



Deliverable Report for MECON Project

Task 1.2

Baseline energy consumption of MECON household in Myanmar

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1. Overview of energy consumption for MECON target group in Myanmar

In order to set energy consumption baseline for MECON target group in Myanmar, it needs to have energy consumption data for each electric appliances device that are used in the household.

In this project, End-use model is used for project energy consumption in household as shown in Figure 1.

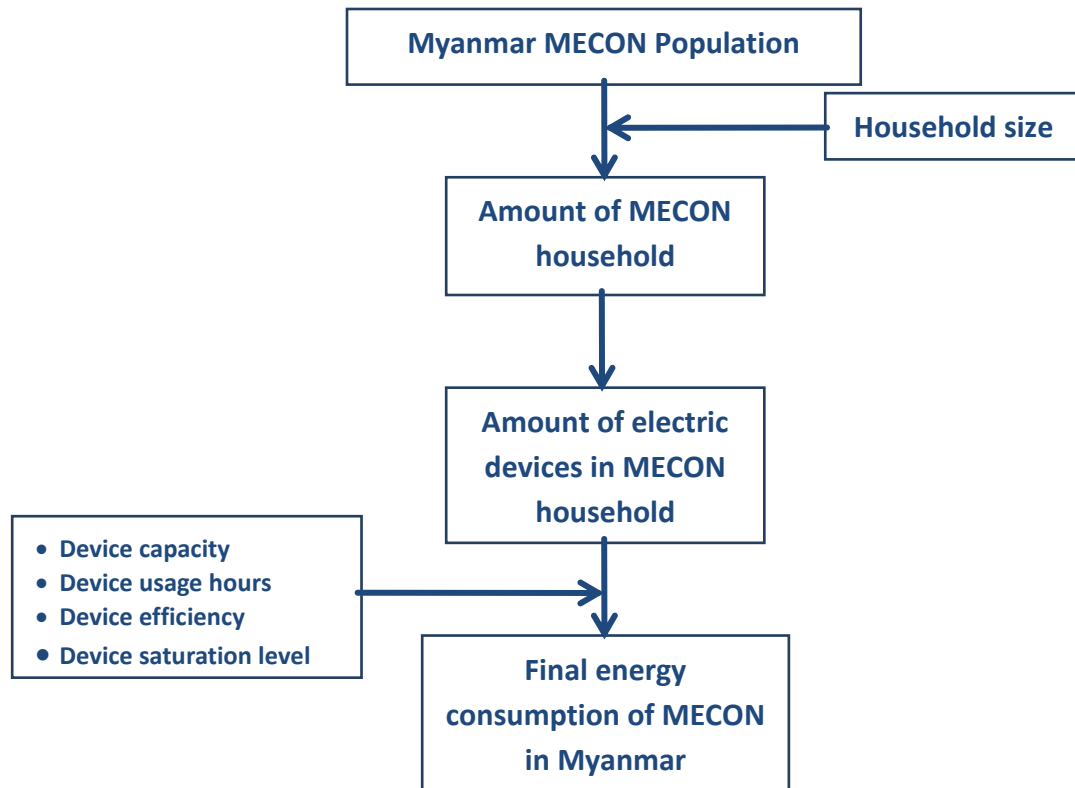


Figure 1: LEAP structure for MECON target group

Figure 1 shows energy consumption structure in LEAP software. Firstly, it is really important to have the proportion of MECON target group to total population in Myanmar. Secondly, it needs to classify what electric appliances are used in MECON target group as the baseline scenario. Finally, energy consumption for each device will be conducted in order to input data into LEAP software (more detail in Task 3).

2. MECON target group percent share

As mentioned above about definition of MECON, we need to know how many percent share of MECON target group in Myanmar in the present. To do this, we use GDP and population historical data between 1990-2012 from the IEA and the World Bank as shown in Table 1.

Table 1: Historical data for GDP, population and those whose income between \$2-5 per day

Year	GDP (current Billion US\$)	Total Population (Million ppl)	Percent share of MECON population	Number of MECON Population (Million ppl)	Number of MECON HH (Million HH)
1990	32.8	39.86	0	0	0
1991	35.9	40.43	0	0	0
1992	38.1	40.99	0	0	0
1993	40.7	41.55	0	0	0
1994	43.6	42.13	0	0	0
1995	46.4	42.74	0	0	0
1996	49.1	43.35	0	0	0
1997	51.9	43.95	23	10.11	2.02
1998	57.6	44.5	0	0	0
1999	65.5	44.96	0	0	0
2000	72.9	45.32	25	11.33	2.27
2001	81.7	45.07	0	0	0
2002	72.9	45.32	0	0	0
2003	105.6	46.07	0	0	0
2004	119.9	46.32	0	0	0
2005	135.6	46.61	0	0	0
2006	151.8	46.92	0	0	0
2007	157.8	47.25	32.7	15.45	3.09
2008	165.4	47.6	33.89	16.13	3.23
2009	174.1	47.96	35.13	16.85	3.37
2010	183.7	48.34	36.41	17.6	3.52
2011		48.79	37.7	18.41	3.68
2012		49.24	39.1	19.26	3.85
2013		49.7	40.5	20.15	4.03
2014		50.162	42.0	21.08	4.22
2015		50.628	43.6	22.05	4.41
2016		51.099	45.2	23.07	4.61
2017		51.574	46.8	24.14	4.83
2018		52.053	48.5	25.25	5.05
2019		52.537	50.3	26.41	5.28
2020		53.025	52.1	27.63	5.53
2021		53.518	54.0	28.91	5.78
2022		54.015	56.0	30.24	6.05
2023		54.517	58.0	31.64	6.33
2024		55.024	60.1	33.1	6.62
2025		55.535	62.3	34.62	6.92
2026		56.052	64.6	36.22	7.24
2027		56.572	67.0	37.89	7.58
2028		57.098	69.4	39.64	7.93
2029		57.629	72.0	41.47	8.29
2030		58.164	74.6	43.38	8.68

The data (percentage of people whose income is 2-5\$/day) has been projected using Cambodian trend because lack of historical data in Myanmar. In the context of MECON, these

two countries have similar economic growth. Therefore, in this study the percent share of MECON household is assumed as same as in Cambodia. However, the amount of households of these two countries are not the same number due to the difference on population growth and household size. The projection of percent share of MECON households is shown in Figure 2 and Table 2.

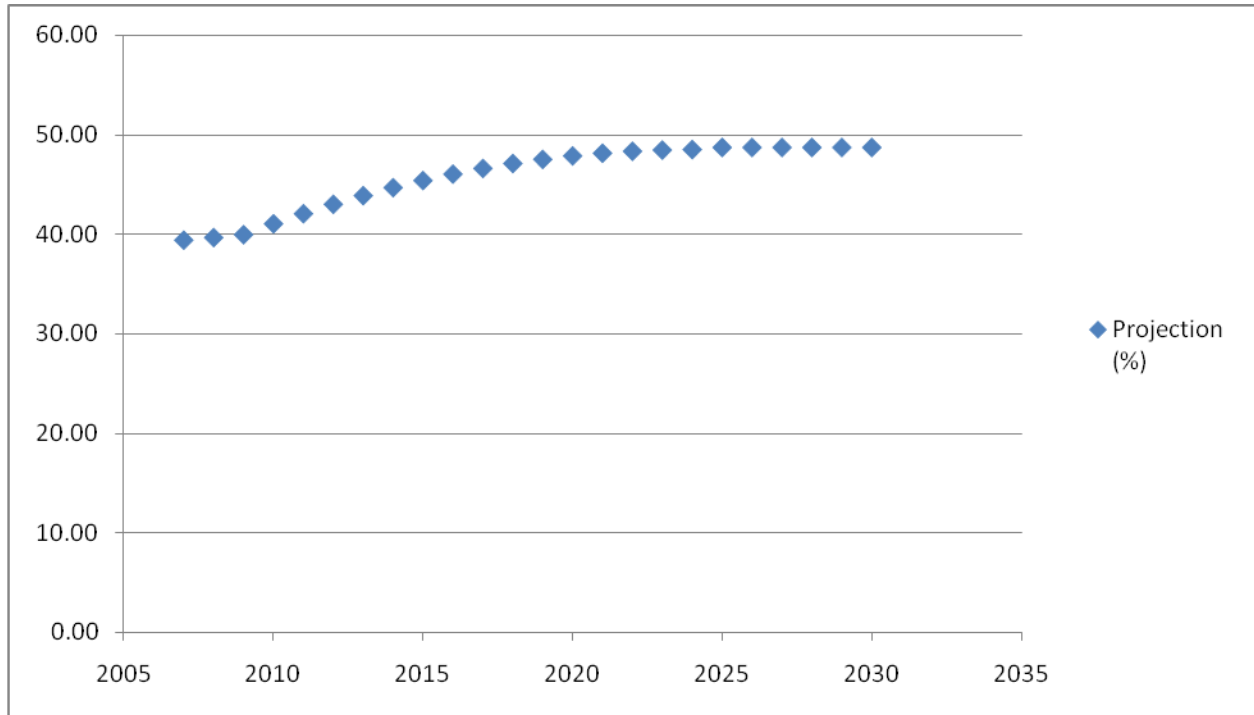


Figure 2: Percentage of the population whose income is 2-5\$ (2005PPP) per capita

