodia's Second National Communication. Ministry of Environment, Phnom Penh.

Gilbert, R., & Perl, A. (2010). Transport revolutions: moving people and freight without oil (Revised and updated. ed., 2. ed.). Gabriola Island, BC: New Society.

Government of India (2019), Charging infrastructure for electric vehicles (EV) – Revised guidelines & standards reg.

UNITAR CIFAL Jeju International Training Center

Workshop on "Scaling-up Renewable Energy Ambition in future Transport"

From 6 to 11 May 2021

Online Training, Jeju South Korea

Article Template on "Country/city's renewable energy portfolio in the transport sector in Cambodia"

Writing by: Samphors SAO

Cambodia Participant

Year 2021

I. Introduction

Cambodia is one of the developing country in Southeast Asia with an estimated population of 16 million. Cambodia is comprised of the central plains of the Mekong River and Tonle Sab Basin, mountain and highland areas. Phnom Penh, the capital, and most populous city in Cambodia, has an estimated population of more than 2 million people and it is projected to grow to 3 million people by 2035. The rapid economic development, improve income, population growth, and rising rates of urbanization have contributed to a high demand for vehicle ownership in Cambodia. Imported fossil fuel vehicles dominate the market in Cambodia, and only a small fraction of vehicles are electric. Urban areas are suffering from traffic congestion, poor air quality, and municipal transport infrastructure is unable to keep up with demand. GHG emissions and air pollution caused by fossil fuel vehicles impact public health and hamper the government's vision to transform Phnom Penh into a sustainable and green city. The development of electric motorcycles could contribute to achieving the government's vision by reducing GHG emissions and air pollution in Cambodia cities.

II. Energy

In Cambodia, petroleum is traditionally the main source of energy for transportation include gasoline, diesel, heavy fuel, and fuel oil. Currently Cambodia have 8 big petroleum distributors including: Caltex, Sokimex Group Co.Ltd, Kampuchea Tela Co.Ltd, PTT (Cambodia), Tota Cambodia, Bright Victor Mekong Petroleum, Savimex, and LHR. Cambodia, graduated from low-income country status to low middle income status in 2015. This has been paralleled by increasing urbanization with a total population at 16 million and an estimated 23% urbanization rate in 2017. According to the World Bank, Cambodia's pace and scale of urbanization is likely to rise to reach an urbanization rate of 36% in 2050. Phnom Penh, the country's capital, has witnessed significant urban growth over the last 10 years, and now has close to 2 million residents. The total primary energy supply in Cambodia was about 4.8 million tons of oil equivalent in 2015. Fuel wood and other biomass accounted for an estimated 44.4% of the total while oil and petroleum products for 38.5%, coal for 10.7%, hydropower for 3.6%, and Electricity imports for 2.8%.

The share of coal and electricity in Cambodia's energy supply increased significantly from 2010 to 2015 with the commissioning of new coal and hydropower plants; during this period, the share of coal increased from 0.7% to 10.7%, while the share of hydropower increased from 0.1% to 3.6%.

With exploration, production, and refining of oil still in the early stages, and lacking coal for power generation, Cambodia was dependent on imports to fulfil its energy supply needs. The major fuel imports were oil products: diesel, gasoline, and coal. Road transport dominated the share, mostly with the consumption of gasoline and diesel oil.

With strong economic growth in recent years, the number of vehicles has been growing rapidly in Cambodia. Motorcycle registration has increase by:

* From 1990 to 2018, approximately 4 million motorcycle. Motorcycle represent around 87% of all vehicle. 422,631 cars and 261,885 minibus, buses, pick-up truck, and truck have been registered.
* Motor transport have been significant role in today transport.

The transport sector energy consumption in Cambodia, entirely from imported petroleum products. As there is no domestic fuel source, the country fully relies on imports. Considering that much of the petroleum products are consumed in transportation, there is high potential for a positive impact on GHG emissions by switching conventional vehicles to greener alternatives.

The growing number of imported second-hand vehicles and increase motorizing in Cambodia contribute to air pollution. The transport emission from old and inefficient vehicle are not equipped with polluted mitigation technology will damage air pollution in urban area in the future.

III. Renewable energy on transportation

Electric vehicles will contribute to reducing GHG emissions in the congested urban area, together with significant co-benefits such as improvement in air quality, reduction of noise, and positive impacts on public health.

In 2015, renewable energy accounted for 65% of Cambodia's total energy consumption, according to Tracking SDG7: The Energy Progress Report released in May 2018 of this includes:

* 46% came from traditional biomass such as wood and charcoal
* 15% from modern biomass such as biogas produced from human and animal waste.
* 3% from hydropower.

Traditional biomass remains the cooking fuel for 82% of the population. With regard to electricity generation, while large hydropower represented 52% of the total national electricity capacity (980 megawatts out of 1,878 MW total capacity) in 2017, Cambodia's uptake of non-large hydrorenewable generation was relatively limited and represented around 30 MW of capacity.

Renewable energy will contributed to reduce GHG emission in to the atmosphere while electric vehicles will contribute to reducing GHG emissions in the congested urban area, together with significant co-benefits such as improvement in air quality, reduction of noise, and positive impacts on public health.

Cambodia has potential to promote low Carbon transport toward 2050. Since there have not yet developed strategy and policy the study has proposed low Carbon transport such as: buses, eco-driving, and E-vehicle. Cambodia currently low Carbon vehicle transport include: Hybrid Cars, electric cars, and E-motorbike but the number of these vehicles on the streets is unknown. In Cambodia hybrid cars are all secondhand and at least 10 years old. The Cambodia Angkor E-vehicle, a Cambodia made electric car, was launched in 2013. However, locally produced vehicles have not proved to be popular. Companies that import electric cars to the Cambodian market include:

Table 4. EVs in the Cambodian market (EnergyLab, 2019)

Electric Vehicles (EVs)	Brands
E-passenger Cars	LevDeo Blue Mobility Angkor Car
EMs	Thada Oyika Voltra Motors Star8

For Cambodia E-vehicle are part of an emerging e-vehicle market in Cambodia while there are no estimates for the number of E-motorcycle in the country. The model of e-vehicle are:

Figure 8. Voltra MATRIX mode

Table 7. Voltra MATRIX model technical specifications

Voltra MATRIX Technical Characteristics	
Model	MATRIX
Motor	1500W Brushless DC
Charging time	5,5 hours
Max speed	55-60 km/h
Dimension (L*W*H)	1690 × 620 × 1050 mm
Removable battery option	60V28AH Li-Ion battery
Charging voltage	AC 220V
Brake front/rear	Disc
Drive range	80 km
Tires	Fr. & Rr. 10"×3

Figure 7. Voltra OFF-ROAD model

Table 6. Voltra OFF-ROAD model technical specifications

Voltra OFF-ROAD Technical Characteristics	
Model	OFF-ROAD
Motor	500W Brushless DC motor
Charging time	4 hours
Max speed	38 km/h
Dimension (L*W*H)	1690 × 620 × 1050 mm
Removable battery option	48V12AH Li-Ion battery
Charging voltage	AC 220V
Brake front/rear	Disc/Expand
Drive range	50 km
Tires	Fr. & Rr. 18"×2.5

Figure 9. Oyika Ego model

Table 8. Oyika Ego model technical specifications

Oyika Ego Technical Characteristics	
Motor	800W
Maximum speed	50 km/h
Drive range	Up to 80 km
Battery	60V 20 Ah Lithium Ion
Charging time	Through swap stations
Tires	10 inches tubeless
Wheelbase	1330 mm
Measurements	1660 mm x 710 mm x 1070 mm
Brakes	Front Disc/Rear Drum

Figure 10. Star8 EM Pegasus model

Table 9. Technical specifications of the Pegasus model

Star8 Pegasus Technical Characteristics	
Model	Pegasus
Motor	2500W
Charging time	5-8 hours
Max speed	70 km/h
Battery	72v20Ah Lead-acid
Drive range	50 km

Figure 11. Thada-OX model

Table 10. Technical specifications of the Thada-OX

Thada-OX Technical Characteristics	
Model	Thada-OX
Motor	1200W
Maximum speed	Up to 50 km/h
Drive range	Up to 60 km
Battery	Lithium Ion
Dimension	1.8L × 0.7W × 1.0H
Brakes	Full Hydraulic Disc

Motorcycles dominate Cambodia's national vehicle market. The royal government of Cambodia sees motorcycles as the potential entry point to promote electric mobility in Cambodia. Electric (e-) motorcycles with a lithium-ion battery are currently more expensive to purchase than fuel motorcycles, but their total cost of ownership including lifetime operating costs is often lower than that of gasoline motorcycles. This implies that the adoption of e-motorcycles could be accelerated with the

right set of supporting policies, if incentive mechanisms are provided to consumers to lessen the burden of higher purchase costs and if consumers' uncertainty about the performance of e-motorcycles is eased through awareness programs.

The current using of e-vehicle are yet popular in the country while competing to energy motor like Honda, Yamaha are not stylish to entice customer. When purchasing a motorcycle, customer tend to focus on initial purchase price and rarely consider the lifetime cost of the product which include to operation and maintenance. Customer still consider EMs expensive with low capacity and reliability.

- **Quality**: EMs are new to Cambodia market, consequently, customer trust on technology compare to ICEM (International combustion Engine Motorcycle). A common perception EMs are not durable and cannot drive for long distance, the quality battery, how long it charge, and how long it's lasts are also concern. Cambodia customer are tend to use high quality with a high level of trust in Japanese motorcycle.
- **Resale Market**: is importance to support customer demand for new motorcycle model. New ICEMs model are release every year and many customer are selling existing motorcycle in order to upgrade the new on while Ems are not accepted on resale market which will make customer to hesitate to purchase it.
- **Charging system**: there are no charging system in the country while it can only dry on average 50 to 60 km per full charge and driver must to go back home and recharge the power.
- **Maintenance:** only one showroom are provide for customer. It's difficult for customer, if break down they require to showroom in order to repair motorcycle while ICEMs have maintenance and repair every street.

IV. Experience of participation

After I was participation on that workshop, I can say that I was gain more knowledge and experience from productive trainer who have shared qualify and clear objective on scaling up renewable energy in transport portfolio with clear explanation related to decarbonizing, analysis of current policy measure to scale-up renewable in transport by specific case and clearly demonstrate political and implemental strategy in order to responded Co2 or GHG emission. In order word, I can be identify how renewable energy in transport are and how it can contributed to environment as like as reduced GHG emission and make sustainable development in transport and promote better quality of living in my country. One more thing base on educator has mention the specific key policy point on how to promote renewable energy in transport is the best for policy maker or participant in the meeting in order to make it happen in future transport in their country by promoting on electric transport. In addition, before I have not joined this workshop I do not know what and how renewable energy in transportation are, but after I joined and listened from speaker I can understand on how it was. In addition the best methodology of this workshop is that not only speaker can speak but participant also participated sharing their

knowledge, experience, and current situation in their country related governmental policy and major problem related to renewable energy in transportation. Best of the best, this workshop short time with full meaning and productive knowledge with provided as much as time for grouping country to discussed and shared their research or country situation in renewable transportation to all participant and raised the challenges or issue in order to find the solution on how to implement or take an action. And one more thing as sharing country on transportation I can better understanding on the situation of policy, strategy plan, challenges, and issue from all participant in Southeast Asia.

V. Expectation on how future transport

As my expectation on future transport will be transform from fuel transportation to electricity transportation in the future with can ensure the quality on transport and promote better quality for people living by reducing Co2 emission with impact to environment and public health. As today trends, there are some company are trying to promote electricity cars with high capacity in transport and a wide range of function with will assist to all people with reliable and best quality on transport. Even though, by achieving this government and private sector are importance role to participant in this sector. Base on success story from neighboring country such as Viet Nam, Thailand show the significant number that people are starting to use electric transport with benefit to economic and environment. Environmental benefit including mitigation of air and noise pollution and subsequence public health benefit. Base study research E-vehicle or E-motorcycle produce nine time less Co2 emission than motorcycle as like fuel vehicle.

Articles on Renewable Energy
and Transport Policy Portfolio

Indonesia

Next Generation: Climate-Friendly Transportation Development in Indonesia

Jaya R Clarrio Dimasssetya

Indonesia Portfolio

Indonesia has promulgated relevant legal and policy instruments for addressing climate change, including the national action plan on GHG emissions (RAN-GRK) as stipulated in Presidential Regulation Number 61/2011 and the GHG inventory through Presidential Regulation Number 71/2011. Under the Presidential Regulation Number 61/2011, provincial governments are also obligated to develop and implement a Regional Action Plan for GHG Emission Reduction (RAD-GRK). The national government has also made significant efforts towards developing and implementing a National Action Plan on Climate Change Adaptation (RAN-API), which provides a framework for adaptation initiatives that has also been mainstreamed to development plans at the national and city level.

Table National Climate Change Reduction Initiatives

Nationally Determined Contributions	
Mitigation	Indonesia is committed to reducing emissions by 29% compared to the business as usual (BAU) scenario by 2030. Indonesia's target should encourage support from international cooperation, which is expected to help Indonesia to increase its contribution up to 41% reduction in emissions by 2030
Adaptation	• Study and map regional vulnerabilities as the basis of adaptation information system. • Strengthen institutional capacity and promulgation of climate change sensitive policies and regulations by 2020. • Reduce risks on all development sectors (agriculture, water, energy security, forestry, maritime and fisheries, health, public service, infrastructure, and urban system) by 2030 through local capacity strengthening, improved knowledge management, convergent policy on climate change adaptation and disaster risks reduction, and application of adaptive technology.

Source: Indonesia's First Nationally Determined Contribution. 2016

Renewable Energy Initiatives: Infrastructure to Transportation

Refers to International Energy Agency (IEA) data on Global EV Outlook 2019, EV growth is fascinating. In 2018, EV sold to 5,1 million or two million higher than 2017. EV growth is influenced by the nation policies. Nowadays, EV in US, EU, and East Asia is driven by the massive investment (Kang et.al., 2016). Nordic countries adopted smart grid technology in the its area. Even though, leading countries enacts attractive incentives to zero emission vehicle and low emission (Ruiz et al., 2018; Shaukat et al., 2018; Ahmad et al., 2018). Indonesia government could replicate the incentive policy to attract EV investment, but it could be obstructed since decentralization influenced various political will in the local level.

Opportunities and Challenges

The role of research development in Indonesia to renewable energy and transportation is unsuitable to the GDP

comparing to Singapore, Malaysia, Thailand, and Vietnam, so that Indonesia could not attract EV investment although EV materials are plenteous. Due to low level of R&D, Indonesia could not decide suited EV standard to be developed (Sidabutar, 2020). On the other hand, regional development imbalance between west and east area in Indonesia reduce EV investment attractiveness. However, Indonesia Government has issued Presidential Regulation Number 55/2019 concerning program acceleration of Battery Electrical Vehicle for Land Transportation. The regulation stipulates Electric Vehicle Industry Development Road Map, in the hope that it could enhance Emission Reduction on Transportation Sector.

Lessons Learned (CIFAL Jeju Workshop)

The UNITAR CIFAL Jeju's Online Workshop on Scaling-up Renewable Energy Ambition in Future Transport resonate me. I was already familiar with some of the approaches from the past, but the way this knowledge is shared is a total game changer. In my work I am listening and talking about the future ways of transportation and renewable energy ambition in a co-creative manner, whereas in the workshop, the lecturers share their knowledge and professional experience to address the renewable energy ambition. CIFAL Jeju designed an event framework in which everyone can learn, receive as well as offer, contribute, which is much more than a double win in itself. Another exceptional perception is how attentively they provide space for all participants to meet and to exchange at their best the wisdoms and the novelties. I experienced them as living best practice of renewable energy and transportation development on the eve of the emerging future. Factors of future success, I would say, were very strong commitment to make these qualities to manifest; based on very strong belief (and experience) that this is possible to achieve the renewable energy and climate-friendly transportation in the future.

References:

Ahmad, A., Khan, Z.A., Saad A.M., & Khateeb, S. (2018). A Review of the Electric Vehicle Charging Techniques, Standards, Progression and Evolution of EV Technologies in Germany. Taylor & Francis Journal of Smart Science, 6,(1), 36–53. https://doi.org/10.1080/23080477.2017.1420132

Kang, N., Ren, Y., Feinberg, F.M., & Papalambros, P.Y. (2016). Public Investment and Electric Vehicle Design: A Model-Based Market Analysis Framework With Application to a USA-China Comparison Study, Design Science, 2(e6), 1–42. https://doi.org/10.1017/dsj.2016.7

Ruiz, V., Pfrang, A., Kriston, A., Omar, N., Van den Bossche, P., & Boon-Brett, L. (2018). A Review of International Abuse Testing Standards and Regulations For Lithium Ion Batteries in Electric and Hybrid Electric Vehicles. Renewable and Sustainable Energy Reviews, 81(1), 1427–1452. https://doi.org/10.1016/j.rser.2017.05.195

Shaukat, N., Khan, B., Ali, S.M., Mehmood, C.A., Khan, J., Farid, U., Majid, M., Anwar, S.M., Jawad, M., & Ullah, Z. (2018). A Survey on Electric Vehicle Transportation Within Smart Grid System. Renewable and Sustainable Energy Reviews, 81(1), 1329–1349. https://doi.org/10.1016/j.rser.2017.05.092

Sidabutar, V.T.P. (2020). Kajian pengembangan kendaraan listrik di Indonesia: prospek dan hambatannya. Jurnal Paradigma Ekonomika, 15(1), 21-38. https://core.ac.uk/download/pdf/322516039.pdf

Mirzayanto Bin Muchtar

1. Indonesia Renewable Energy Portfolio In the Transport Sector

Indonesia has a Renewable Energy target of 23% in the national energy mix by 2025. This policy, combined with Indonesia's commitment to reduce emissions by 29% by 2030, is a clear effort towards a more sustainable energy system. For electricity sector, the target of renewable energy is 21.600 MW (hydro 14.100 MW, geothermal 6.300 MW, others (Incl. Solar) 1.200 MW). Until the end of 2020, the achievement of the renewable energy target in the new energy mix reached 11.20%.

Indonesia is hightly dependent on fossil fuel not only for energy but also for tax and export. That's why it take time longer for Indonesia for converting to renewable energy than other countries. Renewable energy coversion is driven not only by national target, but many factors such as political, economy and social factors. Pressure from international organization like World Bank which has stop to finance fossile energy based projects is one example of why Indonesia has to sift to renewable energy

Indonesia targets in Renewable Energy sector:

1. Fulfilling electricity needs through the completion of the 35,000 MW program by utilizing clean and renewable energy sources.
2. Encouraging the development and utilization of biodiesel as an effort to reduce GHG emissions and improve the community's economy.
3. Construction of electricity and gas transmission to support the tourism sector.
4. Increasing the Domestic Market Obligation (DMO).
5. Public education through outreach to support the policy implementation process.

