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Sustainable Energy Management at KMUTT Thailand

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Abstract. King Mongkut's University of Technology Thonburi (KMUTT) committed to be Sustainable University for SDGs 2030 since 2017 and committed to sustainability leadership in all of our activities from operations, teaching, to conducting research. Our commitments are to be a sustainable university providing a role model on Energy, Environment, Safety Management Systems and provide sustainability platform to promote sustainability leadership. Sustainable energy management system has been provided by top management policy since 2010 which focus on energy usage reduction, energy efficient appliances usage, renewable energy usage and carbon footprint reduction. To achieve the sustainable energy goal which comply to SDG 7: Affordable and Clean Energy and SDG13: Climate Action, KMUTT focus on student leadership which provide awareness raising, perception, and leading to implementation for all in KMUTT by using SEP for SDG concept. Moreover, KMUTT initiate sustainable strategy which provide the learning environment to make all campus as living lab, promote people participation and monitoring to make continual improvement with positive reinforcement. The sustainable energy goal achieved along with the expansion activities to community surround according to the student engagement.

Keyword:

energy management, sustainable energy, SEP for SDG, SDG 7, SDG 13

1. Introduction

King Mongkut's University of Technology Thonburi (KMUTT) is one of the Science and Technology universities in Thailand which is committed to be a sustainable university which complies with the global and national sustainable agenda. Sustainability is one of the major challenges of the current and future generation of students & staff. KMUTT is determined

to develop education, research, and social services based on goals of SDGs 2030 in producing green-hearted students who will become the social change agents to apply their knowledge and skills to create an impact at societal, national, and global levels as shown in **Figure 1**. Energy and climate change at KMUTT focus on the activities which comply with SDG 2030 Goal 7: Affordable and clean energy and Goal 13: Climate action. To Ensure access to affordable, reliable, sustainable and modern energy, KMUTT concerns to the use of energy and climate change issues and provide the energy reduction policy, renewable energy usage policy and greenhouse gas emission reduction policy including the energy efficient appliances usage, the implementation of smart buildings/green buildings, total electricity use, energy conservation programs, climate change adaptation and mitigation programs. Moreover, KMUTT has a plan to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology. KMUTT plans to educate our students and encourage them to learn outside the classroom and transform its campuses to be an ideal for developing awareness and innovative solutions to relevant problems that will improve the world for current and future generations. To achieve the sustainable energy goal which complies with SDG 7: Affordable and Clean Energy and SDG 13: Climate Action, KMUTT focuses on student leadership which provides awareness raising, perception, and leading to implementation for all in KMUTT by using SEP for SDG concept. The purpose of this study is to share our experience on sustainable energy management which comply with SDG 7 and SDG 13.