It can be seen that the proportion of MECON target group will be increase slightly from 44.68% in the year 2014 to 48.7% in the year 2030. It will be increase at approximately 9% as compared in 2014. This data will be inputted to LEAP as the percentage of MECON households to total households in the country.

Table 2: Number of Myanmar MECON household in The future

Year	Number of MECON HH (Million HH)
2013	4.47
2014	4.59
2015	4.71
2016	4.81
2017	4.91
2018	4.99
2019	5.07
2020	5.14
2021	5.21
2022	5.26
2023	5.31
2024	5.35
2025	5.41
2026	5.45
2027	5.49
2028	5.52
2029	5.56
2030	5.60

3. Structure of demand use for MECON target group

Before creating structure of energy consumption in household in LEAP, it is important to have the basic structure of electric appliances that are used in the MECON target group. To do this, household survey is needed in order to have the right information to this specific group. In

LEAP structure, they are divided into 7 categories which are lighting, cooking, cleaning, entertainment, cooling, heating and others as shown in Figure 3.

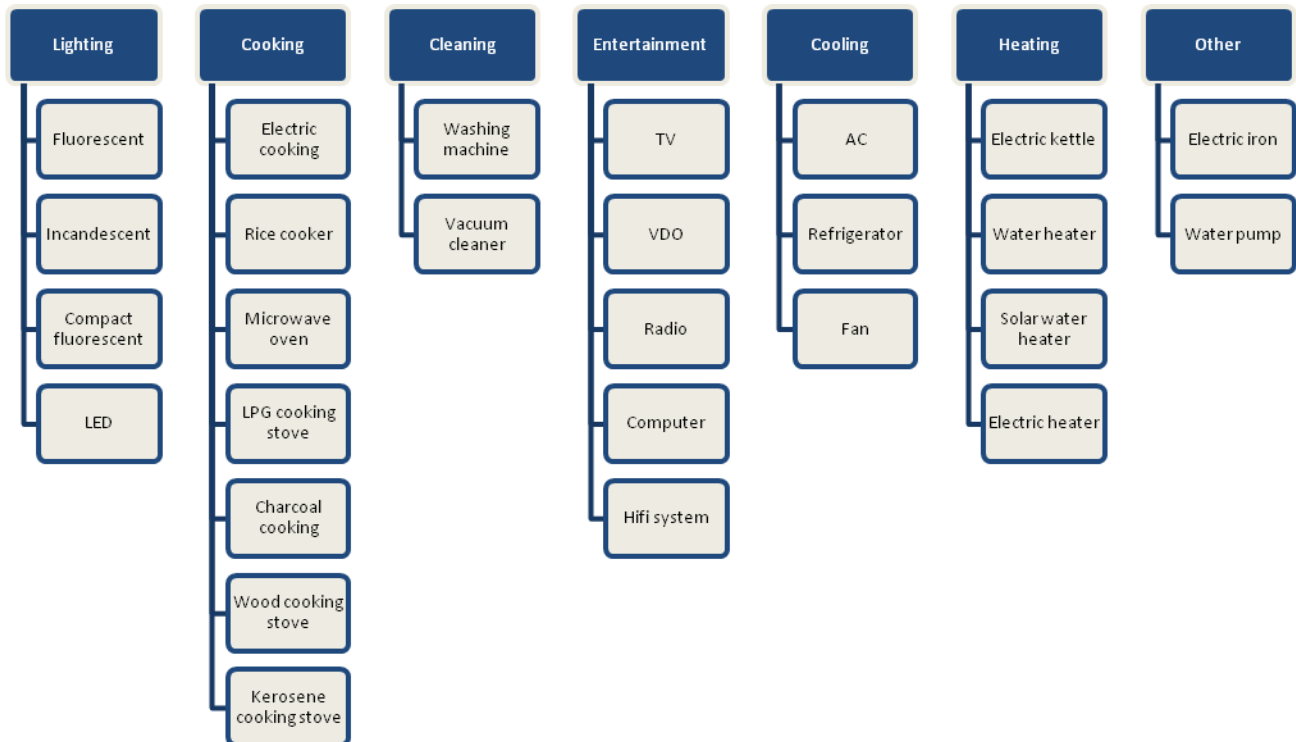


Figure 2: Electric appliance categories in MECON household in Myanmar

The structure above is classified based on the purpose of use electric appliance. For lighting, there are four main types of lamps which are fluorescent, incandescent, compact fluorescent and LED. Low income households in Myanmar have different type of cooking appliances which use variety of fuel such as electricity (i.e. electric cooking stove, microwave oven, and rice cooker), LPG, charcoal and biomass. For cleaning purpose, there are only two devices which are washing machine and vacuum cleaner. It was found from the household survey in Task 3 that there is not much use on vacuum cleaner for low income household. However, it was found that entertainment device especially TV is very common for each household. Two types of TV commonly found are CRT and LCD. The proportion of LCD is still low compared to the CRT. For cooling devices, electric fan is commonly used in the surveyed households follow by refrigerator and AC. For heating purpose, there are electric kettle, electric and solar water heater, and electric heater. It is not common for households in Myanmar to have electric heater because of the tropical climate here. However, the appliance is included in the model structure anyway, so the model can be applicable to the country that uses the device like

Vietnam. For those devices that are not related to categories that mentioned above, they will be in the “Other” category such as electric iron, water pump and etc.

4. Key assumptions

Key assumptions for LEAP software to project energy baseline for MECON target group are shown in Table 3

Table 3: Fundamental key assumptions

Parameter	Detail	Unit
Base year	2013	
End year	2030	
Population (2013)	50.98	Million people
Population growth rate	1.5%	Percent
Household size	5	person per household
Amount of total household	10.20	Million households
MECON population share (2013)	43.89	Percent
Number of MECON population (2013)	22.4	Million people
Number of MECON household (2013)	4.5	Million households

From household survey in Task 3, we conducted 334 samples of MECON target group in Myanmar (see the Annex A). The data is used to calculate energy consumption in the household as shown in below

$$\text{Electricity consumption (kWh/year)} = \text{Power of appliance (Watt)} \times \text{Hour use per year (Hr)} \times \text{amount of appliances} \times \text{coefficient} \quad \text{Eq.(3)}$$

However, some of the household devices such as refrigerator do not use the rated power all the time. This is because those devices have an on/off function in order to save electricity while maintaining desirable temperatures. Therefore, a coefficient is used in Eq.(3) which is applied from the study of China’s urban households. For this study, the coefficient for refrigerator is 0.36.

As shown in Eq.3, there are three factors to calculate electricity and energy consumption for each device. However, we cannot use the real number for LEAP software but the average number. This is because we cannot do the survey for all over Myanmar due to the budget and time constraints. Therefore, the 334 samples are represented as the MECON household Myanmar which is used in LEAP software as presented in the Table 4.