Indonesia Policies / strategies related to the use of Renewable Energy:

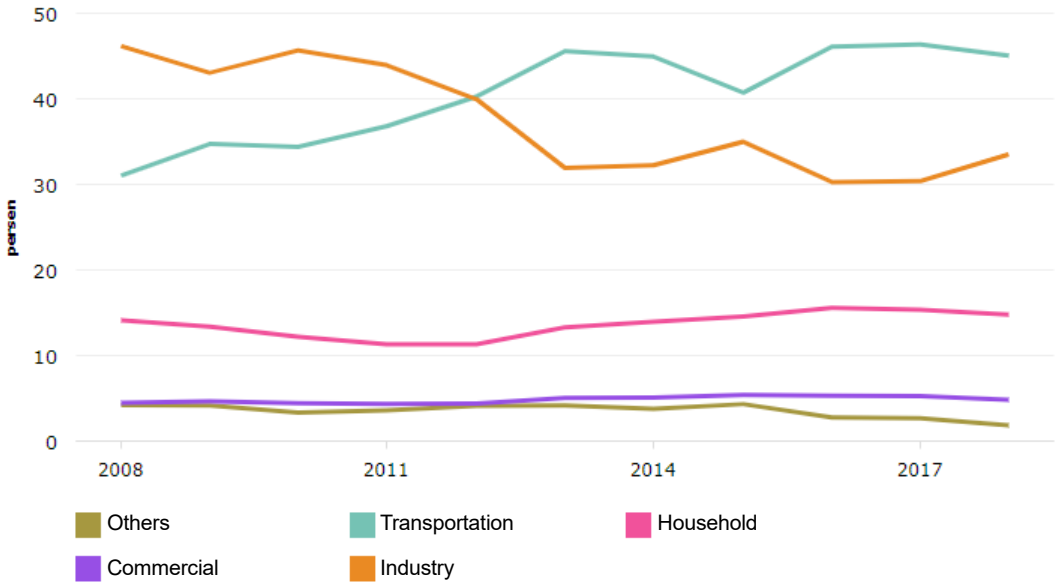
1. Implementation of the mandatory B30 program for all sectors, followed by the development of trials for biodiesel as a substitute for fossil diesel with B100 development technology.
2. Mixing RON 92 Oil Fuel in East Java in the context of efforts to procure Bioethanol-Type Biofuels, in accordance with the Minister of Energy and Mineral Resources Regulation Number 12 of 2015.
3. Accelerate the development of Waste Based Power Plant in 12 selected cities, according to the mandate in Presidential Regulation Number 35 of 2018 concerning the Acceleration of the Waste Based Power Plant Development program.
4. Encouraging the use of roof solar power plants in accordance with the mandate of the Minister of Energy and Mineral Resources Regulation Number 49 of 2018 concerning the Use of Rooftop Solar Power Generation Systems by PLN Consumers.
5. Simplify the bureaucratic process through the Minister of Energy and Mineral Resources Regulation Online Licensing Application which is integrated with data on natural resources, operations, production, marketing / sales of each type of energy.

6. Increasing the use of renewable energy to reduce dependence on fossils, which has an impact on increasing Indonesia's economic stability. (RWS)

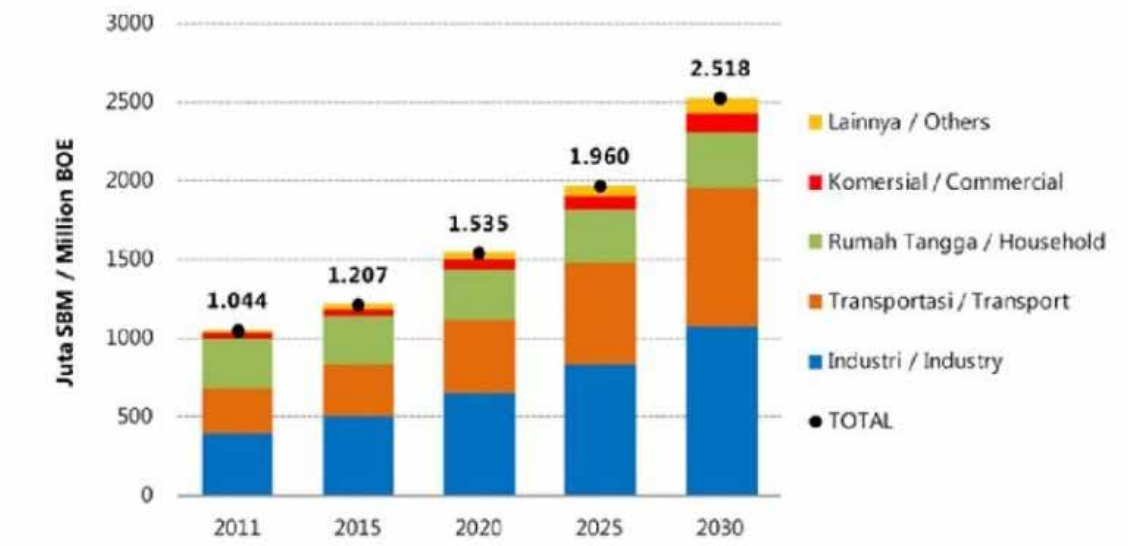
Energy Utilization Action Plan in Tranportation Sector

1. Increase the use of Gas Fuel (eNG and LPG) for land transportation. The wider use of Gas Fuel for land transportation will reduce the use of Oil Fuel, which in turn will reduce environmental pollution caused by the use of Gas Fuel. Increasing the use Gas Fuel must be accompanied by an increase in infrastructure development.
2. Increase gas fuel utilization in the transportation sector through alternative technologies such as LNG, gas hydrates and DME.
3. Developing biodiesel as an alternative fuel.
4. Increasing the use of electricity for the development of land transportation modes for mass public transportation in urban areas and between cities.
5. Develop efficient and comfortable means of transportation. The use of efficient means of transportation will save fuel usage.

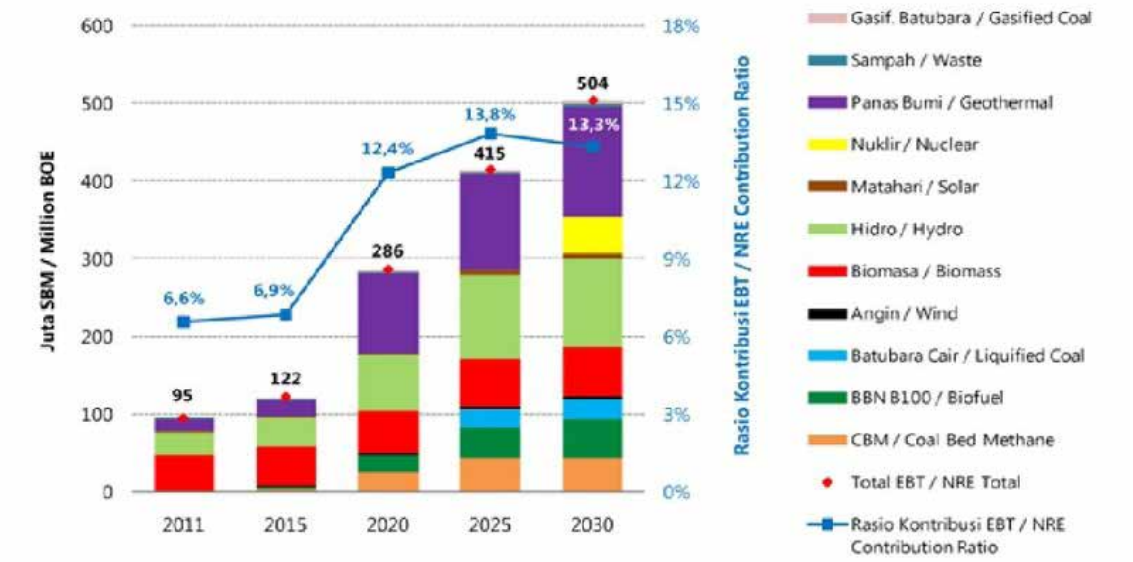
Indonesia Energy Consumption (%) per Sector (2008 – 2018)



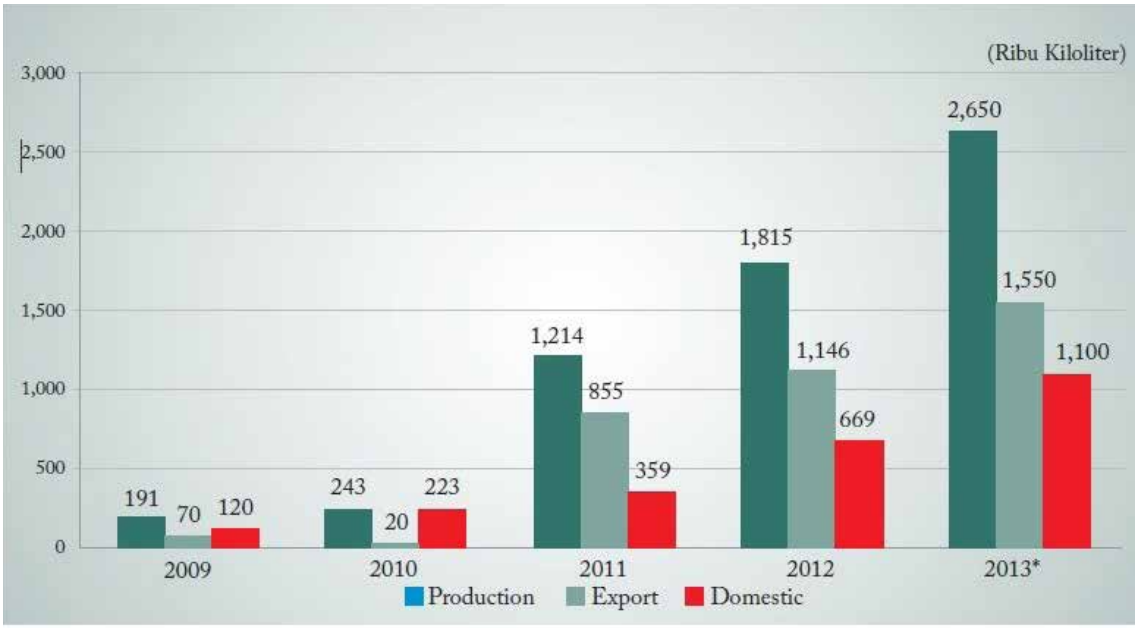
Projection of Total Energy Demand by Energy Sector



Projection of New and Renewable Enerby suply and Their Contribuion Ratio



Biodiesel Production/Export/Domestic



Sumber Kementerian ESDM diolah kembali oleh Dewan Energi Nasional
*) Data tahun 2013 merupakan data sementara (masih dalam proses pemutakhiran data)

Potential Resource and Installed Capaciy of Renewable Energy in Indonesia

No.	Type Of Energy	Resource	Reserve	Installed Capacity
1	Geothermal	12,386 MW	16,524 MW	1,643 MW
2	Hydro	75,000 MW		4,010 MW
3	Mini-Microhydro			212 MW
4	Bio Energy	32,654 MW		1,656 MW (Off Grid) 131.4 MW (On grid)
5	Solar Energy	4.8 kWh/m2/day		70 MW
6	Wind Energy	970 MW (4-6 ms)		
7	Uranium	3,000 MW		
8	Methane	456.7 TSCF		
9	Shale Gas	574 TSCF		
10	Sea Wave Energy	1,995.2 MW		
11	Sea thermal Energy	41,012 MW		
12	Tidal Energy	4.800 MW		

2. Experience of participating in UNITAR CIFAL Jeju's workshop

This online session of Scaling-up Renewable Energy Ambition in Future Transport is not my fisrt workshop with CIFAL Jeju. In November 2010, I have joined a workshop titled Low Carbon City: Green Growth for Local Government in Jeju Republic of Korea, facilitated by CIFAL/JITC Jeju. Both worshop were benefit a lot for me in understanding the national/global situation in different issue in different cities/countries perspective. Hopefully this will enhance my personal and profesional knowledge to contribute more to my city and my society.

3. How the future transport should be like

For Indonesia case, the future transportation should be focused on develop infrastructute for public mass transportation and reduce the private vehicle population to prevent traffic conjestion and reduce carbon emission in transportation sector . Along with the programme the government should step by step convert all the transportation mode either private vehcles or public vehicles from fossil fuel based vehicle to zero emission vehicles.

Articles on Renewable Energy and Transport Policy Portfolio

India

Ritesh Kumar Sinha

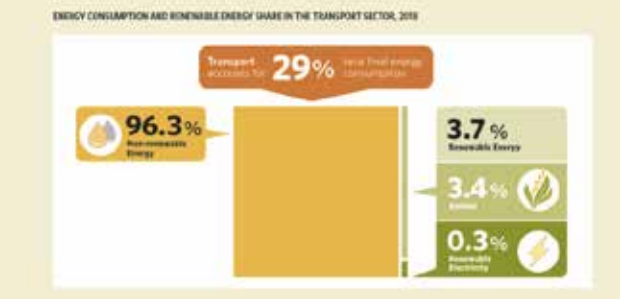
Renewable Energy in India – Context

Energy sources are necessary element of socio-economic development of any country and likewise economic growth in a country affects to accelerate the increase in energy consumption. Therefore, it is evident that to sustain the economic growth especially that in the developing countries, sustaining its energy requirements is essential. Renewable energy is also a very important & lucrative market with investors looking for options stressing on sustainable businesses such as these given global policies like ESG (Environment, Social & Governance) are prevalent. Strong policy measures and increasingly opportune economic situation have pushed India to be one of the top players in the world's most attractive renewable energy markets. Among the top countries that are investing in or plans to invest in using renewable energy in the near future is India, ranked at no. 3 with a score of 6.3 following Brazil at 6.5 and USA at 7. Such investments are also necessary for sustainability because India also is responsible for nearly 6.65% of the total global carbon emissions, ranked fourth following China at 26.83%, the USA at 14.36% and the EU at 9.66%. India being the second most populous nation and one of the major economies is naturally expected to commit to the 'net zero target'.

India has taken active voluntary steps to reduce its emissions. The focus on renewables, electric mobility, energy efficiency, compensatory afforestation etc. is mandatory in this endeavor of achieving India's net zero targets. According to the International Renewable Energy Agency (IRENA), a quarter of India's energy demand can be met with renewable energy. The country could potentially increase its share of renewable power generation to over one-third by 2030. India has committed its contribution through its Nationally Determined Contributions (NDCs). Its per capita carbon footprint is sixty percent lower than the world average. To further show its commitment and solidarity, India and US have launched the "India-US Climate and Clean Energy Agenda 2030 Partnership" that aims to mobilize finance and speed clean energy deployment; demonstrate and scale innovative clean technologies needed to decarbonize sectors including industry transportation, power and buildings; and build capacity to measure, manage and adapt to the climate related impact risks. India is aiming to attain 175 GW of renewable energy which would consist of 100 GW from solar energy, 10 GW from bio-power, 60 GW from wind power, and 5 GW from small hydropower plants by the year 2022. Investors have promised to achieve more than 270 GW through foreign investments, private sector, navy, railways etc.

Renewable Energy in Transportation Sector of India

Energy demand for transport is growing much faster than any other sector. In 2018, transport represented 29% of total final energy consumption of which only 3.7% was met by renewable sources.



The last decade saw substantial growth in fully electric cars which run exclusively on electric power. The overall market shares are still small (only about 2% of the global market), and still much lower than PHEVs, but growth rates have been enormous (see Section 4.2). Fuel cell vehicles (FCEVs) are a special type of electric vehicle, where the electricity is not stored in batteries, but generated within the vehicle using hydrogen that combines with oxygen in a fuel cell. India has undertaken a lot of measures to promote renewable energy in the transportation sector such as mentioned by one of the speakers, Mr. Soman from India during the Session 1 of UNITAR CIFAL Jeju on the same topic –

- Introduction of demand incentives for end-use to purchase EVs. In FY 21, 2,36,802 units were sold.
- Phased manufacturing plans and production linked incentives launched to encourage indigenously made EVs.
- Indian Railways committed to be fully electrified by end of 2023.
- National policy on biofuels introduced 20% blending of ethanol in petrol and 5% biodiesel in diesel by 2030.
- National Hydrogen Energy Mission announced in 2021
- Trial of hydrogen blended CNG buses launched in the Capital of India, Delhi.

Leveraging Covid-19 to promote RE in Transport

Additionally, it is interesting to note that while Covid-19 is being called out to be a hindrance in achieving the national commitments in every sector, some govt. reports identify how Covid-19 is beginning to influence the clean energy transition in India especially for the transport and power sectors. It further recommends principles and strategic opportunities for the country's leaders to drive economic recovery and maintain momentum towards a clean energy economy. Covid-19 is presenting a significant shift in consumer demand and preferences. Clean energy is set to be a major driver of India's economic recovery and international competitiveness.

Opportunities in the transport sector include –

1. Making public transport safe and comfortable
2. Enhancing and expanding non-motorized transport infrastructure
3. Reducing vehicle kilometers travelled through work from home
4. Further promotion of EVs in freight and passenger segments
5. Making India an automotive export hub

Touching further upon the last two points, in freight transport, considering India's skewed modal share (71 percent of India's freight transport is road-based, whereas only 17 percent is rail-based), less fuel-efficient vehicles, and low operational efficiency, India has an opportunity to shift to a cost-effective, clean, and optimized freight transport system. A supportive policy environment has also been created in the freight segment through Make in India, an initiative to encourage domestic manufacturing; Digital India, a program to transform India into a digitally empowered society; and the Logistics Efficiency Enhancement Program, which aims to improve infrastructure, procedures, and information technology. To maintain its momentum in clean transport, India must continue to prioritize shared, electric, and connected passenger mobility and cost-effective, clean, and optimized freight transport. Together, India's passenger and freight transport sectors can avoid about 600 Mtoe of oil equivalent (Rs 20 lakh crore ~ USD 307 billion of oil import savings) and 1.7 giga tonnes of tailpipe carbon dioxide emissions by 2030.

