POLICY BRIEF

Institute of Energy Policy and Research

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The Impact of COVID-19 on Electricity Consumption in the Residential Sector: A Shift Towards Energy Saving Appliance Usage

EXECUTIVE SUMMARY

The implementation of Movement Control Order (MCO) due to the COVID-19 pandemic has influenced household energy consumption patterns around the world. By employing a household online survey and statistical analyses, this study investigated the impact of MCO on the consumption patterns of electrical appliances used in the residential sector and the shift towards energy-saving appliances. This paper delivers findings on the change in the Household Electrical Appliance Consumption Level (HEACL) in Malaysia before, during and after the Movement Control Order from 18 March to 9 June 2020.

The consumption pattern was evaluated based on the hour and frequency of use of 29 household electrical appliances. The appliances are segmented under (i) Home and Living Appliances (4), (ii) Cleaning and Getting Ready Appliances (5), (iii) Entertainment, Office and Personal Use Appliances (8) and (iv) Kitchen Appliances (12). Energy behaviours and energy star labeled (EESL) appliances inquiries are also included in the survey to provide insights into energy efficient behaviours. About 1482 survey samples across the geographic regions in Malaysia was analyzed.

The result yields significant increase in HEACL during and after MCO. The result also implies that energy wasting habits are proved hard to shift across the middle- and high-income households. The findings presented herein focusing on Malaysia with COVID-19 pandemic, which provides insights for Malaysian policymakers in developing future action plans for longer MCO or new waves of an outbreak.

KEY FINDINGS

- The HEACL was significantly higher after-the-MCO compared to before-the-MCO which implied that the respondents were deeply acclimated to the HEACL during the MCO.
- The reduced consumption level of the getting ready appliances such as clothes irons during-the-MCO continued after the MCO, resulting in lower consumption levels even after-the-MCO compared to before the MCO.
- The introduced reliefs and initiatives to mitigate the increase in household electric bills by the Government and Tenaga Nasional Berhad did little to inspire energy-saving behaviours.
- The B40, M40 and T20 reacted differently to energy behaviours measured in Purchasing Behaviour (PB), Money Saving (MS), Social Context (SC) and Environmental Conscience (EC). The results showed that EESL appreciation strongly influenced the energy behaviours of the B40. However, the EESL's appreciation did not influence the energy behaviours of the M40 and T20 as much as the B40 respondents.

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The Impact of Movement Control Order on Household Electrical Appliances Consumption Levels (HEACL)

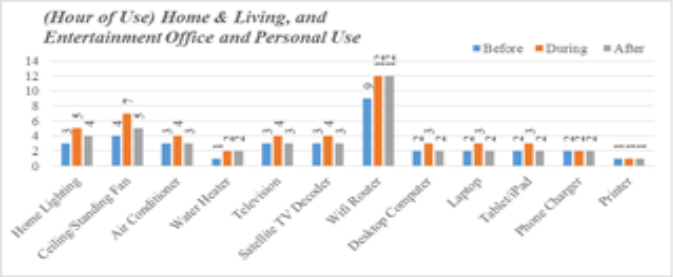

Figure 1 Home & Living, and Entertainment Office and Personal Use (Hour of Use)

The main impact on home & living appliances is the significant increase of hourly use of almost 12 appliances a day, especially of WI-FI routers, fans and lighting during the MCO period. While most of the home and living appliances usage reduced to the before MCO period, it is interesting to observe that the WI-FI router hours of use did not return to before the MCO levels but continued the same during the MCO instead. It seems that the pandemic led to a surge in the longer term use of the internet for working and studying from home due to the social distancing norms. The same pattern of hourly usage indicated no change for phone chargers and printers.

Figure 2 Cleaning and getting Ready (Frequency of Use)

The results of the Cleaning and Getting Ready appliances suggests a considerable increase in the frequency of use of washing machines and dryers as a consequence of MCO, but the frequency returned to its normal figure after MCO. As expected, the clothes iron usage reduced during MCO but showed a partial surge in frequency of use after the MCO. Both vacuum cleaners and hairdryers usage was unchanged over the different periods.

