Final Sustainable Report of Chiang Mai University for the UI Green Metric Ranking 2019

By Assistant Professor Dr. Sumavalee Chindapol

Building Innovation Technology and Management Center

Faculty of Architecture, Chaing Mai University

Present to

Department of Strategies, Chaing Mai University

Under

Proactive Strategy No. 1: Environment and Energy Innovation

2019

UNIVERSITAS INDONESIA
Veritas, Probitas, Iustitia

Kampus Salemba Jl. Salemba Raya No. 4, Jakarta 10430
Kampus Depok Kampus Universitas Indonesia Depok 16424
Tel. 62.21. 7867 222/ 7884 1818 **Fax.** 62.21. 7884 9060
Email pusadmui@ui.ac.id | **www.ui.ac.id**

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Subject : Invitation to 2019 UI GreenMetric World University Rankings on Sustainability

Dear University Leaders
Clinical Professor Niwes Nantachit, M.d.
Chiang Mai University
239 Huay Kaew Road, Muang District, Chiang Mai, Thailand, 50200

It is my great pleasure to invite your esteemed university to participate in our 2019 UI GreenMetric World University Rankings.

Since 2010, UI GreenMetric World University Rankings has ranked universities worldwide according to six indicators: setting and infrastructure, energy and climate change, waste management, water, and transportation, and education. 719 universities from 81 countries were ranked in 2018 (http://greenmetric.ui.ac.id/overall-ranking-2018/). Complementing other University rankings which can be found on IREG Observatory on Academic Ranking and Excellence, UI GreenMetric is the first and only ranking that has established a Voluntary Standard for improving university infrastructure and action towards sustainable campuses worldwide.

Currently, we have 25 active national coordinators from 25 countries in Middle East, Asia, South America and Europe. In 2018, we have held one international and 15 national workshops. During which Universities can share their best practices and learn from each other's experience. This year's themes is "Sustainable University in a Changing World: Lessons, Challenges and Opportunities". Thus, our questionnaire will focus in more details on efforts and programs to improve sustainability on campus.

UI GreenMetric World University Rankings is an important initiative to promote sustainability in higher education institutions globally. By participating, you will be able to measure your sustainability policy and performance and compare them with other institutions in the ranking. You can also share your experience and best practices on the issues of sustainability with other universities in our network. Most importantly, this ranking can serve as a platform for future cooperation among higher education institutions to make our world a better place.

Participating in UI GreenMetric is simple and free as the submission is done on line. There is no fee for participating. The online questionnaire can be accessed at: http://questionnaire.greenmetric.ui.ac.id/ using the following username and password:

Username: cmu.ac.th
Password: cmu123

Please email any questions you may have to Ms. Sabrina Hikmah at greenmetric@ui.ac.id. We do hope your esteemed institution will be able to join us in the 2019 survey.

Thank you for your kind attention. I am looking forward to see your university in UI GreenMetric World University Rankings.

Yours sincerely,

Prof. Dr. Ir. Muhammad Anis, M. Met
Rector of Universitas Indonesia
rector@ui.ac.id

University Name Chiang Mai University
Date of Establishment 1st July 2018
Address 239 HuayKew Road, Suthep, Muang, Chiang Mai, 50200 THAILAND
Longitude 98° 57'28.2"E **Latitude** 18° 47'46.5" N
Web Address www.cmu.ac.th
Region (Based on region classification) Tropical wet and dry [Aw : rainy wet season but dry in winter]
Rector / President / Vice Chancellor of University Clinical Professor Niwes Nantachit, M.D., FRCP(T)
Sustainability Director Associate Professor Prasert Rerkkriangkrai [Vice President - Physical Facilities and Environment]
Person in Charge Assistant Professor Dr. Sumavalee Chindapol [Coordinator of Chiang Mai University UI Green Metric Project]
PIC/Sustainability Director e-mail address sumavalee.ch@cmu.ac.th

UI GreenMetric World University Rankings
ver. 19.1

Partnership on Sustainability

a. Network:

1. **Local (please specify)** Sustainable University Network of Thailand
2. **Regional (please specify)** Asia Sustainable Campus Network
3. **International (please specify)** International Sustainable Campus Network

b. Partner :

1. **Government**
2. **Community**
3. **Educational Institution** (circled)

No	Points		CRITERIA	INDICATIVE PERFORMANCE MEASURE					Evidence
1		1500	Setting and Infrastructure (SI)						
1.1.			Type of higher education institution	[1] Comprehensive (circled)	[2] Specialized higher education institution				
1.2.			Climate	[1] Tropical wet	[2] Tropical wet and dry (circled)	[3] Semiarid	[4] Arid	[5] Mediterranean	
				[6] Humid subtropical	[7] Marine west coast / Oceanic Climate	[8] Humid continental	[9] Subarctic		
1.3.			Number of campus sites	Provide number 2					Required
1.4.			Campus setting	[1] Rural	[2] Suburban	[3] Urban (circled)	[4] City center	[5] High rise building area	Required
1.5.			Total campus area (m^2)	Provide number 2,899,200 sq.m					Required
1.6.			Total campus ground floor area of buildings (m^2)	Provide number 617,220 sq.m					
1.7.			Total campus buildings area (m^2)	Provide number 825,686 sq.m					
1.8.	SI1	300	The ratio of open space area to total area	[1] <= 1%	[2] > 1 - 80% (circled)	[3] > 80 - 90%	[4] > 90 - 95%	[5] > 95%	
1.9.	SI2	200	Total area on campus covered in forest vegetation	[1] <= 2%	(provide total area in square meter)		[4] > 22 - 35% (circled)	(provide total area in square meter) 877,908 sq.m	Required
				[2] > 2 - 9%	(provide total area in square meter)		[5] > 35%	(provide total area in square meter)	
				[3] > 9 - 22%	(provide total area in square meter)				
1.10.	SI3	300	Total area on campus covered in planted vegetation (%)	[1] <= 10%	(provide total area in square meter)		[4] > 30 - 40%	(provide total area in square meter)	
				[2] > 10 - 20%	(provide total area in square meter)		[5] > 40%	(provide total area in square meter)	
				[3] > 20 - 30% (circled)	(provide total area in square meter) 599,698 sq.m				
1.11.	SI4	200	Total area on campus for water absorption besides forest and planted vegetation (%)	[1] <= 2%	(provide total area in square meter)		[4] > 20 - 30%	(provide total area in square meter)	
				[2] > 2 - 10%	(provide total area in square meter)		[5] > 30%	(provide total area in square meter)	

No	Points		CRITERIA	INDICATIVE PERFORMANCE MEASURE					Evidence
				[3] > 10 - 20%	(provide total area in square meter)	333,611 sq.m			
1.12.			Total number of regular students (part time and full time)	Provide number	36,276 people				
1.13.			Total number of online students (part time and full time)	Provide number	42,004 people				
1.14.			Total number of academic and administrative staff	Provide number	12,155 people				
1.15.	SI5	300	The total open space area divided by total campus population	[1] <= 10 m2	[2] > 10 – 20 m2	[3] > 20 - 40 m2	[4] > 40 – 70 m2	[5] > 70 m2	
1.16.			Total university budget (in US Dollars)	Provide number	31,9332,006 $US				
1.17.			University budget for sustainability effort (in US Dollars)	Provide number	38,492,793 $US				
1.18.	SI6	200	Percentage of university budget for sustainability efforts within a year	[1] <= 1%	[2] > 1 - 3%	[3] > 3 - 10%	[4] > 10 - 12%	[5] > 12%	
2		2100	Energy and Climate Change (EC)						
2.1.	EC1	200	Energy efficient appliances usage	[1] < 1%	[2] 1 - 25%	[3] > 25 - 50%	[4] > 50 - 75%	[5] > 75%	Required
2.2.			Total campus smart building area (m^2)	Provide number	14,673 sq.m				
2.3.	EC2	300	Smart building implementation	[1] < 1%	[2] 1 - 25%	[3] > 25 - 50%	[4] > 50 - 75%	[5] > 75%	Required
2.4.	EC3	300	Number of renewable energy sources in campus	[1] None	[2] 1 source	[3] 2 sources	[4] 3 sources	[5] > 3 sources	
2.5.			Please specify renewable energy sources in campus and provide capacity produced in kilowatt hour	[1] Not applicable			[5] Geothermal	provide capacity in kilowatt hour	Required
				[2] Bio diesel	provide capacity in kilowatt hour 1,989,000 kWh		[6] Wind power	provide capacity in kilowatt hour	
				[3] Clean biomass	provide capacity in kilowatt hour 1,080,000 kWh		[7] Hydropower	provide capacity in kilowatt hour	
				[4] Solar power	provide capacity in kilowatt hour 31,160,000 kWh		[8] Combine Heat and Power	provide capacity in kilowatt hour 1,247,699 kWh	
2.6.			Electricity usage per year (in kilowatt hour)	Provide number	73,767,400 kWh				Required
2.7.	EC4	300	The total electricity usage divided by total campus population (kWh per person)	[1] >= 2424 kWh	[2] < 2424 - 1535 kWh	[3] < 1535 - 633 kWh	[4] < 633 - 279 kWh	[5] < 279 kWh	
2.8.	EC5	200	The ratio of renewable energy production divided by total energy usage per year	[1] <= 0.5%	[2] > 0.5 - 1%	[3] > 1 - 2%	[4] > 2 - 25%	[5] > 25%	
2.9.	EC6	300	Elements of green building implementation as reflected in all construction and renovation policies	[1] None (There is no green building implementation in your university)	[2] 1 element	[3] 2 elements	[4] 3 elements	[5] > 3 elements	Required

No	Points		CRITERIA	INDICATIVE PERFORMANCE MEASURE					Evidence
2.10.	EC7	200	Greenhouse gas emission reduction program	[1] None (Reduction program is needed, but nothing has been done)	[2] Program in preparation (e.g. feasibility study and promotion)	[3] Program(s) aims to reduce one out of three scopes emissions (Scope 1 or 2 or 3)	[4] Program(s) aims to reduce two out of three scopes emissions (Scope 1 and 2 or Scope 1 and 3 or Scope 2 and 3)	[5] Program(s) aims to reduce all three scopes emissions (Scope 1, 2 and 3)	
2.11.			Please provide the total carbon footprint (CO2 emission in the last 12 months, in metric tons)	Provide number	39,121 metric tons				Required
2.12.	EC8	300	The total carbon footprint divided by total campus population (metric ton per person)	[1] >= 2.05 metric ton	[2] < 2.05 - 1.11 metric ton	[3] < 1.11 - 0.42 metric ton	[4] < 0.42 - 0.10 metric ton	[5] < 0.10 metric ton	
3		1800	Waste (WS)						
3.1.	WS1	300	Recycling program for university waste	[1] Not applicable	[2] Partial (1 - 25% of waste)	[3] Partial (> 25 - 50% of waste)	[4] Partial (> 50 - 75% of waste)	[5] Extensive (> 75% of waste)	Required
3.2.	WS2	300	Program to reduce the use of paper and plastic on campus	[1] Not applicable	[2] 1 program	[3] 2 programs	[4] 3 programs	[5] More than 3 programs	Required
3.3.	WS3	300	Organic waste treatment	[1] Open dumping	[2] Partial (1 - 25% treated)	[3] Partial (> 25 - 50% treated)	[4] Partial (> 50 - 75% treated)	[5] Extensive (> 75% treated)	Required
3.4.	WS4	300	Inorganic waste treatment	[1] Burned in open	[2] Partial (1 - 25% treated)	[3] Partial (> 25 - 50% treated)	[4] Partial (> 50 - 75% treated)	[5] Extensive (> 75% treated)	Required
3.5.	WS5	300	Toxic waste treatment	[1] Not managed	[2] Partial (1 - 25% treated)	[3] Partial (> 25 - 50% treated)	[4] Partial (> 50 - 75% treated)	[5] Extensive (> 75% treated)	Required
3.6.	WS6	300	Sewage disposal	[1] Untreated into waterways	[2] Treated conventionally	[3] Treated technically for reuse	[4] Treated technically for downcycling	[5] Treated technically for upcycling	Required
4		1000	Water (WR)						
4.1.	WR1	300	Water conservation program implementation	[1] None (Conservation program is needed, but nothing has been done)	[2] Program in preparation (e.g. feasibility study and promotion)	[3] 1 - 25% implemented at early stage (e.g. measurement of potential surface runoff volume)	[4] > 25 - 50% water conserved	[5] > 50% water conserved	Required
4.2.	WR2	300	Water recycling program implementation	[1] None (Water recycling program is needed, but nothing has been done)	[2] Program in preparation (e.g. feasibility study and promotion)	[3] 1 - 25% implemented at early stage (e.g. measurement of waste water)	[4] > 25 - 50% water recycled	[5] > 50% water recycled	Required
4.3.	WR3	200	Water efficient appliances usage (hand washing taps, toilet flush, etc)	[1] None (Water efficient appliances are needed, but nothing has been done)	[2] Program in preparation (e.g. feasibility study and promotion)	[3] 1 - 25% of water efficient appliancs installed	[4] > 25 - 50% of water efficient appliances installed	[5] > 50% of water efficient appliances installed	Required
4.4.	WR4	200	Treated water consumed	[1] None	[2] 1 - 25% treated water consumed	[3] > 25 - 50% treated water consumed	[4] > 50 - 75% treated water consumed	[5] > 75% treated water consumed	
5		1800	Transportation (TR)						
5.1.			Number of cars actively used and managed by university	Provide number	918 cars				
5.2.			Number of cars entering the university daily	Provide number	12,243 cars				

No	Points		CRITERIA	INDICATIVE PERFORMANCE MEASURE					Evidence
5.3.			Number of motorcycles entering the university daily	Provide number	8,560 cars				
5.4.	TR1	200	The total number of vehicles (cars and motorcycles) divided by total campus population	[1] >= 1	[2] < 1 - 0.5	[3] < 0.5 - 0.125	[4] < 0.125 - 0.045	[5] < 0.045	
5.5.	TR2	300	Shuttle services	[1] Shuttle service is possible but not provided by university	[2] Shuttle service is provided (by university or other parties) and regular but not free	[3] Shuttle service is provided (by university or other parties) and the university contributes a part of the cost	[4] Shuttle service is provided by university, regular, and free	[5] Shuttle service is provided by university, regular, and zero emission. Or shuttle use is not possible (not applicable)	Required
5.6.			Number of shuttles operated in your university	Provide number	99 cars				
5.7.			Average number of passengers of each shuttle	Provide number	84 passengers				
5.8.			Total trips of each shuttle services each day	Provide number	1,575 trips				
5.9.	TR3	200	Zero Emission Vehicles (ZEV) policy on campus	[1] Zero Emission Vehicles are not available	[2] Zero Emission Vehicles use is not possible or practical	[3] Zero Emission Vehicles are available, but not provided by university	[4] Zero Emission Vehicles are available, provided by university and charged	[5] Zero Emission vehicles are available, and provided by university free	Required
5.10.			Average number of Zero Emission Vehicles (e.g. bicycles, cano, snowboard, electric car, etc.) on campus per day	Provide number	1,432 vehicles				
5.11.	TR4	200	The total number of Zero Emission Vehicles (ZEV) divided by total campus population	[1] <= 0.002	[2] > 0.002 to <= 0.004	[3] > 0.004 to <= 0.008	[4] > 0.008 to <= 0.02	[5] > 0.02	
5.12.			Total parking area (m^2)	Provide number	391,274 sq.m				
5.13.	TR5	200	Ratio of parking area to total campus area	[1] > 11%	[2] < 11 - 7%	[3] < 7 - 4%	[4] < 4 - 1%	[5] < 1%	Required
5.14.	TR6	200	Transportation program designed to limit or decrease the parking area on campus for the last 3 years (from 2016 to 2018)	[1] Not applicable	[2] Program in preparation (e.g. feasibility study and promotion)	[3] Program resulting in less than 10% decrease in parking area	[4] Program resulting in 10 - 30% decrease in parking area	[5] Program resulting in more than 30% decrease in parking area or parking is restricted	
5.15.	TR7	200	Number of transportation initiatives to decrease private vehicles on campus	[1] Not applicable	[2] 1 initiative	[3] 2 initiatives	[4] 3 initiatives	[5] > 3 initiatives	Required
5.16.	TR8	300	Pedestrian path policy on campus	[1] Pedestrian paths are not applicable	[2] Pedestrian paths are available	[3] Pedestrian paths are available, and designed for safety	[4] Pedestrian paths are available, designed for safety and convenience	[5] Pedestrian paths are available, designed for safety, convenience, and in some parts provided with disabled-friendly features	Required
5.17.			Approximate daily travel distance of a vehicle inside your campus only (in Kilometers)	Provide number	5,692 km				

No	Points		CRITERIA	INDICATIVE PERFORMANCE MEASURE					Evidence
6		1800	Education and Research (ED)						
6.1.			Number of courses/subjects related to sustainability offerred	Provide number	1,852 subjects				Required
6.2.			Total number of courses/subjects offered	Provide number	13,417 subjects				Required
6.3.	ED1	300	The ratio of sustainability courses to total courses/subjects	[1] <= 1%	[2] > 1 - 5%	[3] > 5 - 10%	[4] > 10 - 20%	[5] > 20%	
6.4.			Total research funds dedicated to sustainability research (in US Dollars)	Provide number	12,617,324 $US				Required
6.5.			Total research funds (in US Dollars)	Provide number	65,797,883 $US				Required
6.6.	ED2	300	The ratio of sustainability research funding to total research funding	[1] <= 1%	[2] > 1 - 8%	[3] > 8 - 20%	[4] > 20 - 40%	[5] > 40%	
6.7.	ED3	300	Number of scholarly publications on sustainability	[1] 0	[2] 1 - 20	[3] 21 - 83	[4] 84 - 300	[5] > 300	
6.8.	ED4	300	Number of events related to sustainability	[1] 0	[2] 1 - 4	[3] 5 - 17	[4] 18 - 47	[5] > 47	Required
6.9.	ED5	300	Number of student organizations related to sustainability	[1] 0	[2] 1 - 2	[3] 3 - 4	[4] 5 - 10	[5] > 10	
6.10.	ED6	200	University-run sustainability website	[1] Not available	[2] Website in progress or under construction	[3] Website is available and accessible	[4] Website is available, accessible, and updated occasionally	[5] Website is available, accessible, and updated regularly	
6.11.			Sustainability website address (URL) if available	Provide website address (URL)	http://green.cmu.ac.th ; http://enis.cmu.ac.th				
6.12.	ED7	100	Sustainability report	[1] Not available	[2] Sustainability report is in preparation	[3] Sustainability report is available and accessible	[4] Sustainability report is available, accessible and updated occasionally	[5] Sustainability report is available, accessible and updated annually	Required

Note: Please refer to the 2019 Guideline for further information

UI GreenMetric Answer 2019

cmu.ac.th

University Profile

Username	:	cmu.ac.th
University Name	:	Chiang Mai University
University Leader	:	President : Clinical Professor Niwes Nantachit, M.D.

PIC Profile

PIC Name	:	Assistant Professor Dr. Sumavalee Chindapol
PIC Position	:	Coordinator of Chiang Mai University UI Green Metric Project
Email	:	sumavalee.ch@cmu.ac.th

No	Question	Choice	Answer
Setting and Infrastructure			
1.1(o)	Type of higher education institution	○ Comprehensive ○ Specialized higher education institution	◉ Comprehensive
1.2(o)	Climate	○ Tropical Wet ○ Tropical Wet and Dry ○ Semiarid ○ Arid ○ Mediterranean ○ Humid Subtropical ○ Marine west coast / Oceanic Climate ○ Humid Continental ○ Subartic	◉ Tropical Wet and Dry
1.3(o)	Number of campus site		2
1.4(o)	Campus setting	○ Rural ○ Suburban ○ Urban ○ In city center ○ High rise building	◉ Urban
1.5(o)	Total campus area (m^2)		2899200
1.6(o)	Total campus ground floor area of buildings (m^2)		617220
1.7(o)	Total campus buildings area (m^2)		825686

No	Question	Choice	Answer
1.8(SI.1)	The ratio of open space to total area. Formula: ((1.5-1.6/1.5)*100%)	○ <= 1% ○ > 1 - 80% ○ > 80 - 90% ○ > 90 - 95% ○ > 95%	◉ > 1 - 80%
1.9(SI.2)	Total area on campus covered in forest vegetation (please provide total area in square meters)	○ <= 2% ○ > 2 - 9% ○ > 9 - 22% ○ > 22 - 35% ○ > 35%	◉ > 22 - 35% | Total area : 877908
1.10(SI.3)	Total area on campus covered in planted vegetation (please provide total area in square meters)	○ <= 10% ○ > 10 - 20% ○ > 20 - 30% ○ > 30 - 40% ○ > 40%	◉ > 20 - 30% | Total area : 599699
1.11(SI.4)	Total area on campus for water absorption besided forest and planted vegetation (please provide total area in square meters)	○ <= 2% ○ > 2 - 10% ○ > 10 - 20% ○ > 20 - 30% ○ > 30%	◉ > 10 - 20% | Total area : 333611
1.12(o)	Total number of regular students (part time and full time)		36276
1.13(o)	Total number of online students (part time and full time)		42004
1.14(o)	Total number of academic and administrative staff		12155
1.15(SI.5)	The total open space area divided by total campus population. Formula: ((1.5-1.6)/(1.12+1.14))	○ <= 10 m^2 ○ > 10 – 20 m^2 ○ > 20 – 40 m^2 ○ > 40 – 70 m^2 ○ > 70 m^2	◉ > 40 – 70 m^2
1.16(o)	Total university's budget (in US Dollars)		319332006
1.17(o)	University's budget for sustainability effort (in US Dollars)		38492793
1.18(SI.6)	Percentage of University's budget for sustainability effort within a year	○ <= 1% ○ > 1 - 3% ○ > 3 - 10% ○ > 10 - 12% ○ > 12%	◉ > 10 - 12%
Energy and Climate Change			

No	Question	Choice	Answer
2.1(EC.1)	Energy efficient appliances usage	○ < 1% ○ 1 - 25% ○ > 25 - 50% ○ > 50 - 75% ○ > 75%	◉ > 75%
2.2(o)	Total campus smart building area (m^2)		14673
2.3(EC.2)	Smart Building implementation (percentage of the total floor area of smart building to the total all floors building area (smart and non-smart buildings area).	○ < 1% ○ 1% - 25% ○ > 25% - 50% ○ > 50% - 75% ○ > 75%	◉ 1% - 25%
2.4(EC.3)	Number of renewable energy sources in campus (solar power, bio diesel, wind power, etc)	○ None ○ 1 source ○ 2 sources ○ 3 sources ○ > 3 sources	◉ > 3 sources
2.5(o)	Please specify renewable energy sources in campus and provide capacity produced in kilowatt hour	☐ Not Applicable ☐ Bio Diesel ☐ Clean Biomass ☐ Solar Power ☐ Wind Power ☐ Geothermal ☐ Hydropower ☐ Combine Heat and Power	☑ Combine Heat and Power | Total kWh : 1247699 ☑ Solar Power | Total kWh : 31160000 ☑ Clean Biomass | Total kWh : 1080000 ☑ Bio Diesel | Total kWh : 1989000
2.6(o)	Electricity usage per year (in kilo watt hour)		73767400
2.7(EC.4)	The total electricity usage divided by total campus population (kWh per person). Formula: (2.6) / (1.12+1.14)	○ >= 2424 kWh ○ < 2424 - 1535 kWh ○ < 1535 - 633 kWh ○ < 633 - 279 kWh ○ < 279 kWh	◉ < 1535 - 633 kWh
2.8(EC.5)	The ratio of renewable energy production divided by total energy usage per year	○ <= 0.5% ○ > 0.5 - 1% ○ > 1 - 2% ○ > 2 - 25% ○ > 25%	◉ > 2 - 25%

No	Question	Choice	Answer
2.9(EC.6)	Elements of green building implementation as reflected in all construction and renovation policies	○ None ○ 1 element ○ 2 elements ○ 3 elements ○ > 3 elements	◉ > 3 elements
2.10(EC.7)	Greenhouse gas emission reduction program	○ None (reduction program is needed, but nothing has been done) ○ Program in preparation (e.g. feasibility study and promotion) ○ Program(s) aims to reduce one out of three scopes emissions (Scope 1 or 2 or 3) ○ Program(s) aims to reduce two out of three scopes emissions (Scope 1 and 2 or Scope 1 and 3 or Scope 2 and 3) ○ Program(s) aims to reduce all three scopes emissions (Scope 1, 2 and 3)	◉ Program(s) aims to reduce all three scopes emissions (Scope 1, 2 and 3)
2.11(o)	Please provide the total carbon footprint (CO_2 emission in the last 12 months, in metric tons)		39121
2.12(EC.8)	The total carbon footprint divided by total campus population (metric tons per person). Formula: (2.11)/(1.12+1.14)	○ >= 2.05 metric ton ○ < 2.05 - 1.11 metric ton ○ < 1.11 - 0.42 metric ton ○ < 0.42 - 0.10 metric ton ○ < 0.10 metric ton	◉ < 0.42 - 0.10 metric ton
Waste			
3.1(WS.1)	Recycling program for university waste	○ Not Applicable ○ Partial (1% - 25% of waste) ○ Partial (> 25% - 50% of waste) ○ Partial (> 50% - 75% of waste) ○ Extensive (> 75% waste)	◉ Extensive (> 75% waste)

