

Sustainable and Resilient Energy Management Program

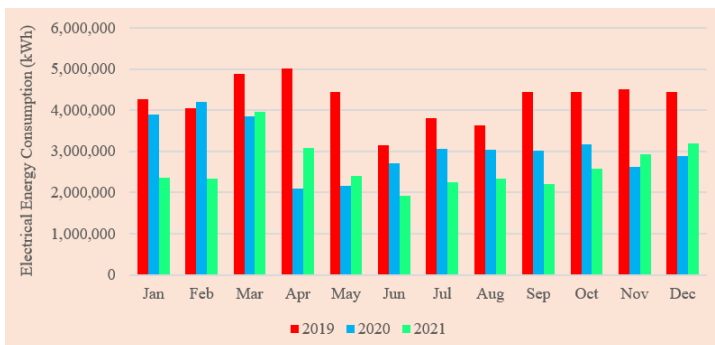
Since 2011, UTM energy management initiative has evolved into the *Sustainable and Resilient Energy Management Program (SREMP)* that considers aspects of policy, managerial, capacity building as well as technical measures. UTM SREMP is driven by the top management under the office of Deputy Vice Chancellor of Development. The UTM energy management policy inclusively covers UTM community and leverages on its extensive research capacity to develop innovative energy management solutions, to disseminate technology and to implement energy conservation measures that build resilience through the use of 4IR-driven technology to overcome crisis such COVID19 and to sustain energy efficiency practices as well as cost savings.

Sustainable energy management practices have become a culture within UTM campus. Table 1 shows the reducing trend of UTM electricity from 2015 to 2021. Between year 2016 and 2017, UTM went through a major retrofit phase where UTM invested on many new energy-efficient equipment (air conditioner retrofit into VRF, WCPU and split unit system) totaling RM3 million, and another RM 2.5 million for energy saving initiatives for 2019 - 2021.

Taking 2015 as the baseline (pre-retrofit), under UTM Smart and Resilient Energy Management Programmed (SREMP), several energy-saving initiatives have been implemented (see **Figure 4**) and it has successfully reduced the electricity consumption (kWh) by 11% in 2019. During the Covid-19 pandemic crisis, energy bills were expected to be low as compared to 2019. The continuous implementation of energy-saving initiatives and activities has shown further (kWh) reduction by 47% in 2021 when compared to 2015 and a total of 6 million kWh (17%) in 2021 as compared to 2020.

Year	kWh	% Saving in kWh	RM	% Saving in RM
2015	57,546,794	-	24,812,697	Baseline
2019	51,056,866	-11%	20,662,462	-17%
2020	36,720,792	-36%	14,474,360	-42%
2021	30,658,388	-47%	11,181,887	-55%

Table 1. Energy Saving 2019-2021



2021

Figure 2. Energy Reduction (kWh) 2019-2021

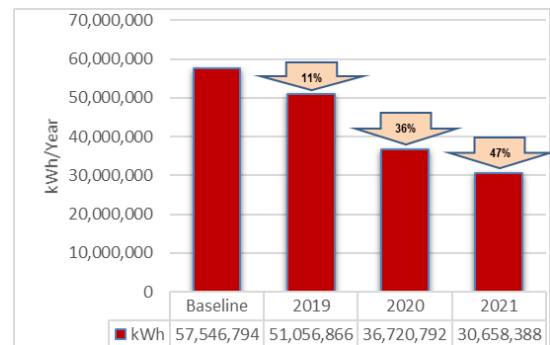


Figure 1. UTM Monthly Energy Consumption 2019-

7.2.3 Carbon Emission

CO₂ Reduction:

The electricity mix in Malaysia comes from a mix between natural gas, coal and hydro power. Using a conversion of 0.585kgCO₂/kWh from CDM grid electricity emission factors, Table 2 shows the carbon emission for 2019 to 2021. UTM has reduced its carbon emission by 8,639.55 ton CO₂ since the implementation of SREMP.