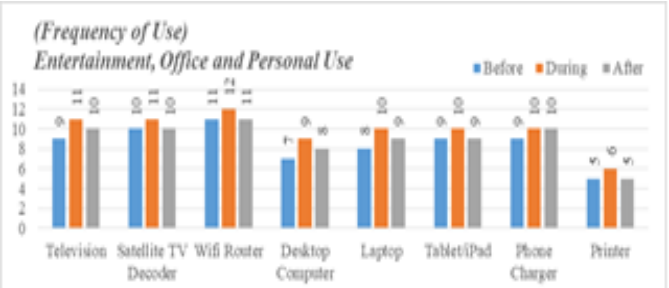

Figure 3 Entertainment, Office, and Personal Use (Frequency of Use)

The main impact of the Entertainment, Office and Personal Use appliances suggests an increase in the frequency of use of all appliances. However, the trend seems to have returned to the level before the MCO, albeit a slightly higher frequency for televisions, desktop computers and laptops after the MCO. The limited outdoor activities after the MCO led to an increase in home entertainment options.

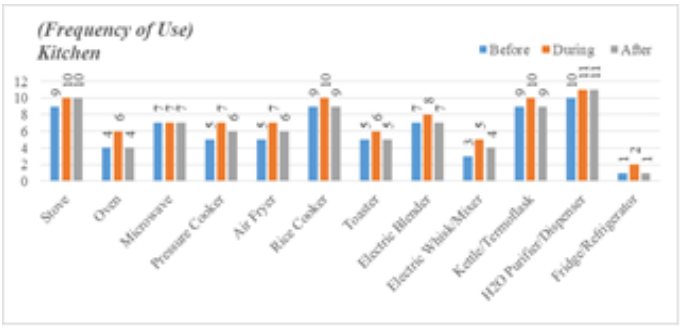

Figure 4 Kitchen appliances (Frequency of Use)

The demand for the local foodservice market and eating outdoors is thriving in Malaysia in tandem with increasing household incomes and sophisticated lifestyles (Ali & Abdullah, 2012). The main impact on Kitchen appliances was the significant increase in frequency of use of all appliances daily, except for microwaves which showed similar trends during the 3 periods of the study. It is also observed that the frequency of use of stoves and purifiers did not return to pre MCO levels but stayed the same during MCO perhaps due to the limited availability of eating outdoors activities which led to more frequent usage of household kitchen appliances as an alternative.

These findings revealed that the consumption levels of appliances were significantly greater during-the-MCO compared to before and after the MCO. The pattern is consistent across almost all electrical appliances. Exceptions were observed in the consumption level of the getting ready appliances ie clothes irons.

The findings concerning the HEACL were significantly higher after-the-MCO compared to before-the-MCO and this is revealed in several ways. First, the output implied that the respondents were deeply acclimated to the HEACL during the MCO, resulting in lower consumption levels after-the-MCO compared to before the MCO.

Secondly, the introduced reliefs and initiatives to mitigate the increase in household electric bills by the Government and Tenaga Nasional Berhad did little to inspire energy saving behaviours. The HEACL was evidenced only to increase during-the-MCO and the consumption pattern continued after-the-MCO was lifted. Perhaps the reliefs and initiatives only encouraged, if not enabled energy wasting habits to become more apparent.

The Impact of Energy Efficient Star Labelling (EESL) behaviors across B40, M40 and T20 Households

This study investigated the effect of EESL appreciation on energy behaviours across the B40, M40 and T20 households. As EESL appliances tend to be higher priced than appliances without the EESL, households with higher incomes should have a stronger influence of EESL energy behaviours.

EESL appreciation is measured through binary questions regarding familiarity, understanding, availability and the purchasing priority of Energy-Star appliances at home. The respondents' answer No, to questions was valued at 0; Yes, was valued at 1, for a series of questions relating to EESL. Table 1 shows the frequency of respondents who answered Yes or No to each of the EESL Appreciation questions.

The energy behaviours are calculated through a series of socio-psychological statements measured on a Likert scale from 1 (strongly disagree) to 7 (strongly agree). The socio-psychological statements pertain to purchasing behaviour (PB), money saving factors (MS), social context (SC) and environmental conscience (EC) questions (refer to Appendix 1).

The findings suggest that B40, M40 and T20 reacted differently to energy behaviours measured in PB, MS, SC and EC. Surprisingly, the results showed that EESL appreciation strongly influenced energy behaviours of the B40. However, EESL appreciation did not influence energy behaviours of the M40 and T20 as much as the B40 respondents.

Table 2 shows the impact of EESL behaviours in colour scale. The colour codes indicate the most significant difference in green, the less significant difference in yellow and insignificant difference in red. The second colour tabulation summarizes which of the seven (7) EESL appreciations caused the greater level of PB, MS, SC and EC across B40, M40 and T20.

The effect of energy-efficient awareness, represented by the EESL appreciation of energy behaviours, represented by PB, MS, SC and EC; were least observed among higher-income respondents. The findings aligned with the claim that Malaysians' energy-saving behaviours are caused by cost savings and financial backgrounds rather than environmental concerns.