No	Question	Choice	Answer
3.2(WS.2)	Program to reduce the use of paper and plastic on campus	○ Not applicable. If there is no program in your university. ○ 1 program ○ 2 programs ○ 3 programs ○ more than 3 programs	◉ more than 3 programs
3.3(WS.3)	Organic waste treatment	○ Open dumping ○ Partial (1% - 25% of treated) ○ Partial (> 25% - 50% of treated) ○ Partial (> 50% - 75% of treated) ○ Extensive (> 75% treated)	◉ Extensive (> 75% treated)
3.4(WS.4)	Inorganic waste treatment	○ Burned in the open ○ Partial (1% - 25% of treated) ○ Partial (> 25% - 50% of treated) ○ Partial (> 50% - 75% of treated) ○ Extensive (> 75% treated)	◉ Extensive (> 75% treated)
3.5(WS.5)	Toxic waste treatment	○ Not Managed ○ Partial (1% - 25% of treated) ○ Partial (> 25% - 50% of treated) ○ Partial (> 50% - 75% of treated) ○ Extensive (> 75% treated)	◉ Extensive (> 75% treated)
3.6(WS.6)	Sewage disposal	○ Untreated to waterways ○ Treated conventionally ○ Treated technically for reuse ○ Treatment for down cycling ○ Treatment for up cycling	◉ Treatment for down cycling
Water			

No	Question	Choice	Answer
4.1(WR.1)	Water conservation program implementation	○ None (Conservation program is needed, but nothing has been done) ○ Program in preparation (e.g. feasibility study and promotion) ○ 1 - 25% implemented at early stage (e.g. measurement of potential surface runoff volume) ○ > 25 - 50% water conserved ○ > 50% water conserved	◉ > 50% water conserved
4.2(WR.2)	Water recycling program implementation	○ None (Water recycling program is needed, but nothing has been done) ○ Program in preparation (e.g. feasibility study and promotion) ○ 1 - 25% Implemented at early stage (e.g. measurement of waste water) ○ > 25 - 50% water recycled ○ > 50% water recycled	◉ > 50% water recycled
4.3(WR.3)	Water efficient appliance usage	○ None (Water efficient appliances is needed, but nothing has been done) ○ Program in preparation (e.g. feasibility study and promotion) ○ 1 - 25% of water efficient appliances installed ○ > 25 - 50% of water efficient appliances installed ○ > 50% of water efficient appliances installed	◉ 1 - 25% of water efficient appliances installed

No	Question	Choice	Answer
4.4(WR.4)	Treated water consumed	○ None ○ 1% - 25% treated water consumed ○ > 25% - 50% treated water consumed ○ > 50% - 75% treated water consumed ○ > 75% treated water consumed	◉ > 75% treated water consumed
Transportation			
5.1(o)	Number of cars actively used and managed by University		918
5.2(o)	Number of cars entering the university daily		12243
5.3(o)	Number of motorcycles entering the university daily		8560
5.4(TR.1)	The total number of vehicles (cars and motorcycles) divided by total campus population. Formula: (5.1+5.2+5.3)/(1.12+1.14)	○ >=1 ○ < 1 - 0.5 ○ < 0.5 - 0.125 ○ < 0.125 - 0.045 ○ < 0.045	◉ < 0.5 - 0.125
5.5(TR.2)	Shuttle service	○ Shuttle service is possible but not provided by university ○ Shuttle service is provided (by university or other parties) and regular but not free ○ Shuttle service is provided (by university or other parties) and the university contributes a part of the cost. ○ Shuttle service is provided by university, regular, and free ○ Shuttle service is provided by university, regular, and zero emission. Or shuttle use is not possible (not applicable)	◉ Shuttle service is provided by university, regular, and zero emission. Or shuttle use is not possible (not applicable)
5.6(o)	Number of shuttles operated in your university		99

No	Question	Choice	Answer
5.7(o)	Average number of passengers of each shuttle		84
5.8(o)	Total trips of shuttle services each day		1575
5.9(TR.3)	Zero Emission Vehicles (ZEV) policy on campus	○ Zero Emission Vehicles are not available ○ Zero Emission Vehicles use is not possible or practical ○ Zero Emission Vehicles are available, but not provided by university ○ Zero Emission Vehicles are available, and provided by university and charged ○ Zero Emission Vehicles are available, and provided by university for free	◉ Zero Emission Vehicles are available, and provided by university for free
5.10(o)	Average number of Zero Emission Vehicles (e.g. bicycles, cano, snowboard, electric car, etc.) on campus per day		1432
5.11(TR.4)	The total number of Zero Emission Vehicles (ZEV) divided by total campus population. Formula: (5.10)/(1.12+1.14)	○ <= 0.002 ○ > 0.002 - 0.004 ○ > 0.004 - 0.008 ○ > 0.008 - 0.02 ○ > 0.02	◉ > 0.02
5.12(o)	Total parking area (m^2)		391274
5.13(TR.5)	Ratio of parking area to total campus area. Formula: ((5.12/1.5) x 100%)	○ > 11% ○ < 11 - 7% ○ < 7 - 4% ○ < 4 - 1% ○ < 1%	◉ > 11%

No	Question	Choice	Answer
5.14(TR.6)	Transportation program designed to limit or decrease the parking area on campus for the last 3 years (from 2016 to 2018)	○ Not Applicable ○ Program in preparation (e.g. feasibility study and promotion) ○ Less than 10% decrease ○ Between 10% - 30% decrease ○ Program resulting in more than 30% decrease in parking or parking is restricted	◉ Less than 10% decrease
5.15(TR.7)	Number of transportation initiatives to decrease private vehicles on campus (e.g. car sharing, charging high parking fees, metro / tram / bus services and etc)	○ Not Applicable ○ 1 initiative ○ 2 initiatives ○ 3 initiatives ○ > 3 initiatives	◉ > 3 initiatives
5.16(TR.8)	Pedestrian path policy on campus	○ Pedestrian paths are not applicable ○ Pedestrian paths are available ○ Pedestrian paths are available, and design for safety ○ Pedestrian paths are available, designed for safety and convenience ○ Pedestrian paths are available, designed for safety, convenience, and in some parts provided with disabled-friendly features	◉ Pedestrian paths are available, designed for safety, convenience, and in some parts provided with disabled-friendly features
5.17(o)	Approximate daily travel distance of a vehicle inside campus only (in Kilometers)		5692
Education and Research			
6.1(o)	Number of courses/subjects related to sustainability offered		1852
6.2(o)	Total number of courses/subjects offered		13417

No	Question	Choice	Answer
6.3(ED.1)	The ratio of sustainability courses to total courses/subjects	○ <= 1% ○ > 1 - 5% ○ > 5 - 10% ○ > 10 - 20% ○ > 20%	◉ > 10 - 20%
6.4(o)	Total research funds dedicated to sustainability research (in US Dollars) (average per annum over the last 3 years).		12617324
6.5(o)	Total research funds (in US Dollars) (average per annum over the last 3 years).		65797883
6.6(ED.2)	The ratio of sustainability research funding to total research funding	○ <= 1% ○ > 1 - 8% ○ > 8 - 20% ○ > 20 - 40% ○ > 40%	◉ > 20 - 40%
6.7(ED.3)	Number of scholarly publications on sustainability published. (average annualy for the past 3 years)	○ 0 ○ 1 - 20 ○ 21 - 83 ○ 84 - 300 ○ > 300	◉ 84 - 300
6.8(ED.4)	Number of events related to sustainability. (average annualy for the past 3 years)	○ 0 ○ 1 - 4 ○ 5 - 17 ○ 18 - 47 ○ > 47	◉ > 47
6.9(ED.5)	Number of student organizations related to sustainability	○ 0 ○ 1 - 2 ○ 3 - 4 ○ 5 - 10 ○ > 10	◉ > 10
6.10(ED.6)	University-run sustainability website	○ Not available ○ Website in progress or under construction ○ Website is available and accessible ○ Website is available, accessible, and updated occasionally ○ Website is available, accessible, and updated regularly	◉ Website is available, accessible, and updated regularly

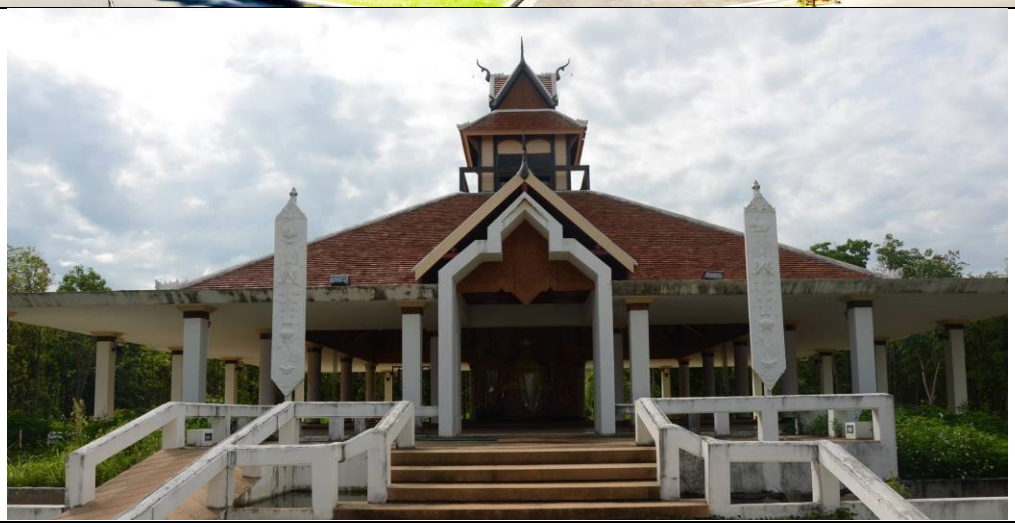
No	Question	Choice	Answer
6.11(o)	Sustainability website address (URL) if available		http://green.cmu.ac.th/;http://enis.cmu.ac.th/
6.12(ED.7)	Sustainability report	○ Not available ○ Sustainability report is in preparation ○ Sustainability report is available and accessible ○ Sustainability report is available, accessible and updated occasionally ○ Sustainability report is available, accessible and updated annually	◉ Sustainability report is available, accessible and updated annually

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[1] Setting and Infrastructure (SI)

[1.3] Number of Campus sites

 	Muang Chaing Mai, **Suan Sak – Suan Dok Campus** (Chiang Mai University, Thailand)
	Lamphun, **Hariphunchai Campus** (Chiang Mai University, Thailand)

Description:

Chiang Mai University aims to be a **'Green and Healthy University'** , a society of Lanna Cultural conservation and developing sustainable economy. Ready to define approach of 'CMU Transformation' towards 'CMU New Step', encouraging education reform, promoting life-long learning and being the university of prototyped-innovation for community and sustainable development. To produce graduates who have morale, quality and skills to be global citizens. The university's commit to conducting research and innovations for excellence and serving academic services for society benefit.

Chiang Mai University (CMU) was founded in January 1964, under a Royal Charter granted by His Majesty King Bhumibol Adulyadej. CMU is the first provincial university in Thailand, based on the government's policy and the objectives of the northern people, as a center for academic and occupational knowledge in order to benefit the region and the country as a whole.

This university is a place for knowledge collection, studies, research, and knowledge transfer according to academic freedom based on morality and academic excellence, application and transfer, and arts and culture development.

Graduates from Chiang Mai University emphasize self-training in order to become knowledgeable, thoughtful, and practical persons, as well as being able to manage themselves and other people, with work ethics and social awareness.

Chiang Mai University is an educational institution with two campuses. The main campus locates in Muang District, Chiangmai Province and the second campus is in Lamphun Province (Please note that other research facilities without educational activity are not counted towards criteria).

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

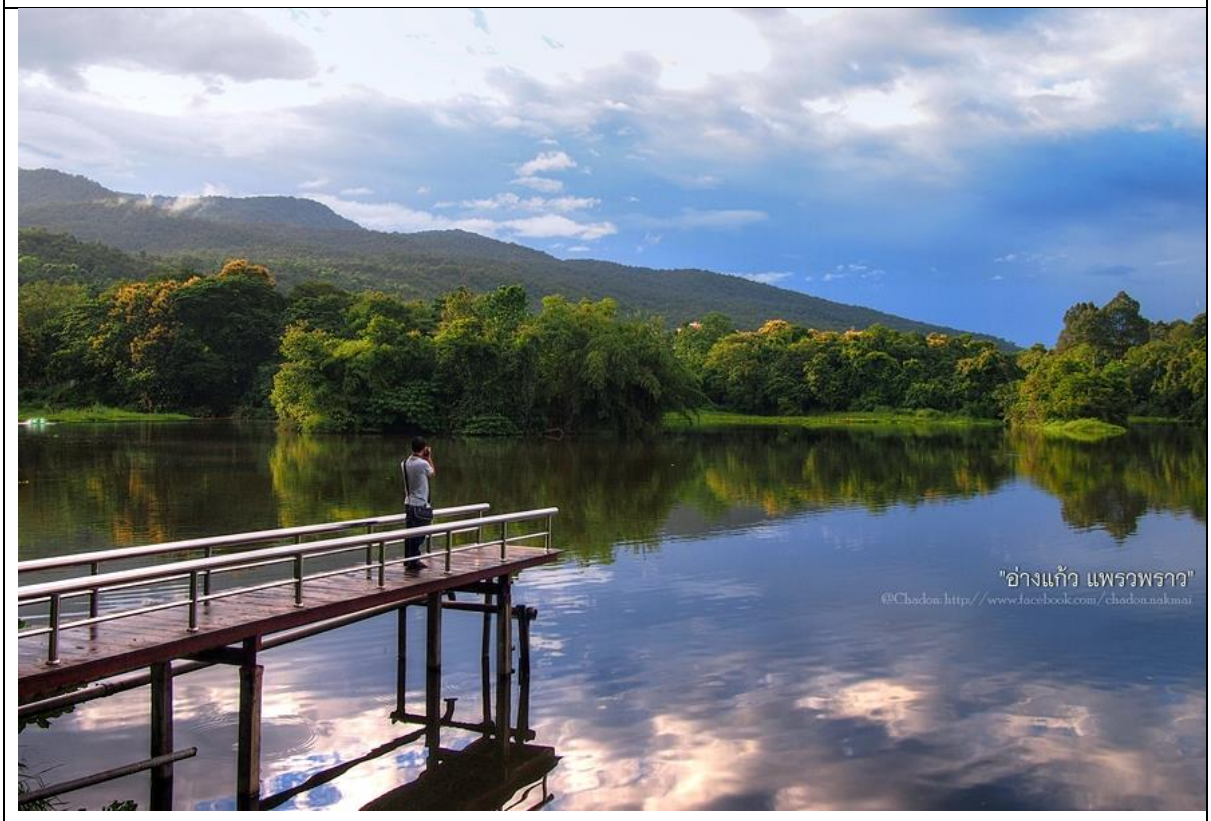
[1] Setting and Infrastructure (SI)

[1.4] Main campus setting

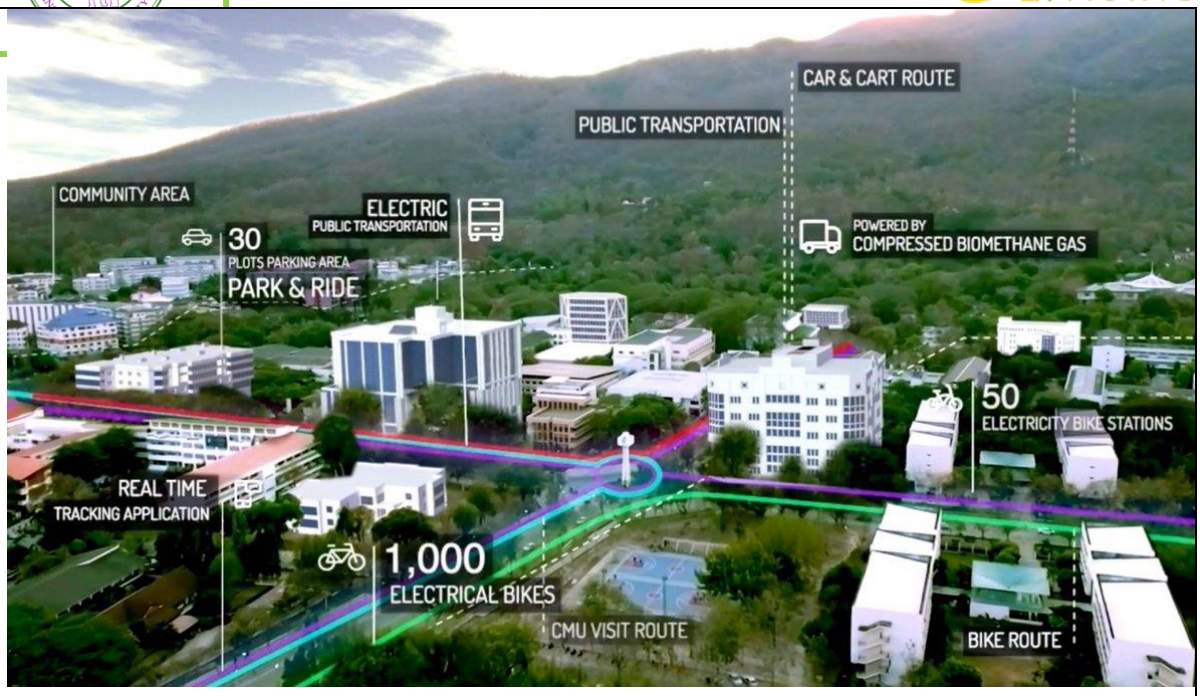


High rise buildings of Suan Dok Hospital in Suan Dok Zone of Chiang Mai University

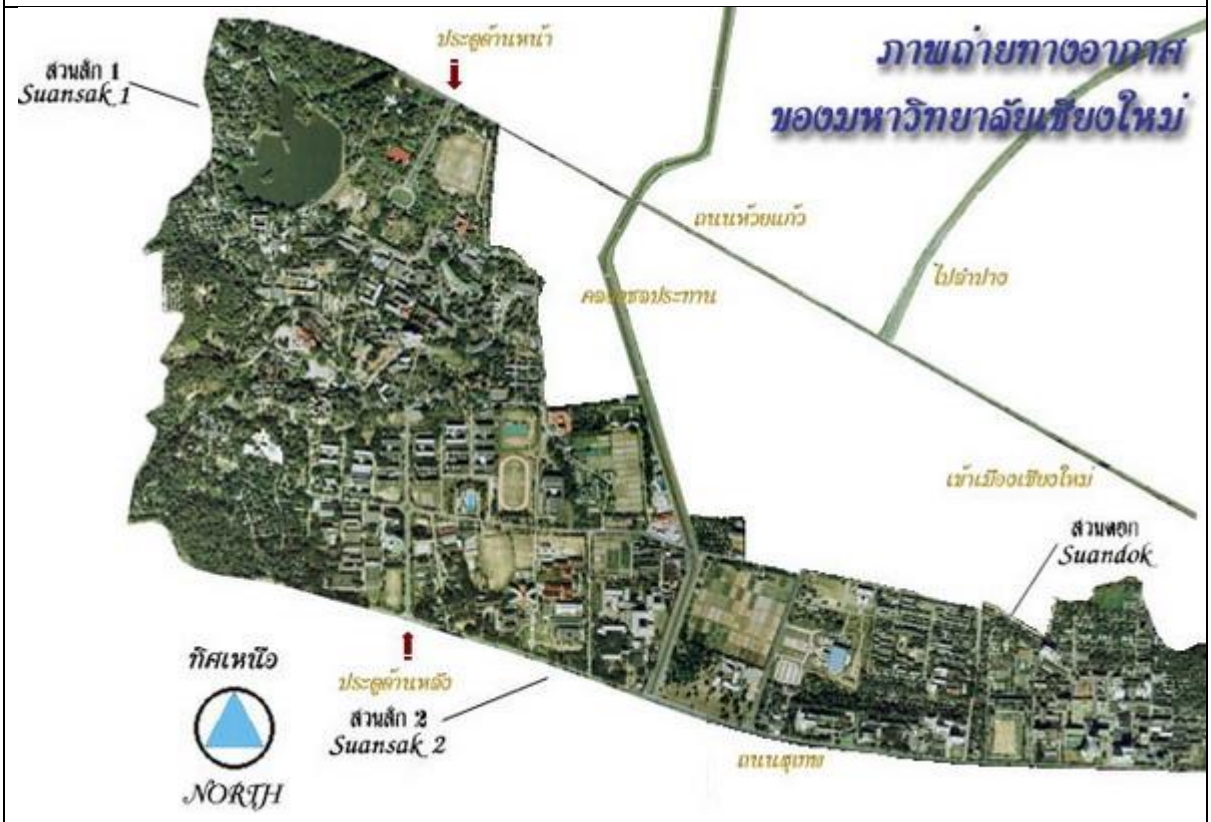
Nature Conservation forest area around the Sala Tham building at the front part of the Suan Sak Zone of Chiang Mai University



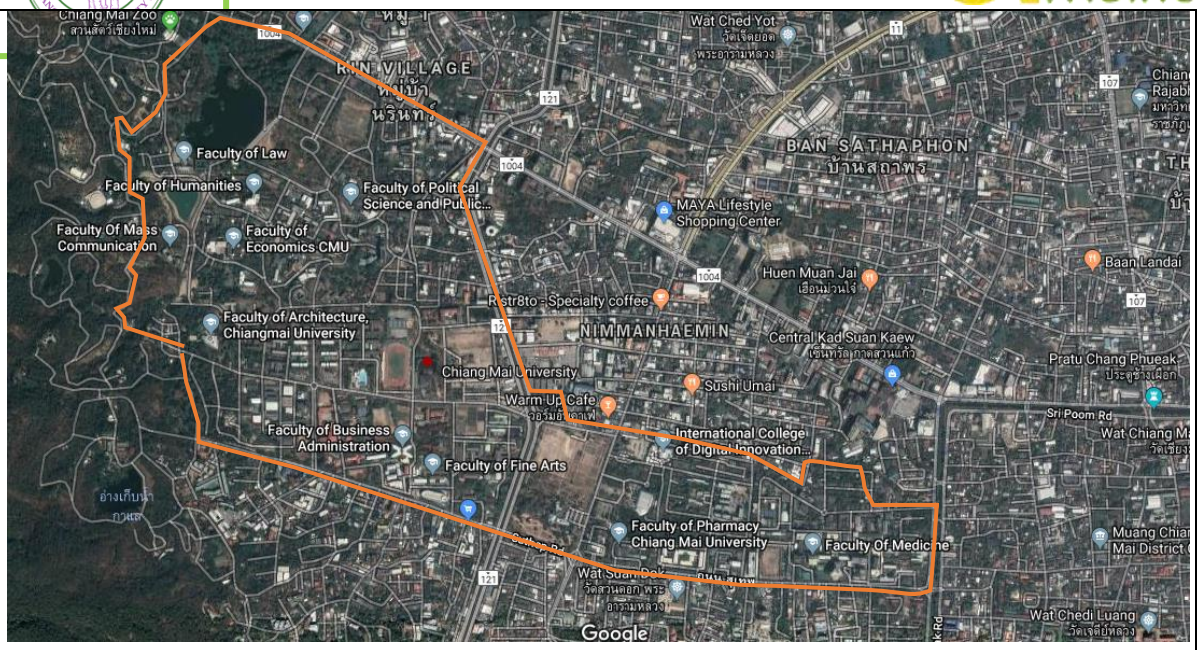
Forest conservation Area around the Ang Kaew reservior at the front part of Suan Sak Zone of Chiang Mai University