Table 4: Energy consumption of each device for MECON target group in Myanmar in 2013

Appliance	Detail					
	Wattage (Average)	Amount of appliances per household	Hours used (hours/day)	% of households owning the appliance	Energy consumption (kWh/HH/year)	% of household owning the EE technology
Lighting technologies						
Incandescent light bulb	50.00	2.82	3.75	28.47	192.90	-
Fluorescent light bulb	35.84	4.98	5.33	48.47	346.96	-
Compact fluorescent light bulb	18.66	3.12	2.29	24.41	48.63	-
LED	36.00	1.81	0.52	11.86	12.33	-
Kerosene light bulb	0.00	2.92	5.45	3.73	0.00	-
Cooking appliances						
Electric cooking stove	1300.00	0.01	1.58	38.31	7.50	-
Rice cooker	583.73	0.85	1.84	48.14	333.23	-
Microwave oven	850.00	0.03	0.02	4.41	0.19	-
Biomass Stove	0.00	0.00	0.00	13.90	0.00	-
Improve biomass stove	0.00	0.00	0.00	11.53	0.00	-
Charcoal Stove	0.00	0.00	0.00	32.20	0.00	-
LPG Stove	0.00	0.00	0.00	7.80	0.00	-
Kerosene Stove	0.00	0.00	0.00	1.36	0.00	-
Cleaning						
Washing machine	572.02	1.00	0.20	9.49	41.76	5.56
Vacuum cleaner	1000.00	0.05	0.01	0.34	0.18	-
Cooling appliances						
AC	1533.33	0.03	1.39	7.80	23.38	11.11

Refrigerator	83.76	0.83	14.00	32.88	177.63	1.07
Electric fan	57.81	1.29	2.86	40.00	77.83	23.49
Heating						
Electric kettle	679.69	0.39	0.43	30.51	41.60	6.09
Electric water heater	945.45	0.04	0.04	4.41	0.61	
Electric Heater	500	0	0	1	0	
Solar water	300	0	0	0	0	
Entertainment						
TV CRT (box TV)	91.92	1.12	2.57	39.92	96.59	
TV LCD (flat screen TV)	147.00	1.08	1.57	19.32	91.00	19.32
Video/DVD player	50.25	0.16	2.11	47.46	6.19	
Radio	31.15	0.18	2.30	19.66	4.71	
Computer	130.36	0.17	4.34	15.25	35.11	
Hi-fi system	50.00	0.03	0.01	5.76	0.01	
Mobile phone	4.81	1.00	4.00	51.53	7.02	
Other appliances						
Water pump	145.83	0.04	0.88	25.08	1.88	
Electric iron	1000.00	0.97	0.27	86.67	95.59	

The data from Table 4 will be used in LEAP software as Business As Usual (BAU) scenario in Myanmar. The result of energy consumption baseline for MECON household in Myanmar is described in the next sections. For efficient technology, the energy consumption is assumed 20% lower than the conventional technology for every appliance. As seen the Table 4, there are only six appliances that MECON households own the EE technology; washing machine 5.56%, AC 11.11%, refrigerator, 1.07%, electric fan 23.49%, electric kettle 6.09%, and TV 19.32%.

5. Results

From key assumptions and energy consumption of MECON household in section 4, they are inputted into LEAP software. The final energy consumption for MECON target group in Myanmar is shown in Figure 4

As the amount of MECON household is expected to increase in the next 16 years, the final energy consumption for this specific group will rise as well. In 2014, the total energy consumption was 145.746 ktoe and it increase to 177.054 ktoe in 2030 as shown in Figure 4.

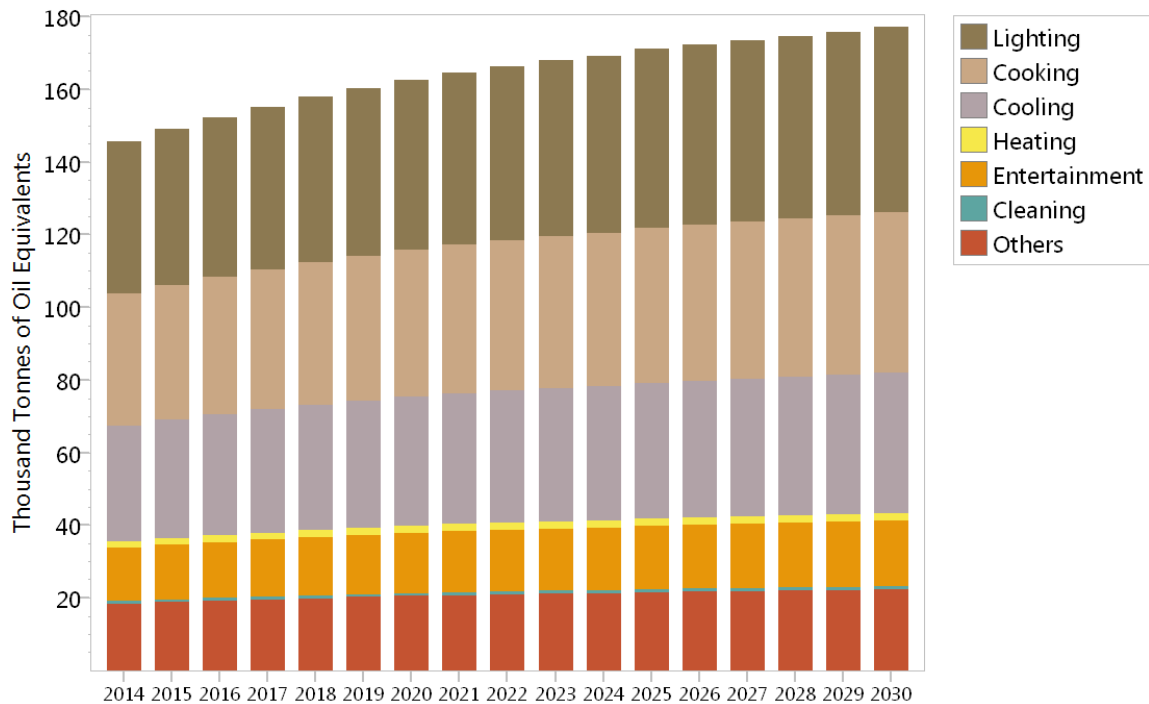


Figure 3: Energy consumption by category for MECON group in Myanmar in BAU scenario during 2014-2030

It was found that lighting category takes the highest energy consumption at 50.982 ktoe or accounts to 28.79% of total energy consumption in 2030 followed by cooking (24.91%) 44.097 ktoe, cooling (21.83%) 38.654 ktoe, other appliances (12.61%) 22.318 ktoe, entertainment (10.15%) 17.97 ktoe, heating (1.22%) 2.152 ktoe, and cleaning (0.5%) 0.877 ktoe respectively. For the other device category, there are appliances that are used for specific purposes for each household e.g. water pump and iron.

5.1 Lighting

Four technologies are in this category. Fluorescent lamps dominates as the highest usage for MECON household, accounting at 77.23% of total lighting energy consumption followed by incandescent (ICD) 19.85% ,compact fluorescent (CFL) 2.72%, LED 0.16% and kerosene 0.03%.

As a result, final energy consumption in lighting was 41.966 ktoe (FLS 32.411ktoe, ICD 8.33 ktoe, CFLS 1.143 ktoe, LED 0.068ktoe and kerosene 0.012ktoe) in 2014 and it is expected to increase according to the increasing MECON percent share in Myanmar which will take account in 2030 at 50.982 ktoe (FLS 39.37ktoe, ICD 10.121 ktoe, CFLS 1.388 ktoe, LED 0.083 ktoe and kerosene 0.015 ktoe)as shown in Figure5. The energy consumption percent share by technology remains the same as of 2014 because it is under the BAU assumption that no new policies are applied in the future.