Table 1 EESL Appreciation

	Questions on Energy Efficiency Star Labelling	No		Yes	
		Freq	%	Freq	%
Q1	Have you ever seen the above Energy Efficiency Label?	83	6	1399	94
Q2	Do you have appliances at home with the Energy Efficiency Label?	126	9	1356	91
Q3	Did you understand the purpose of the Energy Efficiency Label?	263	18	1219	82
Q4	Did you search for the above label when purchasing electrical appliances?	334	23	1148	77
Q5	Did you prioritize the above label when purchasing electrical appliances?	322	22	1160	78
Q6	If you knew and fully understood the purpose of the Energy Efficiency Label, would you purchase appliances with Energy Efficiency Label in the future?	100	7	1382	93
Q7	Would you purchase electrical appliances with the most star rating even if they cost much greater than the alternatives?	297	20	1185	80

Table 2 Colour Scale Summarizing EESL Appreciation on Energy Behaviours by Level of Income

	B40				M40				T20			
	PB	MS	SC	EC	PB	MS	SC	EC	PB	MS	SC	EC
Q1	-3.29 ✓	-2.90 ✓	-2.74 ✓	-2.33 ✓	-0.07 ✗	-0.25 ✗	-0.62 ✗	-1.67 ✗	-1.59 ✗	-1.07 ✗	-1.31 ✗	-1.50 ✗
Q2	-5.36 ✓	-4.63 ✓	-3.78 ✓	-4.18 ✓	-1.68 ✗	-0.37 ✗	-0.47 ✗	-1.39 ✗	-0.47 ✗	-0.85 ✗	-0.21 ✗	-0.15 ✗
Q3	-5.86 ✓	-3.85 ✓	-4.08 ✓	-2.61 ✓	-3.24 ✓	-1.81 ✗	-2.16 ✓	-1.39 ✗	-2.38 ✓	-1.41 ✗	-0.77 ✗	-0.74 ✗
Q4	-9.13 ✓	-7.32 ✓	-6.79 ✓	-5.32 ✓	-6.87 ✓	-4.61 ✓	-3.92 ✓	-2.12 ✓	-2.50 ✓	-1.19 ✗	-1.06 ✗	-0.35 ✗
Q5	-9.58 ✓	-6.64 ✓	-6.76 ✓	-4.49 ✓	-6.48 ✓	-4.80 ✓	-2.60 ✓	-3.33 ✓	-2.31 ✓	-1.34 ✗	-0.11 ✗	-1.59 ✗
Q6	-5.16 ✓	-4.64 ✓	-3.47 ✓	-4.90 ✓	-1.30 ✗	-1.23 ✗	-0.26 ✗	-1.16 ✗	-0.96 ✗	-2.38 ✓	-0.53 ✗	-2.14 ✓
Q7	-7.07 ✓	-4.15 ✓	-5.24 ✓	-5.31 ✓	-4.30 ✓	-2.63 ✓	-2.10 ✓	-0.32 ✗	-2.92 ✓	-2.31 ✓	-1.40 ✗	-1.85 ✗

Note. ✓ indicate significant difference ($p < .05$; $z > \pm 1.96$), ✗ indicate insignificant difference ($p > .05$; $z < \pm 1.96$)

EESL Appreciation (Yes)	B40				M40				T20			
	PB	MS	SC	EC	PB	MS	SC	EC	PB	MS	SC	EC
1. Familiar with EESL appliances	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗
2. Have the EESL appliances at home	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗
3. Understood the meaning of EESL	✓	✓	✓	✓	✓	✗	✓	✗	✓	✗	✗	✗
4. Searched for EESL during purchase	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
5. Prioritize EESL when purchasing appliances	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
6. Would purchase if understood the EESL in the future	✓	✓	✓	✓	✗	✗	✗	✗	✗	✓	✗	✓
7. Would prioritize most energy stars even if cost more	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✗	✗

Note. ✓ indicate PB/MC/EC/EC is greater for those who claimed Yes, ✗ indicates equal between Yes and No

POLICY IMPLICATIONS

The study verifies that there was an inevitable increase in household electricity consumption, mainly related to the more prolonged use of electrical appliances, during the MCO. Based on the findings, the following policies would help to alleviate the increase in energy consumption and stimulate energy efficiency improvements in Malaysia for longer MCOs or new waves of an outbreak:

(1) **Continuous Improvement to Minimum Energy Performance Standard (MEPS) appliances in the market.** Introducing more 5-star rated appliances in the market would lead to a positive new normal to widespread efficiency improvement in Malaysia. The conventional products in the market should be aggressively phased out and replaced with energy-efficient products.