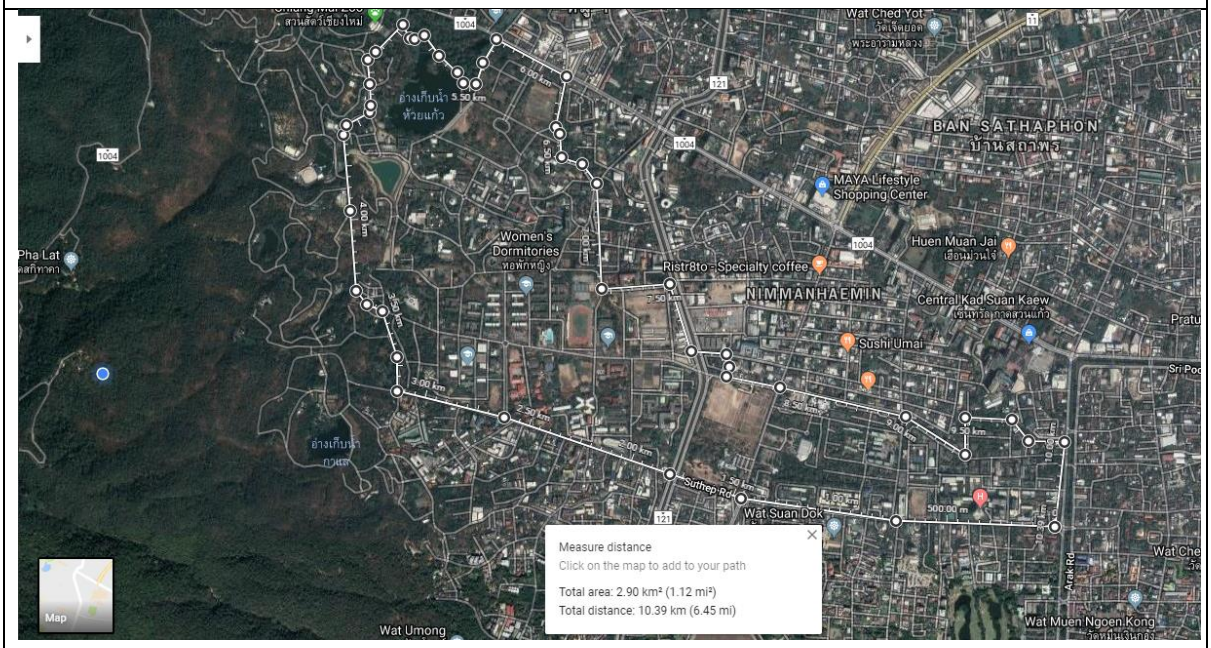


Buildings are located in the planting areas in the Suan Sak zone of Chiang Mai University



Aerial photos of Chiang Mai University campus plan, source: Aerial photo maps department





Aerial photos showing the campus and the connected urban area (google earth)

Description:

Chiang Mai University's main campus situates on 239 Huay Kaew Road, Suthep Sub-district, Muang District, Chiang Mai Province, Thailand, Postal code 50200 THAILAND

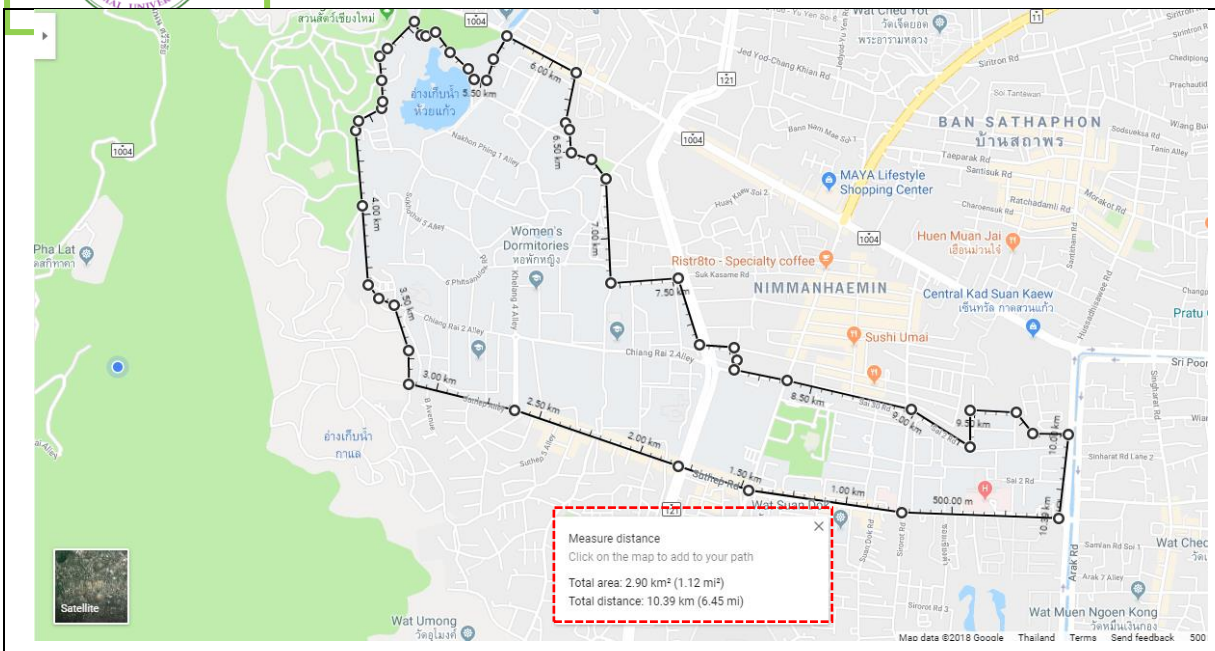
The university is located in Muang District of Chiang Mai. High-rise buildings of Suan Dok Hospital are in Suan Dok Zone whereas the buildings' height in Suan Sak Zone is a maximum of 7 floors, based on height limit of Suthep foothill regulation.

Template for Evidence(s)
UI GreenMetric Questionnaire

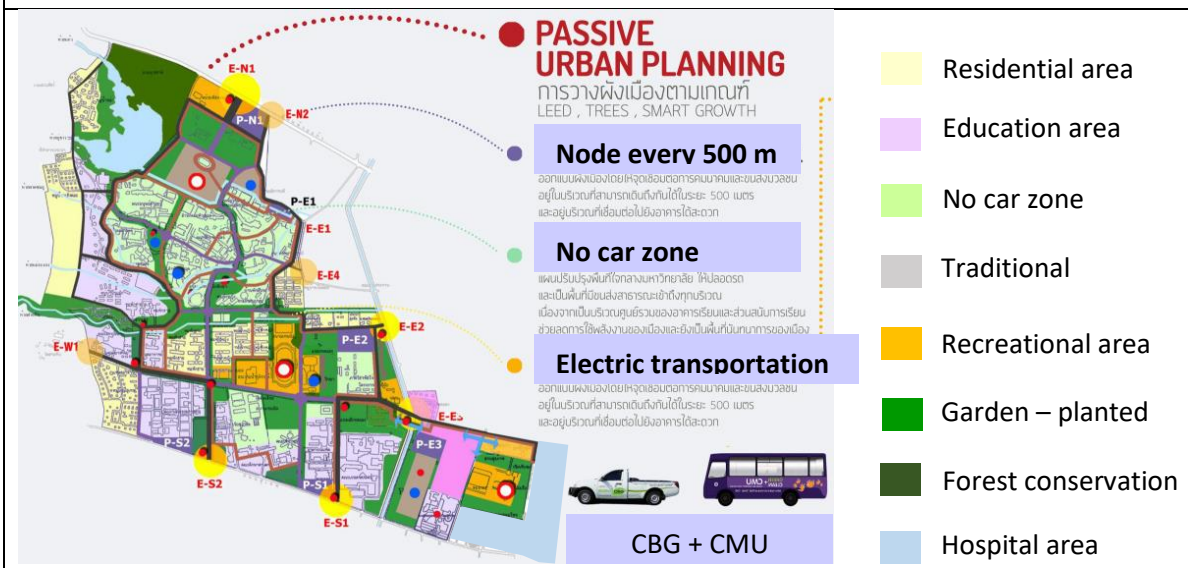
University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[1] Setting and Infrastructure (SI)

[1.5] Total main campus area (meter^2)



Gross site area of the university's main campus is 2.9 sq.km. calculated from Google Map



Land-use of Chiang Mai University

Description:
Total area of Chiang Mai University's main campus by Suthep foothill, including Suan Dok and Suan Sak areas is 1,812 Rais or 2,899,200 square meters

Total area: 2.90 km² (1.12 mi²) = 2,899,200 m^2
Total distance: 10.39 km (6.45 mi) = 10,390 m

https://www.cmu.ac.th/en/cmu/aboutus

[1.6] Total campus ground floor area of buildings (meter^2)
[1.7] Total campus buildings area (meter^2)

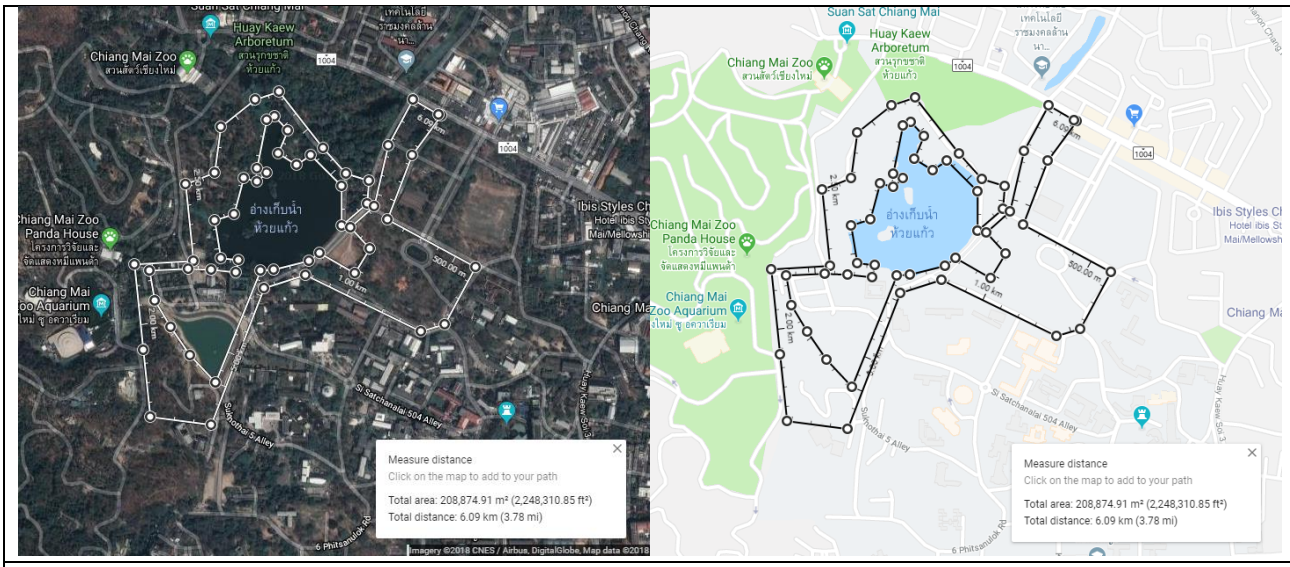
Total area of Chiang Mai University's building footprint is 617,220 sq.m. (21.3% land covering ratio), including 175 buildings with 815,175 sq.m. total campus buildings area.

Template for Evidence(s)
UI GreenMetric Questionnaire

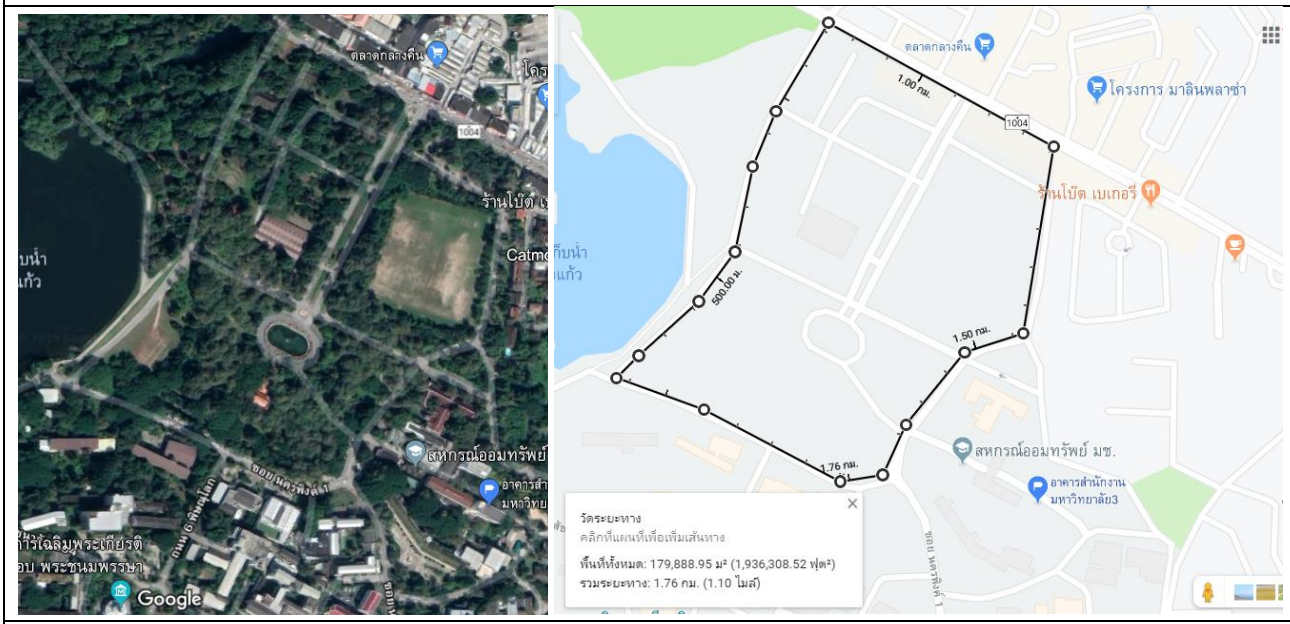
University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[1] Setting and Infrastructure (SI)

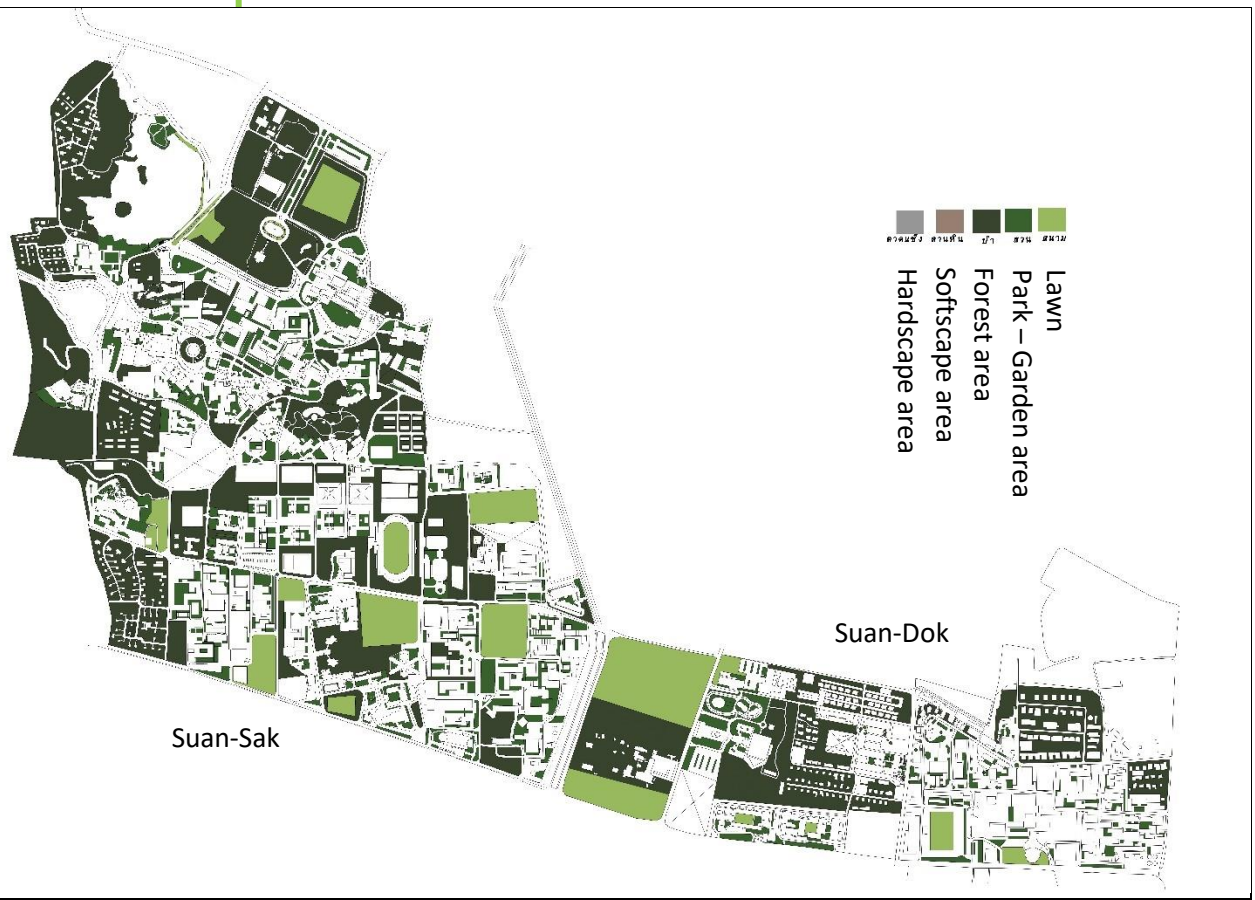
[1.9] Total area on campus covered in forest vegetation (meter^2)



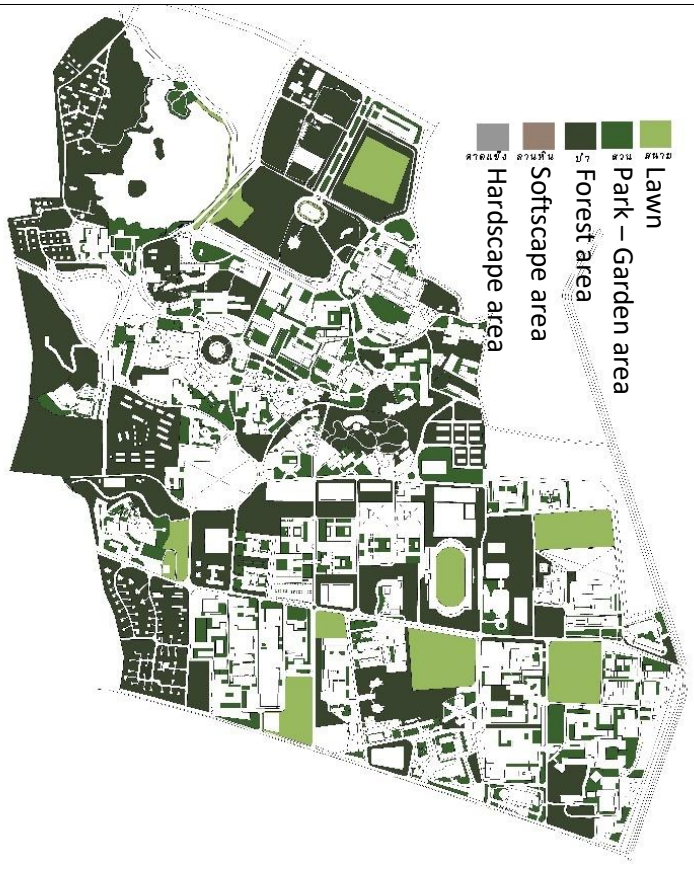
Forest Conservation Area around Huay Kaew Reservoir (Ang Kaew)



Forest conservation area around Sala Tham Building



Forest areas and planting areas on campus (Suan Sak zone + Suan Dok zone)



Forest areas and planting areas on campus (Suan Sak zone)

Description:

[1.8] The ratio of open space area to total area (SI1)

From the university's land data, the size of the university's land plot is 2,899,200 sq.m. with the open space area of 1,145,384.25 sq.m. in Suan Sak zone and that of 388,952.89 sq.m. in Suan Dok zone. The net open space area is 1,534.337.14 sq.m., consisting of gardens, lawns, dirt/stone grounds, and forest (Table 2.2). The proportion of the open space is 52.92% of the total area of the campus. If calculated based on 1.5-1.6 the open space area will be 2,281,980 sq.m., which is 78.98%.

[1.9] Total area on campus covered in forest vegetation (SI2)

Based on the university's survey data, the forest vegetation area of Suan Sak zone is 726,740.58 sq.m. and that of Suan Dok zone is 151,167.8 sq.m. The forest vegetation area is 877,908.38 sq.m. in total (Table 2.2). The proportion of forest vegetation area is 30.28% of the total the university's area of 2,899,200 sq.m.

Table 2.2. Summary of open space areas within the university classified by area types

No.	ZONE	Area types (sq.m.)			
		Gardens (G)	Lawns (GL)	Dirt/Stone Grounds (A)	Forest (F)
Suan Sak Zone					
1	In-front of the university area	5,008.00	24,507.00	0.00	105,604.00
2	Forest conservation area around Sala Tham Building	0.00	0.00	0.00	187,736.00
3	CMU Office buildings	7,592.00	0.00	2,479.00	4,952.00
4	The Faculty of Political Sciences and Public Administration	7,197.00	0.00	0.00	0.00
5	Park around Ang Kaew Reservoir	9,761.00	1,997.00	0.00	89,988.00
6	Park around Tad Chomphoo Reservoir	0.00	0.00	0.00	28,299.00
7	The Faculty of Humanities	7,531.00	0.00	916.00	19,776.00
8	The Faculty of Social Sciences	8,847.00	0.00	0.00	2,680.00
9	The Faculty of Economics	2,073.00	0.00	1,939.00	2,304.00
10	College of Arts, Media and Technology	2,720.00	0.00	3,339.00	0.00
11	The Faculty of Sciences	28,781.00	0.00	1,252.00	41,469.00
12	Registration Learning Building	6,858.00	0.00	1,086.00	8,770.00
13	Fai Hin area (food court)	10,260.00	7,863.00	1,433.00	125,928.00
14	The Faculty of Engineering	16,820.00	12,761.00	2,064.00	6,438.00
15	CMU Demonstration School	1,908.90	28,697.00	0.00	5,342.00
16	The Faculty of Education + ACCBA	10,989.29	26,299.00	5,749.92	4,394.00
17	Language Institute – The Faculty of Fine Arts	10,694.40	0.00	6,171.95	5,643.00
18	The Faculty of Agriculture	26,421.03	20,358.00	0.00	14,503.62
19	Park around PTT Gate area	5,617.24	17,902.00	0.00	10,021.34
20	Gymnasium building	14,315.27	9,790.00	0.00	55,195.62
21	Students' Dormitories	26,008.54	17,902.00	4,715.13	43,697.00
22	The Faculty of Architecture	7,170.00	0.00	3,150.00	0.00
	Total	**216,572.67**	**168,076.00**	**34,295.00**	**726,740.58**
Total open space		**1,145,384.25**			

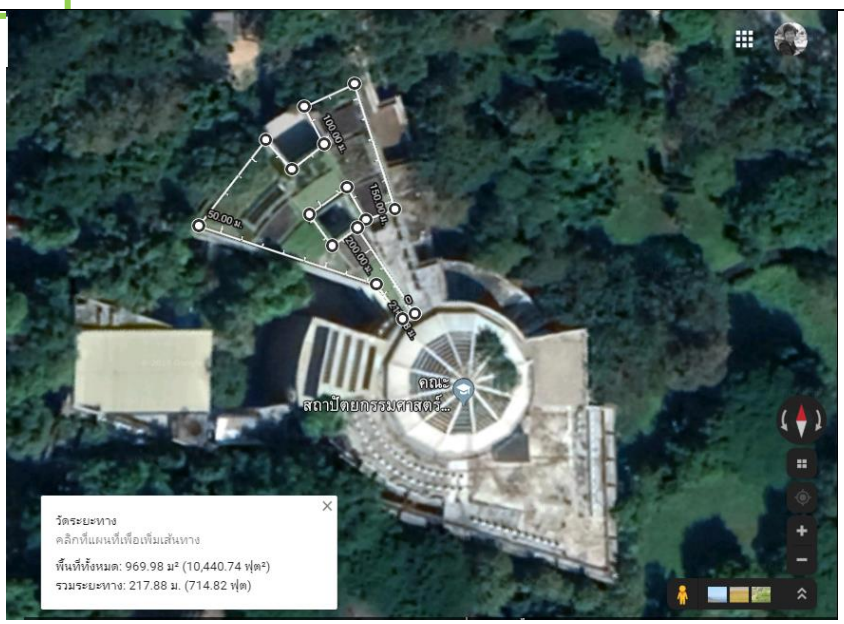
Table 2.2. Summary of open space areas within the university classified by area types (continued)

No.	ZONE	Area types (sq.m)			
		Gardens (G)	Lawns (GL)	Dirt/Stone Grounds (A)	Forest (F)
Suan Dok Zone					
1	Ford Field Park area	57,996.00	90,216.97	0.00	0.00
2	CMU Convention Center	14,077.98	0.00	2,047.8	8,124.63
3	Uni-serve Building	2,474.16	3,900.35	0.00	16,659.92
4	The Faculty of Pharmacy	4,550.53	1,563.86	4,999.98	0.00
5	The Faculty of Dentistry	3,807.5	1,019.01	0.00	0.00
6	Staff's housing and dormitories	1,442.42	0.00	6,028.05	75,022.74
7	Suan Dok Hospital	22,196.00	9,305.26	12,159.2	51,360.53
	Total	**106,544.59**	**106,005.45**	**25,235.03**	**151,167.82**
Total open area		**388,952.89**			

1.10 Total area on campus covered in planted vegetation (SI 3)

The planted vegetation areas of the university in 2018 is composed of 384,648.67 sq. m. of Suan Sak Zone and 212,550.04 sq. m of Suan Dok Zone including gardens, indoor and outdoor gardens as shown in Table2.2., 970 sq.m. rooftop gardens at the Faculty of Architecture building, and 1,530 sq.m. of vertical gardens at S1 Building. The total planting area is, thus, 599,698.71 sq.m., 20.68% of the total area of the campus (as shown in light green color in Suan Sak & Suan Dok maps). The university plans to increase the green areas from 52.92% + 20.68% = 73.60% to 80% by 2021.