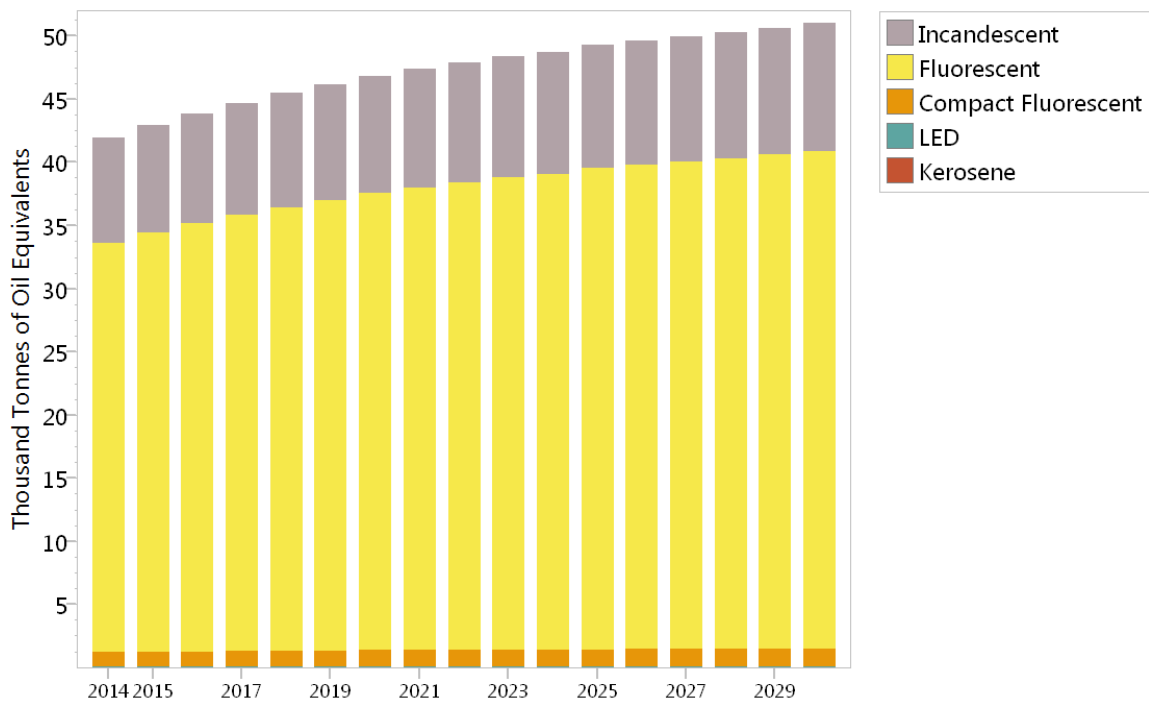


Figure 4: Energy consumption for lighting of MECON group in Myanmar in BAU scenario during 2014-2030

5.2 Cooking

For this category, there are seven appliances which are electric cooking stove, rice cooker, microwave, biomass stove, charcoal stove, LPG stove and kerosene stove. In 2014, rice cooker is the major appliances consuming energy in this category which accounts approximately 33.289 ktoe and it is expected to increase in next 16 years because the trend of MECON households. The energy consumption in cooking will be 44.097 ktoe or 24.91% of total energy consumption by cooking category by 2030 as shown in Figure 6. The charcoal stove is the second highest energy consumption after rice cooker which will accounting at approximately 1.62 ktoe or 4.46% of total energy consumption by cooking category. The rest of cooking appliances which are electric cooking stove, LPG stove, biomass stove, kerosene stove and microwave will use energy consumption total at 1.39 ktoe or equivalent to 1.2%, 2.12%, 0.503%, 0.007% and 0.0004% respectively.

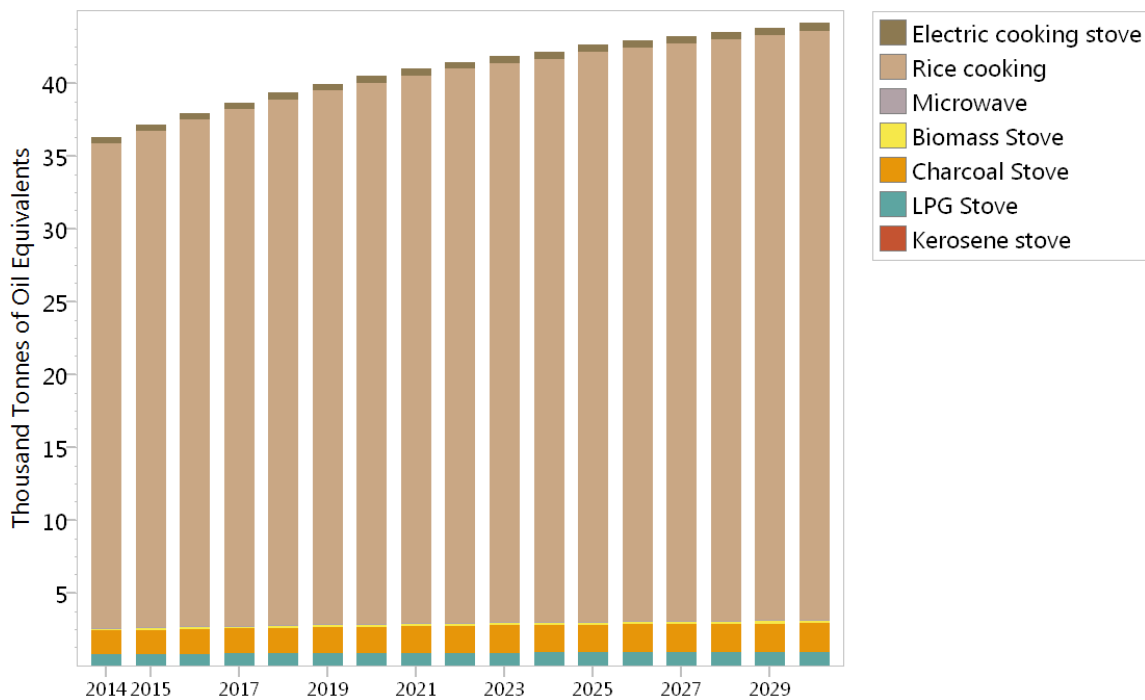


Figure 5: Energy consumption for cooking appliances of MECON group in Myanmar in BAU scenario during 2014-2030

According to BAU scenario, LPG cooking stoves, electric cooking stove and microwave do not consume energy as much as rice cooker, but it is expected to be high energy consumption devices once this target group is shifted to have more income in the future.

5.3 Cooling

For cooling category, there are only three appliances which are AC, fan and refrigerator. It was found that MECON households in Myanmar do not have AC that much when compared to fan and refrigerator. In 2030, the cooling category will consume at approximately 38.653 ktoe. Refrigerator is the highest energy consumption device in this category at approximately 22.205 ktoe(12.54%) in 2030, followed by electric fan and AC at about 16.34ktoe (9.23%) and 0.106 ktoe (0.06%).

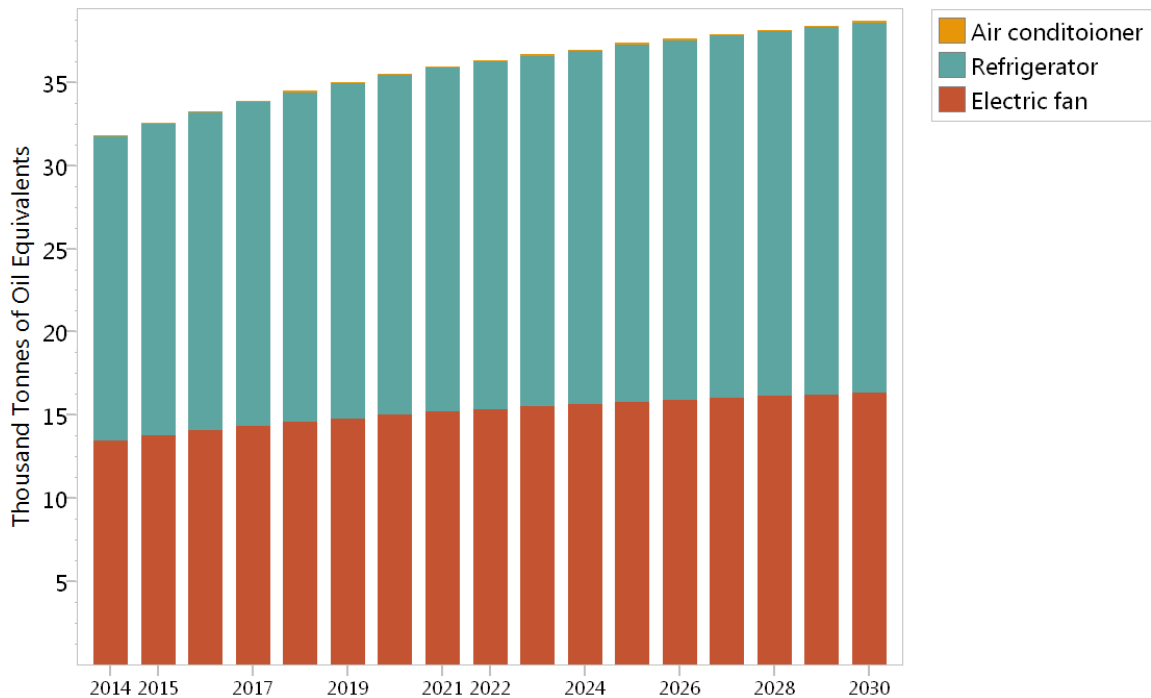


Figure 6: Energy consumption for cooling of MECON group in Myanmar in BAU scenario during 2014-2030

Under the BAU scenario, it is assumed that EE technology accounts for 74.33% of total AC ownerships, 1.08% of total refrigerator ownerships, and 17.15% of total fan ownerships. As a result, EE technology will take AC market share over than refrigerator and fan as shown in Figure 8, 9 and 10. This is because AC consumes higher energy than fan and refrigerator; therefore the producers are mandated to improve their product efficiency to use less energy.