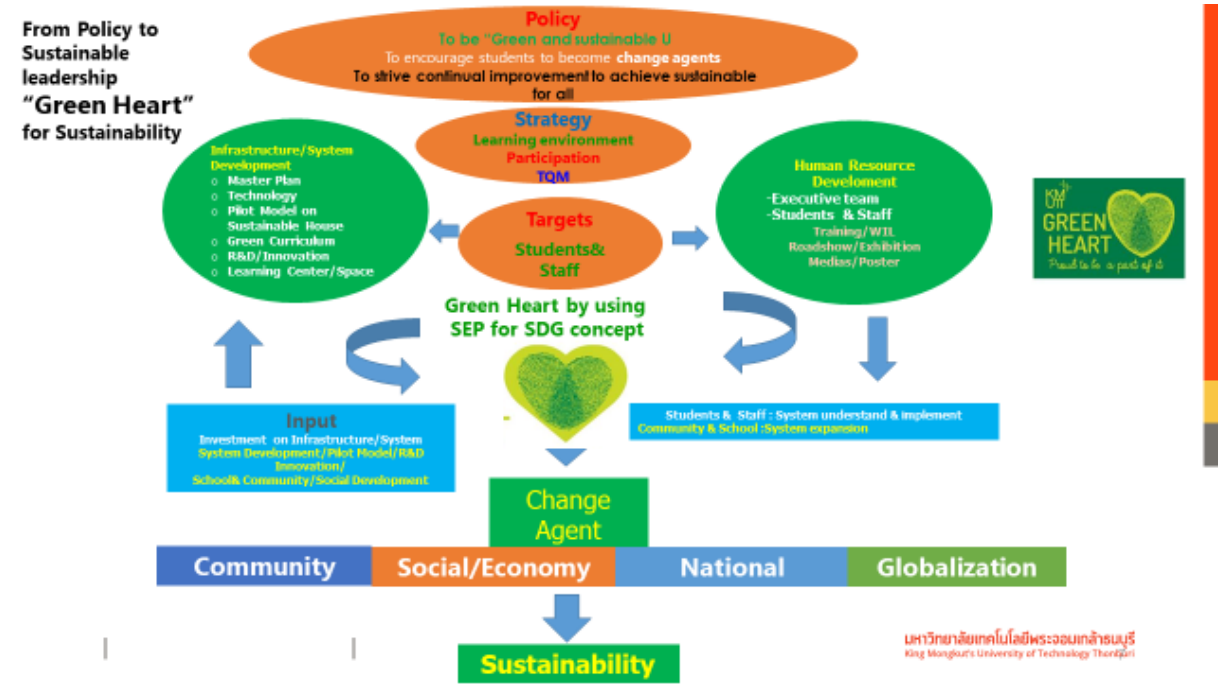

Figure 1. From policy to sustainable leadership "Green Heart" for sustainability

2. Methodology

Sustainable energy management in KMUTT Energy management plays a key role in the SDG 2030 Agenda, especially in the Sustainable Development Goals (SDGs) for SDG 7: Affordable and Clean Energy and SDG 13: Climate Action. Developing fully-functional waste

management systems and a circular economy contributes positively to achieving Good health and well being (SDG 3), and climate action (SDG 13). **Sustainable energy management in KMUTT** focuses on Energy usage reduction, Energy efficient appliances usage, Renewable energy usage and Carbon footprint reduction.

2.1. Energy usage reduction.

KMUTT set up the target of 40% reduction on energy usage (capita/year) by 2024 compared to 2003 baseline. The results have been shown in **Figure 2**. Electricity consumption has continued decreasing rapidly from 1,548.15 kWh/ capita/year in 2015 to 1,357.38 kWh /capita/year in 2019. This dramatic decrease represents that university is a high concern for saving electricity and energy conservation under the concepts of **peopleware, hardware** and **software.** Peopleware refers to the human role in an electricity saving and conservation, hardware refers to the implementation of replacing inefficient equipment with energy efficient devices and software refers to set of data and programs used to operate Building Automation System for studying trend of energy consumption and power demand profile.

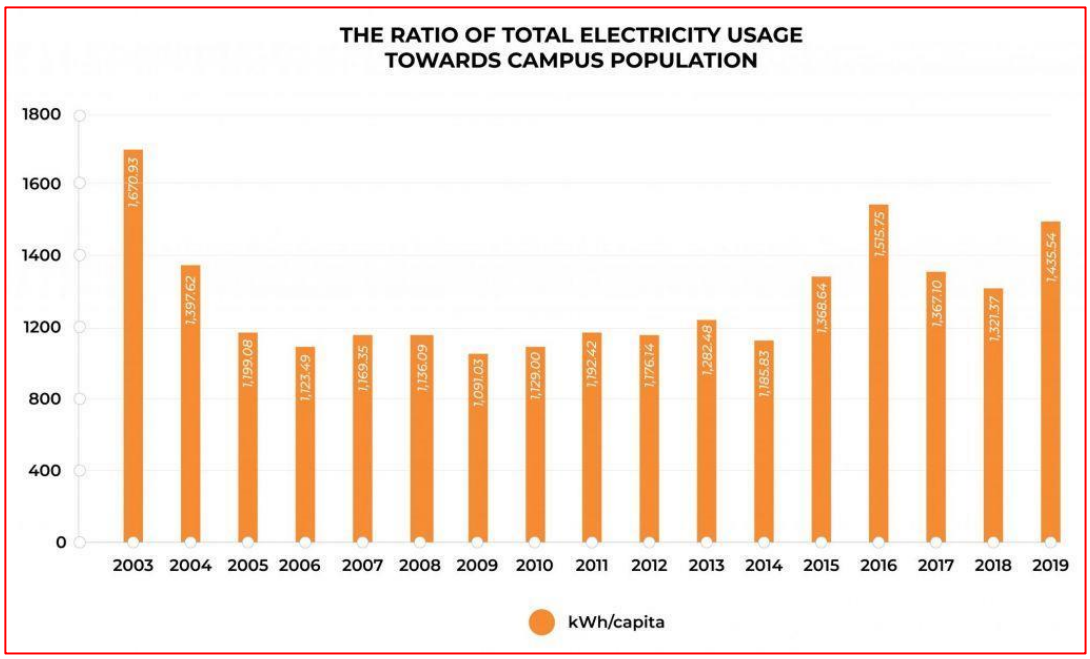

Figure 2. Electrical usage (KWh /capita) in KMUTT from 2003-2019

2.2. Energy efficient appliances usage.

KMUTT set up the target of 100% energy-efficient appliances usage by 2024.The results have shown 87.61% of energy-efficient appliances usage in 2019 according to KMUTT's Energy Efficiency development plan. The results of energy efficiency appliances implementation showed energy saving and CO2 emission reduction in KMUTT.

2.3. Renewable energy usage

KMUTT set up the target of 10% renewable energy usage and installing 2 MW Solar rooftop by 2024. In 2019 the results showed 1.66% renewable energy usage **with** 297.12 kW Solar rooftop installation as shown in **Table 1.**

Using renewable energy not only serves the clean energy usage but also serves as Renewable Energy Learning Center and Living lab for student, researcher and staff.