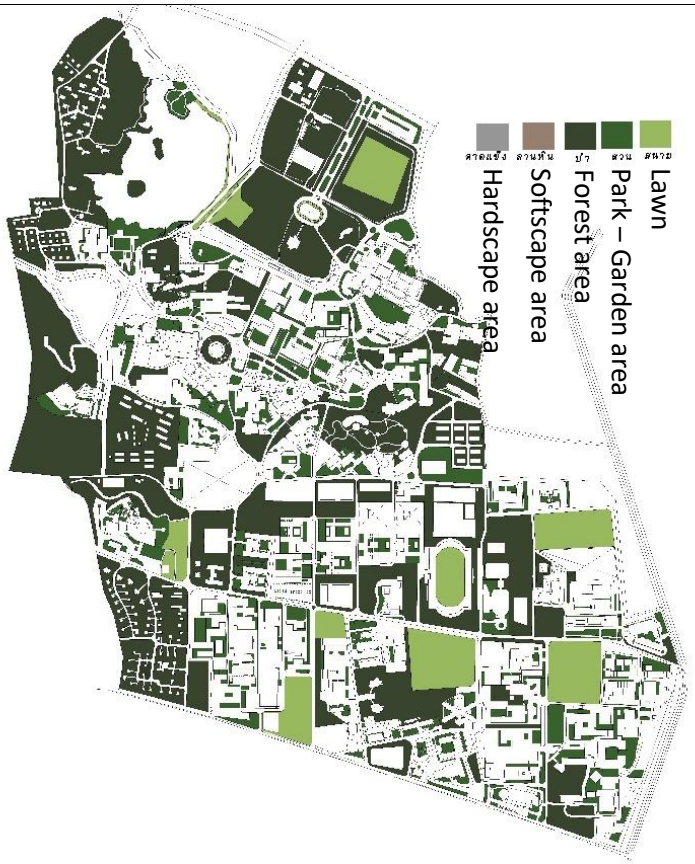
Vertical Gardens at S1 Building



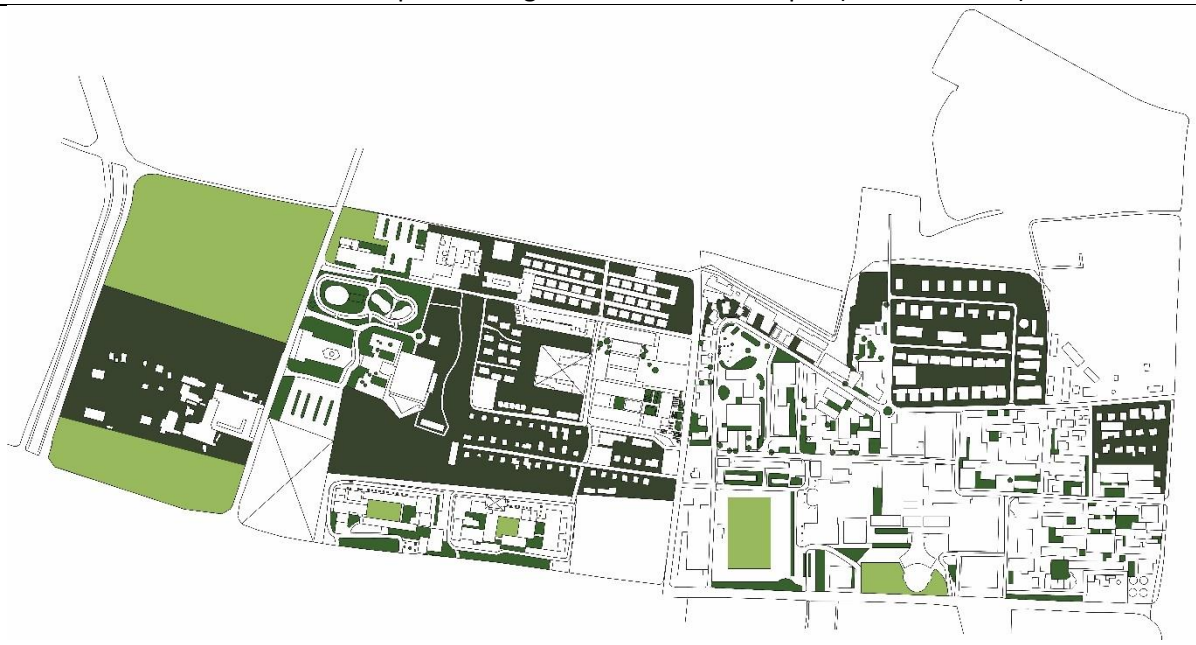
The 970 sq. m. roof garden at the Faculty of Architectural Building

Garden areas at the Faculty of Medicine and Suan Dok Hospital

The Kad Kong Kong (flea market) in the Faculty of Agriculture area and the garden at the Faculty of Humanities



Forest areas and planted vegetation areas on campus (Suan Sak Zone)



Forest areas and planted vegetation areas on campus (Suan Dok Zone)

1.11 Total area on campus for water absorption besides the forest and planted vegetation (SI 4)

The university's open space area is 2,088,811 sq.m. or approximately 1,305 Rai (excluding the building area) is composed of 1,756,800 sq.m. in Suan Sak Zone and 331,200 sq.m. of Suan Dok Zone. The land cover

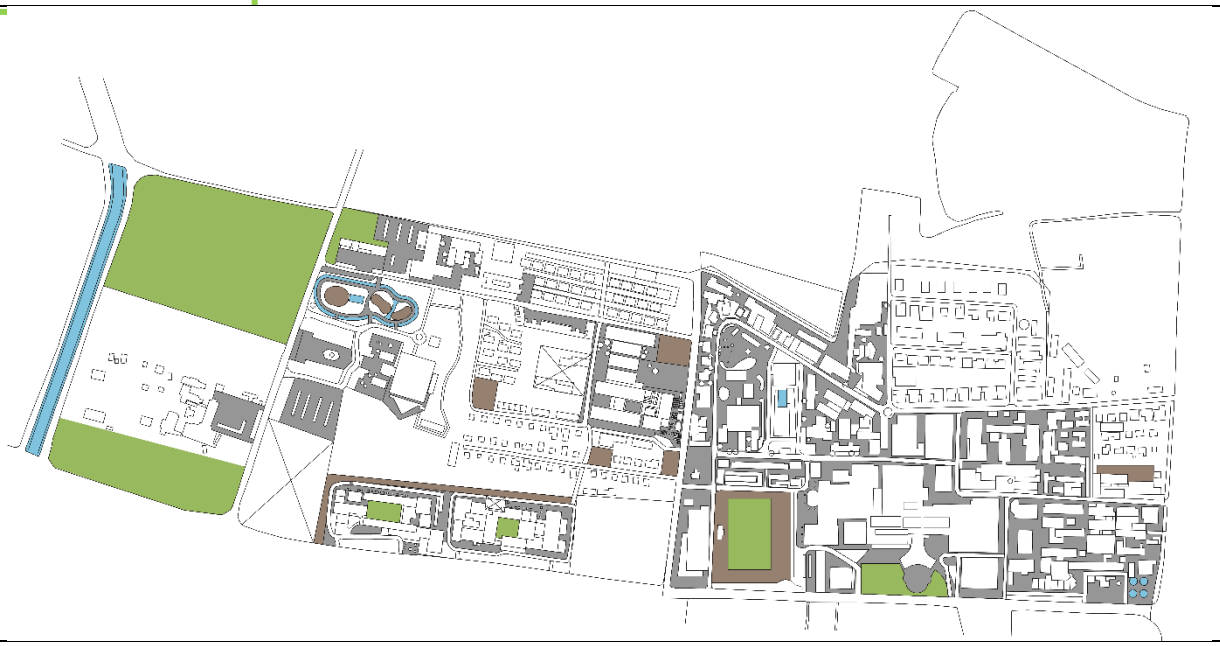
classification can be divided into 4 categories, impervious surface areas, cultivated areas, lawns, and forest areas.

The net water absorption area (permeable surface) of the university other than forests and planted vegetation areas (gardens) are lawns, dirt/stone grounds with approximately 333,611.48 sq.m. It is 15.97% of the total open space area or 11.54% of the gross land area of the university, as shown in open space area types maps. Details of the proportion of each area are as follows;

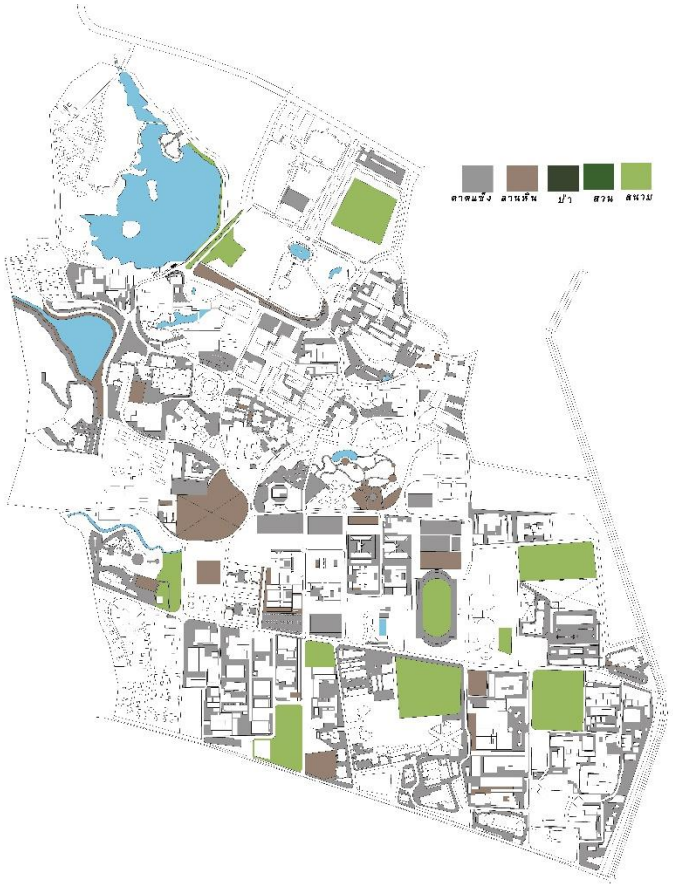
Lawns	274,081.45 sq.m., as in 13.12%
Permeable surface like dirt/ stone grounds	59,530.03 sqm., as in 2.84%
Impervious surface	31,145.00 sq.m., as in 1.49%

Based on the estimation of the preliminary effects of surface water hydrology, considering soil cover and Area-Weighted Average Runoff Coefficient calculation, the area of Chiang Mai University has an average surface water flow coefficient of 0.16. It has met the water absorption and flood reduction criteria of TREEs standard. Each of Suan Sak and Suan Dok area has an average surface water flow coefficient of 0.27 and 0.19, respectively.

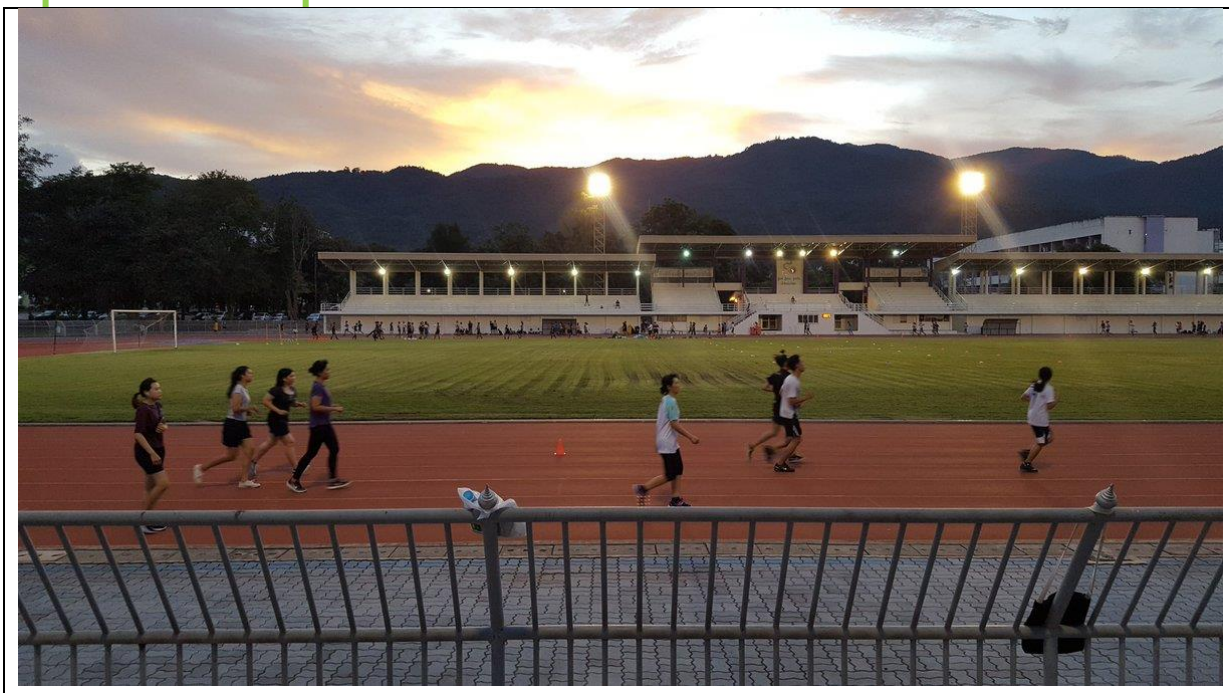
Water absorption area (permeable surface) of the university (Suan Sak zone and Suan Dok zone).



Water absorption area (permeable surface) of the university (Suan Dok zone).



Water absorption area (permeable surface) of the university (Suan Sak zone).



One of 5 main football fields

Rugby Field, Archery Arena

Ang Kaew reservoir (left) and Ang Tad Chomphoo reservoir (right)

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[2] Energy and Climate Change (EC)

[2.1] Energy efficient appliances usage are replacing conventional appliances

Since 2017, Chiang Mai University has established a policy concerning the use of energy-saving equipment. All new buildings must be energy-saving and environmentally friendly, certified by the Thai Green Building Institute. For old buildings, new energy-efficient appliances including smart meter lighting system (LED lighting system) replace conventional equipment. Existing air conditioning appliances have regularly been cleaned and maintained, while the old ones have been replaced. Solar roofs and solar water heaters have been added, which reduced the use of energy by 27.54% by comparing with the total amount of energy 75,172,000 kW, used in 2016. The university has implemented many projects concerning energy conservation plans by **replacing 90% of existing appliances with new energy-efficient devices**. Based on those plans, energy used will be reduced up to 32% by 2020 in comparison with the usage of energy in 2016 as the followings.

Table 2.5 Energy Saving Measures

No.	Energy Saving Measures	Decrease in electrical power (KWH)	The lower the amount of electricity compared to the year 2016 (%)	Proportion of energy saving equipment Installation
1	Change to LED light system measures in all buildings of the university	6,741,664	9.1	100%
2	Environment and Energy Innovation and Management			
2.1	Installation of ESM (EASY Smart meter) in all buildings of CMU Smart building Projects	7,572,100	10.26	100%
2.2	Cost reduction measures by using electricity generated from Solar roof	281,531	0.38	10%*
2.3	Cost reduction measures by using electricity generated from thermal energy systems by Solar Collector	1,247,669	1.7	100%**
3	A/C-cleaning Project in the university	4,486,727	6.1	100%
Total		**20,329,691**	**27.54**	**90%**

* The Solar roof installation was completed by 10% in 2018.

* * Install in all 24 -hour-operation buildings, including 10 dormitories and 8 inpatient hospital buildings.

Description:

Chiang Mai University has implemented the energy consumption reduction plan by replacing old electrical appliances by energy efficient appliances. The aim is to reduce energy consumption by 32% in 2020, compared with 2016. Details are follows.

1) CMU's LED lighting system installation Project: The university has replaced 71,670 conventional light bulbs and, as a result, saved up to 6,741,663.7 kWh, which equals to 68.07%. (Only electrical consumption decrease of the lighting system is counted.) This can be calculated as 9.1% less energy consumption.

Table 2.6 The University's lighting appliances Replacement Project

No.	Existing light bulb type	LED light bulb wattage	Number (tubes)
1	36 W Fluorescent lamps	18 W	62,110
2	18 W Fluorescent lamps	9 W	8,809
3	160 W Moonlight Bulbs	75 W	266
4	250 W Moonlight Bulbs	120 W	6
5	250 W High-pressure Sodium tubes (hpml)	120 W	229
6	250 W High-pressure Sodium tubes (hpml)	30 W	250
Total			**71,670**

LED lighting fixtures are replacing conventional appliances
(individual adjustment in all fixtures)
Photo: Faculty of Architecture, CMU, by Sumavalee Chindapol, 20 Dec2017

2) The Combined electricity and heat energy Cost Reduction Project by Environment and Energy Innovation and Management, 20,620,340 Baht/year (Budget year 2018) with 3 measures as follows:

2.1) Smart Building Operation Project: All the university's buildings on campus installed ESM (EASY Smart Meter) to monitor and analyze the actual energy consumption in order to create suitable electrical energy saving plans based on electricity usage behavior. The program had completed the installation during 2016-2018, which, based on the energy analysis, helped minimize the use of unnecessary energy by 10% (7,572,100kWh). This allows the energy consumption per the number of populations to be calculated. In 2018, the production of onsite power generation was 66,908,330 kWh, while the total usage of electricity was 73,767,400 kWh.

Easy Smart Meter Monitoring Screen shot (Source: http://enis.cmu.ac.th)

2.2) The cost reduction measure by using electricity generated from solar roof (1,126,123 Baht per annum)

Rooftop solar energy system, in total production size of 327.6 kW (Administration 2 Building and S1 Building = 121.6, ERDI Building = 37, Or.Kor. Building = 29, Faculty of Pharmacy Building = 80 STEPs Building = 40, Faculty of Architecture Building = 20), have been operating 5.23 * * hours per day and 250 days per year. The solar panels have 0.7 *energy yield derating factor (EF).

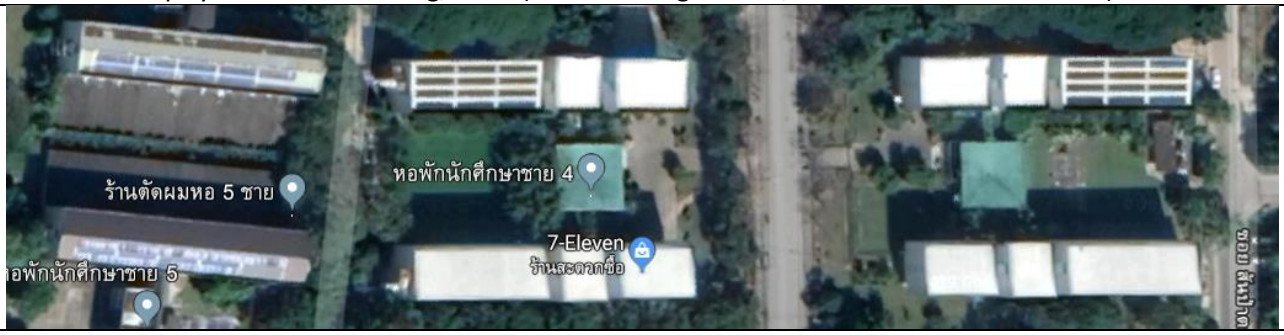
The production of electric power is 327.6 x 5.23 x 250 x 0.7 = 299,835.9 kWh/year, as a result, in 2018, the energy consumption can be reduced 0.406% (due to partial usage). The electricity cost reduction is 299,835.9 x 4 = 1,199,343.6 Baht/year.

* Energy yield derating factor is calculated from an energy loss occurring in the system, such as tilt angle installation, the location, inverter wiring, dust etc., which typically equals to 0.7 (based on www.greenzone-thailand.com) .

** See NASA Langley Research Center Atmospheric Science Data Center (2011)

Solar Parking Canopies, CMU (Source: CMU, taken on 15 Feb 2018)

A solar rooftop system of S1 building, CMU (Source: Google earth, accessed on 10 June 2018)



A solar rooftop system of Domitory zone, CMU (Source: Google earth shot on 10 June 2018)

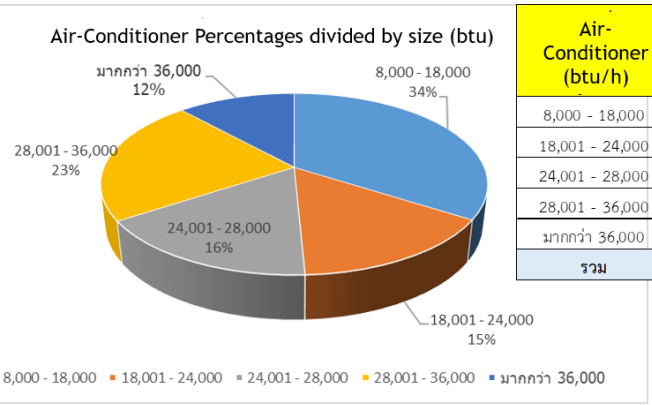
2.3) The Cost reduction Measure by using a Solar Collector Power System (4,990,676 Baht/year): The installation of solar water heating system university's dormitory buildings can reduce the university's electricity usage for 1,247,669 kWh. In 2018, it could reduce energy consumption by 1.7%.

The 1420 sq.m. rooftop solar water heating systems or Solar Collector produce an average of 0.7 KW/ sqm heating capacity per day, with ***x5.23 hours/day and 240 days/year, as a result, has saved heat energy for 3, 600x 0.994 x 1,255.20= 4,491,608 MJ/ year. This causes electrical power consumption reduction for 460,909.40/3.6 = 1,247,669 kWh/ year, which can be calculated as electricity cost reduction to 1,247,669x4 = 4,990,676 Baht / year .

Solar rooftops on Domitory Buildings, CMU (Source: Google earth, accessed on 10 June 2018)

3) A/C Cleaning Program cleaned 8,714 existing machines in 2018. The electricity consumption for old A/C systems of the university was 29,911,519 kWh. The program is able to reduce 4,486,727 kWh, 15% reduction of energy consumption used for A/C, and 6.1% of total energy consumption in 2018.

Air-conditioning system in CMU



Air-Conditioner (btu/h)	Operation (year)					Number of Air/Con
	<3	3-5	6-7	8-9	>10	
8,000 - 18,000	769	356	448	89	1,309	2,971
18,001 - 24,000	209	359	79	74	600	1,321
24,001 - 28,000	191	168	86	72	914	1,431
28,001 - 36,000	368	252	131	69	1,148	1,968
มากกว่า 36,000	239	145	85	52	502	1,023
รวม	1,776	1,280	829	356	4,473	8,714

Air-conditioner percentages divided by size (btu) (Source: reported on 15 Dec 2018)

A/C cleaning in Faculty of Architecture Building. (Source: shot on 15 Feb 2018)

4) In addition, Chiang Mai University also produces organic waste energy, biodiesel and biomass, using fermented food debris and organic waste. Since 2016, this has reduced fuel consumption for 2.64% and 1.44% respectively.

2.2 Total areas of Smart Buildings on campus (sq. m.)

The university has updated its existing teaching and learning buildings as a full-fledged smart building to meet the Thai Green Building Institute's criteria by 2021. At present, the faculty of Architecture building, covering the area 14,673 sq.m, is the first building to be upgraded by using more than 5 intelligent components according to 2019 UI Green Metric Guideline (see details in 2.3). As a result, the university's smart building area can be calculated as 1.7% of the whole building areas on campus. In addition, since 2018, the Easy smart meters, automatic energy inspection instruments, have been installed in all 178 buildings within the university's campus to monitor the electricity consumption and usage behavior.

Examples of the renovation policy to upgrade existing teaching and learning buildings to be smart buildings

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[2] Energy and Climate Change (EC)

[2.3] Smart Building implementation

According to the definition of a smart building based on the UI Green Metric Guideline 2019 , to be considered as a smart building requires more than 5 intelligent components . Although Chiang Mai University completed the installation of Easy Smart Meter (ESM) in all the 178 buildings in CMU in 2018, with management system from CMU Management Center, only one building can be counted as a smart building. It is the building of the Faculty of Architecture, with **the area of 14,673 sq. m, which is 1.7%** of the all building areas of the main campus. (815,175 sq. m.). The building has 7 elements that meet the smart building criteria, which are B2-APP, S3-CCTV, E1-Monitoring, E2-Management, I1-Thermal Comfort, I2-Air Quality and L1-LEDs. The S1 building does not have the inspection system of temperature and air quality in the building as shown in the table 2.7.

B2-App - Building Systems can be connected and monitored 24 hours online through website (www.asciitech.net/monitor) with password accessible for only the building users.

S3-CCTV - Functional areas of the Faculty of Architecture building are equipped with a closed-circuit camera system. Online inspection, with HD quality resolution, and information can be accessed by the staff and executives.

E1-Monitoring - All buildings at Chiang Mai University have been equipped with an electrical power meter. Using the Easy Smart meter (ESM) tool of Nakornping Energy Institute (Erdi) allows CMU to function real-time monitoring of electrical power consumption behavior via http://www.enis.cmu.ac.th/ and www.asciitech.net/monitor.