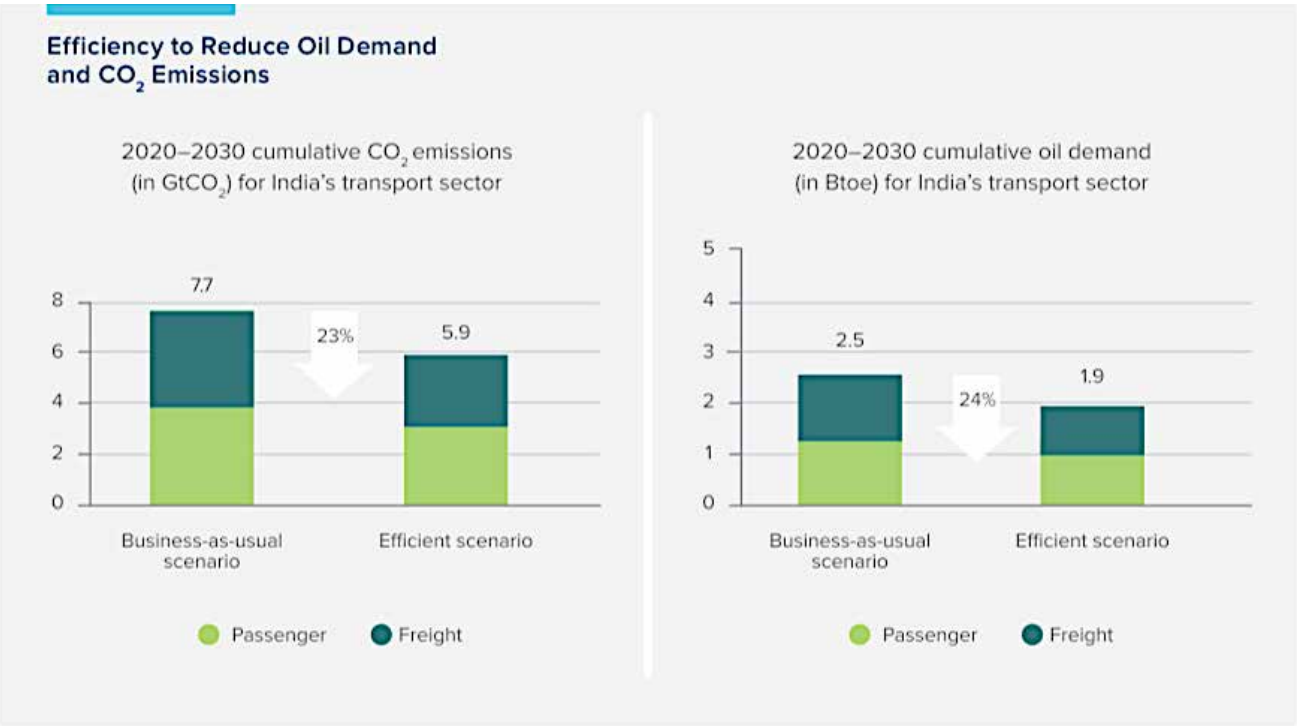


EXHIBIT 5: Oil Demand and Tailpipe Carbon Dioxide Emissions in India's Passenger and Freight Transport Sectors for Business-as-Usual and Efficient Scenarios (Niti Aayog and RMI analysis). *Note: Numbers in the graph and text may not match due to rounding.*

India is looking to invest in improving its R&D, design and manufacturing and export for vehicle industry and become a hub for generating eco-vehicles complying with international emission norms.

Summary & Suggestions

To Summarize some of the innovative steps taken in the area of promoting renewable energy in India and what else can be focused on based on discussions during both the session in the UNITAR CIFAL Jeju workshop –

- Promotion of public transport by making them safe and comfortable to use especially considering Covid-19 requirements
- Promotion of RE technology in passenger (public) and freight transport especially technologies having longer life so that the capital investments can be balanced off with operational costs of the vehicles.
- Exploring RE technology in shipping and aviation as well as road and railways.
- Investments in promotion of clean energy by integrating economic development with agenda of RE promotion. India plans to invest largely on MSMEs in making India a manufacturing hub for EVs and vehicles and/or components that run on clean energy meeting international emission standards.
- Promotion of bio-fuel based vehicles and EVs by leveraging the shifting consumer focus and preference arising from consciousness towards air pollution and its effects on health especially post Covid-19
- Incentivization and penalties to promote clean energy and discourage polluting vehicles and congestion
- Life cycle approach to emissions reduction
- Encouraging private players & foreign investments in achieving RE agenda through partnerships & strengthening international relationships.

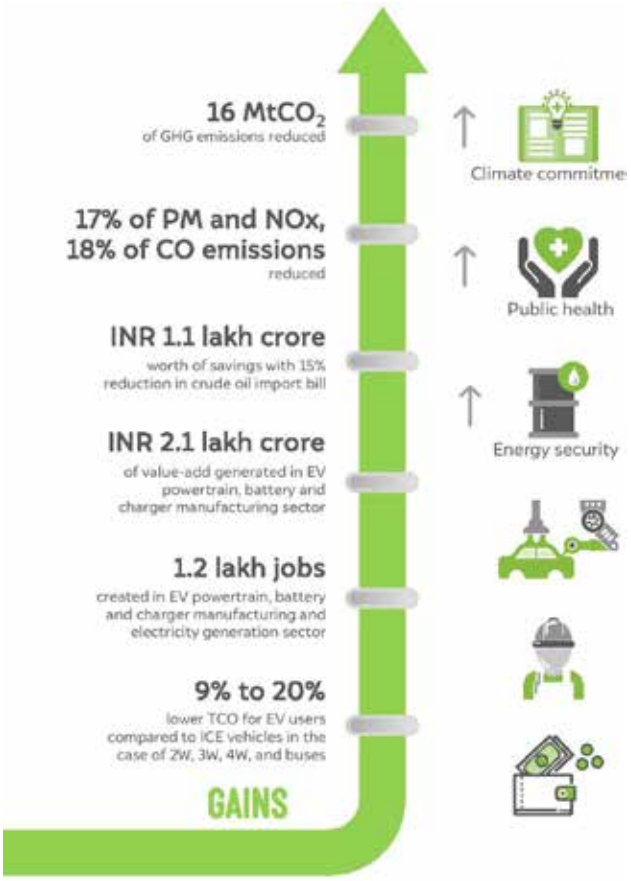
Jahnavi Ganguly

CONTEXT

India currently ranks fifth among the countries of the world when it comes to size of its energy economy, measured by the combined revenue of energy companies. India also ranks 3rd on renewable energy investment and future plans according to a study conducted by British Business Energy. The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for everything relating to new and renewable energy. The broad aim of the Ministry is to develop and deploy new and renewable energy to supplement the energy requirements of the country. The primary objective behind the efforts to make India energy sufficient and advance the causes of economic development, improving energy security, improving access to energy and mitigating climate change.

RENEWABLE ENERGY (RE) IN INDIAN TRANSPORTATION SYSTEM

India has committed to meet up to its goal agreed upon under the Paris climate agreement i.e. to make renewable sources take up to 40% of power-generation capacity by 2030. Integrating this goal with curbing the issue of toxic air pollution in the urban areas, India has set a target to convert all cars to 100% electric vehicles by 2030. This is also based on the assessment of future vehicular traffic and car sales which tells that the no. of vehicles on Indian roads is set grow to above 550 million by 2030. As discussed during the session conducted by UNITAR CIFAL Jeju on the topic, such a move will tremendously support the cause of economic development in the county. Below is a representation made by one of the speakers, Mr. Abhinav Soman, during the session to substantiate the same.



While India has introduced several options in the public transportation such as introduction of e-rickshaws (small battery operated public vehicles to carry 4-5 persons at a time) for short distances to CNG driven public buses in a lot of major cities of India, India has also embraced sustainability in the unlikeliest of places – the Indian Navy which recently inaugurated its largest solar power plant having a capacity of 3MW in one of the states of India (Kerala) and 2MW in another state (Maharashtra). Sustainability in transport infrastructure with an increased attention on operational efficiencies and reduction of the environmental impacts of daily operations were the driver to Indian Navy's Environment Conservation Roadmap (INECR) pledging to support 24MW of solar power generation projects.

WAY FORWARD

Some of the ways the potential of renewable energy (RE) goal be increased are –

- Explore more options in solar energy as solar energy is prevalently available in India
- Setting clear micro-targets for decarbonizing transport sector that translates to the over RE goals taken up by the country
- Sub-sectors in transport sector that contributes the most to energy and emissions demand may be focused upon
- Incentivize usage of RE based technologies in private vehicles and more so usage of RE powered public vehicles
- Balancing the incentives through taxes and fees on congested roads to reduce road congestion
- Decision making on various fuel and vehicle technology alternatives should be based on life cycle emissions assessments
- Explore sustainable options for RE powered public passenger vehicles and those used for freight which have longer life encompassing road, railway, aviation and shipping freight.
- Involvement of private players in financing and expertise development through promotion of public-private partnerships, especially to expand charging stations/ bio-fuel filling stations in order to promote RE based vehicles.
- Sensitization of general public on efficiency and longevity of EVs. EVs may currently be capital intensive comparatively but the operations are cheap. Strong policies to promote clean energy based vehicles may be profitable for those already investing in clean energy.

Articles on Renewable Energy and Transport Policy Portfolio

Mongolia

Anu-Ujin Lkhagvasuren

Ulaanbaatar city RE ambition in the transport sector:

As of January 10, 2020, a total of 604,818 vehicles were registered in Ulaanbaatar city. The average annual growth of vehicles is 9.5 percent. Of the total registered vehicles, 65 percent or 393,132 vehicles are privately owned.

The largest number of vehicles registered in Ulaanbaatar, 74 percent, are gasoline-powered vehicles, 23.5 percent are diesel vehicles, 0.1 percent are electric vehicles, and 2.45 percent are gas-powered vehicles.

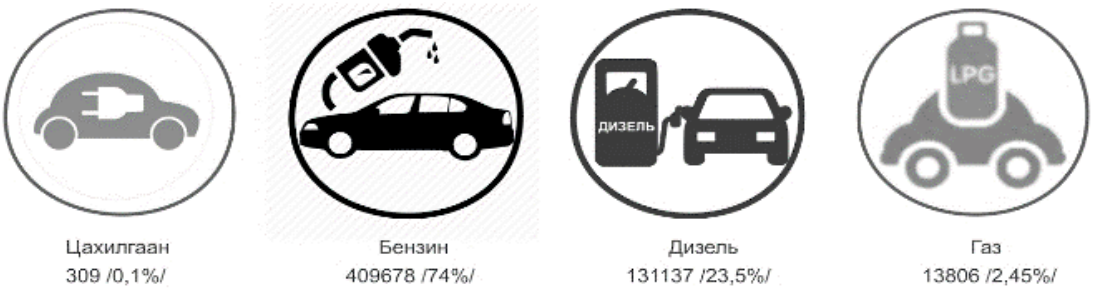


Figure 5: Vehicle fuel survey

In 2010, there were 173,359 passenger cars registered in Ulaanbaatar, compared to 439,730 or 73 percent of the total number of vehicles in 2020, and the average annual growth of passenger cars increased by 9.3 percent. In Ulaanbaatar, 326,982 vehicles are involved in traffic per day, with an average speed of 13 km / h during peak hours. In order to increase the average speed of vehicles to 30 km / h, it is necessary to have 141692 vehicles or 43% of the vehicles currently involved in road traffic.

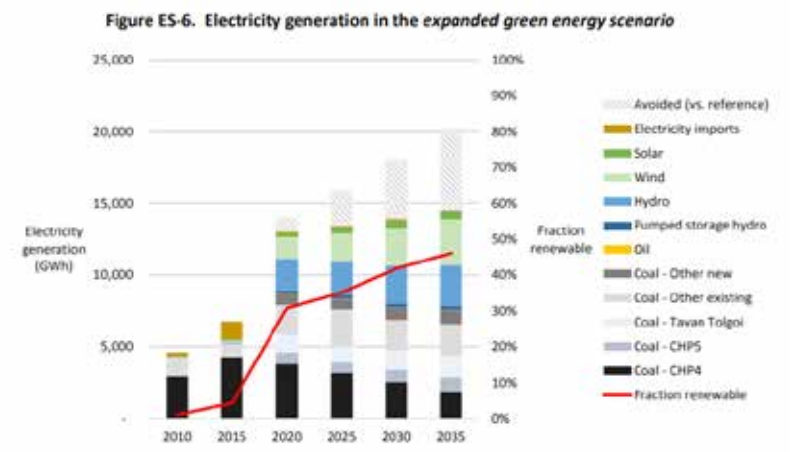
Type	Quantity	Percentage
Passenger car	439730	73%
Truck	80318	13%
Bus	16726	3%
Special	6942	1.2%
Cistern	2890	0.5%
Locomotive	15850	2.5%
Mechanism	10891	1.8%
Trailer	21676	3.6%
Motorcycle	9795	1.4%

Table 4: Classification by type of vehicle

As we can see, increasing mobility usage, traffic congestion and aging of the vehicles in UB city are the main source of the Air pollution and Public health issue. Currently, there are many ongoing projects in transportation sector. Government is taking serious consideration of traffic congestion and transportation issues in the capital city.

One of the megaproject that is to be implemented in UB city is LRT system. According to the SDGs and Paris agreement that Mongolia follows, all public transportations should run on CNG and Electricity.

If the LRT system is implemented in 5 years, one of the major electric consumer of will be public transport. But the current installed capacity of whole energy system is 1,100kW and we import electricity from Russia when the energy consumption increases more than our own capacity. With such capacity, we can't run public transportation yet can't develop anything. If we want to reduce traffic congestion, alleviate air pollution level and implement green transportation system, we need to start with Public transportation master plan and Mass transit plan which are processing now. I am working at mass transit system project and studying and considerin LRT as public transportation. Along with the project, we will renew policies and financing scheme. Therefore, I'll try to reduce air pollution and traffic congestion by introducing green transportation modes.



My experience of attending this UNITAR CIFAL JEJU was quite interesting and nice experience. The government just released 4 tier lockdown and we are getting back to normal life amidst COVID situation. Therefore, attending international workshops and conferences are best opportunity to learn and engage with society. Presentations by lectures were full of new knowledge that we could benefit.

HEAD OF THE INFRASTRUCTURE AND ENGINEERING DEPARTMENT IN ULAANBAATAR GAS NETWORK

Erkhembayar Jambalsuren

Ulaanbaabar In Mongolia

Ulaanbaatar is capital city of Mongolia and the most populous city of Mongolia. The municipality is located in north central Mongolia at an elevation of about 1,300 metres a valley on the Tuul River. The city was originally founded in 1639 as a nomadic Buddhist monastic center, changing location 28 times, and was permanently settled at its current location in 1778.

The city features brief, warm summers and long, bitterly cold and dry winters. The coldest January temperatures, usually at the time just before sunrise, are between −36 and −40 °C with no wind, due to temperature inversion. Most of the annual precipitation of 267 millimetres falls from May to September. The highest recorded precipitation in the city was 659 millimetres at the Khureltogoot Astronomical Observatory on Mount Bogd Khan Uul. Ulaanbaatar has an average annual temperature of −0.4 °making it the coldest capital in the world (almost as cold as Nuuk, Greenland, but Greenland is not independent). Nuuk has a tundra climate with consistent cold temperatures throughout the year. Ulaanbaatar's annual average is brought down by its cold winter temperatures whereas it is significantly warm from late April to early October.

The city has officially 1.2 million dwellers as well as 613,450 cars. Currently, Ulaanbaatar city has There are no underground lines, and the city government is conducting a feasibility study to establish an underground public transportation system. There are 800-1000 buses and trolleybuses serving residents every day. 98% of buses have diesel engines and only 2% electric buses. Most electric buses are devoted to warm countries and during the winter electric bus efficiency rapidly dropped by 80% in Ulaanbaatar. Today's level of technology is inappropriate in cold and harsh weather conditions. Since 1980, we have been using trolley buses and from 2002, Mongolians are producing trolley buses locally. Trolley buses are one of the fully eco-friendly public transportation types. However, when we want to increase the number of trolleybuses, additional infrastructure is needed.

From the course, I have known international public transportation system's trends. This is essential for the rapidly rising cities and its residents. Hence, I have made friends and we can change the information to each other according to the theme. I appreciate dear conductors I want to participate every year.

Duusuren Munkhbat

Should I buy a car?

Our world is changing so much that affects the way we live and require us to think differently. I would like to analyze how should I make the decision of buying a car. There is certain degree of need to efficiently move in busy city and need of own a car because this has been everyone's mind as our country become free economic market and peaceful democratic revolution brough us the right to private property ownership. However, there are several considerations to reflect to make this decision.

I am living in Ulaanbaatar city, the capital city of Mongolia. The city has been rapidly urbanizing for the last three decades and when I look out on the street you can see a lot of cars on the road which causing terrible traffic jam as most big cities. The number of cars increased dramatically in last 2 decades that reached almost 700,000 with annual growth rate of 5 to 6% in Ulaanbaatar city that has 1.5 million people. However almost 90% of these cars are second hand imported vehicles which 80 percent of them from Japan because we do not have any car production in the country. And 70 percent of the cars are more than 10 years old which generates more pollution. Transportation contributes about 10 percent of the air pollution for the city where it ranked one of the worst polluted cities globally.

As impact of climate change is already here, I am considering environmentally friendly low carbon electric car to reduce my greenhouse gas emission and the world is moving forward with electrification of the transport in the future which lot of car manufacturers announcing its shift to full electric vehicle production strategy. In addition, the government initiated incentive framework to promote electric cars by cutting off the custom tax, provision of special green car plates, and allowing to run without any restriction which is in place to reduce traffic jam such as bus only lane and plate number limitation on specific days. Initial capital cost of such greener technologies often more expensive and however, overall life cycle cost is beneficial considering fuel and maintenance. Banks started providing low interest rate green loans for electric cars in attempt to make it more affordable.

But there are some problems to owning electric car in the city. First, we do not yet have proper infrastructure, for instance charging stations in place. There are only a few numbers of private spots in the city which is inconvenient, and another issue is low efficiency of battery engine during the cold winter season. You might also concern that even though the car itself may not produce any GHG emission, its power source is almost 90% coming from the coal plants. Mongolia has accelerating the renewable energy projects and installed capacity reached 27% of total energy generation. On the positive side this is the only green policy target that is on track that shows future potential.

Other transport modality is also not a preferable choice to move around the city. Walkways and cycling are poorly developed and have the safety issues. Mass transportation system is not developed and around 1000 buses are in operation to serve public. Service quality is poor, and people opt out to drive their cars even though they will be stuck in traffic for hours.

Indeed, traffic congestion has been the biggest urban challenges and we need to transform it to more low carbon, sustainable and accessible on every layer of the sector and collaboration of multi-stakeholders. I do believe that these issues can bring more greener opportunities which I currently trying to solve step by step. It is complicated and hard work that requires expertism and I am thankful UNITAR CIFAL Jeju's effort to provide platform to improve and network.

Articles on Renewable Energy
and Transport Policy Portfolio

Nigeria

NIGERIA RENEWABLE ENERGY PORTFOLIO IN THE TRANSPORT SECTOR.