Table 1. Renewable energy installation in KMUTT from 2012-2019

Source of energy	Installed capacity (kWp) in each year					Annual Energy Saving (KWh)	2019-202 (MWp)
	Past-2012	2013 - 2015	2016-2018	2019 - 2020	Total Capacity (KWp)		
Solar Rooftop	312		295.12	40	337.12	492,195.2	2.6
Solar floating			2		2	2,552	
Wind (Horizontal Axis Wind Turbine)	10	1.2			11.2	1,803	
Biogas (Food waste loading average 100 kg/day)	10 m^3/day				10 m^3/ day	4,562	
Hydropower	0.03		4.3		4.6	18,834	

2.4. Carbon footprint reduction

KMUTT set up the target of 50 % reduction in CO2 emission by 2024 compared to 2015 baseline. In 2020, the results showed 51.17 % reduction in CO2 emission in KMUTT as shown in **Table 2.** Carbon Footprint calculator software **(**SimaPro**)**, Intergovernmental Panel on Climate Change and Thailand Greenhouse Gas Management Organization guideline are the major tools and reference to calculate carbon emission from activities within campus**.** The following table provide the total carbon footprint which main source are from both electricity consumption and transportation i**.**e**.** shuttle bus, EV**–**bus, private car and motorcycle**.**

Table 2. Reduction on Green House emission or Carbon foot print in KMUTT from 2012-2020

Reduction on Greenhouse Gas Emission	2012	2013	2014	2015	2016	2017	2018	2019	2020
Energy usage reduction & Energy efficient program									
• Energy usage reduction in Air condition System	895,356	196,217	296,966	519,924	519,924	220,802	487,658	179,765	179,765
• Energy usage reduction in Lighting System	142,044	55,290	90,596	19,024	19,024	19,024	37,580	729,418	729,418
• Energy conservation measures (ECM)	78,204	12,874	440,362	377,326	33,443	33,443	33,443	33,443	33,443
Renewable Energy Usage Program									
• Solar cell	22,800	17,909	26,513	296,259	296,259	331,482	331,482	331,482	280,551
• Biogas	2,383	3,268	5,514	7,880	7,880	7,880	4,970	4,970	4,970
• Wind	798	798	1,028	1,028	1,028	1,028	1,028	1,028	1,028
Green area expanding program	2,806	5,757	7,757	9,000	9,000	30,000	30,000	30,000	150,000
Car & van pool	7,329,608	7,943,520	11,086,572	14,076,017	16,863,274	17,237,074	18,722,196	20,203,868	20,203,868
To reduce Electricity usage per head (Compare to previous year)	494,751	202,975	445,474	377,326	42,192	58,419	58,419	36,491	1,678,220
To reduce LPG consumption (Compare to previous year)	4,440	43,879	37,297	31,703	54,464	54,464	54,464	54,464	54,464
To reduce diesel consumption (Compare to previous year)	4,734	4,671	4,904	5,150	5,150	5,150	5,150	5,150	5,407
To reduce pipe-water consumption (Compare to previous year)	365	683	681	72	510	203	203	203	621
To reduce solid & hazardous waste generation (Compare to previous year)	29,969	23,542	5,766	35,129	2,555	1,277	3,548	4,093	4,093
Promoting walk and Bike soceity activity		6,026,971	6,556,496	6,810,788	8,172,946	8,990,240	8,990,240	10,788,288	10,788,288
Total	9,008,258	14,538,354	19,005,928	22,566,624	26,027,646	26,990,485	28,760,380	32,402,661	34,114,135

2.5. Community energy expansion.

KMUTT have cooperated with other organizations to produce various research outputs on energy efficient technology and appropriated renewable energy usage which have been used for the benefit of communities and society. More than 10 programs a year for the local community to learn about the importance of energy efficiency and clean energy. Moreover, KMUTT expand the Clean energy for community projects to National parks, Islands and rural communities such as Kho Hong, Kho Jik, TaruTao National Park, Phu Kradueng etc for helping them improving energy efficiency and transfer appropriated clean energy technology to make sustainable energy in their communities.

3. Sustainable Energy Management for Next normal under COVID-19 Pandemic

According to the COVID-19 outbreak which affects all activities of the university, KMUTT has implemented the KMUTT's Business Continual Management Plan in all activities including Energy management. These have been done to fit our social distancing protocol and 5 years plan for next normal infrastructure installation including Online monitoring for Energy usage, Renewable & From Waste to Energy learning space and Living lab, 2.5 MW Solar roof installation, Platinum Green Building as living lab for sustainability and KMUTT Carbon Neutrality Campus.

4. Summary/Concluding Remarks

The purpose of this study is to share our experience on sustainable energy management in KMUTT which comply with SDG 7 and SDG 13. The results achieved along with the decrease of energy usage and greenhouse gas emissions within university and communities which make sustainable energy for all according to the university policy and student engagement.

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