E2-Management - Solar energy system can be online connected and monitored at all time via (www.asciitech.net/monitor), with password accessible for only the building users.

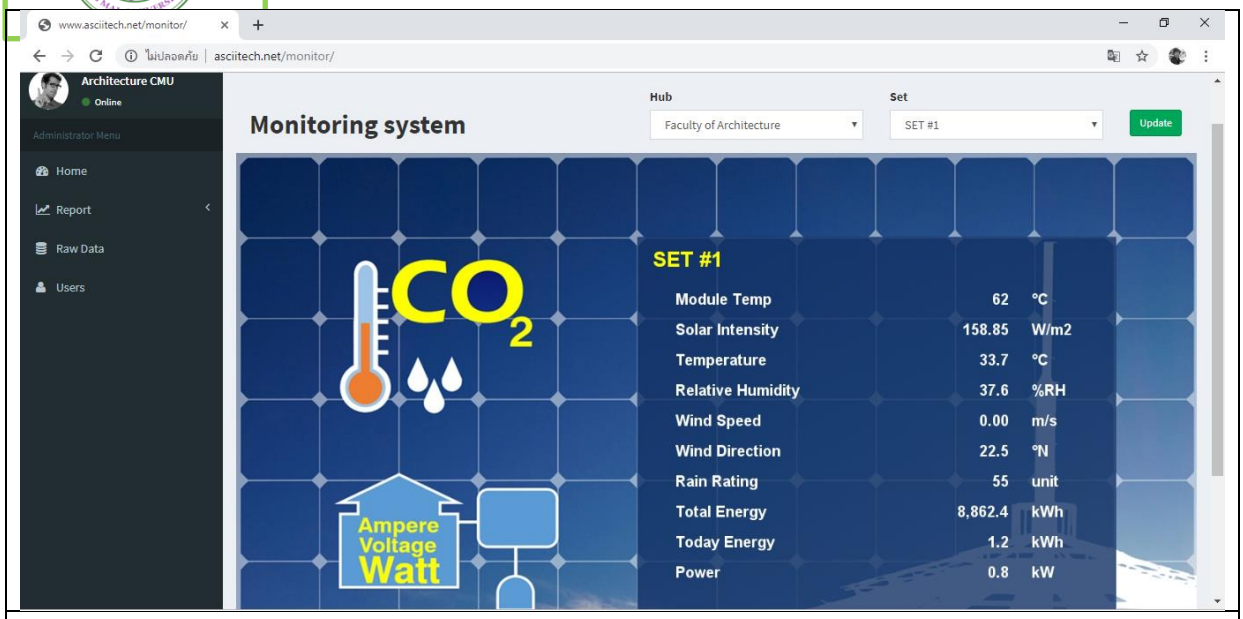
I1-Thermal Comfort – Weather measuring instruments in the Faculty of Architecture (FACMU) building are TENMARS made TM-185/TM-185D model, distributed by the Engineo company. The equipment can measure temperature ranging from-20 °c to 60 °c (-4°f to 140 °f) and relative humidity measurements from 0-100%, real-time monitoring via www.asciitech.net/monitor.

I2-Air Quality - Carbon dioxide measuring instruments in the Faculty of Architecture (FACMU) building are TENMARS made TM-185/TM-185D model, distributed by the Engineo company, which can measure CO_2 ranging from 0-10000 ppm, real-time monitoring via www.asciitech.net/monitor.

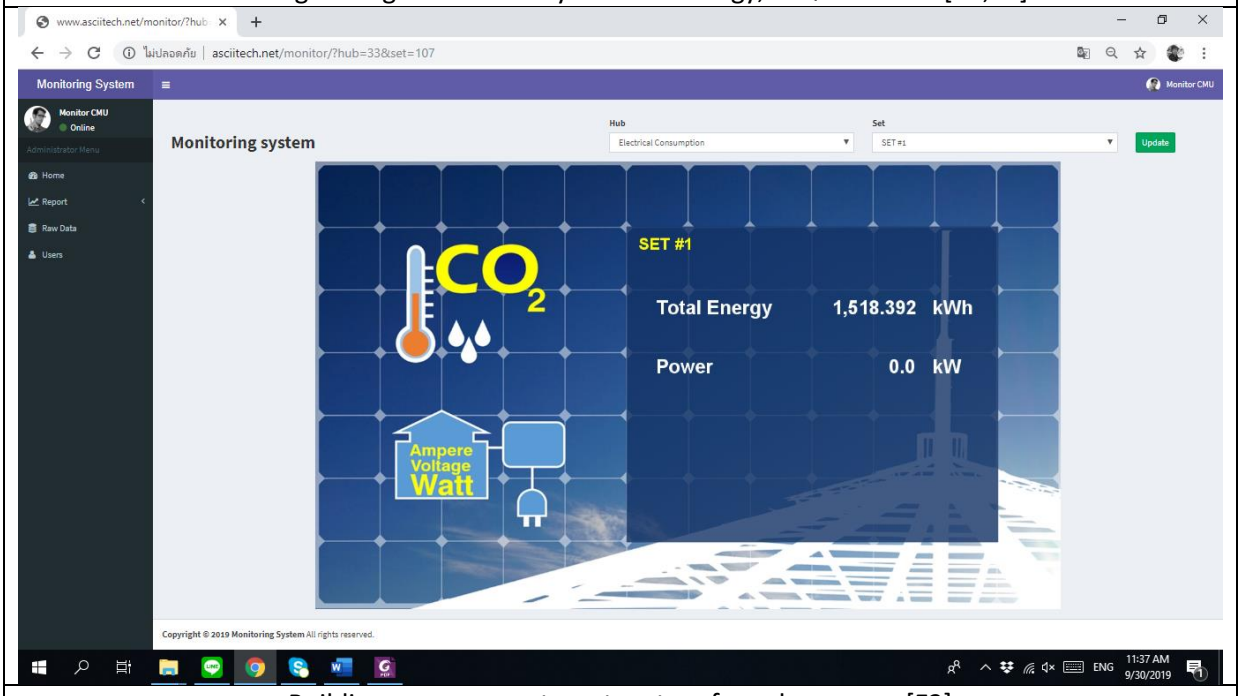
L1-LEDs - All buildings in Chiang Mai University have been completely equipped with LED lighting fixtures since 2017.

Table No. 2.7 CMU Smart Building - Comparison of FACMU building features and S1 Buildings

UI Green Metric Smart Building Criteria					FACMU	S1
List and Description of Smart Building Requirements					-	-
Field		**Requirement**		**Description**		
B	Automation	B1	BMS	Presence of Building Management System (BMS) / Building Information Modelling (BIM) / Building Automation System (BAS) / Facility Management System (FMS) **(recommended requirement)**	B2	B2
		B2	APP	Interactive support for users via APP or online service	-	-
S	Safety	S1	Intruder Alarm System	Intruder alarm system (recommended: interfaced with BMS)	-	-
		S2	Fire-fighting	Fire-fighting system (recommended: interfaced with BMS)	S3	S3
		S3	Video surveillance	Video surveillance system (recommended: interfaced with BMS)	-	-
		S4	Anti-flooding	Anti-flooding system (recommended: interfaced with BMS)	-	-
E	Energy	E1	Monitoring	Automatic acquisition and logging system of energy consumption (recommended: interfaced with BMS)	E1	E1
		E2	Management	Automatic management system for energy supplies and production (recommended: interfaced with BMS)	E2	-
I	Indoor environment	I1	Thermal comfort	Monitoring (recommended: interfaced with BMS) of environmental parameters related to thermo-hygrometric comfort (e.g. air temperature, relative humidity, air velocity, etc.)	I1	-
		I2	Air quality	Monitoring (recommended: interfaced with BMS)of pollutants (e.g. VOC, PM, CO2 ...)	I2	-
		I3	Real-time	Programming and management in real time according to the occupancy profile of the premises (recommended: interfaced with BMS)	-	-
		I4	Passive system	Passive cooling and/or exploitation/limitation systems for free supplies	-	-
L	Lighting	L1	LEDs	High-efficiency luminaires (LEDs)	L1	L1
		L2	Sensors	Automatic lighting control (recommended: presence/illuminance sensors interfaced with BMS)	-	-
		L3	Shielding	Shielding adjustment and solar control	-	-
		L4	Natural light	Passive systems for natural light exploitation	-	-



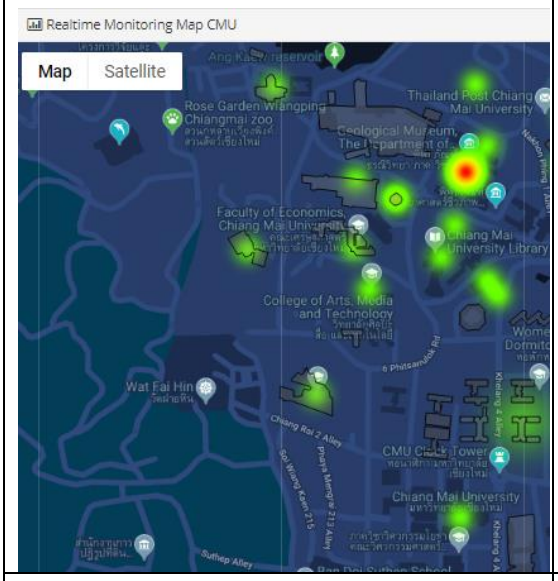
Building managementment system for energy, IAQ and CCTV [B2, I1]



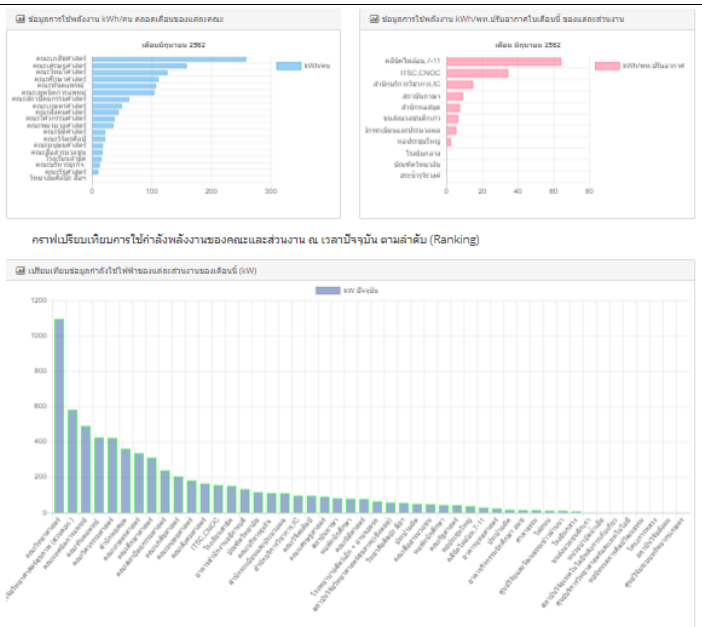
Building managementment system for solar energy [E2]

Interactive support for users-only in Thai [B2]

CCTV system of the Faculty of Architecture [S3]

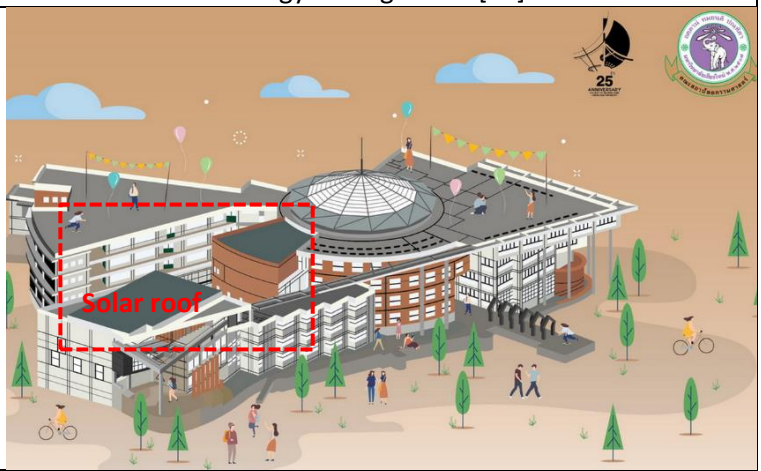


Peak Energy realtime monitoring [E1]



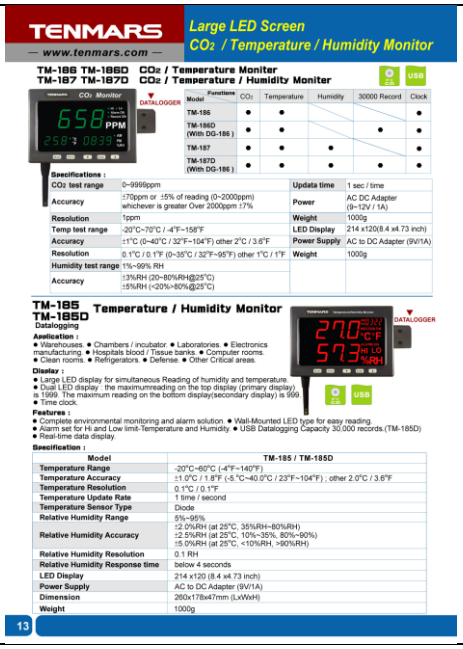
Energy management [E1]

ESM [E1]



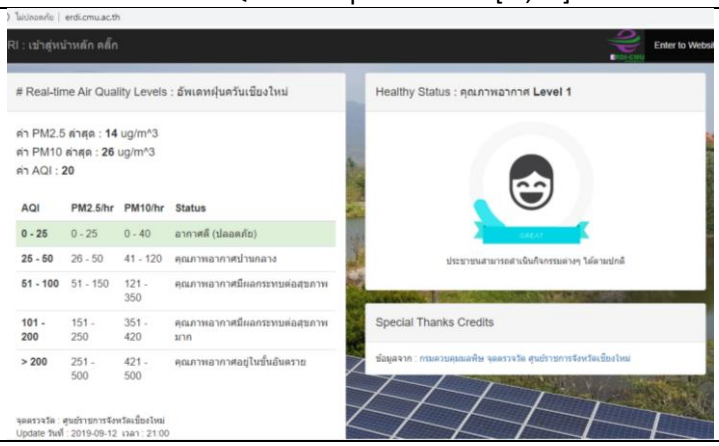
Solar roof at the Faculty of Architecture Building [E1, E2]

The IAQ sensor [I1, I2]



The IAQ sensor specification [I1, I2]

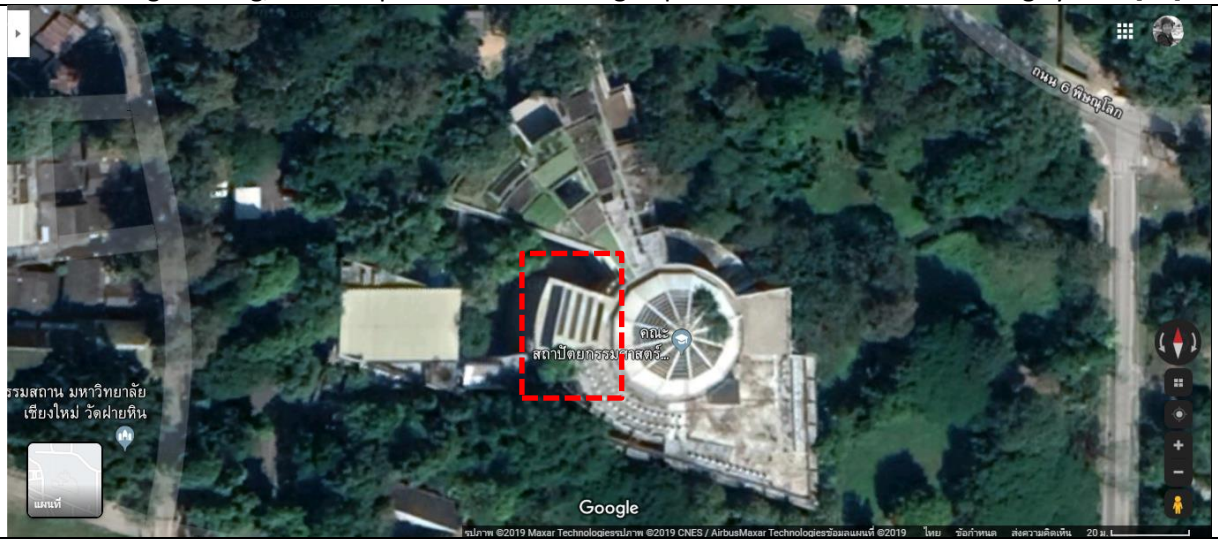
LED replacement [L1]



The installation of the AQI Measurement system in FACMU Building [E2]

Solar rooftop installed on S1 Building (left) and on FACMU building (right) [E1,E2]

S1 Parking Building, an example of Smart Building implementation on Smart Parking system [B2]



Solar rooftop on FACMU building [E1,E2]

Description:

By the time the four smart building renovation projects are completed in 2021, the anticipated Smart Building area percentage will be 6.9% of the total area of the university's main campus which occupies 825,686 square meters. Up until 2017, 'S1 Parking Building' was the only smart building in the university having smart device for energy management and rooftop solar cell. Its area occupies only 1% of the university building area. With an attempt to implement a smart building plan, Chiang Mai University has recently installed smart energy management devices on every building on campus. The plan is expected to complete by the end of 2018.

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[2] Energy and Climate Change (EC)

[2.5] Renewable energy produce inside campus

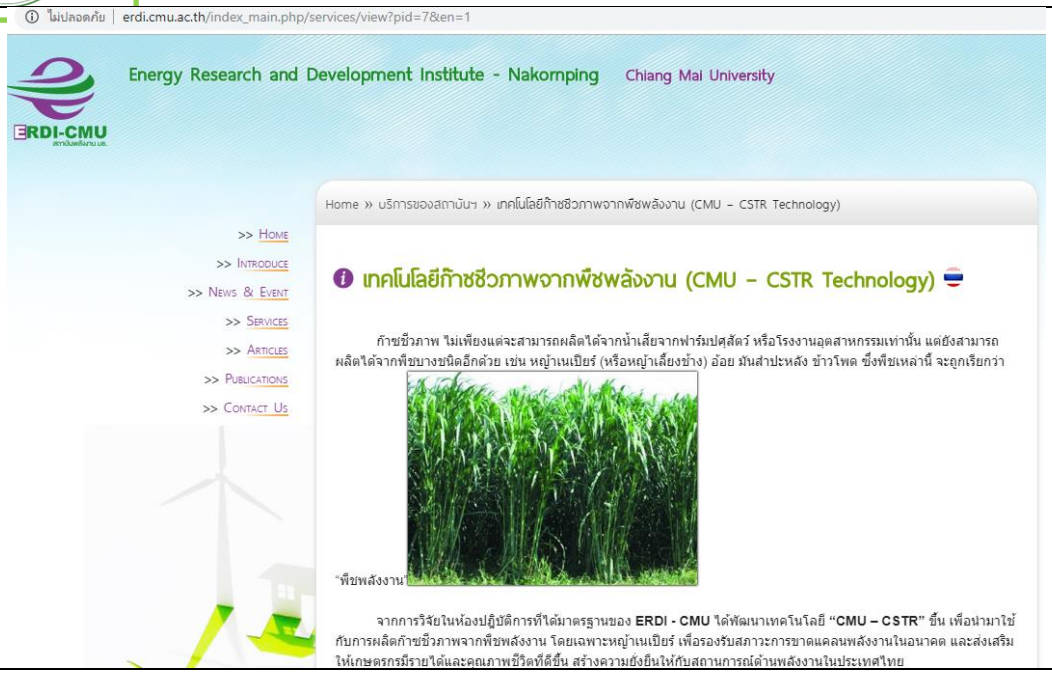
[1] Not applicable
[2] Biodiesel **(Capacity 1,989,000 kWh/y)**
[3] Clean biomass **(Capacity 1,080,000 kWh/y)**
[4] Solar power **(Capacity 31,160,000 kWh/y)**
[5] Geothermal
[6] Wind power
[7] Hydropower
[8] Combine Heat and Power **(Capacity 1,247,699 kWh/y)**

Description:

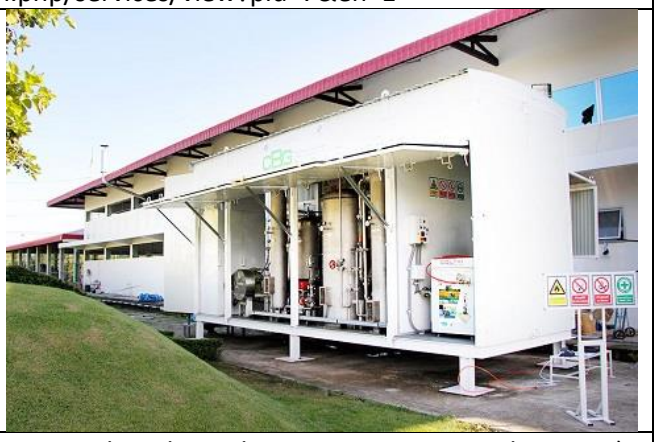
Table 2.8 Renewable Energy Production within Chiang Mai University's Main Campus

Table 2.8 Renewable energy produced on campus per year.

	Capacity (kw)	Productivity/year (kwh)
Biodiesel (Biodiesel)	500	1,989,000
Clean Biomass (Biogas from Garbage/Waste-CBG)	300	1,080,000
Solar Cell	85,120	31,160,000
Combine Heat and Power	400	1,247,699



Biodiesel from 'Energy Plants' such as Nepier grass, used as fuel for generators in buildings on the main campus (Energy Research and Development Institute – Nakornping)
http://erdi.cmu.ac.th/index_main.php/services/view?pid=7&en=1



Biogas – Compressed Biomethane Gas (CBG) (Energy Research and Development Institute – Nakornping)

Clean Biomass from garbage and waste (Energy Research and Development Institute – Nakornping)

Example of Solar Roof (Energy Research and Development Institute – Nakornping)

Table 2.9 Renewable energy produced on campus per year.

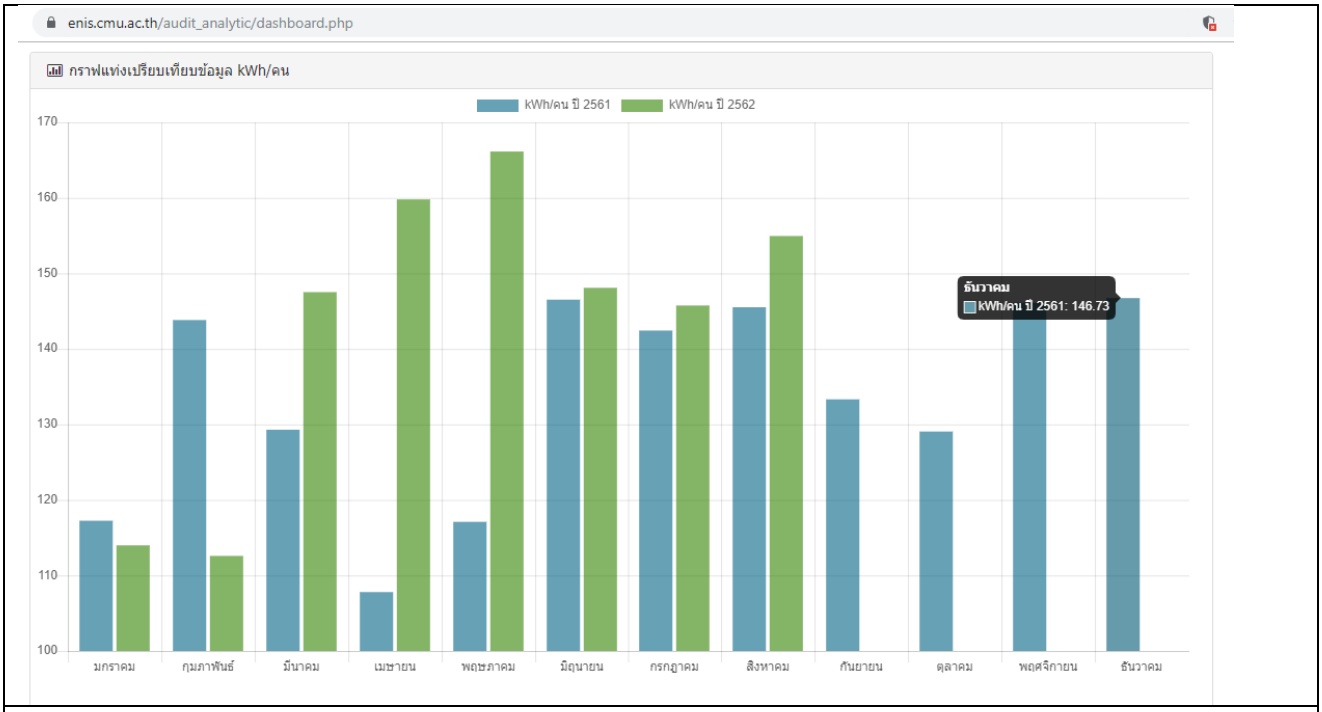
Detail		Unit	In 2017	2018
Electricity usage		kWh/yr	74,367,200	73,767,400
Electricity production				
- Solar Power from ERDI	(36 kWp)	kWh/yr	52,560.00	48,105.54
- Solar Power from Faculty of Agro-Industry	(29 kWp)	kWh/yr	42,340.00	38,751.69
- Solar Power from Faculty of Pharmacy	(62 kWp)	kWh/yr	82,848.00	106,901.20
- Solar Power from S1 building	(121.6kWp	kWh/yr	-	62,489.82
- Solar Power from North Science Park building	(40 kWp)	kWh/yr	-	53,450.60
- Solar Power from Faculty of Architecture building	(20 kWp)	kWh/yr	-	23,980.70
- Solar Heat Pump & Solar Heat Recovery		kWh/yr	-	1,247,699.00
			Total electricity production	**1,581,379.00 [2.143%]**

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[2] Energy and Climate Change (EC)
[2.6] Electricity usage per year (in kilowatt hour)

Description:
In 2016 and 2017 Chiang Mai University consumed 75,172,000 kWh and 74,367,200 kWh of electricity, respectively. In 2018, Chiang Mai University used electricity for 73,767,400 kWh.