Present by:

MUSIBAU NURUDEEN BABATUNDE

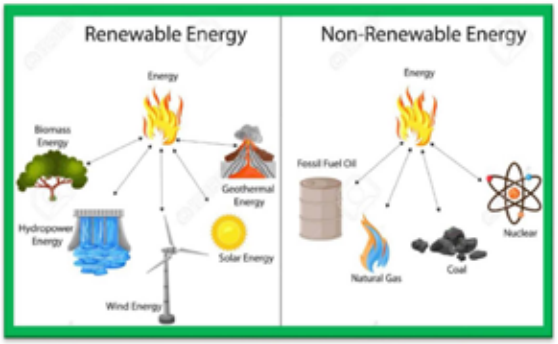
PRESENTATION OUTLINE

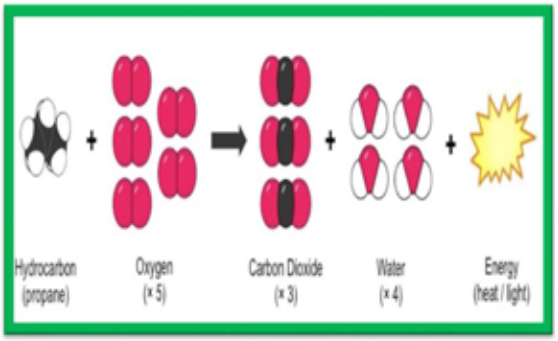
1. *COUNTRY PROFILE*
2. *INTRODUCTION*
3. *ENERGY CONSUMPTION BY SOURCE AND SECTOR*
4. *PORTION OF RENEWABLE ENERGY TYPES*
5. *RENEWABLE ENERGY PROSPECTS*
6. *POWER INDUSTRY STRUCTURE, STATUS AND DEGREE OF REGULATION*
7. *SMART GRID PLAN WITH ANY TRIAL SITE*

COUNTRY PROFILE

1. *Population (Million):* 200
2. *Area (Km2):* 910,770
3. *Population Density (/Km2):* 217.55
4. *Per Capita Income:* 24.61
5. *Access to Electricity:* 45% Urban, 36% rural
6. *Major Sources of Power:* Hydropower and Gas
7. *Average price per KW:* 6.7c Household,10.8c businesses
8. *Average consumption per household/month/kw: Urban: 100kw, Rural: 30kw*

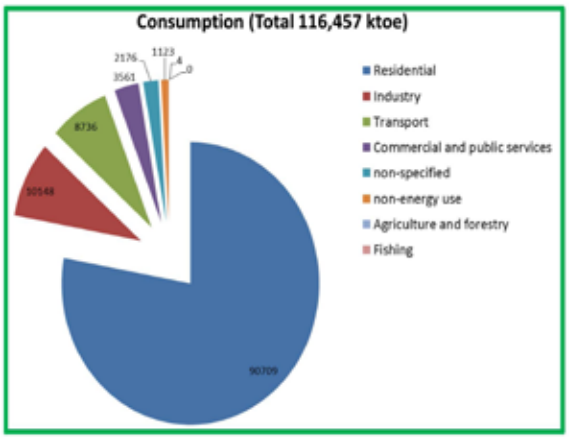
INTRODUCTION





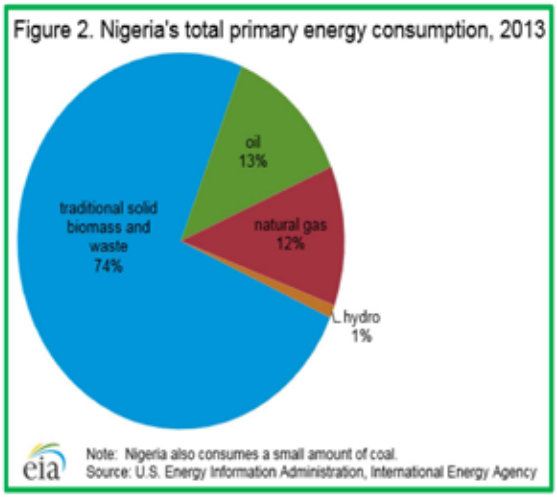
- *Energy by classification could be renewable or non-renewable.*
- *Most of the sources of non-renewable energy are fossil fuel, hydrocarbons which when combusted completely (chemical reaction where a **hydrocarbon** reacts with oxygen) creates carbon dioxide.*
- *While water and heat are environmental friendly and can be converted to other forms of energy, Carbon dioxide poses a lot of danger to the environment and is the number one contributor to Greenhouse Effect*

ENERGY CONSUMPTION BY SOURCE & SECTOR

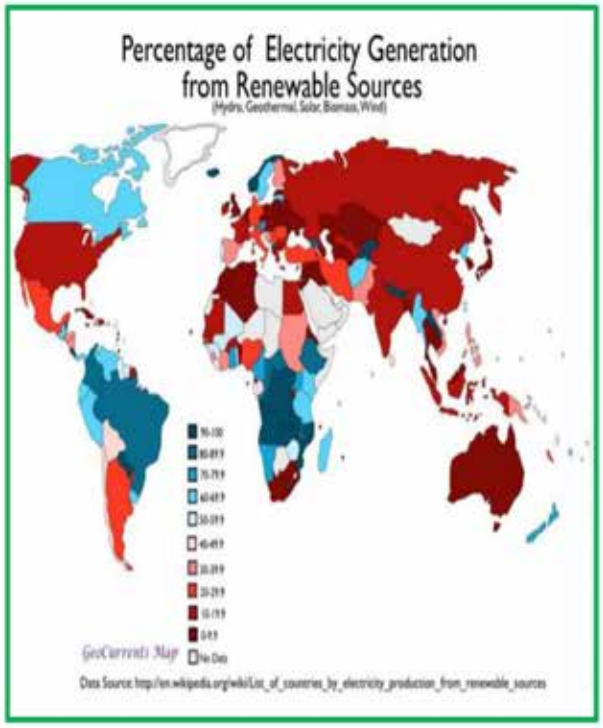


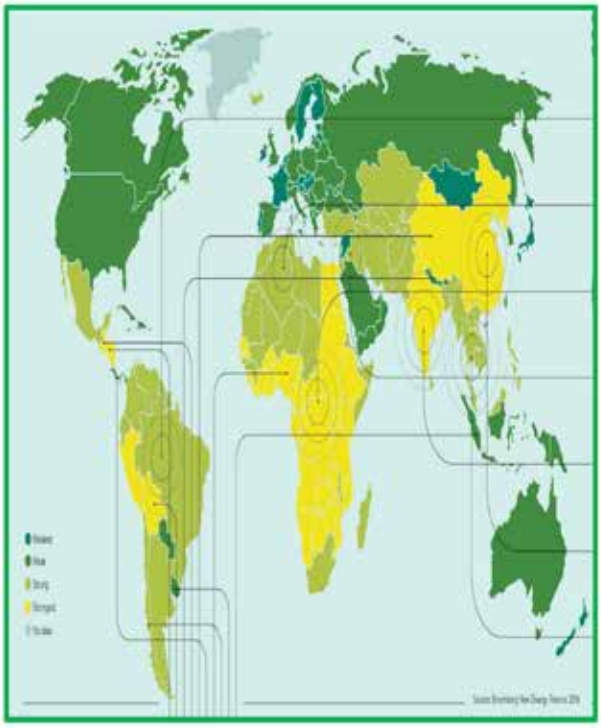
In terms of the distribution of the energy demand, in 2012, the total final consumption was 116,457 ktoe, of which the residential sector accounted for over 77% of the energy consumed.

In 2013, traditional biomass and waste (typically consisting of wood, charcoal, manure, and crop residues).

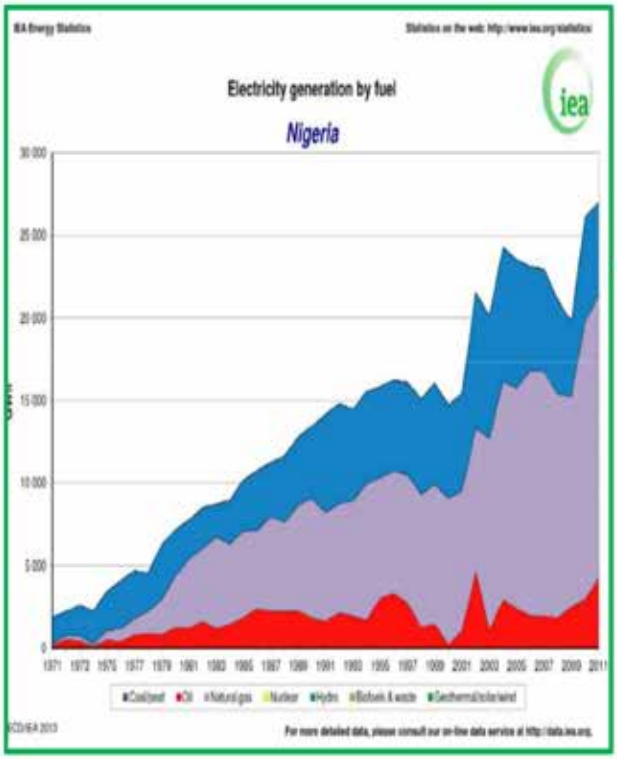


COMPARISON – ENERGY SOURCE

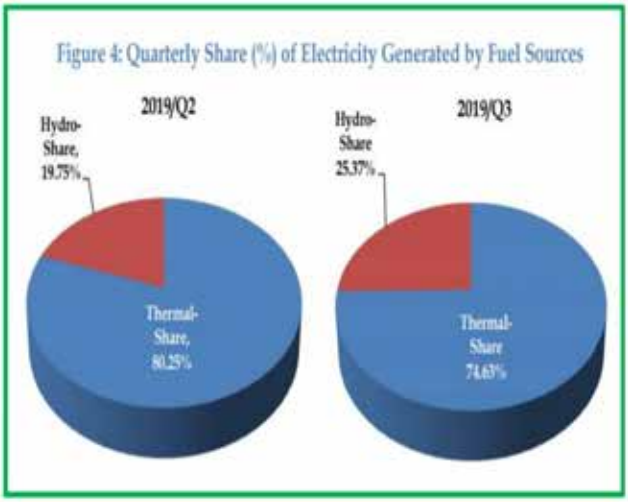




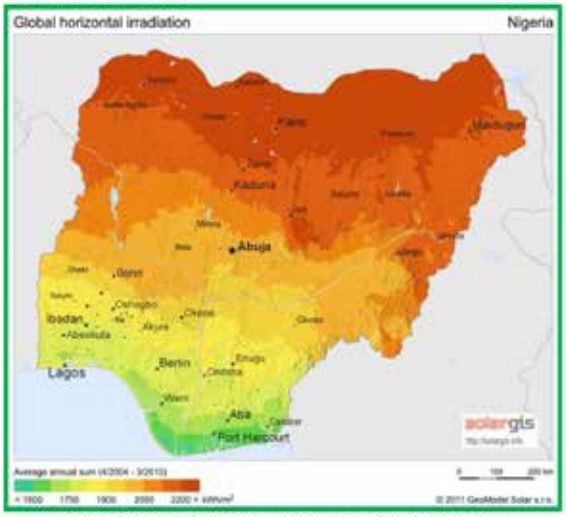
PORTION OF RENEWABLE ENERGY TYPES



Nigeria has 12,522 MW of installed generation capacity which is largely dependent on its twenty two (22) natural gas plants and three (3) hydro plants.



RENEWABLE ENERGY PROSPECTS



Assumed potential for concentrated solar power and photovoltaic generation of around 427,000 MW

Annual average speeds of about 2.0 m/s at the coastal region and 4.0 m/s at heights of 30m in the far northern region

- *In addition to the INDC's plan to install 13GW of off-grid solar capacity by 2030, the Nigeria Renewable Energy Master Plan (REMP) aims to install a total of 2600MW of small hydro power, 500MW Solar PV, 450 MW Biomass-based power plants and 400 MW Wind energy by 2025.*

RENEWABLE ENERGY PROSPECTS – Post Covid19

12. Energy For All: Solar Power Strategy

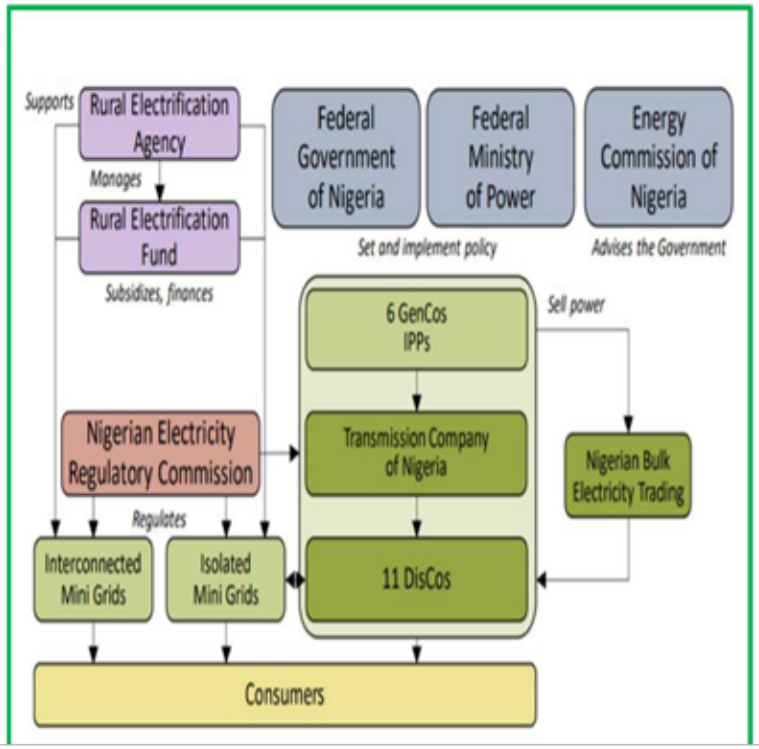
The Solar Power Strategy will support 250,000 jobs and impact up to 25 million beneficiaries through the installation of 5 million Solar Home systems and mini-grids. Provision of reliable electricity to health clinics will also be included as a priority.

The project will swiftly increase the stock of affordable energy by providing solar power to rural communities that have little or no access to the national grid. Private sector installers of solar systems will be supported to access low-cost financing from development finance institutions and the CBN in order to install solar systems at an affordable price. The project will also draw on the experience of the 'Energising Economies' project through which customers with low energy demand were provided with electricity on a monthly 'pay-as-you-go' basis by private sector operators.

The project will also promote the local production of solar components and appliances, taking advantage of the work that has already been done in this regard by the NASENI and others.

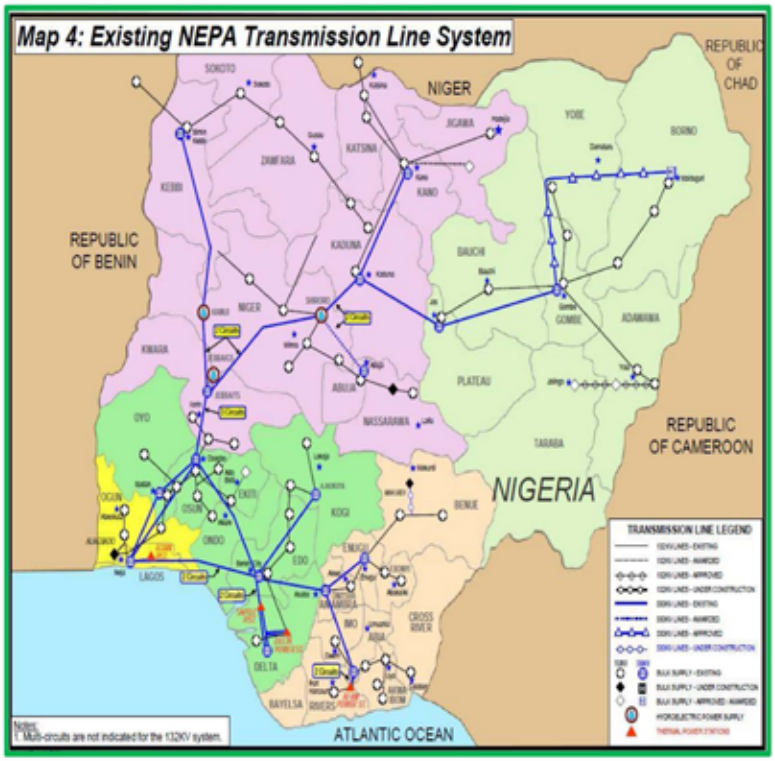
Objective	Create 250,000 jobs in the energy sector while providing solar power to 5 million households by 2023.
Guiding Principle	Leverage private sector knowledge and finance as well as the demonstrated willingness of citizens to pay for reliable power supply to expand access to electricity nationally.
Project Elements	• Identify locations for solar installations working with state governments. • Identify prospective beneficiaries. • Facilitate the participation of private sector solar providers including SMEs in the deployment of solar power to 5 million households. • Encourage private sector financing for off-grid solar energy projects with a minimum Tier 2 (80W – 150W) system. • Attract investment of solar panel manufacturers into Nigeria, building on the work already done by NASENI and others.
Implementing Structure	Federal Ministry of Power, Rural Electrification Agency, Niger Delta Power Holding Company
Estimated Cost	N 240,000,000,000.00
Timeline	12 months

POWER INDUSTRY STRUCTURE, STATUS AND DEGREE OF REGULATION



- *Nigeria's power sector is partially deregulated.*
- *The power Generation and Distribution is fully commercialized while the power transmission remains with the Government.*

SMART GRID PLAN WITH ANY TRIAL SITE



- *The TCN; solely owned by the Federal Government of Nigeria is responsible for wheeling of power from the GenCos to the DisCos.*
- *The current transmission wheeling capacity is about 7,500MW over 20,000km transmission lines adequately higher than the current operational generation capacity of 3,879MW.*

THE OLD NIGERIA SMALL AND BIG BUSES

THE NEW NIGERIA BUSES

On the path towards decarbonizing public transport, Nigeria as not really been into renewable energy because of the economy factor and policies that have not been put in place. Nigeria itself has been battling in decarbonizing public transport which at the end entered into Biomass using feedstock to produce Biofuel. But policy are already going on to shift Nigeria transport sector to renewable energy from the renewable source.

1. Some rather advanced emerging economies have already undertaken serious eff orts to formalize (parts of) their public transport and can start moving on towards el ectrification.

2. The majority of developing countries however, including the Nigeria, currently still rely on semi-informal and fragmented minibus-based low-quality public transport systems. This by far

3. In Nigeria, crop residues are usually left or burnt on farms after the harvest of desired crops. Both primary and secondary based residues have high potential for energy production. About 50% of the agricultural residues are burnt on cropland before the start of the next farming season. They are usually used as fodder for livestock, fertilizer for crop regrowth, for soil conservation (i.e. erosion control), or are burnt off.

- Nigeria has huge potential for energy crop cultivation, and for biofuels production due to the availability of arable lands and water. These energy crops are the major feedstocks for emerging biofuel projects in Nigeria. Table 4 shows substantial cultivation of energy crops in Nigeria over a ten-year period.