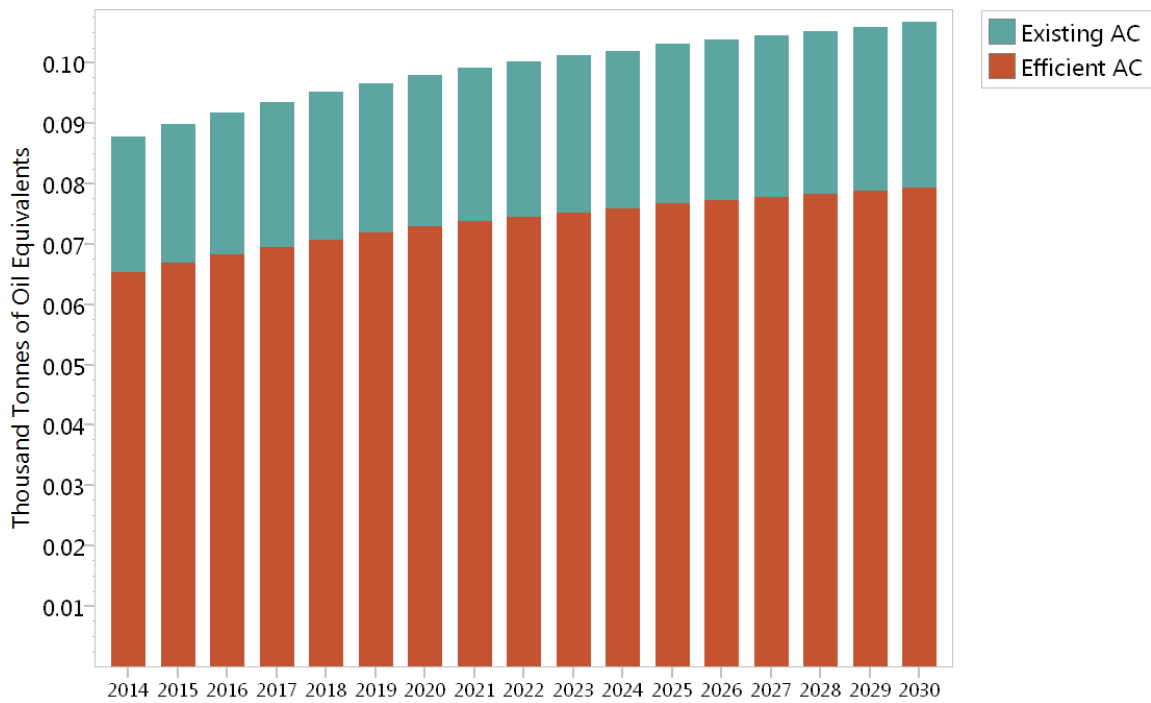


Figure 7: Energy consumption for AC by technology of MECON group in Myanmar in BAU scenario during 2014-2030

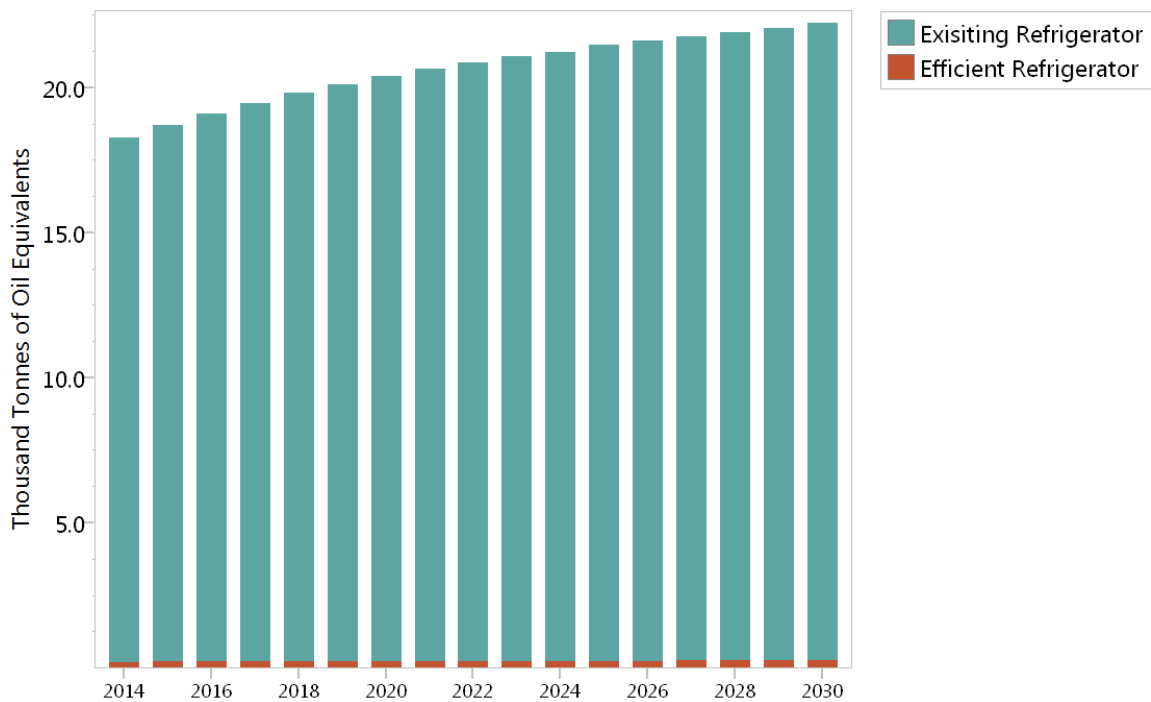


Figure 8: Energy consumption for refrigerator by technology of MECON group in Myanmar in BAU scenario during 2014-2030

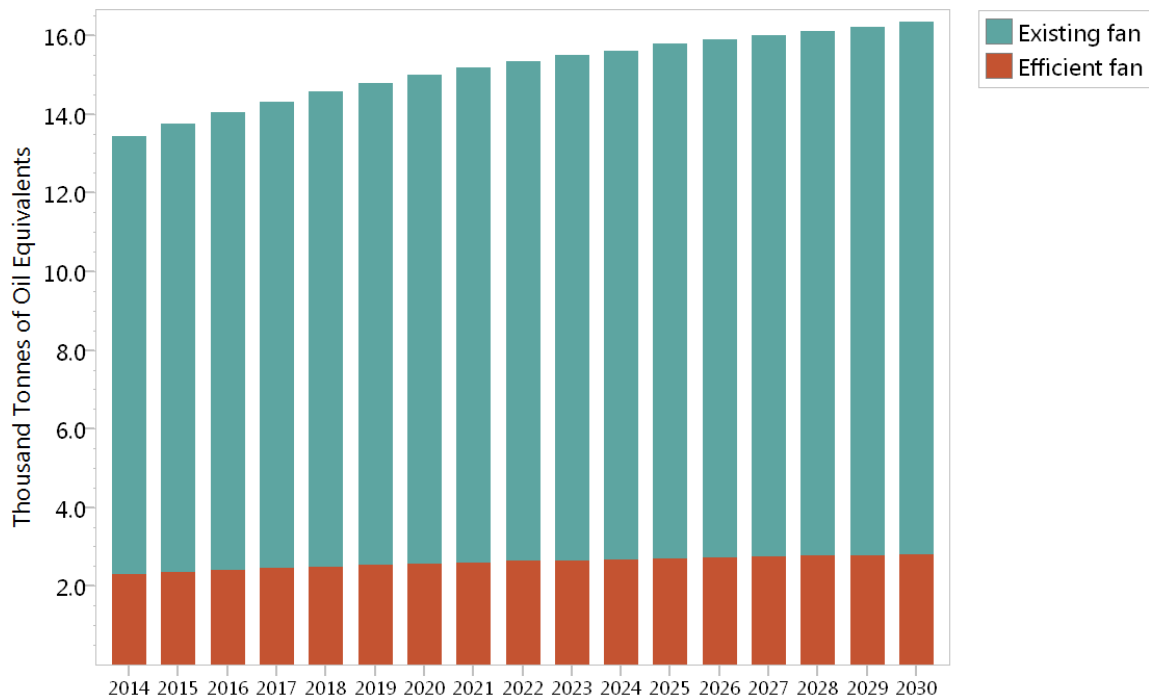


Figure 9: Energy consumption for fan by technology of MECON group in Myanmar in BAU scenario during 2014-2030