Monthly energy consumption recorded by ESM as shown in HTTP//: enis.cmu.ac.th

[2.7] The total electricity usage divided by total campus population (kWh per person) (EC.4)
In 2018, onsite power generation produced 66,908,330 kWh, while electricity consumption was 73,767,400 kWh. Based on the total number of 48,431 people on campus, the proportion of the total electricity use per **the campus's population is 1,523.144 kWh/person.**

Table 2.9 The amount of renewable energy production in 2018

Detail			Unit	In 2017	2018
Electricity usage			kWh/yr	74,367,200	73,767,400
Electricity production					
-	Solar Power form ERDI	(36 kWp)	kWh/yr	52,560.00	48,105.54
-	Solar Power from Faculty of Agro-Industry	(29 kWp)	kWh/yr	42,340.00	38,751.69
-	Solar Power from Faculty of Pharmacy	(62 kWp)	kWh/yr	82,848.00	106,901.20
-	Solar Power from S1 building	(121.6kWp	kWh/yr	-	62,489.82
-	Solar Power from North Science Park building	(40 kWp)	kWh/yr	-	53,450.60
-	Solar Power from Faculty of Architecture building	(20 kWp)	kWh/yr	-	23,980.70
-	Solar Heat Pump & Solar Heat Recovery		kWh/yr	-	1,247,699.00
				Total electricity production	**1,581,379.00 [2.143%]**

[2.8] The ratio of renewable energy production divided by total energy usage per year (EC.5)

In 2018, onsite renewable energy produced 4,650,379 kWh, while electricity consumption was 73,767,400 kWh. Based on the total energy consumption on campus, **the proportion of renewable energy production per energy consumption was 6.304%.**

Table 2.10 The proportion of renewable energy production per energy consumption

	Productivity/year (kWh)	**Proportion of productivity per total energy consumption**
BioDiesel	1,989,000	2.69%
BioGas from Garbage / Waste	1,080,000	1.46%
Solar Rooftop (only in 2018)	333,680	0.45%
Combined Heat and Power	1,247,699	1.69%
Total	**4,650,379**	**6.304%**

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

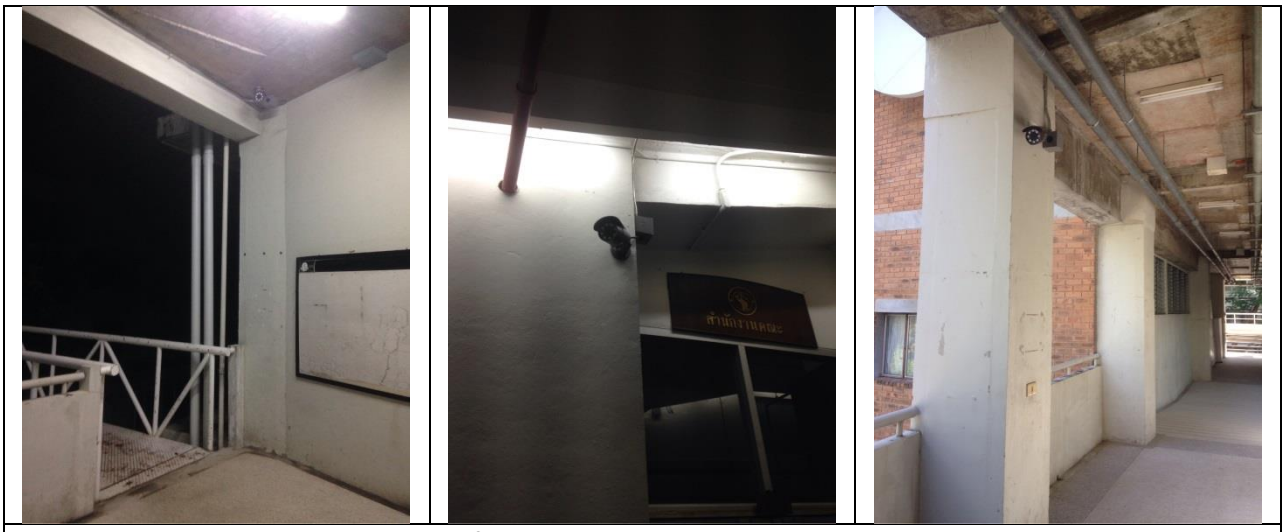
[2] Energy and Climate Change (EC)

[2.9] Elements of green building implementation as reflected in all construction and renovation policy

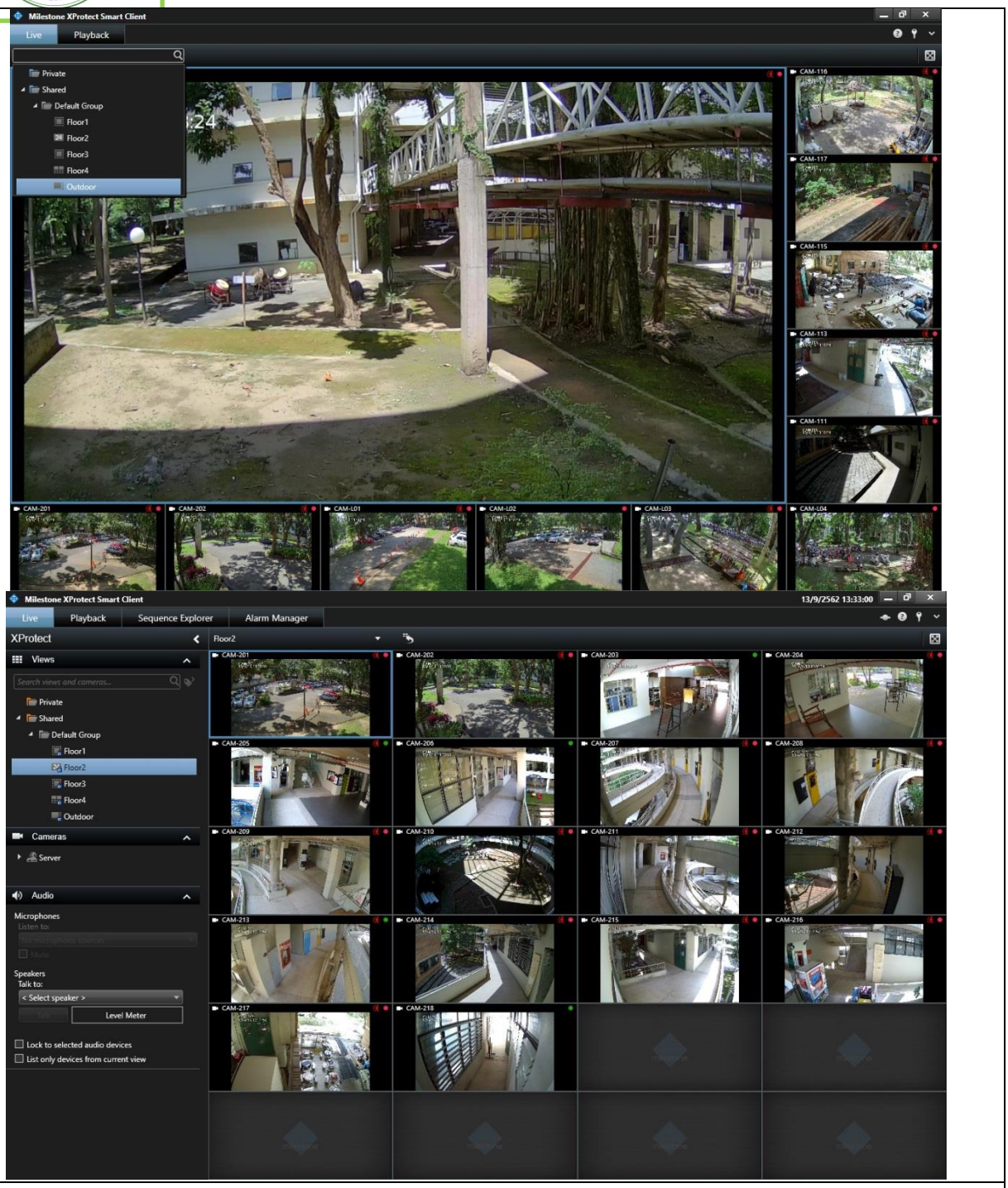
Description:

Chiang Mai University has operated more than 11 green building measures, as follows:

1) Urban planning, with intelligent energy system and smart city management system, was completed in 2018. All buildings have smart meters and CCTV systems, which can be checked by the Smart City Management Center (SCMC-CMU) [https://scmc.cmu.ac.th/]. This allows the central authorities to issue energy efficiency policy and management measures to increase 10% of energy performance of operational parts yearly. The policy includes the increase of electricity usage fine to the operational segments' if their electricity consumption exceeds the average energy usage per person of the university.



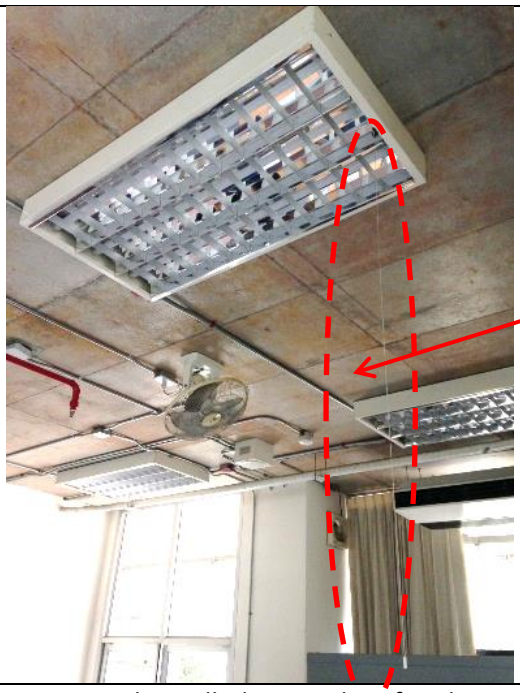
Example of CCTV installing in the FACMU building



Example of CCTV monitoring system on FACMU

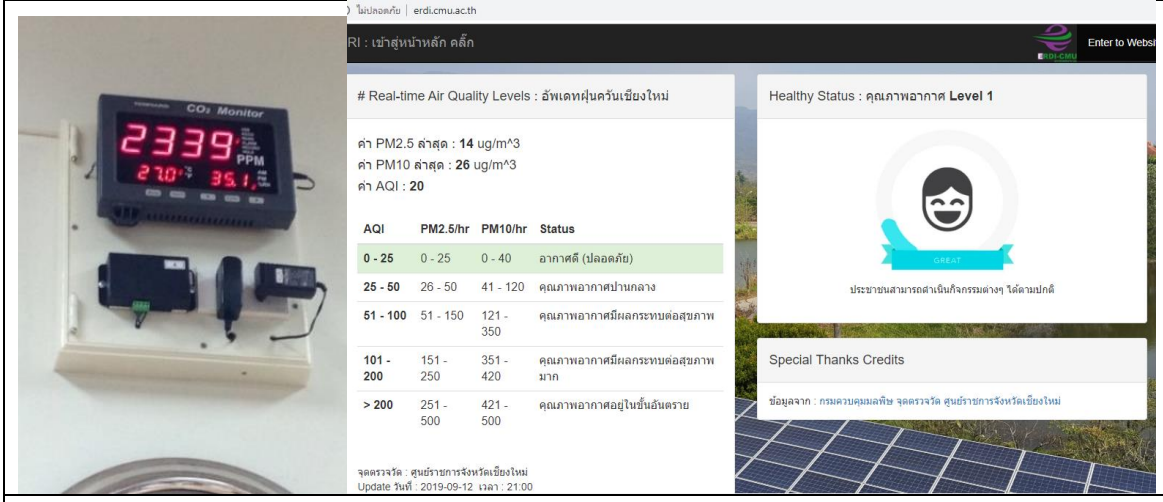
2) The installation of solar PV panels on all buildings' rooftops by using Smart Grid System enables the use and the production of electricity in all buildings to be kept and distributed. According to the plan, all buildings are able to use solar power to replace the use of the electricity at least 2% per annum.

3) The change of entire lighting fixtures of the university to high-performance LED bulbs increases efficiency in lighting energy utilization. In addition, it also increases individual lighting control by installing separate managing devices.



Personal lighting control installed at Faculty of Architecture (FACMU)

4) Healthy Building Measures: Chiang Mai University sets up a policy to create a healthy workplace by installing indoor and outdoor air quality measuring equipment, measuring indoor carbon dioxide and small and medium sized dust particle level (PM_{10} & $PM_{2.5}$) in front of the buildings. Any area that exceeds the standard level will be reported back to the SCMC-CMU center to proceed in the next security measures.



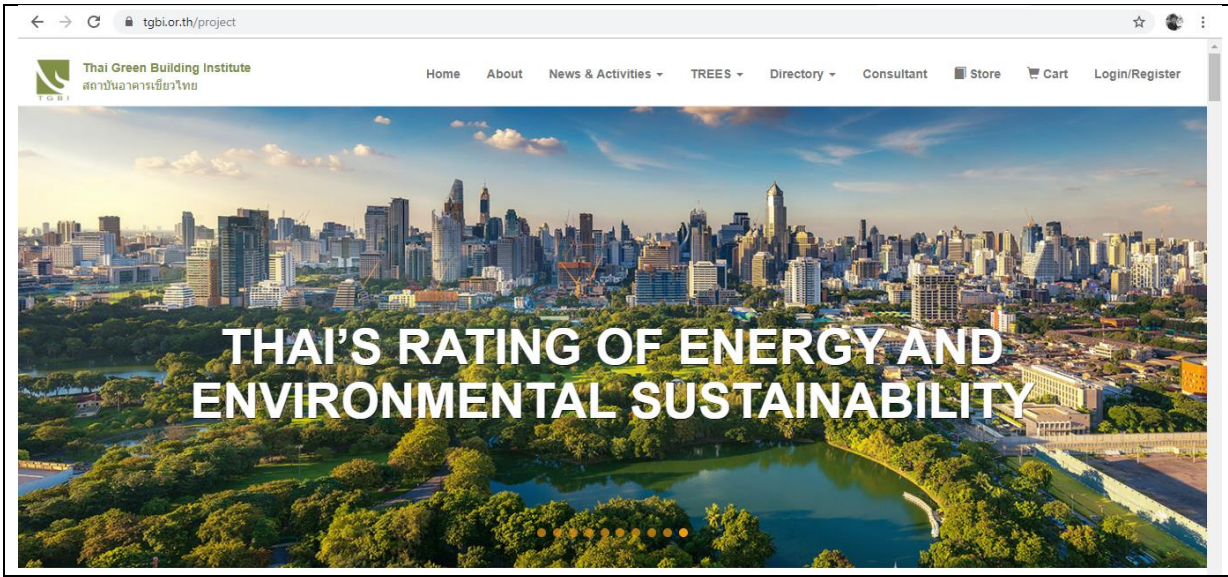
The installation of indoor air quality sensors

5) Increase the green areas in the buildings by allowing all operational segments to increase the green areas in their designated areas for no less than 5%. If there is no space available, indoor potted plants and a vertical garden (green wall/Vertical garden) are suggested such as the S1 building.

The S1 car park building, a green building prototype with vertical garden (parking building – Green wall Prototype)

Green parking building concept with vertical green walls (Parking building – Green wall Design)

6) New buildings with a functional area more than 10,000 sq. m. will be designed and constructed from 2016 onwards. These buildings must be designed as energy-saving and environmentally friendly buildings, certified by Thai Green Building Institute (TGBI, https://www.tgbi.or.th/). They are more than 25% energy savings, utilizing water-saving equipment, natural light and renewable energy in the building, as well as using the local materials in construction.

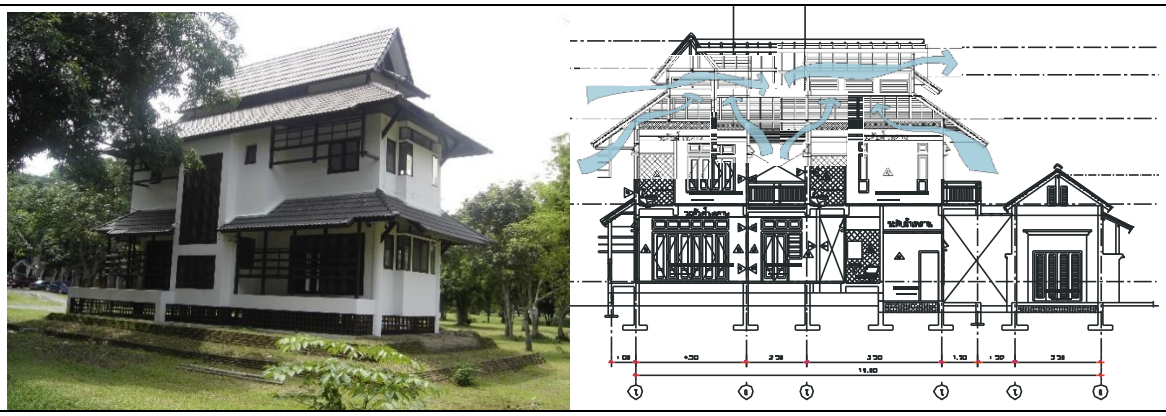


Thai Green Building Institute, the authority of Thailand's Green Building assessment certification

7) Low heat-deposition painting of the existing buildings will be done if it is not possible to upgrade them to be energy saving buildings. The operational segments are responsible for improving buildings by painting the buildings with low heat or reflective heat paints, with a guaranteed effect that improves energy saving efficiency.

8) Building improvement measure: The construction sites must be maintained to produce pollutions and impacts to the surrounding environment as less as possible, by covering them with plastic filters that can handle large dust particles like PM10.

9) The buildings without A/C systems should be designed with natural ventilation principle, orienting the buildings with less heat accumulation. The Faculty of Architecture, CMU, built an passive energy-saving and eco- friendly house, a house prototype that uses natural ventilation, in 2007 and has been used until 2015. The Green Building concept was applied to a new building, S1 car park building, using green walls as shading devices, cross-ventilation design, solar rooftop system and the intelligent power tracking system (Easy Smart Meter). Finished in 2016, the S1 building is nearly-zero energy consumption and becomes a building model for upcoming green building projects, which are North Science Park, the Small animal Laboratory Center, and Smart Car Parking Buildings

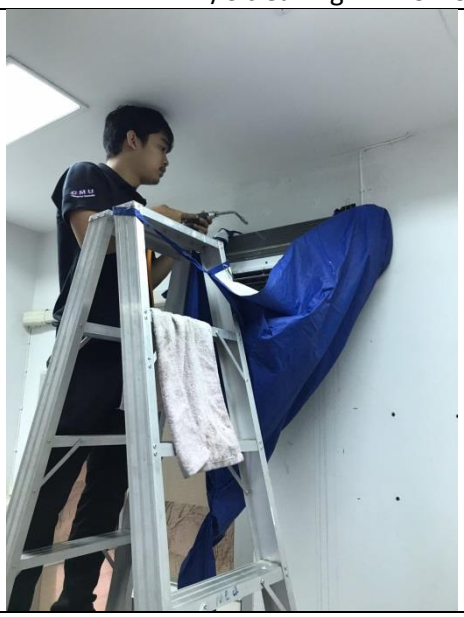


Passive energy-saving house at the Faculty of Architecture
(Passive House – Energy Saving)

An energy-saving building of Northern Science Park Project

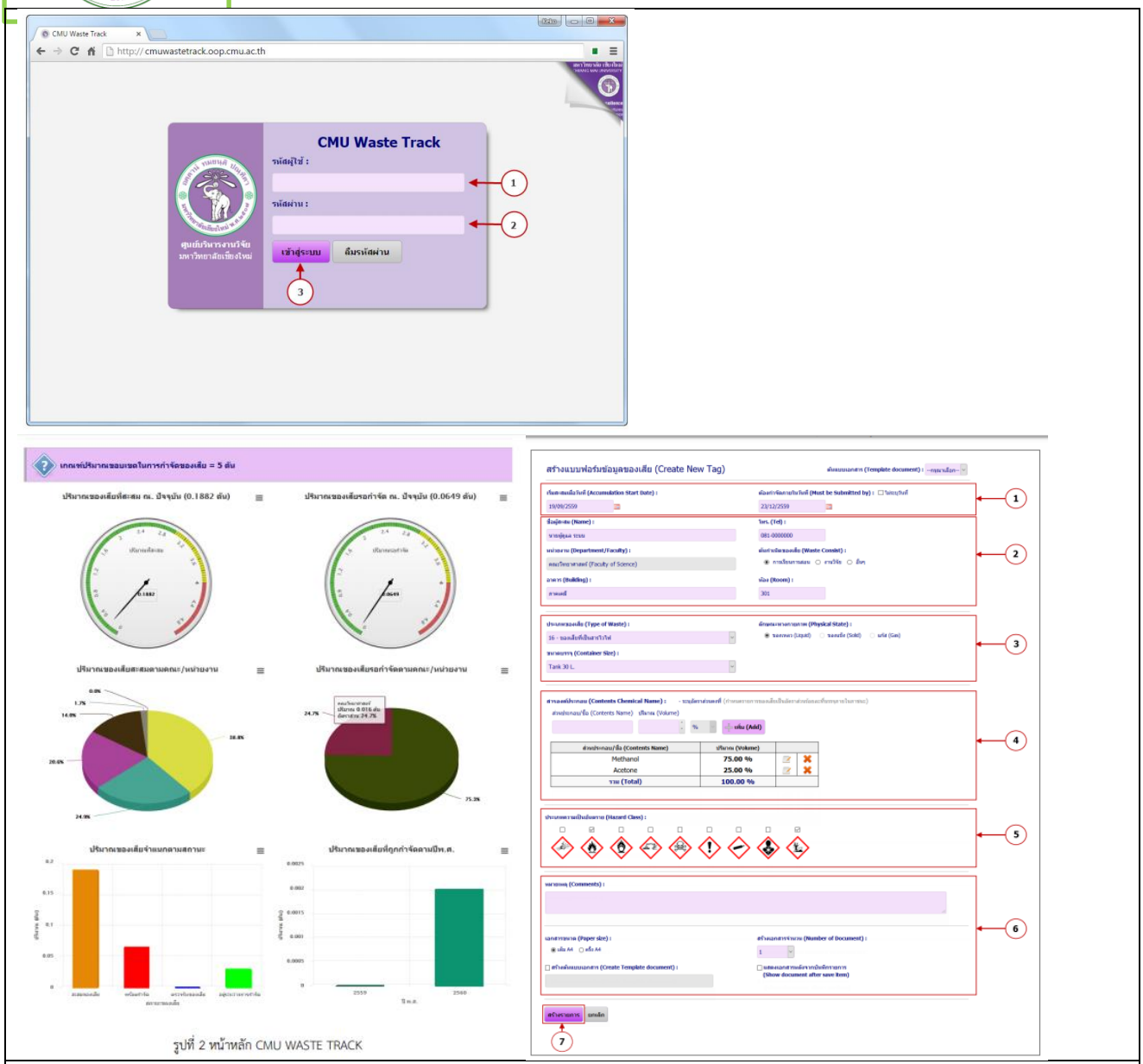
10) The improvement of the air conditioning system policy has all A/C systems modified to be energy-saving ones. Due to the problem of limited budget, the defective or longer than 10-year air conditioning units are gradually released. In addition, A/C cleaning is conducted for all functioning air conditioning units in the university every 6 months to help improve A/C efficiency by 15%. Setting the air-conditioning no less than 25 °c. temperature all year round also increases energy saving.


A/C cleaning in FACMU building (Source: shot on 7 Aug 2019)




A/C cleaning in FACMU building (Source: shot on 12 Aug 2019)

11) Chemical Toxins handling measures: Chiang Mai University has participated in laboratory chemical toxins management program. All buildings require a proper management to store chemical toxins and dispose of toxic waste. These toxins are processed by the CMU-waste track project, with 20 types of toxic waste management measures, including chemicals used for building cleaning and chemicals from the photocopiers.