Energy crop	Element	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Sugar cane	Area harvested (Ha)	43,000	44,000	47,000	63,000	71,890	73,060	73,060	74,000	74,000	74,000
	Yield (Hg/Ha)	198,605	207,727	210,000	239,048	196,421	191,853	191,623	195,946	195,946	195,946
	Production (tonnes)	854,000	914,000	987,000	1,506,000	1,412,070	1,401,680	1,400,000	1,450,000	1,450,000	1,450,000
Cassava	Area harvested (Ha)	3,531,000	3,782,000	3,810,000	3,875,000	3,778,000	3,129,030	3,481,900	3,737,090	3,850,000	3,850,000
	Yield (Hg/Ha)	110,011	109,902	120,003	112,026	118,004	117,679	122,155	140,225	140,260	140260
	Production (tonnes)	38,845,000	41,565,000	45,721,000	43,410,000	44,582,000	36,822,250	42,533,180	52,403,455	54,000,000	54,000,000
Sorghum	Area harvested (Ha)	7,031,000	7,284,000	7,308,000	7,812,000	7,617,000	4,736,830	4,960,130	4,891,150	5,500,000	5,500,000
	Yield (Hg/Ha)	12,200	12,600	13,500	11,595	12,233	11,145	14,397	14,101	12,545	12,182
	Production (tonnes)	8,578,000	9,178,000	9,866,000	9,058,000	9,318,000	5,279,170	7,140,970	6,897,060	6,900,000	6,700,000
Maize	Area harvested (Ha)	3,479,000	3,589,000	3,905,000	3,944,000	3,845,000	3,350,560	4,149,310	6,008,470	5,200,000	5,200,000
	Yield (Hg/Ha)	16,002	16,598	181,82	17,049	19,571	21,961	18,502	15,279	18,096	20,000
	Production (tonnes)	5,567,000	5,957,000	7,100,000	6,724,000	7,525,000	7,358,260	7,676,850	9,180,270	9,410,000	10,400,000
Oil, palm	Production (tonnes)	1,094,000	1,170,000	1,287,000	1,309,000	1,330,000	1,233,050	970,820	930,000	940,000	960,000
Soybeans	Area harvested (Ha)	587,000	601,000	630,000	638,000	609,000	592,000	281,890	608,650	570,000	600,000
	Yield (Hg/Ha)	8995	9401	9603	9091	9704	7206	10,112	9263	10,175	10,000
	Production (tonnes)	528,000	565,000	605,000	580,000	591,000	426,590	285,050	563,810	580,000	600,000
Millet	Area harvested (Ha)	4620000	4685000	4,971,000	5,056,000	4,904,000	3,787,730	4,364,140	2,889,020	3,800,000	3,800,000
	Yield (Hg/Ha)	14,500	15,300	155,00	16,001	18,483	13,016	11,848	4400	13,158	13,158
	Production (tonnes)	6,699,000	7,168,000	7,705,000	8,090,000	9,064,000	4,929,950	5,170,430	1,271,100	5,000,000	5,000,000
Cocoa, beans	Area harvested (Ha)	1,062,000	1,088,698	1,104,000	1,359,550	1,349,130	1,354,340	1,272,430	1,240,000	1,196,000	
	Yield (Hg/Ha)	3879	4051	4393	2652	2720	2684	3137	3153	3202	
	Production (tonnes)	412,000	441,000	485,000	360,570	367,020	363,510	399,200	391,000	383,000	
Coffee, green	Area harvested (Ha)	3580	3670	3710	2000	2100	1800	2000	2100	2200	
	Yield (Hg/Ha)	13,017	13,597	14,394	12,600	14,286	11,333	12,000	12,381	12,727	
	Production (tonnes)	4660	4990	5340	2520	3000	2040	2400	2600	2800	
Groundnuts, with shell	Area harvested (Ha)	2,097,000	2,187,000	2,224,000	2,202,638	2,336,400	2,643,330	2,789,180	2,342,810	2,420,000	2,360,000
	Yield (Hg/Ha)	15,498	15,903	17,199	12,927	12,296	11,265	13,621	12,646	12,690	12,712
	Production (tonnes)	3,250,000	3,478,000	3,825,000	2,847,373	2,872,740	2,977,620	3,799,240	2,962,761	3,071,000	3,000,000

Biomass Feedstock in Nigeria

- Biomass feedstocks can be obtained from two principal different categories:
  - conventional agricultural products such as sugar- or starch-rich crops, and oilseeds; and
  - lignocellulosic products and residues.
- However, Lignocellulosic feedstocks (such as trees, shrubs, grasses, agricultural and forest residues) are potentially more abundant and cheaper than feedstock from conventional agriculture because they can be produced with fewer resources and on marginal and poor lands. Also, agricultural and forest residues are currently available from current harvesting activities without the need for additional land cultivation.

Table 2. Production data for major Agricultural crops in Nigeria, 2012

Agricultural resource	Production area (thousand ha)	Total production (thousand metric tons)	State with highest production	Production in the state with highest (thousand metric tons)
Cowpea	2860	3368	Benue	428
Cassava	3482	42533	Benue	3792
Maize	4149	7677	Kaduna	436
Cotton	399	602	Zamfara	155
Soybeans	291	356	Benue	79
Groundnut	2785	3799	Niger	547
Sorghum	4960	7141	Kano	746
Millet	4364	5171	Sokoto	714
Rice	2433	4473	Kaduna	732

Table 3. Proximate composition of major crop residues., 2012

Crop residues	Moisture content (%)	Crude protein	Organic matter	Crude fibre	Ether extract	Ash	Nitrogen extractives free
Maize stover	10	2.8	85-91	28-46	1-2	9-15	35-53
Sorghum stover	10	3-6	96	31-35	1-2	4	50-56
Rice straw	10	2-9	75-90	20-45	1-4	10-25	29-48
Groundnut haulms	10-12	11-17	87-90	21-29	1.5-2.5	10-13	51-57
Cassava tops	70-80	17-27	89-90	8-26	3-8	6-11	35-60
Sugar cane tops	70-80	5-8	81-95	28-34	1.5-2.5	5-9	44-54
Cocoa pods	75	2-9	75-90	20-45	1-4	10-25	33-56
Empty oil palm fruit bunch	56	3-4	95	-	6-8	5	-

Biofuel Potential Production in Nigeria

- Table . Biofuel potential production in Nigeria

Derivable feedstock	Cultivated area (ha) 2007	Derivable biofuel type	Estimated Biofuel production potential (million litres, ML)
Sesame	196,000	Biodiesels	136.4
Palm oil	3,150,000	Biodiesels	18742.5
Palm kernel	3,150,000	Biodiesels	18742.5
Ground nut	2,230,000	Biodiesels	2361.6
Soybean	638,000	Biodiesels	284.5
Coconut	41,000	Bioethanol	110.2
Sugarcane	63,000	Bioethanol	378
Cotton seed	434,000	Biodiesels	141.1
Cassava	3,875,000	Bioethanol	15500
Sweet corn	3,944,000	Bioethanol	678.4

Table: are first generation biomass feedstocks in competition with food. Nigeria needs to harness its renewable energy potential from non-food biomass feedstocks for sustainable production of biofuel. Biofuels can positively influence agriculture if non-food feedstocks are utilized.

Therefore, the main goal of the Nigeria in transportation sector is to establish a for malized, high quality public transport system inducing ongoing fleet renewal, a tra nsition towards higher capacity vehicles, higher operational efficiency and better se rvice levels. This will reduce the emission footprint of public transport, mitigate ra pid motorization and limit the shift of trips to the carbon intensive use of cars. It fu rthermore lays the groundwork for the future electrification of the public transport fleet, which is needed to achieve full decarbonization.

Recently, the Nigerian president constituted the Presidential Power Initiative and re ached an agreement with Siemens AG with the support of the German and Poland government regarding the modernisation of the Nigerian electricity transmission in frastructure in renewable energy source. Improving generation capability, overhaul of transmission grid, Adoption of Smart Grid, AMI infrastructure and smart meters are possible solutions to this lingering challenge. The Nigerian electricity industry suffers from challenges varying from inadequate power generation due to old powe r plants, Transmission AT&C losses, billing and collection efficiency.

THANK YOU

REFERENCES

1. https://energypedia.info/wiki/Nigeria_Energy_Situation
2. https://www.sciencedirect.com/science/article/pii/S0360544213007627?via%3Dihub
3. https://www.researchgate.net/figure/Historical-electricity-consumption-in-Nigeria-by-economic-sectors-GWh-16-17_fig1_333845232
4. https://energsustainsoc.biomedcentral.com/articles/10.1186/2192-0567-2-15/tables/8
5. https://www.researchgate.net/publication/260043020_Solar_energy_applications_and_development_in_Nigeria_Drivers_and_barriers
6. https://knoema.com/atlas/Nigeria/CO2-emissions?compareTo=
7. http://www.iea.org/statistics/statisticssearch/report/?year=2014&country=Nigeria&product=ElectricityandHeat
8. https://www.get-invest.eu/market-information/nigeria/energy-sector/
9. https://www.get-invest.eu/market-information/nigeria/energy-sector/
10. https://www.climatelinks.org/sites/default/files/asset/document/2019_USAID_Nigeria%20GHG%20Emissions%20Factsheet.pdf
11. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Nigeria%20First/Approved%20Nigeria%27s%20INDC_271115.pdf
12. https://www.get-invest.eu/market-information/nigeria/energy-sector/
13. https://www.iea.org/policies/4974-nigeria-renewable-energy-master-plan
14. https://www.nigeriaelectricityhub.com/2020/06/01/heres-how-nigerias-electricity-deal-with-siemens-will-work/
15. https://www.se4all-africa.org/fileadmin/uploads/se4all/Documents/Country_PANER/Nigeria_National_Renewable_Energy_Action_Plans_.pdf

Articles on Renewable Energy and Transport Policy Portfolio

Nepal

Electric Mobility: Prospects and Challenges for Nepal

Hemant Tiwari
Chairperson, Safe & Sustainable Travel Nepal

Background:

Movement of people goes unrecorded in human history back to the many centuries ago. Since then people used to move in search of food but gradually their movement range had been increased for the trade lead to the discovery of easier moving instruments. This pace of development begins from various phases from development of wheel to the various luxurious modes with higher utility and different traction power. Counteracting depletion rate of fossil fuels and pollution caused by these Internal Combustion Engine (ICE), vehicle with different traction power like electric, hybrid has been introduced. Use of electric vehicle (EV) have been introduced from 1890's with a market share of more than one-third of automobiles but back then they cannot survive with the lower prices of ICE and lower petroleum price. In addition to that, higher cost and lower range made them outmoded from automobile market. (Reseach Institute of Applied Economics, 2012)

Norway has the highest percentage of electrification but the rate of electrification of China is so enormous which could cross the Norway landmark for electrification. Along with China, India vowed to go complete electric by 2030 to reduce the hazardous tail pipe emission.((Internation Energy Agency, 2018), (kohle & Madusha , 2017)). Norway has running its EV under its complete developed clean hydropower energy (kohle & Madusha , 2017) whereas Bhutan has similar scenarios of Nepal like enormous potential for hydro-energy, trade deficit being caused by the fuel import and major revenue collected by custom duty of ICE vehicles. With credence of international EV initiatives about the decreasing cost of battery and total cost of ownership, Bhutan is preparing to launch EV by deploying EV at government fleet followed by private cars and taxi. (Zhu, Patella, Steinmetz, & Peamsilpakulchorn, 2016).

Current development practice of Nepal is unbalanced with rampant rate of development at city areas leading to the massive population dwelling at urban areas. The total population of 26.4 million of a country has been contributed by 2.5 million only from the Kathmandu valley;9.47% of people is currently dwelling in Kathmandu valley in an area of 899 sq.km. (0.61%) resulting to the 27.9 person per ha and fastest growing city in south Asia. (Japan Internation Cooperation Agency (JICA), 2012). According to the report of JICA on traffic survey of Kathmandu valley shows the daily trips of 3,483,393 with an average rate of production of 1.409 per persons and distance of trip 5.1km. Eventually leading the air quality of Nepal to be ranked as the lowest as per the report of global environmental performance index(EPI) which killed 215.6 in every 100,000 people. Study of world bank on 2008 depicted the total loss of USD 21millions equivalent to the 0.29% of GDP due to air pollution and its consequences and looking at current emission scenarios air quality has been decreasing in rampant way as the number of emitting vehicle has been continuously increasing. To counteract the aforementioned problems EV vehicle is regarded as eminent and sustainable means.

History of Electric Mobility In Nepal

Observing the history of Nepal, it has begun from the introduction of trolley bus in Nepal in 1975 along the suryabinayak- budhanilkantha(13km) from the grant of NRs 40 million(then) from Chinese government. By 1989 they were the major preferred mode choice with ride share of 88.5% in the route. Chinese government had agreed to supplement 10 more fleet with improved technology in 1997 but shortly after that, showing the loss in the operation, HMG/N discontinued the service on December 2001. Again on September 2003, Kathmandu metropolitan city, Bhaktapur and Madhyapur Thimi under the joint management board was authorized for revival and operational duties of trolley on the same route, but it could not last much further than 2009 when trolley bus finally halted its

operation due to political instability and interference, and due to inefficient management.

Additionally, electric three wheelers known by “Safa-tempo” also plays the major roles in electrification of transport system of Nepal. It was introduced in 1993 on Kathmandu Valley with the help of Global Resources Institute, a U.S based INGO and they are still serving almost 100,000 people of the valley with around 600-700 fleet in 17 different routes with 36 charging station, 4 charger manufacturers, 4 repairs and 4 maintenance workshops and 5-6 battery dealers. Their number has picked up at 1990’s but got halted after 2000 as government put a ban on the three-wheel vehicle showing their speed as a major cause for congestion in the city. Kathmandu had played a role model of the EV initiation by launching three-wheelers EV for the first time in South-Asia.

At present the addressing the problem aroused from the current scenarios of the figures of Vehicle in city and corresponding pollution, government is trying to play exemplary approach for promotion of EV in Nepal. Currently, head of National Planning Commission , Hon. Energy minister and Hon. President are using the EV in Nepal and currently sajha launched the E-buses for the tail-pipe emission free mass transport as green mobility experience.

Electric Vehicle’s Potential

Nepal has enormous capacity of economically viable of 42,000 MW hydro-electricity. (Water and Energy Commission Secretariat, 2013). As per the goals of sustainable development goals 2016-2030 has vowed to uplift the socio-economic condition of people with massive generation of clean-energy. It declares the generation will culminate in short time; more than double of its current generation in coming two year and 10,000 MW in next decade. (National Planning commission, 2017) . At the first quarter of 2019 all sum-up of 830.1 MW is expected soon to be completed and the project that will get commenced by 2019 sums up to 803.1 MW. Country has already planned for electricity generation for next two decades’ whilst the math shows that by the end of 2019 leave us with surplus energy of 525MW and similar trend without intervention shows the surplus of 2000MW by 2023. ((Nepal Electricity Authority, 2075), (Water and Energy Commission Secretariat, 2013)) . In this milieu selling electricity is always a second option first being the creating the market to utilize this surplus energy. The pace of industrial growth seems incompetent to deploy all the electricity but that gap can be easily fulfilled by the electrification of transportation system.

Movement of the fastest growing city in south Asia is bolstered by fastest growing the vehicle figure in the city with an average rate of 14% per annum since 1990. (Japan Internation Cooperation Agency (JICA), 2012).Degrading public transport system has inflated the number of people using private vehicle leading to the number of total vehicle registered to be 23.7 million till 2018 among which more than 40% plying in the roads of valley of capital (Ministry of Physical Infrastructure and Transport , 2075). The majority of share is hold by motorbike i.e. almost 78% and other lower occupancy vehicles. Use of these ICE has contributed to degrade the air quality of valley in tantamount making the vehicle as a major source of emission in the valley with the share of 69% of the total emission loads. (Clean Energy Nepal, 2014). If Nepal Government espouse the idea of electrification and attenuate the custom duty on it and its corresponding parts, then it can be implemented with great success in shorter span.

Policy Supporting Electric Vehicle

Currently Nepal is lacking any clear policy targeted only for promotion of EV in Nepal but there are some policies acting as helping hands. National transport policy summarizes its content regarding EV as a sustainable means to ameliorate the current rising problems of air pollution and also supports for the infrastructural growth (Ministry of Physical Planning and works, 2001).Next fourteenth three year plan(2016) addresses the issue of the need of the sustainable transport development across the country with mono-rail study inside valley and east-west electric railway. (National Planning Commission, 2073). Environment friendly transport policy (2014) sets achievement goals of electrifying the total vehicle by 20% within 2020 by edifying the private sectors to invest in construction

of EV and infrastructure needed. It also targets for setting up the 10 charging station in the ring road. (Ministry of Physical Infrastructure and Transport , 2014). National sustainable transport strategy focused on the electrifying the public transport by encouraging investment in electric railways, trolley buses or electric buses on urban areas and especially targeted tourist areas.

Likewise national urban development strategy focused on developing the road infrastructure required for city considering the introduction of electric modes in near future whilst fiscal and financial regulation espouses this with the attenuation in custom tax and providing soft loans to both the users and those private investors who are willing to start local manufacturing. To further enhance the idea of EV in Nepal is done by the climate change policy 2011, sustainable development goals 2016, National ambient air quality standards and Nationally determined contributions (2015) by especially targeting the EV as the zero emission vehicle and to cut-off the emission loads from tail-pipe in coming days. They also highlight on to meet the desired target of EV and promoting the health and safety of the public.

Implementation hurdles

It is envisaged that electric vehicle as the important modes for sustainable travel option in future but there lie difficulties to EV in order to penetrate in the Nepali market as ICE is already stabilized as trusted means in present condition. Major technical hurdles are speed, range, charging time, terrain limitation and battery management system as there is lack of technical manpower at current time. The higher initial upfront cost can be burden to the users and also on the government to subsidize them totally as revenue being collected from custom tax of ICE vehicle and its parts has major allotment on revenue. In addition to that governing body needs to build the costliest charging infrastructure and their planning for electrical upgradation. Durability and sustainability of EV is major issue for both the users and decision making authority to firmly go with the newer technology. Discarding the current running ICE vehicle could be the major socio-political issue as it will be snatch the job of the people associated with ICE which had occurred in the past during the replacement of vikram-tempo by safa-tempo. (Maharjan, 2002). Management and operation responsibilities could be questionable as trolley was eliminated due to improper management in the past. Making people comprehend it is better option than ICE due to the total cost of EV is lesser albeit it has high initial cost could be the major social issues to addressed in adoption of EV by public.

Conclusions

Electrical vehicle seems to have innumerable benefits for the country. With every country being conscious about the environment friendly vehicle EV is indispensable for Nepal as we are troubled by air pollutant with 1926 premature death, COPD, heart disease and ARI diseases, strokes, cancer and cardio-vascular diseases. (Clean Air Network Nepal, 2014). This not only promotes the health only but also helps in fossil fuel independency, balance the trade-deficit losses, cheaper modes of the transport and also utilizes the own clean energy instead. It provides the good platform to enhance the relation with our both the neighbors and transfer of the technology among us. It would be the better decision from the government if it plans to go coterminous of ICE vehicle with other global nations as Nepal needs to follow the global emission guidelines ultimately in near future. So the EV is not an option but righteous decision for sustainable and reliable transport for future with preserving the environment at economic cost.

It recommended to commence the promotion of the EV in Nepal by forming the clear policy only addressing various issues and hurdles related to EV followed by the strategic plan to expand the electric fleet in government and public transport as an exemplary approach followed by private sectors.