Year	kWh	CO ₂ Emission (kg CO ₂ /kWh)	CO ₂ Reduction (kg CO ₂ /kWh)
2019	51,056,866	29,868,267	-
2020	36,720,792	21,481,663	8,386,603
2021	30,658,388	17,935,157	3,546,506
Total CO₂ Reduction			11,933,109

Table 2. Carbon Emission 2019-2021

7.2.4 Short and Long-term Plan

Initiatives on SREMP that have been implemented:

1. Implementation of Energy Initiatives as Master Plan are registered in the UTM enVision 2022 - 2025 under the Strategic Planning Department of Asset and Development (JHB) as shown in Figure 17.
2. Implementation of appropriate measures to reduce energy consumption through change of behavior, improved housekeeping practices, maintenance, operation and purchasing for new and existing buildings or equipment (see Figure 18).
3. Set a minimum 4-star rating requirement for each purchase of electrical equipment within UTM's procurement procedure.
4. New upgrading, renovation and maintenance works shall comply with MS1525.
5. Organize in-house training for the UTM community by UTM's internal resource expertise among lecturers and researchers.
6. Develop an integrated billing system for utility (energy and water) to replace UTM Electrical Billing Management System (EBMS).
7. Collaboration with Deputy Vice Chancellor of Research and Innovation to provide research grants to UTM researchers to come up with translational research projects that can innovate new energy savings initiatives in UTM.
8. Promote the best practices in SREMP locally and internationally through UTM Energy Showcase, workshops, short courses, seminars and webinars.



Figure 3. UTM enVision 2022-2025

	Project/Initiative	Start	Finish	Target Saving (kWh)	Investment (RM)	Saving		Payback Period (Year)
						(kWh)	(RM)	
2019								
1	Replacement of chiller at BCSI	Aug-19	Mac 2020	800,000	1,000,000	350,000	140,000	7
2	Retrofitting of lighting system T8/T5 to LED	Jan-19	Dec-19	270,000	282,001	284,309	98,087	3
3	Energy Audit on Electrical Installation	Mar-19	Sep-19	-	-	-	-	-
4	Load factor monitoring (OPTR discount)	Jan-19	Dec-19	14,000,000	-	13,786,481	951,267	-
5	Replacement of air conditioning system at block T02	Dec-19	Mar-20	200,000	189,400	230,003	79,351	2
2020								
1	Purchasing of Power Quality Analyzer & replacement of digital kWh meter	Jan-20	Mar-20	-	144,500	-	-	-
2	Replacement of air conditioning at D07 Phase 1	Aug-19	Feb-21	1,000,000	1,347,330	753,000	301,200	4
3	Replacement of air conditioning at PSZ & DSI	Dec-20	Jun-21	1,300,000	3,000,000	1,200,000	480,000	6
4	Behavioural Change Program	Jun-20	Oct-20	30,000	9,000	-	-	-
5	Load factor monitoring (OPTR discount)	Jan-19	Dec-19	14,000,000	-	7,721,923	553,737	-
6	Automation building at lecture halls	Oct-20	Apr-22	10%	810,606	-	-	-
7	Installation of analog kWh meter at student	Oct-20	Mac 21	-	295,774	-	-	-
8	Retrofitting of lighting system T8/T5 to LED	Jan-20	Dec-20	141,000	132,099	141,855	48,940	3
9	Energy Management Course & Internal Training	Aug-20	Dec-20	-	7,658	-	-	-
2021								
1	Behavioural Change Program	Jan-21	Dec-21	30,000	20,000	-	-	-
2	Retrofitting of lighting system T8/T5 to LED	Jan-21	Dec-21	170,000	150,000	128,000	50,000	2
3	Load factor monitoring (OPTR discount)	Jan-21	Dec-21	12,000,000	-	10,000,000	555,000	-
4	Replacement of digital meters at academic/admin	Aug-21	Dec-21	-	250,000	-	-	-