5.4 Heating

For heating category, it consists of electric kettle, water heater, solar water heater and electric heater. In Myanmar, there are only two appliances in this category which are electric kettle and water heater because Myanmar does not very cold winter therefore there is no need for electric heater. As a projection, electric kettle and water heater consumes energy at 1.77 ktoe in 2014 and will consume energy at approximately 2.1525 ktoe in 2030. This is because of the increasing of MECON share in Myanmar.

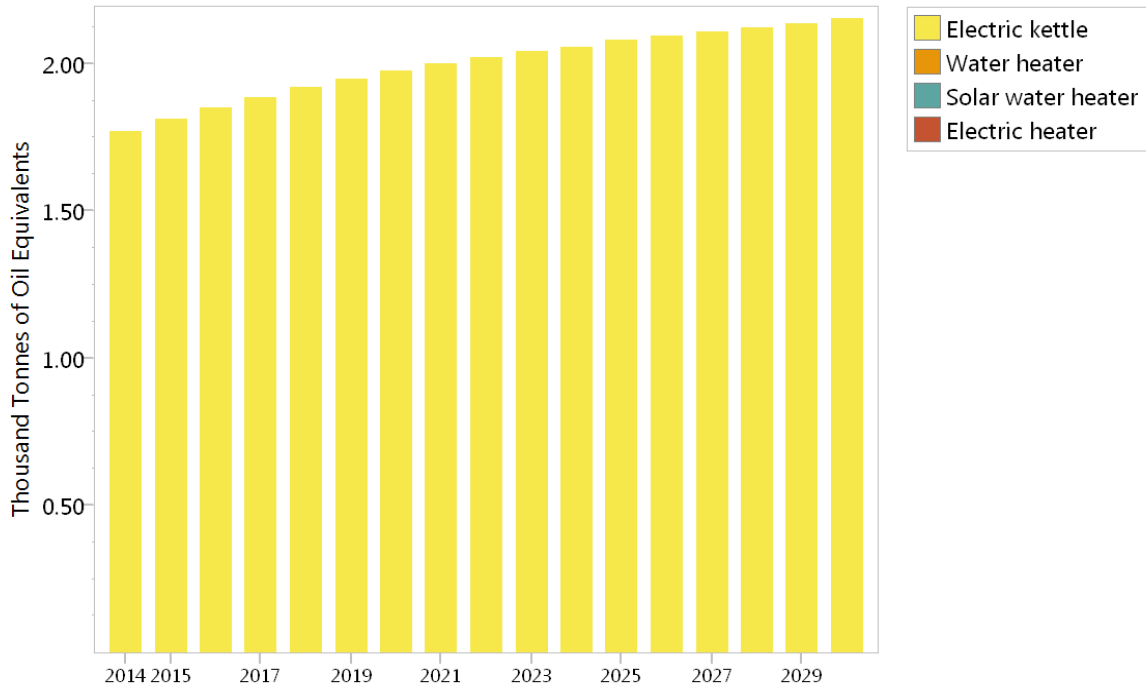


Figure 10: Energy consumption for heating for MECON group in Myanmar in BAU scenario during 2014-2030

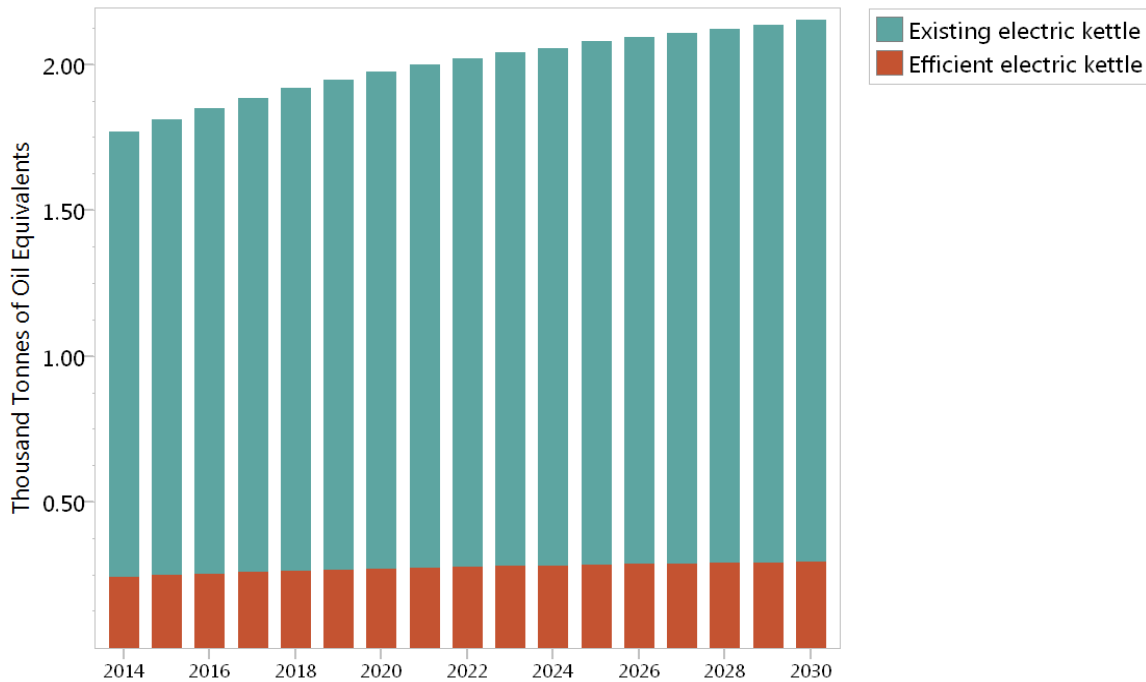


Figure 11: Energy consumption for electric kettle by technology of MECON group in Myanmar in BAU scenario during 2014-2030

It was found that electric kettle and water heater consumes energy 99.97% of total energy consumption by heating category while water heater takes only 0.03%. Electric kettle dominates energy consumption in this category even its wattage is not high as water heater but the percentage of household owning water heater is less than electric kettle as shown in Table 4. Moreover, Myanmar is tropical country and this specific MECON household is not likely to afford the water heater in the daily life.

According to BAU scenario, it is assumed that 86.23% of MECON households own the conventional technology of electric kettle, while the conventional technology of water heater takes 100% of total water heater ownership. As a result, energy consumption for non-energy efficient technology dominates energy consumption in this category.

5.5 Entertainment

For entertainment category, it consumes energy 14.79 ktoe in 2014 and will increase to 17.97 ktoe in 2030. In this category, TV is the highest energy consumer at approximately 15.93 ktoe in 2030 or 88.65% of total energy consumption by entertainment category. It was found that even though there is LED technology in the market in the present, but it is still expensive for low income household. It was found that there are only two technologies that are used in low income household which are CRT and LCD technologies.