Toxic waste management system, CMU waste track

In addition, Chiang Mai University also has a number of sustainability measures at the urban planning level, which are finished in 2018, for example

- Free of charge of clean energy public transportation connection
- City and City-Suburb clean energy public transportation connection
- Functional green areas addition and Tree areas conservation.
- Integrated solid waste management: Each building has 100% waste sorting. Then CMU's integrated solid waste management center will manage to collect, sort and process. Plant waste will be fermented to make CBG fuel for electricity generation. The remaining organic solid waste is made to fertilizer used for the gardens in the university's area. Glasses and paper will be put in re-cycled process. Plastic waste will be processed, manufactured and re-made as a new plastic product.

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[2] Energy and Climate Change (EC)

[2.12] Please provide total carbon footprint (CO_2 emission in the last 12 months, in metric tons)

[2.10] Greenhouse gas emission reduction program (EC 7)

Description:

From the summary table of the greenhouse gas reduction measures of Chiang Mai University, 2016-2018, there are all kinds of direct and indirect greenhouse gas emission reduction projects (Scope 1, 2 and 3).

2018 greenhouse gas reduction measures include

1. The electrical power produced by Solar roofs = 333,679.55 kWh/y. The amount of greenhouse gas is reduced to 333,679.55 x 0.561 * = 187,194.228 kgCO_2 = 187.194 TonCO_2/ปี

2. Thermal content of solar water heating system with a size of 1,420 sq. m. decreases the power consumption of the 1,247,699 kWh/year. This reduces greenhouse gases by 1,247,699x0.561 * = 699,959.1 kgCO_2 = 699.96 TonCO_2/year.

3. 3,147,635.4 kWh/y electrical power decrease by replacing the old lighting fixtures into LED bulbs reduces greenhouse gas intake by 3,147,635.4/1000 * 0.561 = 1,765.82 TonCO_2/year

4. Garbage and biomass conversion to a compressed methane gas. (CBG) for 4,547.66 TonCO_2/year

4.1 90% reduction of solid waste with landfill for 1,575 tons is equivalent to 1, 575x2.32 * * = 3,654 TonCO_2 greenhouse gas reduction.

4.2 100% reduction of food scrap with landfill for 250 tons is equivalent to 250x2.32 * * = 580 TonCO_2 greenhouse gas content reduction.

4.3 CBG gas (Compressed Bio-Methane) is produced as a substitute for 9000 liters of diesel fuel used by the University's van, which is equivalent to 9,000 litres x (2.7080 * * 0.079 * * * *) kgCO_2/litre = 23,661 kgCO_2 = 23.66 TonCO_2 greenhouse gas volume reduction.

4.4 100% reduction of fatty residue with landfill for 125 tons is equivalent to 125x2.32 * * = 290 TonCO_2 greenhouse gas volume reduction.

5. The CMU Transport utilizes 60 electric vehicles replacing four-wheeled diesel cars, using average diesel gas amount of 3,600 liters/day with average fuel consumption of 8 km/litre. This reduces 1,179.45 TCO_2/year greenhouse gas total.

- Greenhouse gas emission from using public four-wheeled diesel cars is 1,314,000 x 0.0027 = 3,652.92 TonCO_2.
- Greenhouse gas emission from using electric cars is 2,102,400 kWh x 0.561/1000 = 371.42 Ton CO_2

Emission Factor

*Electricity 1 MWh =0.561 tCO_2
**elimination of 2.32 kgCO2/kg solid waste with landfill
*** Gas/Diesel fuel emission 2.7080 kgCO_2/litre
****Biomethane emission 0.0079 kgCO_2/litre

Table 2.10 greenhouse gases emission reduction measures 2018

Activities	Greenhouse gas Content			
	2016	2017	2018	
	TonCO2-eq	TonCO2-eq	TonCO2-eq	%
Solar rooftop	-	-	187.94	0.32
Solar heating water			699.96	1.43
LED lighting			1,765.82	3.61
CBG			-	-
- 90% solid waste reduction with landfill			3,654	7.47
- 100% food waste reduction with landfill			580	1.19
- CBG gas (Compressed Bio-Methane) is produced as a substitute for 9000 liters of diesel fuel used for the university's vans.			23.66	0.05
- 100% of fatty residue reduction with landfill			290	0.59
The CMU Transport utilize 60 electric cars replacing four-wheeled diesel cars.			1,179.45	2.41
Total greenhouse gas emissions reduction in the year 2018	**0**	**0**	**8,380.83**	**17.13**
Total greenhouse gas emissions	57,533.7	54,211.1	48,926.7	100.00

From greenhouse gas emissions reduction measures, in 2018 the total of 8,350.83 TonCO2 can be reduced according to the Green Metric UI's calculation criteria.

Table 2.11 Summary of greenhouse gases production activities of Chiang Mai University 2016 – 2018

Activities	Greenhouse gas Content					
	2016		2017		2018	
	$TonCO_2$-eq	%	$TonCO_2$-eq	%	$TonCO_2$-eq	%
Stationary Combustion	5,865.63	10.20%	3,354.83	6.19%	3,353.90	6.85%
Mobile Combustion	259.15	0.45%	161.96	0.30%	153.07	0.31%
Solid Waste (incineration)	649.33	1.13%	799.05	1.47%	-	0.00%
Solid Waste (landfill)	4,241.91	7.37%	4,283.54	7.90%	452.09	0.92%
Wastewater	2,434.22	4.23%	2,233.07	4.12%	2,027.66	4.14%
Livestocks	78.13	0.14%	89.53	0.17%	-	0.00%
Electricity	44,005.36	76.49%	43,289.15	79.85%	42,940.00	87.76%
Total	**57,533.72**	**100.00%**	**54,211.12**	**100.00%**	**48,926.72**	**100.00%**

<u>Option 1</u>: CMU record data for CO_2 footprint

Co_2 (total) = 48,926.72 metric ton

In 2019, the population of 48,431 people made CO_2 footprint per person as 1.01 metric ton/person.

Table 2.12 Summary of Chiang Mai University's greenhouse gas reduction measurement in 2018 (based on the principles of the Green Metric UI)

Activities	2018		
	Amount ($TonCO_2$-eq)	Co-efficient	Metric$TonCO_2$-eq
Stationary Combustion ($TonCO_2$ – eq)*	3,353.90	-	3.35
Mobile Combustion ($TonCO_2$ – eq)*	153.07	-	0.15
Solid Waste (Incineration) ($TonCO_2$ – eq)*	-	-	-
Solid Waste (landfill) ($TonCO_2$ – eq)*	452.09	-	0.45
Wastewater ($TonCO_2$ – eq)*	2,027.66	-	2.03
Livestock ($TonCO_2$ – eq)*	-	-	-
Electricity (kWh)	42,940,000.00	0.84	36,069.60
Transportation – Private cars (cars)	12,243	0.02	2,256.63
Transportation – Private motorcycles (cars)	8,560	0.01	788.89
Total			**39,121.11**

* Data was from Chiang Mai University energy and CO_2 consumption 2018 record.

Option 2: UI Green metric calculation criteria

Co_2 (electricity) = (42,940,000 kWh /1000) x 0.84 = 36,069.6 metric ton

Co_2 (cars) = (12,243*2*1.92*240/100)*0.02= 2,256.63 metric ton

Co_2 (motorcycle) = (8,560*2*1.92*240/100)*0.01= 788.89 metric ton

Co_2 (total) = 39,121.11 metric ton

In 2019, the population of 48,431 people made CO_2 footprint per person as 0.81 metric ton/person.

* A CMU shuttle bus is a Zero emission vehicle using electricity. Its CO_2 footprint has already been counted in electricity.

[2.11] Please provide the total carbon footprint (CO_2 emission in the last 12 months, in metric tons)

Co_2 (total) = 39,121.11 metric ton

[2.12] The total carbon footprint divided by total campus population (metric tons per person) (EC.8)

The university's carbon footprint in 2017 **was 39,121.11 metric ton**, which is equal to **0.807 metric ton per person**, based on the population of 48,431.

References: Emission factors

	Name	Units	EMISSION FACTORS				References
			CO_2 [kg CO_2/unit]	CH_4 [kg CH_4/unit]	N_2O [kg N_2O/unit]	Total [kg CO_2eq/unit]	
Stationary Combustion							
	Natural gas	scf	0.05722	0.00000	0.00000	0.05728	IPCC Vol.2 table 2.2, DEDE

	Lignite	kg	1.05747	0.00001	0.00002	1.06241	IPCC Vol.2 table 2.2, DEDE
	Residual fuel oil	litre	3.07820	0.00012	0.00002	3.08829	IPCC Vol.2 table 2.2, DEDE
	Gas/Diesel oil	litre	2.69872	0.00011	0.00002	2.70797	IPCC Vol.2 table 2.2, DEDE
	Anthracite	kg	3.08662	0.00003	0.00005	3.10144	IPCC Vol.2 table 2.2, DEDE
	Sub-bituminous coal	kg	2.53416	0.00003	0.00004	2.54660	IPCC Vol.2 table 2.2, DEDE
	Jet Kerosene	litre	2.46890	0.00010	0.00002	2.47766	IPCC Vol.2 table 2.2, DEDE
	LPG	litre	1.67972	0.00003	0.00000	1.68118	IPCC Vol.2 table 2.2, DEDE
	LPG	kg	3.11060	0.00005	0.00000	3.11330	LPG 1 litre = 0.54 kg (DEDE)
Mobile Combustion (On road)							
	Motor Gasoline - uncontrolled	litre	2.18156	0.00104	0.00010	2.23755	IPCC Vol.2 table 3.2.1, 3.2.2, DEDE
	Motor Gasoline -oxydation catalyst	litre	2.18156	0.00079	0.00025	2.27629	IPCC Vol.2 table 3.2.1, 3.2.2, DEDE
	Motor Gasoline - low mileage light duty vihicle vintage 1995 or later	litre	2.18156	0.00012	0.00018	2.23803	IPCC Vol.2 table 3.2.1, 3.2.2, DEDE
	Gas/ Diesel Oil	litre	2.69872	0.00014	0.00014	2.74460	IPCC Vol.2 table 3.2.1, 3.2.2, DEDE
	Compressed Natural Gas	kg	2.12619	0.00349	0.00011	2.24724	IPCC Vol.2 table 3.2.1, 3.2.2, PTT
	Liquified Petroleum Gas	litre	1.49338	0.00165	0.00001	1.53623	IPCC Vol.2 table 3.2.1, 3.2.2, DEDE
	Liquified Petroleum Gas	kg	2.76552	0.00306	0.00001	2.84487	LPG 1 litre = 0.54 kg (DEDE)
Mobile Combustion (Off road)							
	Diesel						
	- Agriculture	litre	2.69872	0.00015	0.00104	3.01290	IPCC Vol.2 table 3.3.1, DEDE
	- Forestry	litre	2.69872	0.00015	0.00104	3.01290	IPCC Vol.2 table 3.3.1, DEDE
	- Industry	litre	2.69872	0.00015	0.00104	3.01290	IPCC Vol.2 table 3.3.1, DEDE
	- Household	litre	2.69872	0.00015	0.00104	3.01290	IPCC Vol.2 table 3.3.1, DEDE
	Motor Gasoline - 4 stroke						
	- Agriculture	litre	2.18156	0.00252	0.00006	2.26329	IPCC Vol.2 table 3.3.1, DEDE
	- Forestry	litre	2.18156	0.00000	0.00000	2.18156	IPCC Vol.2 table 3.3.1, DEDE
	- Industry	litre	2.18156	0.00157	0.00006	2.23968	IPCC Vol.2 table 3.3.1, DEDE
	- Household	litre	2.18156	0.00378	0.00006	2.29477	IPCC Vol.2 table 3.3.1, DEDE
	Motor Gasoline - 2 stroke						

	- Agriculture	litre	2.18156	0.00441	0.00001	2.29550	IPCC Vol.2 table 3.3.1, DEDE
	- Forestry	litre	2.18156	0.00535	0.00001	2.31911	IPCC Vol.2 table 3.3.1, DEDE
	- Industry	litre	2.18156	0.00409	0.00001	2.28763	IPCC Vol.2 table 3.3.1, DEDE
	- Household	litre	2.18156	0.00567	0.00001	2.32698	IPCC Vol.2 table 3.3.1, DEDE
Mobile Combustion (Railway)							
	Diesel	litre	2.69872	0.00015	0.00104	3.01290	IPCC Vol.2 table 3.4.1, DEDE

Stationary Combustion

		IPCC [kg/TJ]			DEDE [MJ/unit]	
	unit	CO2	CH4	N2O	NCV	
Natural gas	scf	56100	1	0.1	1.02	dry basis
Lignite	kg	101000	1	1.5	10.47	
Residual fuel oil	litre	77400	3	0.6	39.77	
Gas/Diesel oil	litre	74100	3	0.6	36.42	
Anthracite	kg	98300	1	1.5	31.4	
Sub-bituminous coal	kg	96100	1	1.5	26.37	
Jet Kerosene	litre	71500	3	0.6	34.53	
LPG	litre	63100	1	0.1	26.62	

Mobile Combustion (On road)

		IPCC [kg/TJ]			DEDE [MJ/unit]	
	unit	CO2	CH4	N2O	NCV	
Motor Gasoline - uncontrolled	litre	69300	33	3.2	31.48	gasoline
Motor Gasoline -oxydation catalyst	litre	69300	25	8	31.48	
Motor Gasoline - low mileage light duty vihicle vintage 1995 or later	litre	69300	3.8	5.7	31.48	
Gas/ Diesel Oil	litre	74100	3.9	3.9	36.42	
Compressed Natural Gas	kg	56100	92	3	37.9	*ref. from Petroleum Authority of Thailand
Liquified Petroleum Gas	litre	56100	62	0.2	26.62	

Mobile Combustion (Off road)

		IPCC [kg/TJ]			DEDE [MJ/unit]
	unit	CO2	CH4	N2O	NCV
Diesel					

- Agriculture	litre	74100	4.15	28.6	36.42
- Forestry	litre	74100	4.15	28.6	36.42
- Industry	litre	74100	4.15	28.6	36.42
- Household	litre	74100	4.15	28.6	36.42
Motor Gasoline - 4 stroke					
- Agriculture	litre	69300	80	2	31.48
- Forestry	litre	69300			31.48
- Industry	litre	69300	50	2	31.48
- Household	litre	69300	120	2	31.48
Motor Gasoline - 2 stroke					
- Agriculture	litre	69300	140	0.4	31.48
- Forestry	litre	69300	170	0.4	31.48
- Industry	litre	69300	130	0.4	31.48
- Household	litre	69300	180	0.4	31.48

Mobile Combustion (On road)

		IPCC			DEDE
		[kg/TJ]			[MJ/unit]
	unit	CO2	CH4	N2O	NCV
Gas/ Diesel Oil	litre	74100	4.15	28.6	36.42

Waste Incineration

		IPCC				DEDE
		kg/tonWaste				References
	unit	CO2	CH4	N2O	GHG	
Clinical Waste	ton	792	0.06	0.056	810.19	IPCC Vol.5 table 5.2, 5.3, 5.4

Waste Disposal

		IPCC				DEDE
		kg/tonWaste				References
	unit	CO2	CH4	N2O	GHG	
Municipal Waste	ton	-	-	-	2.49	Thailand Greenhouse Gas Management Organizaton

	Per 1 kg of waste					References
Municipal Waste	Food waste	Plastic	Paper	PET Bottles	Glass	ERDI – Waste management solution, CMU, Project "Comprehensive waste management for Chiang Mai University"
	0.4113	0.17	0.1327	0.11	0.05	
	Leaves	Metal	Fabric	Ceramic	Etc	
	0.0448	0.02	0.0144	0.01	0.04	
	EF: GHG per ton of waste					References

Municipal Waste	Food waste	Plastic	Paper	PET Bottles	Glass	Thailand Greenhouse Gas Management Organizaton
	2.53	2.32	2.93	2.32	2.32	
	Leaves	Metal	Fabric	Ceramic	Etc	
	3.27	-	2	2.32	2.32	

Electricity (PEA)

		IPCC				DEDE
		kg/tonWaste				References
	unit	CO2	CH4	N2O	GHG	
Electricity	ton	-	-	-	0.58	Thailand Greenhouse Gas Management Organizaton

Lifestock: ENTERIC FERMENTATION

		IPCC				DEDE
		kg/head-yr				References
	unit	CO2	CH4	N2O	GHG	
Cows	head	-	55.00	-	1,375.00	
Water Buffalos	head	-	55.00	-	1,375.00	IPCC Vol.4 table 10.10
Pigs	head	-	1.50	-	37.50	
Ducks	head	-	-	-	-	
Chicken	head	-	-	-	-	
Sheeps	head	-	8.00	-	200.00	
Goats	head	-	5.00	-	125.00	
Rabbits	head	-	-	-	-	

Lifestock: ENTERIC FERMENTATION

	Default items			Value	Reference	
1.	Maximum CH4 producing capacity: B_0 (kgCH4/kgBOD)			0.60	IPCC , volume 5, chapter 6, p.6.12	
2.	Maximum CH4 producing capacity: B_0 (kgCH4/kgCOD)			0.25	IPCC , volume 5, chapter 6, p.6.12	
3.	Methane correction factor : MCF (Septic system)			0.50	IPCC , volume 5,	

					chapter 6, p.6.13 (Septic system)	
4.	Methane correction factor : MCF (Anaerobic system)			0.80	IPCC , volume 5, chapter 6, p.6.13 (Anaerobic system)	
5	Methane correction factor : MCF (Aerobic system)			-	IPCC , volume 5, chapter 6, p.6.21	
6	BOD per L: BOD (mg/L)			181.00	Pollution Control Department, Thailand	
7	BOD per L: BOD (kg/m3)			0.18	Pollution Control Department, Thailand	
8	BOD per capita: BOD (g/person/day)			40.00	Pollution Control Department, Thailand	
9	BOD per capita: BOD (g/person/hour)			1.67	Pollution Control Department, Thailand	

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[3] Waste (WS)

[3.1] Recycling Program For University Waste

Description:

Reusing garbage and waste can be counted as value adding, the university's employees carry out 100% standard recycling process, for example, in December 2018, 4,286 Kg of waste was recycled. Each departmental unit managed the recycling process separately. Chiang Mai University has currently established Biomass Waste Management Center, which is operated in two ways:

1. Each departmental unit manage to sell the 74%, or 3 tons of recyclable waste, such as paper, tin cans, plastic bottles, and glass bottles. This recyclable waste is collected every Wednesday by the building department of each faculty and institution, and traded, thus creating an additional revenue to the units.

Table 2.15 Sample data of the trading session around December 2018.

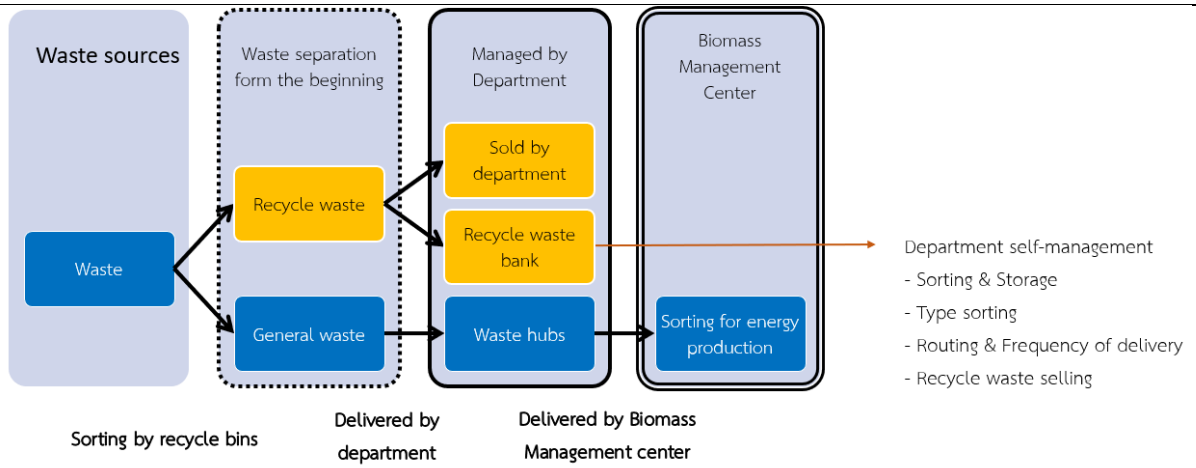
Survey list	Waste weight managed by units (Kg)	Waste weight forwarded to the "Recycle Bank" (Kg.)
Bottles	346.73	73
Plastic	1,105.95	773.8
Plastic Bottles, PET	738.63	-
Paper	881.44	223.2
Steel scrap	-	8.2
Zinc/Aluminum cans	106.94	28.1
Total waste	**3,179.69**	**1,106.3**
Proportion	**74.19%**	**25.81%**
Total revenue	**-**	**7,707.8**

2. The "Recycle Bank" project is a recycling waste disposal project. All departments in CMU bring the collected recyclable waste to sell to the bank each week and the return will be kept separately in an account form. The recyclable waste will be sold to the recycling dealers, which then be processed into reusable material products. For example, plastic waste can be processed into low-grade plastic bags. Recycle Bank deposits can be divided into 5 types: glass, metal, milk box, and plastic. The photos below show an example of the Recycle Book Bank of Planning Department's account, showing the amount of waste deposits and revenue.

The waste deposit criteria are

1) please bring your ID card and recycle book bank with you when you come to deposit;
2) 1 kg minimum weight for each deposit;

3) the balance in the book bank must be equal to the bank record;
4) please inform recycle bank staff immediately if the book bank is lost;
5) the minimum balance must not fall below 20 Baht;
6) the account will be closed automatically if the account has been inactive for one year or if the balance falls below 20 Baht.



Waste separation management diagram
General waste is sorted to be recycled waste and general waste. Recycled waste is managed by selling out to the outsources.

Recycle Book Bank of Chiang Mai University

ธนาคารวัสดุรีไซเคิล (Recycle Bank)

ชื่อบัญชี (Account Name) กองแผนงาน

เลขที่บัญชี (Account No.) D008 ลายมือชื่อ (Signature)

ว.ด.ป. (Date)	รายการ (Transaction)	จำนวน (กก.) (Amount)	ฝาก (บาท) (Deposit)	ถอน (บาท) (Withdrawal)	คงเหลือ (บาท) (Balance)	ลงชื่อ จนท. (Sign Teller)
2/5/61	1	12	72	–	72	
30/5/61	1	18.3	109.8	–	181.8	

Example of Recycle waste list of Division of Strategy and Planning, CMU

Recycle waste categories of Recycle Bank - Chiang Mai University

Waste sorting station for recycle bank

Aluminium cans, soft drink and bier cans (non-magnetic materials) (22.5 baht/kg.)

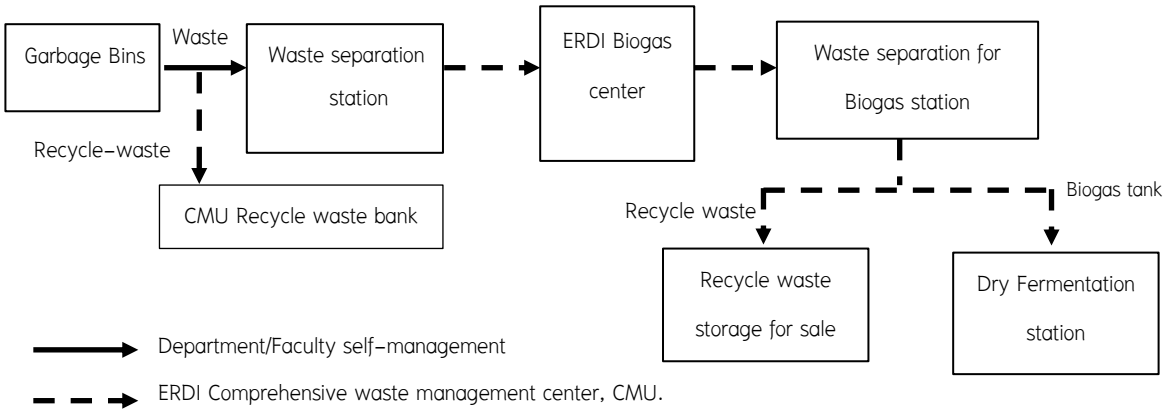
zinc cans, coffee cans, food cans and cookie tin boxes (non-magnetic materials) (2.5 baht/kg)

Examples of saleable metal can waste

			
White A4 paper printed in black or blue ink, or written with pens and white-black paper with all kinds of paint, including shreded paper from paper shredder machines. (5 baht/kg).	Desert boxes, brown boxes and bags, used textbooks and magazines (2 baht/kg)	Various types of carton paper with corrugated layer (3 baht/kg)	Bundles of newspaper (8 baht/kg)
Examples of sellable paper waste			
			
No color and transparent PET bottles for drinking water, green tea, soft drinks, fish sauce. (7 baht/kg)	creened transparent PET bottles for drinking water, green tea, soft drinks, fish sauce (no label but the logo is sceened on plastic) (1.5 baht/kg)	Colored plastic bottles including a floating tough plastic, such as baskets, shampoo and lotion bottles and coffee plastic mug (5 baht/kg).	
Examples of sellable plastic waste			
			
All kinds of no color and transparent bottles (except glasses, roller bottles, ceramic, and fire hazard bottles) (1 baht/kg)	All kinds of red and brown bottles (except glasses, roller bottles, ceramic, and rollers, and fire hazard bottles) (0.8 baht/kg)	All kinds of green bottles (except glasses, roller bottles, ceramic, and rollers, and fire hazard bottles) (0.8 baht/kg)	
Examples of sellable glass waste			

3. Other waste left from recycle process about 1,146.85 Ton (61.8%) or 3 ton/day will be managed from 42 waste hubs to processed at the Biomass Management Center. Separation process from the beginning is very important process for the zero waste management. In 2017, Chiang Mai University launched the Chang-Chang-Yak campaign for promoting waste separation to 5 types: general waste, recycle waste, organic waste, toxic waste and toilet waste. The campaign has increased efficiency of the zero waste management significantly.