Bibliography

British Broadcasting Corporation . (2017, september 10). bbc news. Retrieved from www.bbc.com: https://www.bbc.com/news/business-41218243

DiChristopher, T. (2018, May 30). Consumer News and Business Channel . Retrieved from Consumer News and Business Channel : https://www.cnbc.com/2018/05/30/electric-vehicles-will-grow-from-3-million-to-125-million-by-2030-iea.html

Internation Energy Agency. (2018). Global EV outlook 2018. international energy agency .

Japan Internation Cooperation Agency (JICA). (2012). Data Collection Survey on Traffic Improvement in Kathmandu Valley . kathmandu: Japan International cooperation Agency (JICA).

kohle, M. l., & Madusha , C. T. (2017). The Scenario of electric vehicles in Norway. In T. Muneer, M. L. Kolhe, & A. Doyle, Electriv Vehicles: Perspects and Challenges (pp. 317-340). kristiansand: elsevier.

Ministry of Physical Infrastructure and Transport . (2014). Environment Friendly Transport Policy . Kathmandu: Ministry of Physical Infrastructure and Transport .

Ministry of Physical Infrastructure and Transport. (2015). National Sustainable Transport Strategy for Nepal(2015-2040). Kathmandu: Government of Nepal.

Ministry of Science and Technology . (2012). National Ambient Air Quality Standards. Kathmandu : Ministry of Science and Technology .

Mohanty , P., & Kotak, Y. (2017). Electric vehicles: Status and roadmap for India. In T. Muneer , M. Kolhe, & A. Doyle, Electric Vehicle :Prospects and challenges (pp. 387-414). Elsevier.

Reseach Institute of Applied Economics. (2012). Policy options for the promotion of electric vehicle : a review. Barcelona: Research Institute of Applied Economics .

Water and Energy Commission Secretariat. (2013). National Energy Strategy of Nepal. kathmandu: Government of Nepal.

Zhu, D., Patella, D. P., Steinmetz, R., & Peamsilpakulchorn, P. (2016). The Bhutan Electric Vehicle Initiative: scenarios, implication and economics impact. International Bank for Reconstruction and Development.

Articles on Renewable Energy
and Transport Policy Portfolio

Sri Lanka

Sri Lanka's Renewable Energy Portfolio in the Transport Sector

Dinithi Ferdinando

Sri Lanka, an island country in the Indian Ocean, is transitioning to an upper middle-income economy. Its annual average economic growth was 5.5% from 2001 to 2017. However; the 2017 growth was lower by 3.3% compared with previous years. Sri Lanka's 2017 gross domestic product (GDP) per capita was $4,065.3 in 2017, the country's maximum contribution to the GDP (56.7%) came from the services sector, and the industrial sector contributed 26.9%, while the agricultural sector contributed only 6.8%. (World Bank, 2017)

Roads are the dominant mode of transport in Sri Lanka. About 90% of passengers and 98% Freight are carried by the road. The private sector provides all road freight services, while a mix of private (77%) and public (23%) operators provide bus passenger transport services. The road network is dense and well laid out, providing basic spatial coverage to the country's population and centers of economic activity. The network's density is among the highest in Asia, as the ratio of road kilometers (km) to population exceeds the related indicators in neighboring countries.

The 115,900 km of road network in Sri Lanka is classified into national, provincial, and local roads according to functionality and management responsibility. National roads, comprising about 11,700 km of class A roads (trunk roads) and class B roads (main roads), are managed by the central government through the Road Development Authority (RDA). The provincial road network, comprising 15,500 km of class C and D roads, is managed by the provincial councils. About 64,700 km of roads are managed by local authorities, and about 24,000 km of roads are owned by irrigation, wildlife, and land development authorities. National roads, accounting for about 10% of the network size, carry about 70% of the traffic. More than 50% of the road network, including national and provincial roads, is in poor condition in need of immediate rehabilitation. (Road Development Authority, 2017)

The government's 'Mahinda Chintana development policy framework' (DPF) accepts that development of road infrastructure contributes to the acceleration of sustainable economic growth, balanced regional development, and opening up of opportunities for national integration and political stability. Therefore, government has accorded the highest priority to improving the entire road network in the country with modern technology during 2020–2030 with aspirations to achieve below objectives.

- ✓ Meet Current and expected future demand in the transport of passengers and freight and ensure utilization of Resources.
- ✓ Improve the quality of roads by using effective and innovative modern techniques of design, construction and maintenance.
- ✓ Reduce travel time and operating costs while facilitating greater mobility and improving accessibility.
- ✓ Support economic development of the country by considering future socioeconomic development plans and policies of the Government.
- ✓ Improve institutional capacities of the road administration.
- ✓ Ensure that the required actions are taken to protect the environment

Indigenous energy resources used in Sri Lanka are biomass, hydropower, solar, and wind, all of which are renewable. Coal and petroleum are imported into the country. Biomass and petroleum are the dominant primary energy sources. In 2017, petroleum accounted for about 43% of primary energy supply, biomass provided 37%, and coal provided 11%. The total primary energy supply in 2017 was 12,850 kilotons of oil equivalent (ktoe).

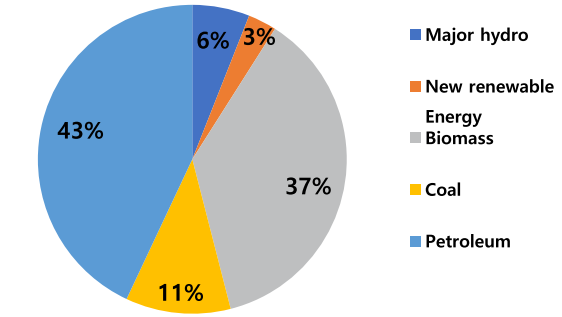


Figure 1. Sri Lanka Sustainable Energy Authority. 2019.

Figure 1 showcases the share of primary energy supply by different sources in Sri Lanka. It further, represents the share of renewable energy comprising biomass 37%, major hydro 6%, and new renewable energy 3% in the primary energy mix is about 46%, showing a 5.8% reduction, compared with 2015. The stagnant supply and demand for biomass, especially in household and commercial sectors, is the reason for the declining contribution of renewable energy to the national energy mix, despite growing contributions of hydropower and new renewable energy sources used for electricity generation.

The Sri Lankan transport sector is totally dominated by petroleum fuel usage such as LPG, petrol (gasoline), diesel oil and electricity. Biofuels are currently not used at all. Unlike other sectors, transport energy remains the exclusive domain of petroleum fuels, and has the least penetration of renewable energy options. This is due to the versatility of liquid petroleum products as an intense energy source, which can be carried along with a quite low penalty on self-weight. There are three main types of transport fuel i.e. Auto Diesel, Gasoline and LP Gas. Market possibilities in the transport sector in the near term can be identified as bio diesel, ethanol and compressed bio methane, substituting parts of diesel, gasoline and LP Gas respectively. Liquid bio fuels, i.e. ethanol and bio diesel, make a small but growing contribution to fuel usage worldwide, providing about 2.7% of global road transport fuels in 2010.

In the longer term, renewable based electricity can become a serious contender in the transport sector due to emerging storage technologies, including hydrogen. Even at present, electric vehicles which use traditional storage devices are becoming popular in the urban sector. Due to the sheer size of the transport energy market, even a mere percentage of market offers a fair sized business opportunity. The market opportunity is best made use of, by following the mechanism used to stimulate renewable resource based electricity generation by offering a market opportunity to industry. As the first step in this regard, bio fuel standards were compiled and are awaiting the concurrence of the petroleum industry stakeholders. Furthermore, the higher taxes and duties imposed on most transport fuels offer a good margin for bio fuel producers, if their produce is allowed to be mixed at pump price of petroleum products. To achieve this, an initial block of market share could be offered to the bio fuel industry with a full tax wavier.

Alternatively, the public transport fleet can be targeted through a special programme to launch bio fuels by first reaching the locomotives and later proceeding to Omni bus fleet. Special market channels which exist in these sectors could be made use of quite easily. Similarly, electricity can be promoted as a transport energy source by creating an off-peak demand for electricity through a low tariff. Tax concessions for electric vehicles can easily make it a viable alternative, as all classes of vehicles are heavily taxed at present. Growth of off-peak demand due to transport demand could very well contribute to increase the share of renewables in the power generation mix. Differential taxation on renewable energy based transport energy systems comprising of bio fuels, deep cycle batteries and electric vehicles will open up a whole new market for renewable energy in the transport sector.

Industrial thermal energy requirements are very many and are met by a variety of fuels ranging from waste wood to LPG, including almost all liquid petroleum fuels. On the 35 contrary commercial sector thermal energy demands are mostly limited to hot water requirements of buildings. This demand is met by liquid petroleum fuels and electricity. During the last few decades, solar water heating too is taking a fair share of hot water supply in the commercial sector.

During the period which saw the oil prices soar beyond USD 100/bbl, many industrial and commercial establishments went into fuel switching from liquid petroleum fuels to biomass, with direct combustion as well as gasification technologies. The possible markets for biomass exposed during this period, which witnessed even certain luxury hotels also converting to biomass gasification. However, with the collapse of oil prices most industries went back to petroleum fuels. At present, the supply of individual thermal energy is dominated by subsidized furnace oil, and there is a campaign to get the subsidy removed, with the belief that the lost market for biomass can be recaptured in such a level playing field.

If the biomass supply industry becomes more organized and formal, which is possible with forward integration to offer final thermal energy using robust contractual arrangements, a substantial portion of industrial and commercial thermal energy market can be exported by the biomass industry. However, markets for other renewable energy sources than biomass and solar in the thermal energy supply will remain difficult, since thermal energy is at the lowest energy quality level by nature. For example, bio fuels will have better markets than industrial thermal energy, where intensity of energy carrier will matter. Stationary conversion facilities with multi fuel capability will remain a very important mode in the energy chain.

Solar energy, which had been the most preferred thermal energy source in drying applications, could become a very attractive source when offered with improved dryer technologies. Such efforts will have a significant positive impact in the agricultural productivities of the country. Considering the fact that industrial and commercial markets having an array of barriers to overcome, it is advisable to device a package of measures to deal with all the barriers and 36 offer it to end users as a 'fuel switching package'. The package will have to include capital grants for conversions and removal of subsidies given to competing products and also strong emphasis on technology provision.

Development of renewable energy has received worldwide attention, mostly due to the bleak future of fossil fuel supply sector and emerging evidence of links between climate change and fossil fuel use. Like in many other developing countries, Sri Lankan case for renewable energy is more inclined to energy security and economic issues than environmental concerns. The principles on which renewable energy development is based on are four fold. They could be broadly identified as;

(i) Government policy on accelerated renewable energy development
(ii) Creation of value from indigenous natural resources
(iii) Energy security concerns
(iv) National economic development objectives A brief description of each principle is warranted to elaborate the rationale behind each principle.

The National Energy Policy & Strategies of Sri Lanka places renewable energy development as a high priority and considers it to be one among the nine main policy elements. This policy paper which is now being reviewed is likely to further strengthen the policy focus on renewable energy development. Already, the 10% electricity generation target for 2015, set for new renewable energy is enhanced to 20% by 2020 in the latest policy statement of the Government. It is very likely that Sri Lanka will retain at least 20% share of electricity generation from renewable energy even beyond 2021, even under business as usual case, counting the major hydropower contribution as well. The objects of the Sri Lanka Sustainable Energy Authority Act No. 35 of 2007, clearly spells out the mandate to develop the optimum capacity of new renewable energy. The guiding principle in implementing the Government Policy will be offering incentives for new renewables in the early stages and to evolve the industry to work through market based instruments, finally reaching grid parity and other benchmarks available, making it a worthy competition to orthodox energy sources.

Renewable energy utilizes natural resources, mostly available at little or no cost. Unlike in many other industries which uses large portion of inputs sourced from foreign sources, renewable energy conversion plants tend to use very little amount of consumable inputs when in operation. Hence, renewable energy offers a strong value proposition. To reap the value benefits, a three phase strategy is required.

Firstly, the natural resources require exploration and development for commercial use. Given the current price levels and due to most technologies being sourced from abroad, energy produced by renewable resources tends to be above market prices even at moderate oil prices. Hence, the difficult phase of exploration and development, especially pioneering blocks of a particular technology require additional incentives to take-off.

Secondly, the demands thus created require to be sustained and enlarged, to maintain a suitable growth in the renewable energy industry. This phase requires the focused attention to build energy supply chains by growing the entire value chain on an in-sourcing effort, starting from the demand side. Technology development initiatives will support each node of the chain, whilst helping to bring down costs. This phase will see the transformation of the market from an incentive dependent one to a truly price based market.

At the final phase, the full value chain from supply to demand can have home grown technologies to bring down the cost of renewable energy below grid parity and other such industry benchmarks. This will ensure full value creation locally and create employment for highly skilled workforce, deriving many other economic benefits. An extension of this could see the industry spilling over to other parts of the world where such services are needed.

Referring the above details, it is quite clear that making investments in hydro, biomass and wind energy is far more beneficial than making such investments in short term oil based power 41 generation. This argument will be still valid, when the full cost of accommodating hydro, biomass and wind energy is compared with power generation investments in coal. In contrast, the above estimations for solar PV indicate that the prices in Solar PV industry fail to justify the implementation of power projects, as it falls short of displacing at least an equivalent value of oil during its useful life.

However, the very recent proposals made by private sector entities to the Authority reveal a different picture, indicating existence of some other factors which presently elude the cost model. For example, there are proponents willing to setup solar power plants using supplier credit or grants, offered at very low cost. There is another group of proponents who has accessed green funds to reduce the overall project costs. Apart from these, there seems to be a severe market upheaval in the solar industry, forcing many manufacturers to supply products at cost or even below, to keep the industries from collapsing. It may be possible to devise a systematic programme to exploit these attributes of solar industry at present for the maximum benefit of the country, which is yet to be materialized.

Therefore, it is evident that hydro, biomass and wind resources require the focused attention, so that these resources can be developed faster to realize the economic benefits. The development approach can be either to depend entirely on foreign technology to exploit the resource at the earliest, as done now or an approach to harness these resources using technologies nurtured locally, at a lesser pace, through an organic growth perspective. Merits and demerits of these approaches are worth closer investigation. Renewable energy will be a stabilizing agent in the energy mix offering price stability, since prices are decided at the project formulation stages. Similarly, depending on local inputs, it will also offer supply stability in a complex and conflict ridden global energy industry in the future.

Few Initiatives Government of Sri Lanka has taken up are introducing zero emission electric and hybrid vehicles and to train unemployed youth to operate, maintain and assemble electric vehicles, which include three wheelers, motor cars, motor cycles and buses. Numerous citizens of Colombo are now using pollution free transportation.
The activity produced the following benefits:

- Reduced air pollution in the city of Colombo and suburbs by introducing the use of electric vehicles as a sustainable means of transportation;
- Employment for youth;
- Knowledge sharing through an awareness campaign on the benefits of electric vehicles;
- Reduced incidences of respiratory illnesses among the urban population, especially among children and the elderly.

Launch of electric tuk-tuks by 2022 to Sri Lanka by the Lanka Electric Vehicle Association and Governments to introduce 'Zero-Emission' vehicles hich would cause minimum levels of pollution and carbon footprint. Further, Government of Sri Lanka have plans to initiate Sri Lanka's first Electric Vehicle plant that pioneers smart tuk-tuks, micro power stations with the support from a Tokyo based high-tech research and development startup. "Our first hi-tech EV manufacturing plant coming in Sri Lanka'-

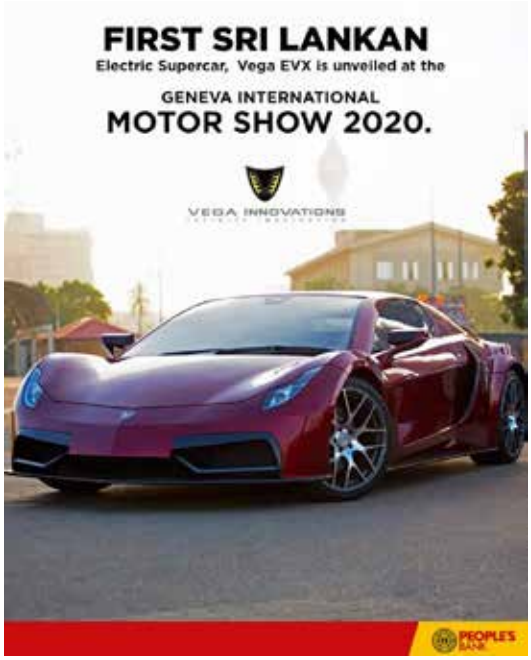
Electric Vehicle Club Sri Lanka, known as EV Club promotes use of environmentally friendly vehicles and empower EV users Encouraging public and the corporate sector to use and improve the EV infrastructure.

First-ever Sri Lankan electric supercar Vega EVX was unveiled at the Geneva International motor show on 5th March. Vega EVX is manufactured in Sri Lanka by a talented team of Engineers, Designers, and Mechanics from the Sri Lankan workforce.

This Supercar is made in the company Vega innovations founded in 2013 December by Dr. Harsha Subasinghe and Dr. Beshan Kulapala, with a vision of manufacturing high performance, cost-effective, sustainable cars to disrupt the Electronic Vehicle market.

This event marks a monumental milestone in Sri Lankan History.

Prospective buyers will be be the Ministry of Tourism, Kandy Shopping Mall, and private sector eco-friendly hotels. In a second phase of the activity, the Ministry of Transport is considering renewing its fleet of buses with new ones designed to run on electricity. The private sector is currently investing heavily in EV technology across the island. Up-scaling is happening organically by businesses and government, testifying to the practical, effective nature of EVs in the Sri Lankan context.



Meera Mohideen Abdul Haleem

My country's renewable energy portfolio in the transport sector

Renewable economy would give a lasting solution to the challenges raised by climate change, energy security, sustainability, and pollution. The conversion of the present transport system appears to be one of the most difficult aspects of such renewable transition.

This study reviews the technologies and systems that are being proposed or proven as alternative to fossil-fuel based transportation, and their prospects for their entry into the post-carbon era, from both technological and energetic viewpoints. The energetic cost of the transition from the current transportation system into global renewable transportation is estimated, as well as the electrical energy required for the operation of the new renewable transportation sector.

The analysis concludes that renewable transportation is feasible, but not necessarily compatible with indefinite increase of resources consumption. The major material and energy limitations and obstacles of each transport sector for this transition are shown.

It would involve major restructuring of infrastructure and an internationally coordinated policy action that would take between 40 and 50 years. Although such transition is urgently needed to avoid catastrophic climate change, governments have not yet supported such a coordinated policy initiative.

Transport is fundamental in the current globalized economy as it allows the exchange of goods, communication between citizens and is one of the causes of suburbanization in cities. However, one of the major problems arising from the transformation of the global transport system is a high dependence on fossil fuels. In particular, oil is the main energy provider in the transport energy mix: over 94% of the total energy demand for transport is provided by oil, 3% by natural gas and other fuels, 2% by biofuels and 1% by electricity.

Different scenarios for Energy system development under environmental and socioeconomic constraints, with the objective to guide Sri Lankan policy toward a low-carbon economy. This study, which is part of that project, discusses some of the main technologies currently proven or in prototype phase which could be used to substitute the current fossil fuel-based transport. We identify the transport modes that are more compatible with material and energy constraints.