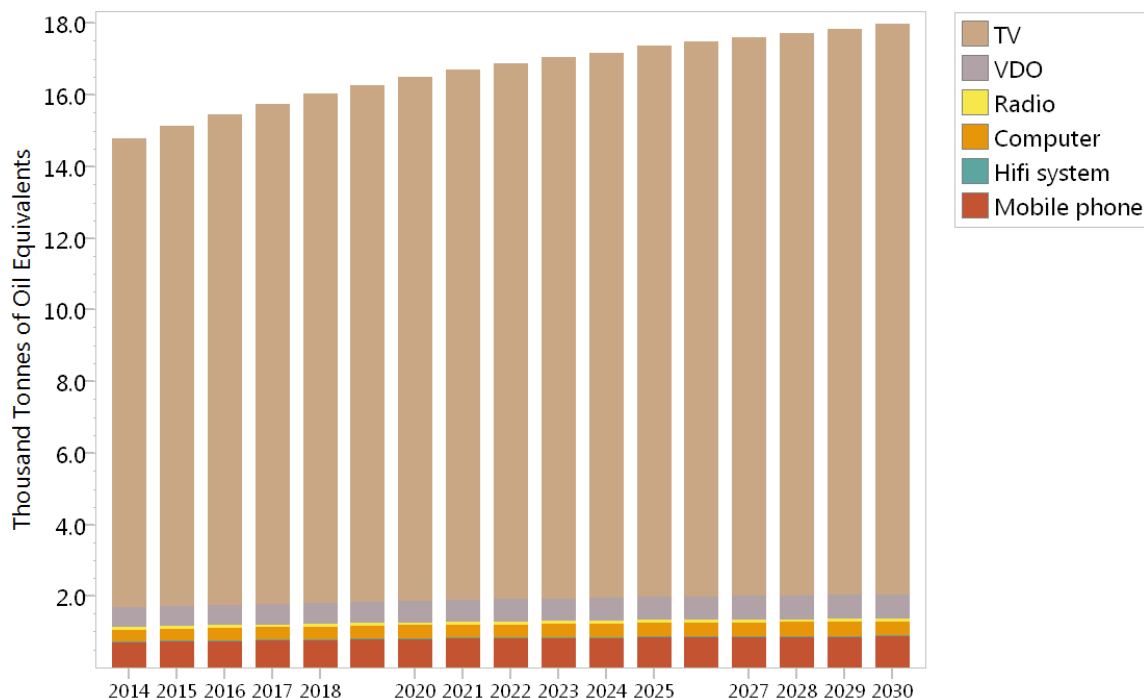


Figure 12: Energy consumption for entertainment of MECON group in Myanmar in BAU scenario during 2014-2030

As can be seen in Figure 14, CRT still takes market share greater than LCD and LED technology under BAU scenario. The assumption for conventional technology is 68.68% of total TV ownership in MECON households. However, this trend is likely to change according to new technology in the market. There will be higher share of LCD and LED in the future for new policy scenario for this target group.

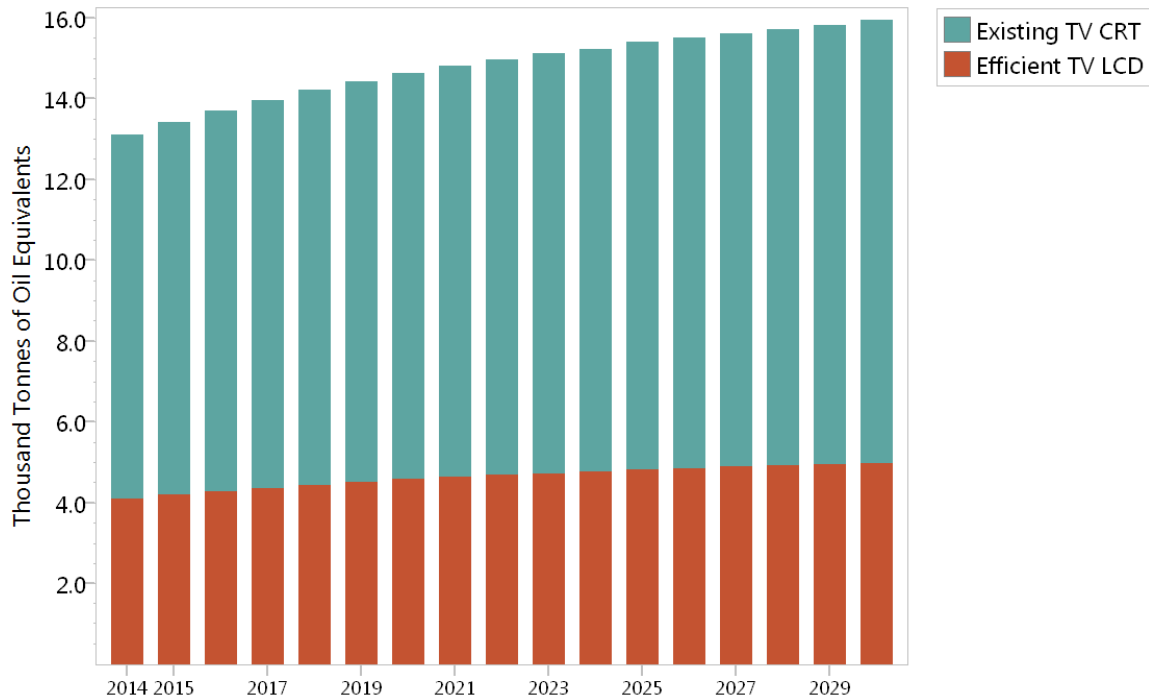


Figure 13: Energy consumption for TV by technology of MECON group in Myanmar in BAU scenario during 2014-2030

5.6 Cleaning

There are two major devices in this group which are washing machine and vacuum cleaner. However, the percent share of washing machine is higher than the vacuum cleaner because of its price compared to other devices. The percent share of ownership of washing machine takes accounts at approximately 99.99%. Comparing to other categories as mentioned earlier, this group consumes the least energy. This is because the MECON households in Myanmar do not own vacuum cleaner much.

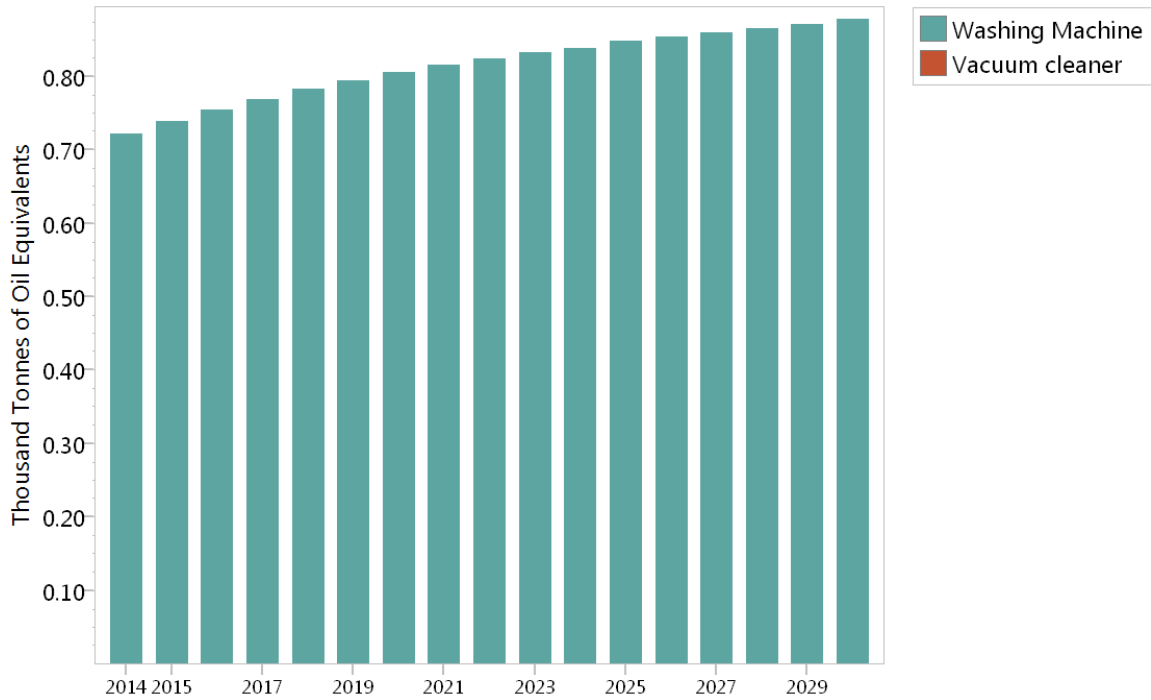


Figure 14: Energy consumption for cleaning of MECON group in Myanmar in BAU scenario during 2014-2030