Figure 4. Energy Initiatives Plan 2019-2021

7.2.5 Energy Wastage Identification

Starting from 2016, UTM went through a major retrofit phase and invested in new energy efficient VRF air-conditioning, WCPU and split unit systems. The impact on energy saving can be clearly seen by comparing the 2019 with the pre-retrofit in 2015 as the baseline. Between 2018 to 2020, UTM invested in UTM Translational Research Grant and High Impact Research Grant for its researchers to come up with various smart and innovative energy technologies that were installed within UTM premises under UTM Living Lab Programmed. UTM also underwent The UTM Synergy 4.0 major restructuring in 2018 that saw 18 Faculties merged into 7 Faculties, and a revamp of the UTM Energy Management Team. Many new energy managers were appointed, capacity building programmer organized and new innovative initiatives undertaken. The Covid-19 crisis started in 2020 and energy bills were expected to be low as compared to 2019. However, UTM intensified its productivity through new online initiatives such as teaching and learning, workshops and conferences involving international stakeholders. The effort of UTM Smart and Resilient Energy Management programmed (SREMP) shows further electricity reductions and exceeds UTM annual targeted energy reduction of 10%. UTM has realized BEI (Building Energy Intensity) reduction of 16.5% in the year 2021 when compared to 2020 or a savings of 20 million kWh (RM9 million) as compared to 2019.

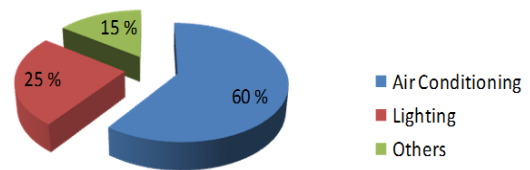


Figure 5. Energy Consumption Ratio

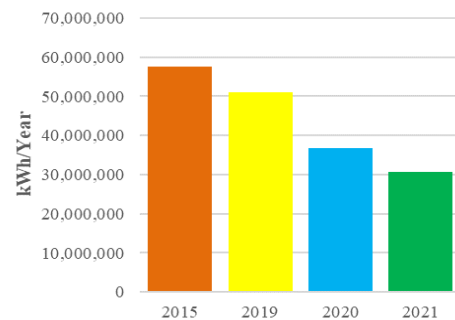


Figure 6. Electrical Energy Consumption 2015 - 2021

7.3 Energy Used Density

Auditing processes for energy consumption for UTM JB Campus – Cluster Approach:

This study aims to conduct an energy audit in UTM JB Campus and develop a baseline Building Energy Intensity (energy efficiency index) using the cluster approach. In this approach, energy consumption is measured and monitored based on building categories. Factors causing major energy usage for each building category will be identified and analyzed through its Building Energy Intensity. With the developed Smart Energy Management System (SEMS), this proposed approach is envisaged to provide a comprehensive analysis of energy saving potentials and measures for the different building categories.

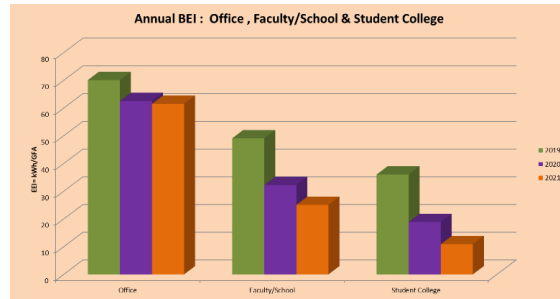


Figure 7. BEI - Cluster Approach (Category of Building)

7.3.1 Energy Efficiency Index

$$\text{Building Energy Index (BEI)} = \frac{\text{kWh}}{\text{Floor Area (m}^2\text{)}}$$

Year	kWh	BEI (kWh/m ²)	% BEI reduction with
Baseline	57,546,794	55.4	-
2019	51,056,866	47.8	-13.8%
2020	36,720,792	34.3	-28.1%
2021	30,658,388	28.7	-40.0%

Table 3. Building Energy Index 2019-2021

In the early stages of the implementation of SREMP in 2018, the BEI was 48.15 kWh/m² for the entire campus with several different categories of buildings consisting of academic buildings, administrative offices and student accommodations. In 2021, UTM managed to reduce the BEI by 40% compared to baseline. Referring to the latest space audit in 2019, the total floor area is 1,069,348 m². Figure 7 shows BEI based on the building category: academic, administrative office and student accommodation. It shows that the administrative office category is the space that uses energy with the highest BEI. This is because most of the administrative offices are fully air-conditioned spaces with centralized air-conditioning system