(2) **Financial policies supporting energy efficiency through e-commerce.** To introduce more stimulus programs such as SAVE 2.0 program for buying energy-efficient appliances through an e-commerce platform. Stimulus plans for efficient appliances purchased online will realise substantial energy reductions, especially for the M40 and T20 consumers, (being the highest online consumers) and increase their awareness of energy-efficient products in Malaysia.

(3) **Role of industry, regulators and NGO in promoting energy saving.** A targeted campaign directed at household residents should be provided with energy conservation guides to conserve energy and save money at home through online advertisements, smartphone apps and social media. This would encourage and motivate households to participate in energy conservation and monitor their consumption levels when most people are quarantined at home during the time of the pandemic.

(4) **Increase consumer understanding (consumer education).** Well-designed energy efficiency labels that can reduce the complexity of information would aid consumer understanding, regardless of their level of educational background, and encourage the purchasing of good quality energy rating products. Besides consumers, other related personnel such as retail staff, contractors, and maintenance/service personnel should also understand the benefits of efficient products. It is also important that the standards and labelling be periodically revised to continue to improve energy efficiency and energy-saving behaviours.

(5) **Technology driven efficient consumption.** The wide implementation of smart meters allows for a comprehensive and flexible approach to facilitating household learning and decisions to increase environmental actions aimed at energy efficiency thus enabling households to self-manage their energy consumption and become more energy efficient. This could also be aided by complementary services or products. Smart metering enables consumer benefits through demand response and consumption feedback services, which are recognized as highly appropriate and beneficial, especially for B40.

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FURTHER INFORMATION

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APPENDIX 1

Table A1 Energy Behaviours (socio-psychological statement)

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither/ Undecided	Slightly Agree	Moderately Agree	Strongly Agree

Self-Reported Statements	$\bar{x}$	std	FL
PB: PURCHASE BEHAVIOUR *(concern on efficiency before purchasing)*	**5.80**	**1.373**	**-**
I am concerned with the efficiency of the electrical appliances I purchase	6.04	1.476	.790
I look for Energy Efficiency Star Labels every time I purchase electrical appliances	5.88	1.546	.882
I find ways to replace old electrical appliances with new and energy efficient ones	5.70	1.594	.853
Even if they cost more than conventional products, I would still purchase energy efficient products	5.60	1.569	.889
I think about my electric bills every time I purchase electronics appliances.	5.79	1.614	.739
MS: MONEY SAVING FACTORS *(concern on energy prices)*	**6.14**	**1.185**	**-**
Energy price influence my energy saving behaviour	6.02	1.438	.692
Saving energy at home helps me save money	6.32	1.217	.797
The cost of energy makes me want to conserve	6.17	1.297	.928
I worry that the cost of energy for my home will increase	6.28	1.256	.946
I worry whether there is enough money to pay my energy bill	5.99	1.494	.832
I always look for ways to reduce my electric consumption to save money	6.14	1.342	.815
The 6 months TNB energy discount encourage me to conserve more and get the best out of the discount	6.08	1.451	.689
SC: SOCIAL CONTEXT *(concerns encouraged by social context)*	**5.46**	**1.341**	**-**
I save energy under the influence of others around me	5.17	1.898	.453
I prompt friends and family members to save energy at home	5.99	1.397	.435
I motivate my neighbours to save energy at their homes	5.09	1.741	.917
I encourage my colleagues to save energy at workplace	5.40	1.667	.883
My friends and family members are enthusiastic to save energy at home	5.59	1.484	.821
My neighbours are eager to save energy at their homes	5.25	1.611	.956
My colleagues at work are positive about energy-saving behaviours	5.48	1.540	.933
The company I work for urge the employers to save energy at workplace	5.74	1.517	.707
EC: ENVIRONMENTAL CONSCIENCE *(concerns raised by awareness)*	**6.25**	**1.176**	**-**
Saving energy at home plays important part in protecting the environment	6.29	1.306	.927
If I carry out some energy saving actions, I'd contribute a lot to the environment	6.28	1.263	.913
Global Warming is a result of high energy use	6.23	1.330	.943
Global climate change has significant negative impact on the environment that my family and I live in	6.25	1.295	.887
Malaysians need more education & exposure on household energy-saving	6.38	1.210	.910
Malaysians need to be forced through strict governmental regulations on saving energy at home	6.06	1.399	.740
More energy security protection works are needed in Malaysia	6.25	1.240	.868

Note. FL refers to Factor Loadings