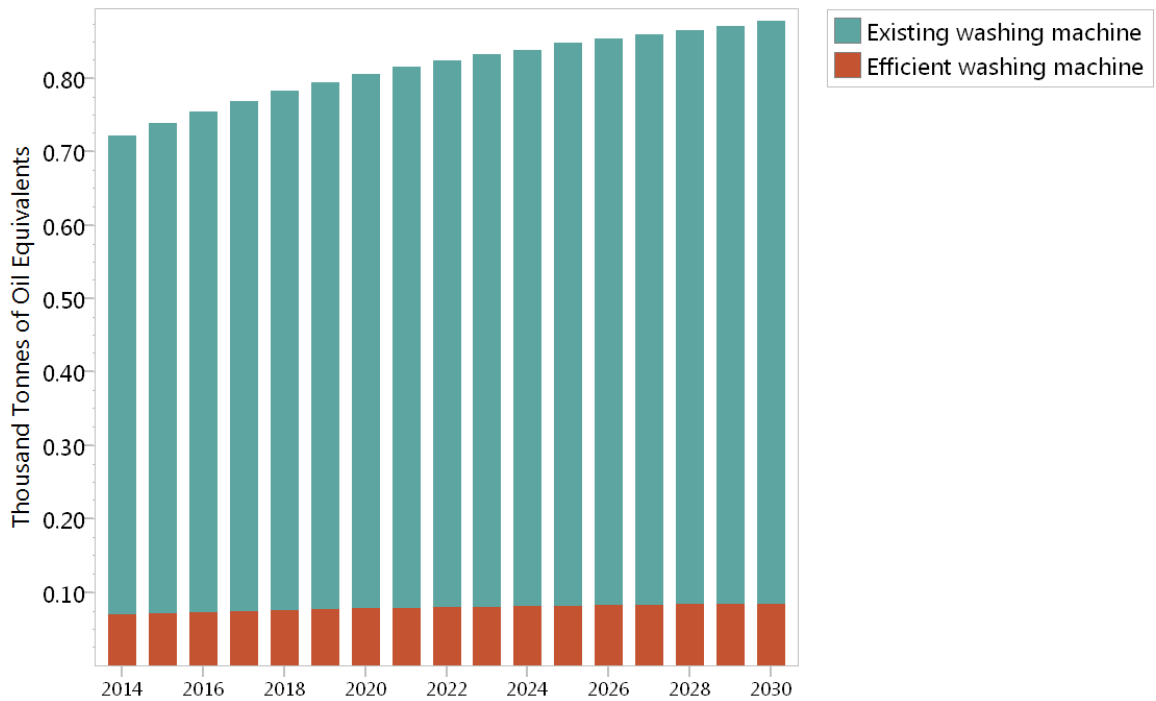


Figure 15: Energy consumption for washing machine by technology of MECON group in Myanmar in BAU scenario during 2014-2030

As a result, washing machine dominates energy consumption in this category. In 2014, it consumes around 0.722ktoe and it will increase to 0.877 ktoe in 2030.

Under the BAU scenario, traditional technology of washing machine is assumed to dominate the market share of MECON household at approximately 90.37%. As a result, the energy consumption of conventional technology is higher than the energy efficient one.

5.7 Others

For those appliances that are not in the earlier categories as mentioned above, there will be in others categories which are water pump and electric iron. In 2014, it was found that these electric appliance consumed at approximately 18.372 ktoe which electric iron dominate energy consumption in this category at approximately 99.97% of total energy consumption by others category. In 2030, this category is expected to consume energy at approximately 22.31ktoe.

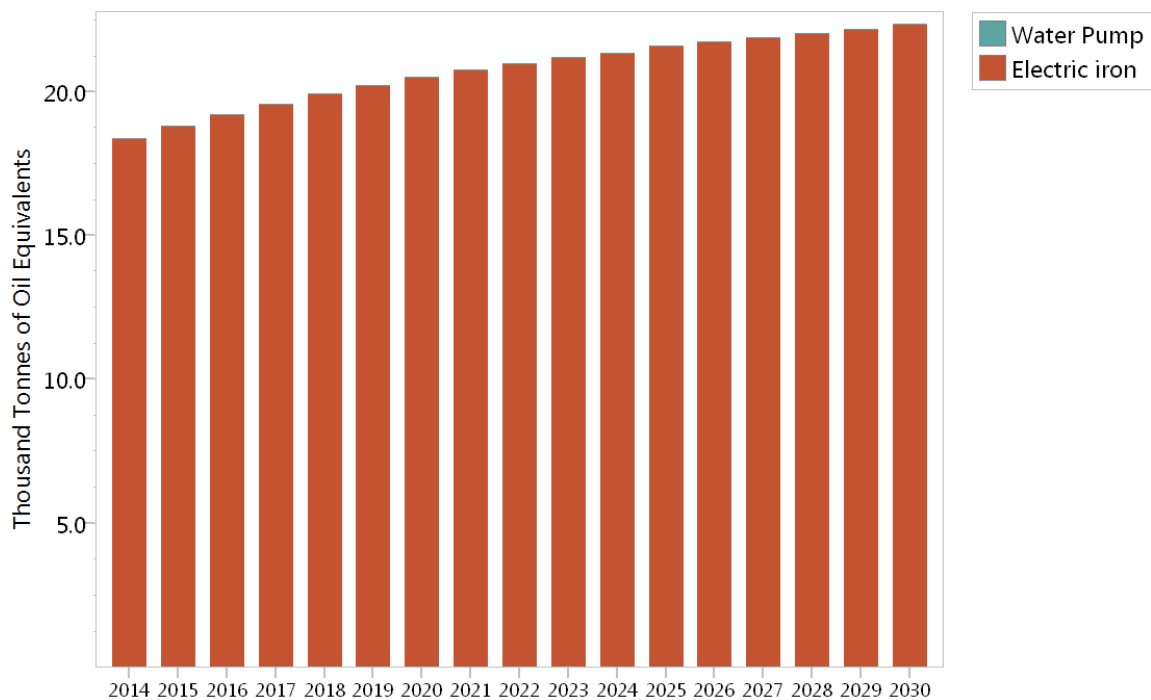


Figure 16: Energy consumption for other category of MECON group in Myanmar in BAU scenario during 2014-2030

Under the BAU scenario, both electric iron and water pump are conventional technology. As a result, there is no energy efficient technology in this category.

6. Conclusion

MECON households in Myanmar have common electric appliance such as fan, rice cooker, TV, lighting and refrigerator. This is because MECON households in Myanmar can access to electricity almost 90%. It is found that daily electric devices dominate energy consumption in household such as fan, rice cooker, TV and lighting. This is because it is common used and most of household own these appliances. Although, their power are not high comparing to large electric device e.g. AC, refrigerator, washing machine but the frequency of use and the share of ownership are higher than the big appliance with higher capacity e.g. AC and washing machine.

According to the projection, the percent share of Myanmar’s MECON population is expected to increase from 43.89% in 2013 to 48.70% in 2030. As a result, the total final energy consumption for MECON household will be increase at approximately 1.22% per annum under BAU scenario.

Under the BAU scenario, the owning rates of all household appliances remain constant while only the share percentage of MECON households and the total population are altered from year 2013 to 2030. However, this target group is expected to have more income in the future, and they will purchase more modern appliances in order to provide more comfortable and reduce electricity bill such as AC, vacuum cleaner, lighting, TV, washing machine. This expectation would affect to energy consumption in the future because MECON household will transfer as medium income group and they will consume more energy. In Task 5 of the MECON project, we will use alternative scenarios to foresee the changes that may take place if the owning rates of some appliances are changed, and if some measures would have been implemented.

Key finding for this target group is common devices that usually use in daily such as rice cooker and fan and lighting. It was found that these devices consume higher energy than those large appliances such as AC, refrigerator, washing machine. This is because, although having lower wattage, these small devices are commonly owned by almost all surveyed households as opposed to AC which is rarely found in these households. Moreover, each household uses these small appliances for several hours per day while they only use washing machine for a few hours per week.

On the owning trend of household appliances, modern entertainment devices such as LCD and LCD television are expected to be more common among these households. Moreover, cooking device such as LPG cooking stove and rice cooking, stoves and microwave oven are likely to be used in rural area as well as in urban area in Myanmar.

Alternative scenarios for energy consumption in MECON household will be addressed in order to analyze how low income household can shift from non-efficient products to efficient product in the future and what appliances should be taken in to consideration. This will result in energy consumption in the household as a whole picture when compared to BAU scenario.