Travel smart!

Your transport bill can be reduced drastically, if you select the most efficient mode of transport, improve the fuel economy of your vehicle, improve your driving habits and ensure quality maintenance.

Let's plan well

- Reduce unwanted trips.
- Opt to cycle or walk short distances. It's good for your health, too.
- Use public transport whenever possible. Imagine that there are 60 people who wanted to travel to the same destination.
- Avoid heavy traffic like office-peak as much as you can. Avoid busy hours of all services you access.
- Promote carpooling.

- Avoid unnecessary traveling. For instance, use internet banking to settle your utility bills and payments. Today all utility bill payments and most subscription services such as insurance can be accessed from your home computer or a smart phone.
- Avoid snap accelerations.
- Prevent instant breaking, unless for safety reasons.
- Anticipate traffic conditions and make use of inertia of the vehicle (conserve the momentum wherever possible).
- Be mindful of speed when you are driving on a highway. The optimum speed is between 70 – 80 km/hr, because this speed range gives the longest distance for the least amount of fuel. Phrased differently, you can drive more km per liters at this speed range.
- Anticipate traffic conditions and make use of the inertia of the vehicle. Use local traffic condition apps supported by Google Maps before hitting the road.
- Minimize idle running

  Minimize idle running of vehicles. Idling can consume 1 – 2 litres of fuel per hour depending on the engine capacity and the use of A/C. Turn off your vehicle when it is parked or has to stop for duration longer more than 2 minutes.
- Proper maintenance

  Keep the engine tuned properly. Fixing back a noticeably out of tune engine can improve the fuel economy of the vehicle by 4%.Change filters, lubricants and coolants at the proper mileage or time. Check wheel alignment at appropriate mileage. It can save up to 2% of fuel. Tyre pressure 3%.By changing blocked air filters of a car with a carbureted engine, you can reduce the fuel consumption by 2 – 6%.Tighten the fuel cap properly. This will help you to prevent wastage of fuel by evaporation
- Quality lubricants

  Use good quality lubricants with the correct viscosity grade as recommended in the “Owner’s Guide” of the vehicle. Change lubricants before exceeding the specified mileage or period.
- Good driving practices

  A badly packed roof-rack can increase fuel consumption by almost 10%, due to increasing the drag force. Install roof-racks only when necessary, not as a fact. Attachments of spoilers and body kits add weight to cars and contribute almost nothing to efficiency.

  Always tow the suitcases and other luggage in the boot of the car.

  Always start driving in the 1st gear, except when u are in a muddy path or going downhill, in which case, drive on the 2nd gear. You can change to a higher gear, when you are within the city and you are sure that the engine will not struggle. Get into a top gear the sooner it is permitted.

  Gear changes made at the right moment increase fuel economy of the vehicle. The engine revolution is faster and it consumes relatively more fuel in a low gear.

  Using the clutch to remain stationary (pause while driving) leads to a loss of fuel. It is advisable to have the vehicle in a neutral mode and in hand-braked condition.

  Use the hand break when the vehicle needs to be stopped on a gradient. Do not forget to release it while restarting.

  Periodically empty the cabin and boot, most of us carry unimaginable and useless things in the vehicle, adding weight, hence loss of efficiency.

• My expectation on how the future transport should be like.

Electrification of urban and inter-urban transport

Future 100% renewable energy economy would use an important fraction of present reserves of copper, lithium, nickel and platinum. The three latter metals will be used mainly in the transportation sector. The last metal would be used in fuel cells, which is better option than batteries for motors requiring high autonomy and power, such as those of ships, heavy farming tractors, and a fraction of the fleet of trucks.

Hydrogen has been proposed as an energy carrier that is similar to oil and natural gas, and that could be used for land and marine transportation [43]. However, present electrolytic systems require around 60 kW h to produce 1 kg of hydrogen [76], which implies an energy efficiency of65% if we take Higher Heating Value (HHV) of hydrogen as output.

Electric vehicles will be necessary, but given that reserves cannot be indefinitely expanded, the number of vehicles that a future post-carbon society could sustain is roughly the number we have currently. A larger number would probably endanger the availability of Li and Ni for other economic requirements.

These also imply the need to reserve the use of fuel cells for necessities that are absolutely essential and foster as far as possible the direct use of electricity by means of electric engines, as well as the convenience of reducing the current size of the car fleet as much as possible.

Demand of electricity, biomass, charcoal, biogas and metals in a 100%renewable industrial economy and concluded that a reduction of the present car fleet of about50% would probably be desirable if we are to use the reserves of the above metals in future industrial necessities. However, I assume that future land transport will instead be based on the electrification of the present vehicle fleet. The forecasts for future transportation consider an increase in the size of the future vehicles fleet. However, such a trend may be balanced by a drift into policies fostering public transport or car sharing, and a reduction of the private car fleet. The size of the future fleet is uncertain because it is dependent on the policies that ultimately are implemented.

Reason to reduce the size of the car fleet is based on the problems that it causes on urban life. Some authors that advocate a model of healthy and efficient mobility in cities have warned that the electric car will not reduce the large number of accidents, abusive occupation of urban space, traffic congestion and sedentary lifestyle that the dominance of the private car entails.

Reason to energy efficiency. Gasoline and diesel have an energy density of approximately12 kW-h per kg (10 kw-h per liter), while lithium batteries used in electric vehicles (including modern Tesla batteries) are around 0.25 kw-h per kg. That means that storing the energy contained in any fuel tank, let say, 50 L (with an approximate energy content of 500 kw-h) would require 141 kW h of electricity, or a battery weighing 562 kg. Even taking into account future improvements, most of the power of the vehicle will be wasted in carrying 1000 or 2000 kg of materials for the transport of one or two people and, in this regard, an electric vehicle (EV) makes no difference in relation to a gasoline one.

Transport system for towns based on private EVs would require an electrified parking space (public or private) for every car owner, due to the necessity to recharge the electric car at night. In big cities this would involve the necessity for millions of electrified parking sites, which is a real challenge to implement. Future considerations about the implementation of the EV fleet will also include infrastructure changes to allow much greater electrical power supply at recharging sites than what is currently available.

If we want to solve the above problems, EVs will have a more limited role in future urban mobility than they do today. Public transport systems and light vehicles are alternative which could circumvent most of the mentioned handicaps.

In parallel, shared electric cars could be encouraged in order to limit the numbers of private cars in large towns. Car sharing can be done in the form of a raise of the mean occupation (in terms of the number of passengers) and lowering of idle time, which for an average private car accounts for 90–95% of its daily usage. It would economically benefit from a changing to a car sharing system.

This system could be combined with automation of EVs for mobility and freight distribution.

Metropolitan and regional transport

In megacities and metropolitan areas a modular shift from individual to more efficient public transport systems powered by renewable electricity is also possible in a decadal time frame and with currently available technologies. We can predict a possible continuation of the current level of freight movement between cities but with very much more of it by rail than by road and rising use of trains, metro and trolleybuses for municipal and inter-city passenger transport. Grid-connected vehicles (GCV) are more efficient than battery-electric vehicles (BEV) and should be the first option in future transports planning.

Long distance terrestrial transport could benefit from a massive shift from trucks to electric trains (for freight) and from cars to public transport (for passengers). In particular, a train is able to transport about 8 times more people per MW than a car. Trains and trolleybuses could be powered via overhead wire power-supply systems or via ground-level power-supply systems, like the APS system used for public transports in Bordeaux (France). Catenary systems are also currently being tested for truck transport on highways.

If a wide power-supply grid is available for trucks, buses or cars (from catenary or ground), onboard battery-power will need to be used only to change lanes and for the “last mile” to destination. This makes it possible to minimize the size of batteries, since they can be re-charged during travelling on main roads, where external power-supplies are available.

Demand reduction

Three main strategies are suggested for demand adaptation of future transport needs. Such strategies deal with the necessary demand reduction in a world with an increased total population. Three main aspects should be considered:

Firstly, travel will need to be reduced. This may be achieved through technological improvements in information and communication technologies. Although there are barriers associated with different broadband capacities in different regions, this will create market opportunities for improved video-conferencing system quality and remote working.

Secondly, behavioral change. This involves reducing private motor vehicle use through pricing policies, e.g., highway charges and parking fees. While, initially, such changes may be unpopular with the public, they will provide opportunities for demonstrations of potential benefits such as better transport outcomes from combinations of pricing, traffic reduction, parking and investment in new infrastructure.

Thirdly, behavioral change resulting from education on the benefits of less motor vehicle use. This may have immediate impacts of 10–15% reduction of Light Duty Vehicle use. In the long-term this will produce significant emissions reductions only where quality transport alternatives are available. Despite the current lack of belief in the value of educational behavioral change by politicians and professionals, it is necessary to give demonstrations of ‘travel smart’ programs and explain the multiple benefits of such behavioral changes

Key opportunities for renewables in transport

Two- and

• Two and Tree weeler - Electrify

• Collective Tranport (buses and Taxi) - Electrify

• Cars - Electrify

• Freight Transport – Electrify, use biofuels and hydrogen

When you think of green energy, are solar and wind power the first things that come to mind? Perhaps you think of hydropower, geothermal or biofuels instead. While regenerative braking has steadily gained traction in terms of adoption, the average person probably does not even rank it in the top 10 of green energy approaches, nor are most people likely to immediately think about green energy in mass transportation, a notoriously energy-intensive industry. However, regenerative braking in transportation is a renewable energy solution that helps make the world a bit greener and deserves greater attention for the benefits it can deliver.

Regenerative braking is the process of recapturing energy that would otherwise be lost during a vehicle's braking event. That energy, rather than being wasted, can then be recycled and put to use — either to accelerate the vehicle again or to power some other electric load. By recuperating braking energy, hybrid cars and buses become up to 30 percent more fuel efficient than conventional combustion vehicles in urban settings. However, it's not just cars and buses that are reaping benefits from green energy.

As energy prices rise and sustainability continues to gain attention. Energy storage project introduces another way an aging industry can reinvent itself and define the future while remaining financially stable. Innovative projects similar to this one will not only benefit their own ecosystems, but also the entire environments around them. The surprising revitalization of the transportation industry through smart grids, new energy generation techniques and energy storage technology signals the potential for other industries to also take advantage of renewable energies and help move the world toward a greener tomorrow.

An Overview of the Policy Framework of Sri Lanka on Renewable Energy in Transport Sector

Bhagya Wickramasinghe

Overview of the Transport Sector and the Key Priorities for Sri Lanka

Development plan of Sri Lanka is geared towards transitioning to an upper middle income country. Transport sector consumed 36.2% of energy in 2017,[1] highly dependent on petroleum[2] and is projected to consume more energy.[3] Petroleum has the highest share (43%) in primary energy supply in Sri Lanka.[4] Research forecasts indicate that growth in sales of petroleum products will remain at 5%– 10% per year[5] and is consistent in its popularity. In comparison, renewable energy sources used in Sri Lanka amount to 46% but, its growth is not consistent.[6]

According to ADB Transport Sector Assessment of Sri Lanka, by end of 2014, the total number of registered motor vehicles exceeded 5.63 million, of which approximately 3.76 million were estimated to be in regular operation. Of these, about one-third were four- or six-wheel vehicles. The ownership rate of private vehicles (cars, motorcycles and other) is 169 per 1,000 population or about 0.7 per household in 2014. One of the key challenges that Sri Lanka is facing is the increasing use of private vehicle ownership and more than one vehicle per household.[7]

This data indicates that what Sri Lanka will see in the coming years is increased investment in the transport sector. As revealed in the presentation by N. Medimorec, SLOCAT Partnerhip at the UNITAR CIFAL Jeju's Online Workshop on Scaling-up Renewable Energy Ambition in Future Transport, it clearly points towards the need for more investment in renewable energy-based transport system, that is supported financial and technologically thorough international cooperation. This is well in line with the Paris Agreement cooperation principle.[8]

Hence this essay focuses on two aspects of moving towards renewable energy in transport sector: the need to increase investments in the public transport system in Sri Lanka[9] which is fuelled by renewable energy, and need for cooperation on finance and technology in the transport sector to decrease the reliance on fossil fuels. The essay will evaluate whether the existing policy framework supports these two priorities identified.

Renewable Energy in Energy and Transport Policies

The increased energy demand in transport sector is attributed to changes in fleet structure with rising demand on private modes of transport and deteriorating quality of public transport.[10] If cane-derived ethanol and biofuel succeed in displacing the market of gasoline, there is a possibility of exporting the surplus, while creating a profit and

---

1. Asian Development Bank, Sri Lanka Energy Sector Assessment, Strategy, and Road Map (2019) 09.

2. Role of Renewables in the Transport Sector, <http://projects.nri.org/biomass/conference_papers/transport_section.pdf> accessed 20 May 2021.

3. Ministry of Environment and Renewable Energy, A Road Map for Cleaner Fuels and Vehicles in Sri Lanka (September 2014) 15.

4. See (n 1) 01. "About 30% of petroleum requirement is imported as crude oil and processed in the country's single refinery, while the balance requirements are imported as refined products."

5. ibid 03.

6. ibid 07.

7. Transport Sector Assessment for Sri Lanka , 2015, <https://www.adb.org/sites/default/files/linked-documents/2-SRI-Sector-Assessment-Transport.pdf< accessed on 20 May 2021.

8. Article 6, Conference of the Parties, Adoption of the Paris Agreement, Dec. 12, 2015, U.N. Doc. FCCC/CP/2015/L.9/Rev/1 (Dec. 12, 2015)

9. A.S Kumarage, Sri Lanka Transport Sector Policy Note, 2012, Final Report, World Bank, Sri Lanka <https://kumarage.files.wordpress.com/2015/03/2012-r-01-tp-kumarage-a-s-sri-lanka-transport-sector-policy-note-world-bank-111pp.pdf> accessed on 20.05.2021.

10. See (n 3) 15.

a renewable energy resource.[11] There are gaps in institutional and technical capacity, lack availability and access to resources and lacunae in government policies.[12]

The Ministry of Power has completed "Promoting Sustainable Biomass Energy Production and Modern Bio-Energy Technologies" project in 2015 with Sri Lanka Sustainable Energy Authority, but it is limited to the industries that use fossil fuels for thermal energy.[13] On that note, there are several Ministries that have influence on biofuel.[14] This indicates that the institutional and policy fragmentation affects the streamlining of investment and movement towards renewable energy in transport sector. The transport agencies focus on increasing access and growth, while the energy sector and environment sector based policies highlight the need to increase investment in more sustainable sources and renewable energy in transport sector.[15]

'Sri Lanka Energy Sector Development Plan for a Knowledge based Economy 2015–2025' established a series of thrust areas and targets in 2015.[16] It includes 'reducing the petroleum fuel use in the transport subsector by 5% by introducing alternative strategies such as efficient modes of transport and electrification of transport by 2020' with ambition to be energy self-sufficient and lower the carbon footprint of energy sector.[17] However, ADB has noted that Sri Lanka lacks a strong policy analysis framework and documentation to analyse the role of biomass and gas in transport, and its financial and economic impacts.[18]

Ministry of Power, Energy and Business Development published 'National Energy Policy and Strategies of Sri Lanka' via Gazette Extraordinary No. 2135/61, dated Friday, 09th of August, 2019.[19] This comprehensive policy elicits the need to upgrade the transport sector, which is the 'largest consuming sector of commercial energy' using other forms of energy beyond petroleum. Energy transition from petroleum to electricity is to be actively pursued for transport sector.[20] It also envisions conducting feasibility studies on the use of natural gas or renewable energy-based hydrogen and GTL in transport and other sectors by 2022.[21]

There are other relevant National Policy documents. National Energy Policy and Strategies 2008,[22] National Energy Policy (Draft) 2005, National Forestry Policy 1995, Forestry Sector Master Plan (FSMP) 1998 and National Environmental Action Plan 1998 – 2001, have recognised the importance of alternative fuels such as biofuel, energy plantations and energy auditing.[23] A Renewable Energy Development Plan 2019 – 2025 has been developed by the Ministry of Power. However, it does not contain any specific reference to transport sector.[24]

Recommendations and Strategies for Implementation

National Energy Policy and Strategies (2008) notes the need of fuel diversification in the transport sector, through

---

11. See (n 2) 06.

12. ibid 06 – 11

13. Ministry of Power, 'Progress of the Development Projects and Programmes During 2015 – 2018' (as updated) <http://powermin.gov.lk/sinhala/wp-content/uploads/2018/08/completed-pro-2015.pdf > accessed 20 May 2021.

14. See (n 2) 11.

15. National Environment Act No , National Environment Action Plan, National Determined Contributions 2017, Clean Air 2000 and 2007

16. See (n 1) 73.

17. ibid 74.

18. ibid 82.

19. <http://www.energy.gov.lk/images/resources/downloads/national-energy-policy-2019-en.pdf> accessed 20 May 2021, page 4A.

20. ibid s 3.5.6 at page 10A.

21. ibid s 4.5 (5a) at page 19A.

22. See ((n 1) 69.

23. See ((n 2) 18 – 19.

24. Website of Ministry of Power (as updated) <http://powermin.gov.lk/english/wp-content/uploads/2019/08/Renewable-Energy-Development-Plan-English.pdf> accessed 20 May 2021.

rail and road transport systems based on off-peak electricity supply and promotion of biofuels as a high-priority research and development need.[25] Over 7000 electric cars are in Sri Lanka and an optional time-of-use tariff had been available since mid-2016 for households, to encourage vehicle charging after peak hours.[26]

ADB has noted that one of the key challenges in moving towards increased public transport is the focus on investment and not on reforms to modernise passenger transport and logistics, capacity limitations and as discussed at the group work held as a part of UNITAR CIFAL Jeju's Online Workshop on Scaling-up Renewable Energy Ambition in Future Transport, other main challenges remain to be infrastructure limitations (such as storage capacity) and market challenges.[27] However a strong commitment to the policies and the international obligations under the Paris Agreement, national commitments under the Nationally Determined Contributions can play a role in streamlining the transport sector priorities and move towards a more sustainable system.

25. ibid 72.

26. See ((n 1) 67.

27. See ((n9) p. 10.

Tarea Karunaratne

Sri Lanka's renewable energy profile, particularly in relation to its transport sector is regrettably minimal, but has great potential to grow, with a relatively extensive public transport sector, and a demonstrated interest in the expansion of the renewables sector. While public transport is widely used in urban areas, Sri Lanka has a relatively large and fast growing private transport sector. Currently, in Sri Lanka the transport sector contributes to about 60.5% of total emissions[1], and with private vehicles per household standing at 0.7% in 2014, it is can be surmised that private transport is a significant contributor to this phenomenon. As the renewables sector in Sri Lanka is still in its infancy, the transport sector is almost entirely reliant on fossil fuels, which attributed 5,010 Ketoes of total energy generation in 2018[2], and renewables accounting for under 25% of total energy generation in 2019[3]. In order for Sri Lanka to meet expected renewable energy targets in the transport sector, the promotion and expansion of public transportation is a key strategy, as highlighted in discussions held during the workshop in alternate locations such as the Bhutan. Additionally, looking at past trends, it can be estimated that investment into ethanol and biofuels will come at the lowest cost and highest efficiency in developing Sri Lanka's transport sector, especially through the development of low cost cane derived ethanol, considering Sri Lanka's position as a nation with a considerable sugar industry.[4]

Additionally, Sri Lanka has demonstrated a keen interest in developing its renewables sector, with commitments to develop pipeline and vehicle-based transport in the downstream gas and oil supply sector in order to improve access by industries and households to ensure appropriate distribution networks. Regional storage facilities connected with the rail-based supply network will also be utilized in order to reduce transport fuel use in petroleum distribution.[5]

One key problem identified during the workshop by Group 4 (Sri Lanka and Indonesia) is the difficulties faced by tropical countries in storage and disposal of batteries and solar cells, which have longer lifespans in regions with more temperate climates, and the implications of heavy investment into renewables which are impeded by factors such as climate or wildlife. This can be a significant challenge to overcome for Sri Lanka, and one that likely requires considerable research and development both locally and globally to ensure a global commitment to developing renewables. Another key challenge identified is a lack of awareness or understanding among the general public, which could be met with education campaigns and outreach programmes.

The development of transportation infrastructure, such as safer and more extensive bus and train routes, particularly those than run inter-district or between provinces, can be a first step in developing the transport sector of the nation, as it will allow for a reduction in both emissions from private transportation and of reliance on fossil fuels for this. As public transport becomes a safer, more reliant, and more affordable option for the general public, accounting for the inclusion of renewables will, so too, become inevitable as the infrastructure grows, and there is increased focus on renewables in the transport sector. The importance of public transport as a means of developing renewables in transport was highlighted throughout the workshop, and is a key takeaway that provides an efficient, sustainable, and equitable application of renewables, and should be prioritised in future plans to identify and amplify renewables in the transport sector in Sri Lanka.

---

1. Celyon Electricity Board

2. Iea."Sri Lanka - Countries & Regions." IEA, www.iea.org/countries/sri-lanka.

3. Ceylon Electricity Board

4. National Resource Institute, "The Role of Renewables in the Transport Sector"

5. National Energy Policy, Sri Lanka. 2019

Articles on Renewable Energy
and Transport Policy Portfolio

Philippines

The Philippine Transport Sector: Shifting the Monochromatic Paradigm

Emil Florence Gatmen

The subsequent introduction of jeepneys after the World War II shifted the transport paradigm of the Philippines from the use of horse drawn carriage to reliance to fossil fuels. Of course, during this time the effects and impact of fossil fuels had not yet been fully scrutinized by scholars. In 2017, the Department of Transport launched “The Public Utility Vehicle Modernization (PUVM) Program” which aims to improve the efficiency of public transportation in the country and reduce the sector’s environmental impact. Therefore, this is the third movement of the country to shift the paradigm of its public transport system.

At present, the use of electric vehicle is gradually overtaking the fossil fuel powered vehicles. This change can also be observed in rural areas. Although the program has the noblest intention, it is also faced by multiple backlash. First, the great gap in capital cost of conventional jeepney versus electric jeepney which polarizes the opinion of the populace. Since electric jeepneys are too expensive, the public transport sector tends to decline the swing to modernization. The poor incentivization scheme which is 5% subsidy per electric jeepney pulled the program further into the void. Second, the ongoing pandemic caused the Philippine’s GDP to fall dramatically. This reduced the ability of jeepney operators to modernize. With controlled transportation, this means reduced earnings and incapability to purchase a new unit. Third, cultural preservation of jeepney as a cultural icon. The new design of electric jeepney is much like a bus as compared to the conventional jeepney. This diminishes the preservation of jeepney as a national symbol of road transportation.

In this trying time, the program may be strengthened by utilizing international networks to improve the incentivization scheme. The country can collaborate with different countries and international organization. The government should also campaign the redesigning of electric jeepneys to suit the aspect of cultural preservation. This, with high hopes, would allow the new jeepneys to represent not just our history but our national contribution to environmental protection. The success of the program is yet unknown, as it is still in its infant stage whilst the road is still long. It is not yet too far off to redraw the program’s mechanisms of implementation. After all, there is always a light at the end of the tunnel.

General Santos City Carbon Emission Reduction by 2030

Hally Bryan Valdehueza

General Santos City is located at the southern most part of the Philippines is among the 15th most populous city in the Philippines. The basic mode of transportation in the city is summarized below (www.spgensantos.ph), with almost 60% are motorcycle driven (tricycle, habal-habal, motorcycle) powered by fuel. Joining the CIFAL-Jeju's Online Workshop on the Future of Renewable Automobile will be sure a huge challenge in the city. Despite it being considered as one of the urbanized cities in the country, awareness on renewable energy is less amongst commoners. Sure, there were 5% of motorized drivers who transition into using electric driven tricycles their ultimate burden is the lifecycle of the battery and charging ports in strategic locations.

However, based on the SWOT Analysis (www.spgensantos.ph) conducted in the city's public transport, such change is doable in implementing the Renewable Energy Act of 2008 on all motorized PUVs (public utility vehicles). This means detailed planning of the LGUs (local government unit) in the city.

Strength	Weakness
• Wider roads and right of ways • Higher percentage of paved road with relatively flat grounds • Most major roads are lighted • Economic Hub (Transportation) in Socksargen	• Indiscriminate parking • Congested intersections • Proliferation of tricycles, habal2x, mini-tricycles and motorcycles • Proliferation of satellite terminals • PUJ operations ease out due to voluminous motorcycles
Opportunities	**Threats**
• Regional Economic Hub • Funds for transport development	• Continuous registration of motorcycles • Increasing fuel cost • Poor national and local coordination

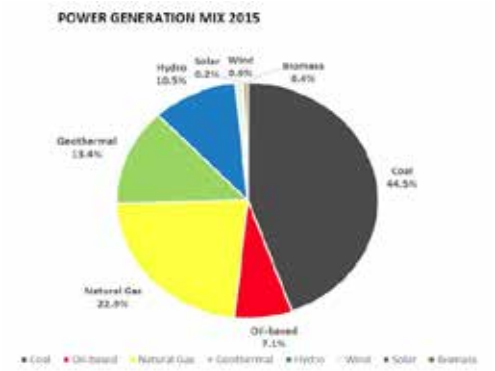
As more and more developed countries are now introducing hybrid and electric driven vehicles, in due time there will be those operated using any of the available renewable energy such as biofuel, hydro, wind and solar. What needs to be strengthen are the policies, awareness to the common masses and managing change from the norm to future transport system. Giving emphasis on future changes would mean a better planet.

Philippine's King of the Road, gearing towards ZERO emission

Rubelyn Valdehueza

The Philippine's iconic public transport hailed back in the 1930's commonly referred to as PUJ (Public Utility Jeepneys), these jeepneys are stretched long enough to accommodate maximum of 25 passengers and runs using diesel fuel. The jeepneys are famously characterized by their vibrant, multi-colored paint jobs and flashy décor, so much so that through the years they have become a symbol of the country and its culture (www.theculturetrip.com).

In aligning with the world's climate change movement, the Philippines approved the RA 9513 commonly known as Renewable Energy Act of 2008. As of 2015, almost 50% switched into renewable energy as shown in the pie chart below (www.doe.gov.ph).



The automobile industry follow suit in decarbonizing public transport and reduces carbon foot print. In Manila alone 94% of the soot particle mass comes from PUJs (www.researchgate.net), to address this problem the government recently launched the "Public Utility Vehicle Modernization Program" – the goal is decarbonizing public transport in the Philippines. Promote the use of e-automobile or electronic automobiles across all cities in the country either by jeepneys, buses, motorcyles and/or scooters.

In Cagayan de Oro City, on 8th May 2021 GOFETCO (Golden Friendship Eco-Friendly Transport Cooperative) formally launched sixteen (16) brand new units of Forland M3 Modern Jeepney Class II which will ply several existing routes in Cagayan de Oro City soon. The new modern jeepneys will be plying exiting routes in the city replacing old and dilapidated jeepneys (www.cdodev.com) to reduce carbon emission in the city.

In the recent CIFAL-JEJU digital workshop, I've found out that most of the participants have the same situation in terms of policies and challenges in transitioning from fuel to renewable energy powered automobiles. Although in developed countries they already started embracing the change. Looking forward in the future, as commuters and consumers will be more aware on the positive outcome of renewable energy in automobiles I guess in developing countries like the Philippines, we can also be 1.

Decarbonizing transportation in the Philippines: the future of jeepneys

Grace Sapuay

The jeepney is a Philippine icon of transportation. It exist anywhere in the PhilippinesThe photos below shows an example of a Philippine jeepney. It's painted with brightcolors and adorned with gaudy accessories. This is the Philippine jeepney, a post-World War II innovation, a cultural symbol, and the undisputed "King of the Road".

But what is the Philippine jeepney? Locally referred to as a jeepney or jeep, this interesting-looking vehicle is an affordable mode of Philippine public transport. With designated routes, which are usually painted on their sides or displayed on their windshields, jeepneys stop anywhere along the way to pick up or let off passengers.[1] So these jeepneys also are a bane for traffic in the metropolis.

Figure 1. Jeepneys in the Philippines can accommodate people and cargo up to the roof. This is why it is the favorite means of transportation in the Philippines.[2]

As the U.S. withdrew from the Philippines after World War II, a large number of jeeps were sold or given to Filipinos. WWI and II destroyed the country's public transportation system and soon, Filipinos began to modify jeeps into a sort of minibus to accommodate more passengers and shelter them with a roof[3].

Issues on the jeepney:

More than 500,000 diesel-fueled jeepneys, buses, trucks and other vehicles in Metro Manila are responsible for about 70 percent of the total soot or black carbon emissions in the Philippines, according to Climate Change Commissioner Heherson Alvarez (2013).

In a speech before the just-ended 2013 Sustainable Development Summit in New Delhi, a copy of which was furnished to the Philippine Daily Inquirer, Alvarez also reported that "public utility vehicles, mostly jeepneys, produce 22,000 metric tons of soot emissions per year" in the country.[4]

---

1. *Escalona, K. 2017. How the Jeepney Became a Filipino National Symbol. Accessed online at https://theculturetrip.com/ asia/Philippines/how-the-jeepney-became-a-philippine-national-symbol/ on May 17, 2021.*
2. *Lakwatserong tsinelas.2014. Province of Abra: Philippines best kept secret. Accessed online at https://www.lakwatserongtsinelas.com/2014/02/province-of-abra-best-kept.html on May 18, 2021. What is a jeepney? Accessed online at https://www.pinterest.ca/pin/573786808750793209.b on May 18, 2021.*
3. *Electric jeepney. Accessed online at Electric Jeepney - Appropedia: The sustainability wiki on May 18, 2021.*
4. *Esplanada, JE. 2013.Diesel powered motor vehicles blamed for Ph's air pollution. Accessed online at https://newsinfo.inquirer.net/353117/diesel-powered-motor-vehicles-blamed-for-most-of-phs-air-pollution#ixzz6uSLjx0HN on May 17, 2021*

Jeepney evolution can be broken down into different generations. Second generation Jeepneys have air conditioning, refurbished engines and more space for passengers. They are known for being noisy, garish and pollutant. That's because they use diesel as fuels.

Third generation Jeepneys have better air conditioning systems, newly assembled engines and closely resemble minibuses. They also tend to be more economical and environmental.

Jeepneys fueled by liquid petroleum gas (LPG) were the first of these vehicles to switch over to cleaner energy. LPG Jeepneys are rare, however their emissions are much lower than those of earlier generations.[5]

After Pres. Rodrigo Duterte was elected, he meant to transform the jeepneys into something like an e-jeepney. But these e-jeepneys are imported, mainly from China and very expensive and drivers and operators are fighting this.

The Philippines transport policy 2017:

These Implementing Rules and Regulations, hereinafter referred to as the "IRR", are promulgated, pursuant to Section 11 of NEDA Board Resolution No. 5, s. 2017, entitled "Approving the National Transport Policy", for the purpose of setting the direction of and parameters for the integrated development and regulation of the Philippine transport sector.

Section 2. Declaration of Policy

To ensure an improved quality of life for the Filipino people, the State envisions a people-oriented national transport system that is safe, secure, reliable, efficient, integrated, intermodal, affordable, cost-effective, and environmentally sustainable. This Transport Vision is based on the principle that mobility is a basic need, and the government should ensure that every Filipino has mobility options to access basic services and economic opportunities. Consistent with the Transport Vision, the provisions of this IRR are intended to guide the government at the national and local levels, in ensuring effective and efficient inter-government coordination, local government participation, and stakeholder collaboration in developing the country's transport system through harmonization of policies, plans, and programs.

The Implementing rules and regulations of the country's transport policy aims to comply with the country's international and regional commitments and to perform obligations under international treatises, conventions, and agreements relating to or affecting transport infrastructure, such as the Sendai Framework for Disaster Risk Reduction 2015-2030, Paris Agreement, 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), ASEAN Integration, Brunei Darussalam Indonesia-Malaysia Philippines East ASEAN Growth Area (BIMP-EAGA), International Maritime Organization (IMO), International Civil Aviation Organization (ICAO), and World Health Organization (WHO) and United Nations (UN) commitments related to human rights and road safety[6], in order to achieve the transport vision. This is why the government has adopted this transport policy.

The author has chosen the future of these jeepneys, because it is the most pollutive of all transportation in the Philippines due to its use of diesel fuels.

Todate, the government has launched an alternative to jeepneys called e-jeepney but it is unlike the jeepneys. The photo below shows the alternative to jeepneys:

---

5. Ibid.

6. NEDA. Feb. 13, 2020. National Transport Policy - The National Economic and Development Authority (neda.gov.ph). Accessed online at https://www.neda.gov.ph/the-national-transport-policy-and-its-implmenting-rules-and-regulations/ on May 18, 2021.

Figure 2. This is the government's alternative to jeepneys, they called e-jeepneys. It has a wider body and can accommodate more passengers and is airconditioned

This alternative to e-jeepneys is more expensive. This e-jeepney investment cost is three times the average price of a brand new modernized diesel jeepney, which only costs USD 18.34 M to USD 27.51 M/unit. Currently, the government provides a 5% subsidy to every e-jeepney unit, which costs between USD 64.19 M and USD 73.36 M/unit, payable within 7 years at a 6% interest rate. Regardless of the potential to solve traffic conditions and air pollution, provide new jobs, enhance the tourism industry, and streamline public transport, the modernization program has faced numerous protests from drivers and operator organizations due to financing issues.

Recently, the government launch the The Jeepney+ NAMA of the Philippine Government will create an important showcase for the transformation of public transport for this group of countries.

Mostly developing countries need to undertake huge efforts first to formalize and professionalize their public transport industry moving gradually to larger capacity buses and consolidate operations before the industry is (financially) capable to introduce hybrid or electric buses at scale.

The main goal of the NAMA is to establish a formalized, high quality public transport system inducing ongoing fleet renewal, a transition towards higher capacity vehicles, higher operational efficiency and better service levels. This will reduce the emission footprint of public transport, mitigate rapid motorization and limit the shift of trips to the carbon intensive use of cars. It furthermore lays the groundwork for the future electrification of the public transport fleet, which is needed to achieve full decarbonisation. Hence, a new era in public transport, which is a partnership between the national government, local government units, and the private sector has been formed to launch "a new developmental route" for e-jeepneys under the Department of Transportation's (DOTr) Public Utility Vehicle Modernization Program (PUVMP). Together with the Land Transportation Franchising and Regulatory Board (LTFRB), Meralco (Manila Electric Company), and the City Governments of Makati and Mandaluyong, 15 electric jeepneys have been deployed to serve the route from the Buendia MRT station in Makati to the Mandaluyong City Hall via Jupiter Street and back[7]. The photo below shows the e-jeepney called e-sakay (or e- ride):

7. Tadeo, PE. 2019. Makati-Mandaluyong e-jeepney launched. Accessed online at https://sg.news.yahoo.com/makati-mandaluyong-e-jeepney- route 040040599.html on May 16, 2021.

Figure 3. E-jeepney launch from Mandaluyong to Makati and back.[8]

	E-jeepney	Diesel Jeepney
Net present value (USD)	4.892 million	3.138 million
Payback Period (PBP) (years)	4.09	3.28
Return on investment (ROI) (30 years)	373%	490%
Internal rate of return (IRR)	32.36	43.89

Table 1. Valuation Method E-Jeepney Modernized Diesel Jeepney[9]

The above table shows the valuation used by the authors to summarize the financial estimation results for PUV modernization projects using the traditional valuation methods. The results show that NPVs for both the e-jeepney and the modernized diesel jeepney projects are positive, which indicates positive returns for investing in any of the alternatives.

Regarding my experience in the workshop, as a transport sector specialist in one ADB project, I just realized the value of decarbonizing the transport sector, such as the jeepneys, which emits so much pollution in our cities. However, this should not be so expensive and should be made locally such as the one shown in the photo below:

Figure 4. This is a locally made e-jeepney. Accessed online at PH's First Electric Jeepney Founder: transport industry set to change (vulcanpost.com) on May 19, 2021.[10]

8. Ibid.

9. Agaton, CB et al. 2019. Diesel or Electric Jeepney? A Case Study of Transport Investment in the Philippines Using the Real Options Approach. Accessed at (10) (PDF) Diesel or Electric Jeepney? A Case Study of Transport Investment in the Philippines Using the Real Options Approach (researchgate.net) on May 17, 2021

10. Panes, Rehmil. 2015. PH's First Electric Jeepney Founder Said Change Is Finally Coming For The Transportation Industry accessed online at PH's First Electric Jeepney Founder: Transport Industry Set To Change (vulcanpost.com) on May 19, 2021.

Locally-made e-jeepneys can be cheaper and affordable to the operators of e-jeepneys. So that they don’t have to spend all their earning in amortization because they also need to feed their families.

Renewable Energy in the Transportation Sector in the Philippines

Helen Grace Antonio

The rapid urbanization in the Philippines especially in the National Capital Region leads to congestion and excessive us of coal as its main source of fuel. According on the study of Asian Development Bank here in the Philippines, the transportation is the biggest energy consuming sector in the country. The fuel that is used is petroleum which comes from coal which is a non-renewable energy source. Aside from this, the emissions from vehicles are the main source of greenhouse gases that pollutes the air and destroy the ozone layer.

Our country initiatives are the use of e-bikes and e-jeeps to reduce the use of fossil fuels. By joining the workshop in renewable energy transport, I learned different strategies used by other countries such as India and Sri Lanka in renewable energy in transportation. Shifting to renewable energy is essential and we must act now to save the earth, our home.

Jeju International Training Center affiliated with UNITAR
227-24, Jungmungwangwang-ro, Seogwipo-si, Jeju-do, Korea
Tel: +82-64-735-6585 **Fax**: +82-64-738-4626 **Website**: www.cifaljeju.org