Waste separation campaign in CMU



CMU Waste management diagram

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[3] Waste (WS)

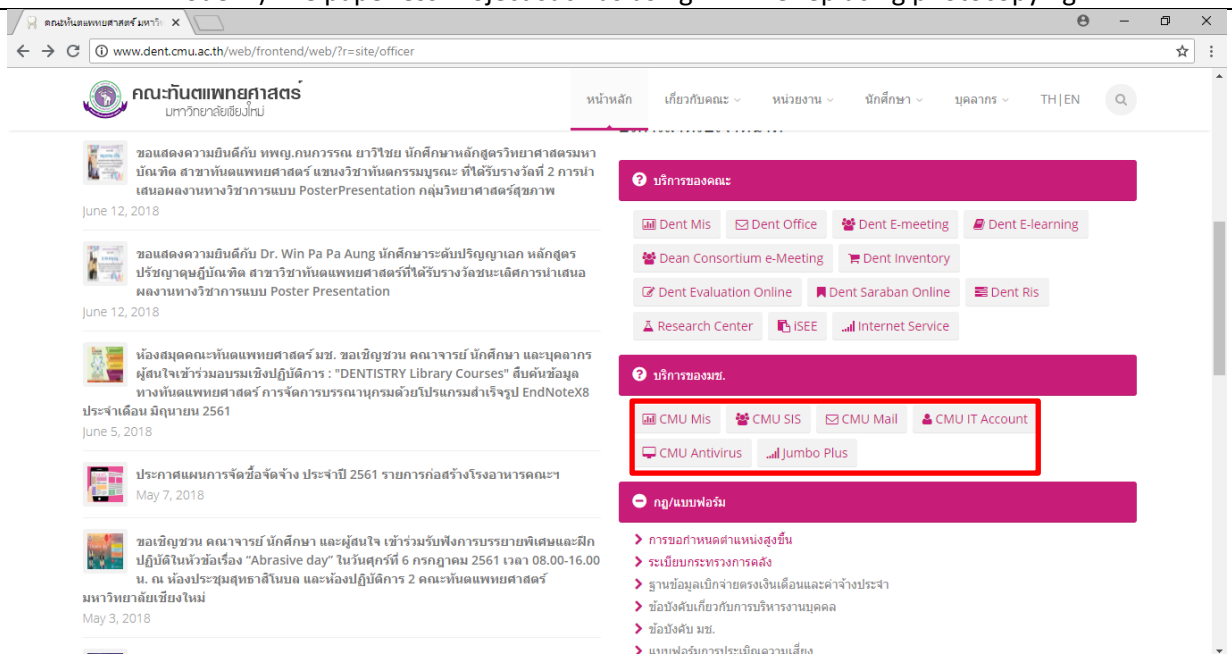
[3.2] Program to Reduce The Use of Paper and Plastic in Campus

Model 1) Examples of fabric bags of several faculties

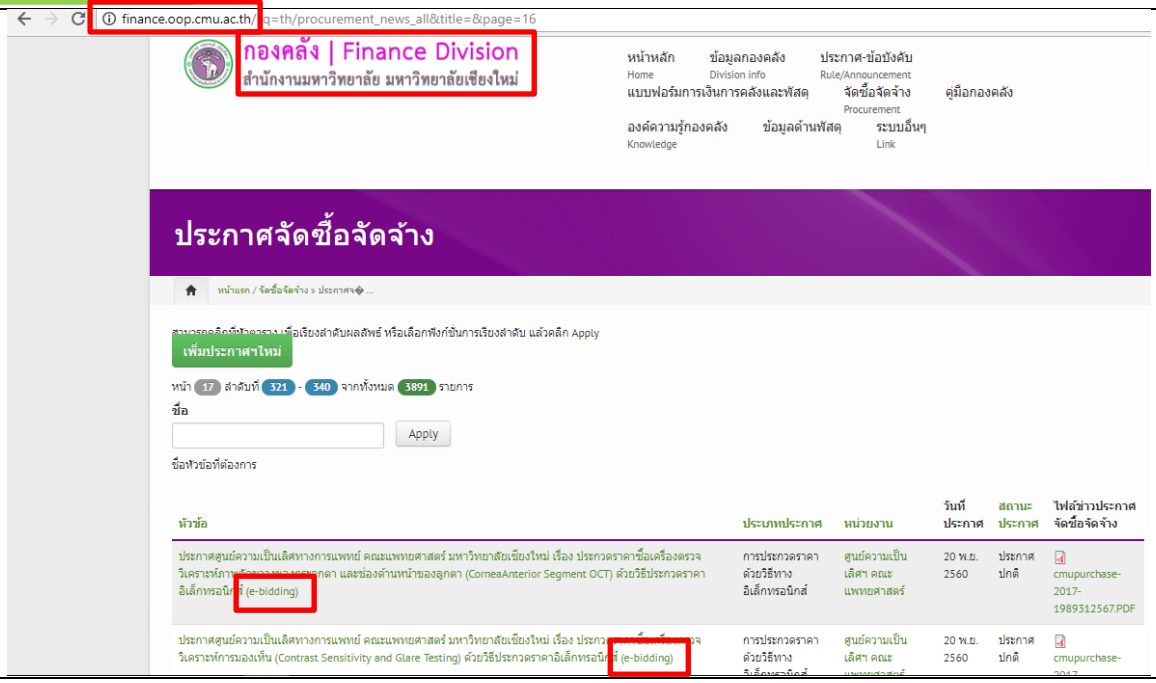
Model 2) 100% plastic bag reduction measure

Model 3) CMU NO FOAM Project

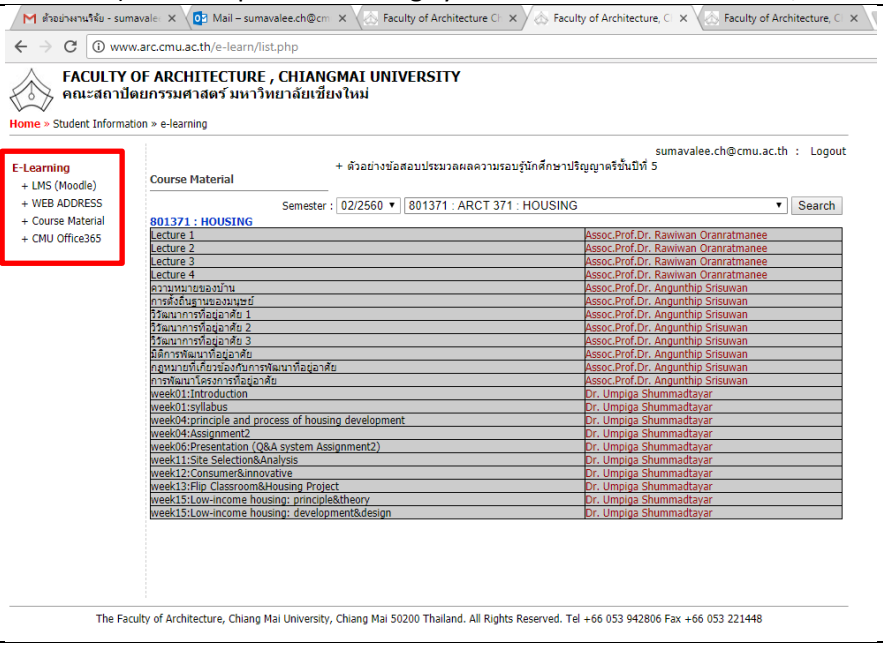
Model 4) The paperless Project such as using PDF file replacing photocopying



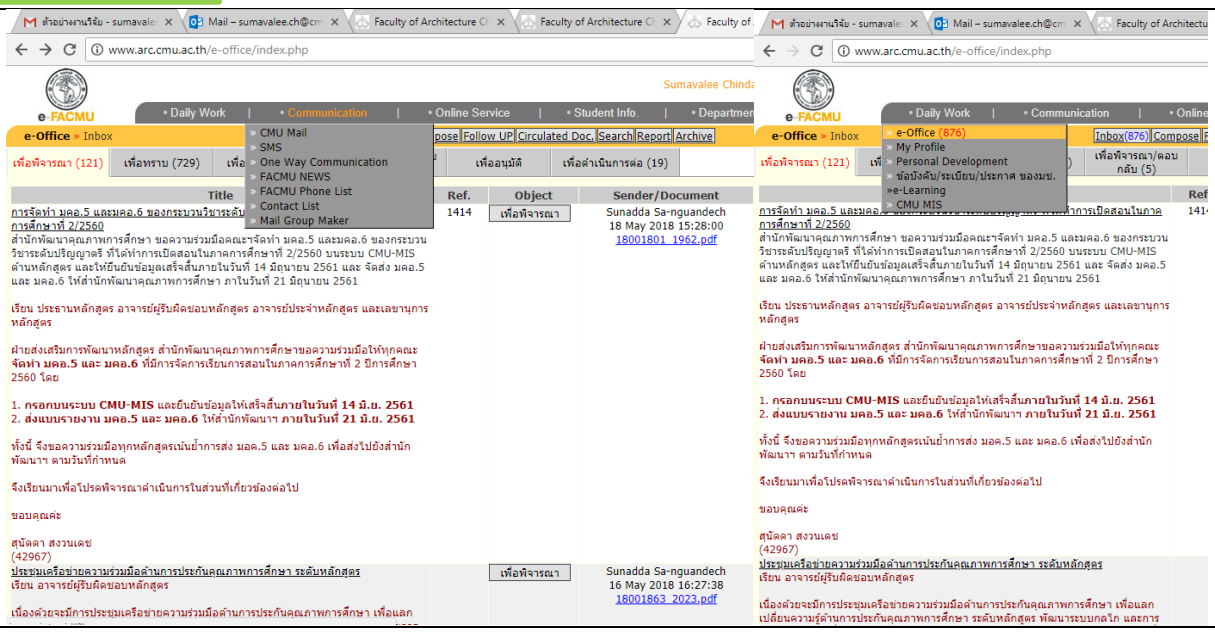
Model 5) An example of e-document system of the Faculty of Dentistry



Model 6) An example of e-bidding system of the Finance Division, CMU



Model 7) An example of e-Learning system at Faculty of Architecture



Model 8) An example of e-document system (e-office) at the Faculty of Architecture

Description:

Chiang Mai University has implemented policies and methods on paper and plastic usage reduction such as two-sided paper printing, using reusable cups instead of plastic cups, using fabric tote bags and printing when necessary.

Since 2014 Chiang Mai University has run a campaign for the use of cloth bags replacing plastic bags including many projects for paper consumption reduction in various departmental units, as shown in the photos including:

Model 1.) The cloth bags campaign project

Model 2.) 100% plastic bags usage reduction measure

Model 3.) The CMU NO FOAM project in every cafeteria and food store of the university.

Model 4.) Scanning document in PDF file format replacing photocopying to reduce uses of paper.

Model 5.) The use of e-document system project for all university document- replacing paper document such as e-meeting, e-evaluating, e-office of the Faculty of Architecture.

Model 6.) The use of e-bidding system project for online procurement to reduce uses of paper.

Model 7.) Using e-learning channels for educational communication and teaching materials, instead of using paper.

Model 8.) Using e-office channels as an electronic system for communication and announcement among all faculty members instead of using paper such as e-document, e-learning, e-office of the Faculty of Architecture.

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
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[3] Waste (WS)

[3.3] Organic Waste Treatment

One-stop Biomass management Center

Garbage sorting machines (upper) Bio-gas testing instrument and CBG station (lower)

CMU integrated solid waste plants (taken on 20 June 2018)

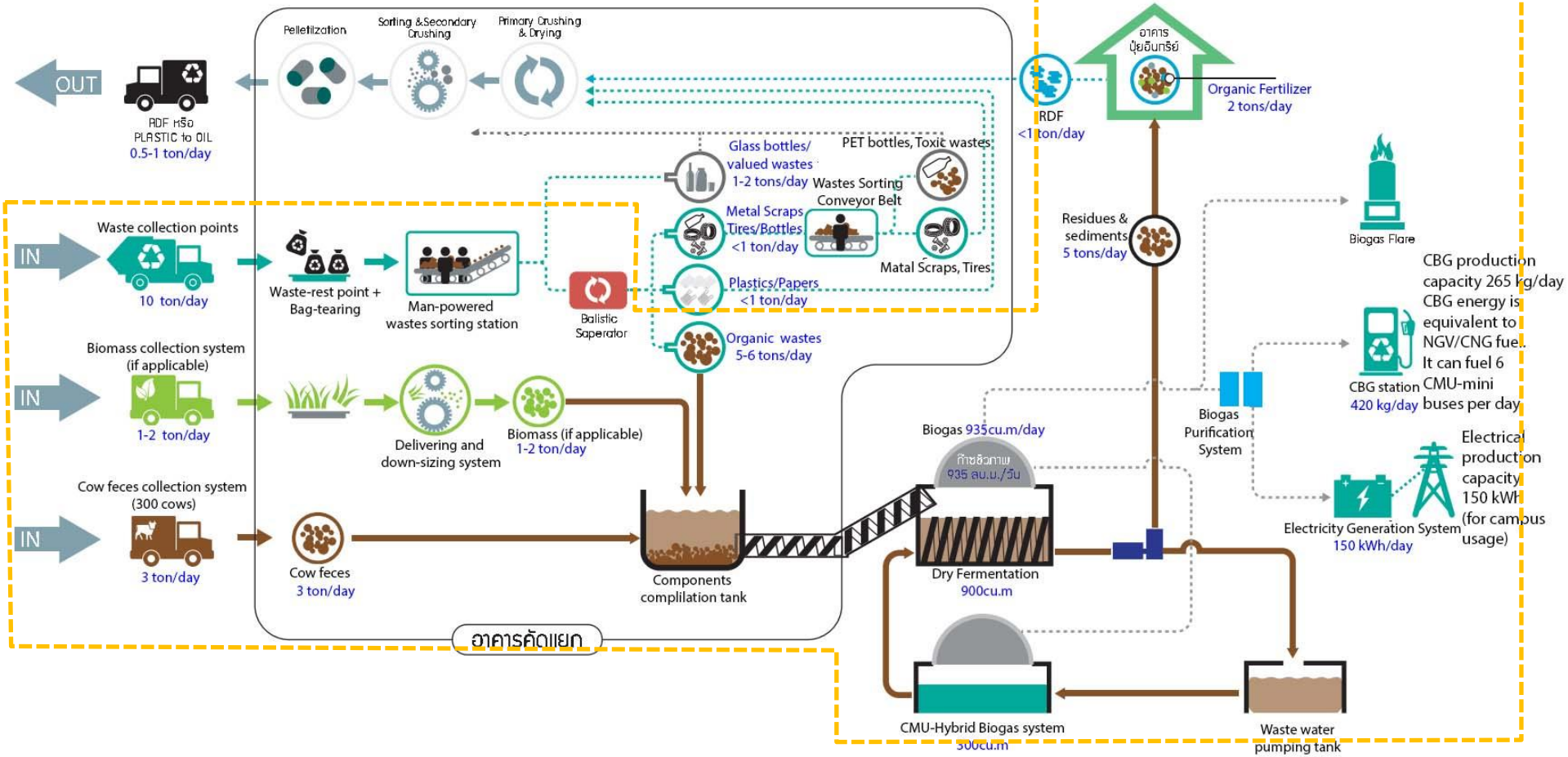
Organic waste sorting campaign

Integrated solid waste management plant (taken on 20 June 2018)

Description:

Based on 2018 data, 48,431 population including academic staffs, medical and nursing staffs, and students are in CMU campus town. 42 spots of garbage drop-off are operated. Throughout the university, the average of 5 tons per day of garbage collection sorted by using separated bins of 3 different categories, which are 2.5 tons per day of hazardous waste (infectious garbage such as needles and sharp objects from the hospital), 3 tons per day of inorganic solid waste (recyclable waste such as bottles, glasses, paper, plastic, and other non-biodegradation waste, for example, rubber and cloth) and 1.5 tons per day of organic waste, which is 100% sorting, collecting, and processing for energy production. Table 2.16 shows 6 main waste sources of the university, 1.) Mixed use area of residential and commercial and/or cafeterias, 2.) Residential area, 3.) Commercial and cafeterias, 4.) Activities areas, 5.) Office buildings, and 6.) Hospital.

In 2018 the amount of **garbage and organic waste** was 547.17 tons in total, equivalent to 20.29 %, consisting of 138.26 tons of food waste, 33.76 tons of fatty residue, and 375.15 tons of other organic waste such as twigs, leaves, paper containers. The estimated proportion of different garbage types are illustrated in Table2.16. Food debris and fatty residue are sorted and separately collected from other waste, then transported to fertilizer plants and charcoal production plants. Other organic waste will be transported to waste management plants to separate inorganic waste again by sorting machines and by hands. The energy production is made from fermented organic waste such as bio-diesel, bio-mass gas, and Compressed Bio-Methane Gas, CBG at CMU Integrated Solid Waste Management Center. (ISWM)



Integrated solid waste management (ISWM) process

The organic waste management process produces biogas for cooking, bio-diesel for generator, and CBG for vehicles. The solid waste from the process will be used as fertilizer.

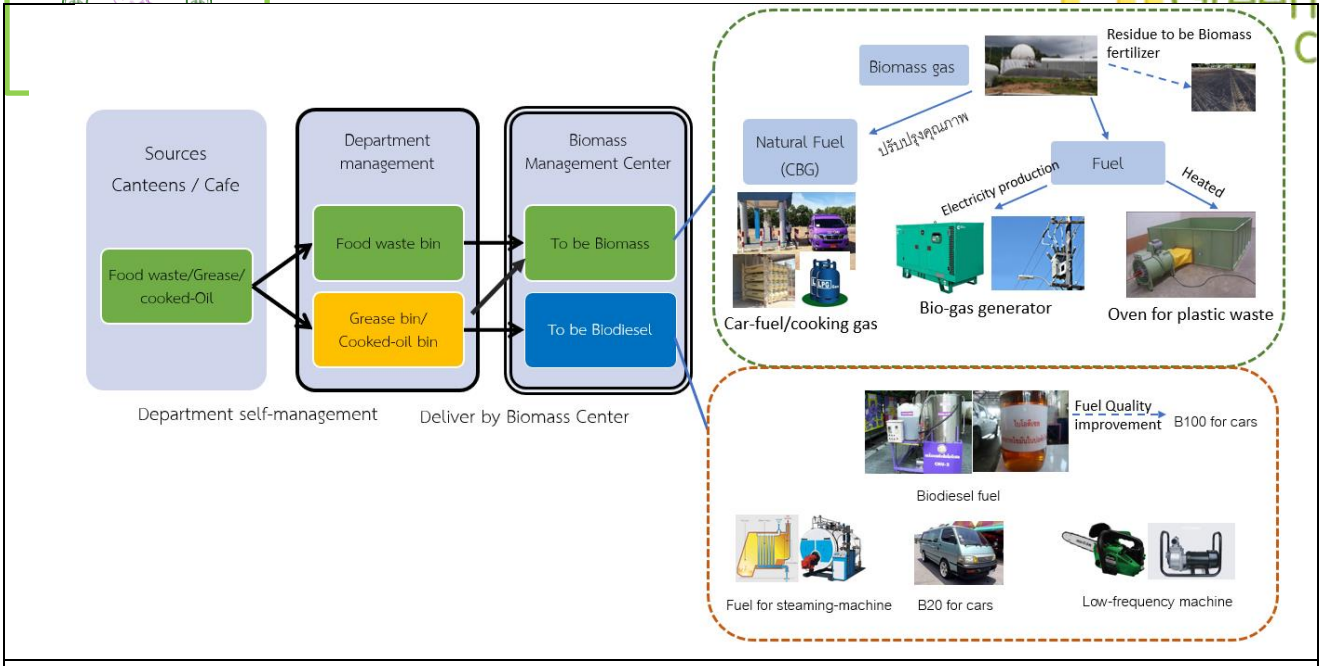
Table 2.16 The amount of manageable waste in 2018

Type	ปริมาณขยะ ปี 2018 2018 Garbage	
	(Ton)	(%)
1. Hazardous waste	**912.5**	**33.84%**
2. Inorganic waste	**1,236.97**	**45.87%**
2.1 Recyclable waste	707.59	26.24%
glasses, bottles	*70.88*	*2.63%*
plastic	*602.15*	*22.33%*
metal	*34.56*	*1.28%*
2.2 Other inorganic waste	529.38	19.63%
3. Organic waste	**547.17**	**20.29%**
Food debris	*138.26*	*5.13%*
Fatty residue	*33.76*	*1.25%*
Other organic waste	*375.15*	*13.91%*
Total waste	**2,696.64**	**100.00%**

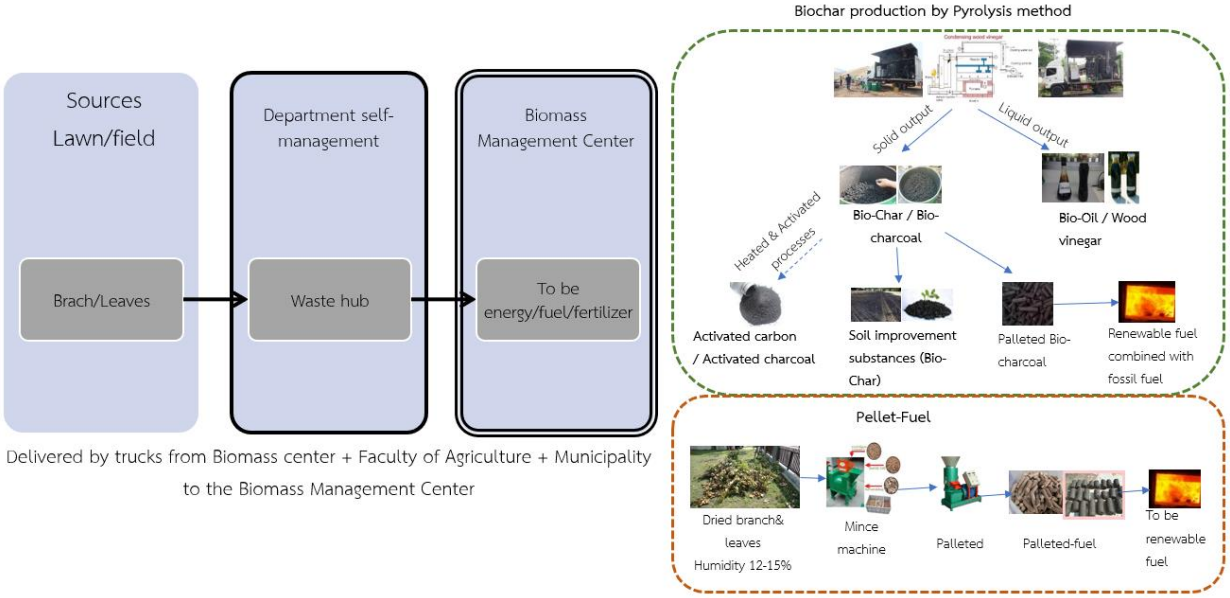
The 20.29% or 547 tons of left-over waste from recycle process including food debris, fatty residue, leaves, and other organic waste has been sorted based on types. **Food debris and fatty residue** is transported to the biomass gas production plant. Leaves are used for fertilizer at fertilization plants of the Faculty of Agriculture. The less is collected at the 42 garbage disposal spots in the university to be transported to the waste sorting plant before processing for the energy production in the next step. Chiang Mai University in collaboration with Chiang Mai municipality use garbage trucks to collect and transport waste to CMU Integrated Solid Waste Management Center. (ISWM) for energy production.

Chiang Mai University aims to achieve sustainable waste management with 100% of waste treatment. The Integrated Solid Waste Management and Organic Agricultural Waste Project are established with the goal of zero waste, making it possible for full-cycled waste management. **Organic waste and fatty residue** are converted into fuels through fermentation process. 200 Kg per day of fatty residue can be used to produce no less than 80 liters per day of Biodiesel. The 30-100 tons per day of the left-over materials such as food debris, fatty residue, and animal manure are disposed at the garbage collector locations every Monday, Wednesday and Friday. Then all waste is gathered at the waste management plant to eliminate and convert into the biomethane fuels and fuel pellets, as well as fertilizer. The project was successfully completed in 2018.

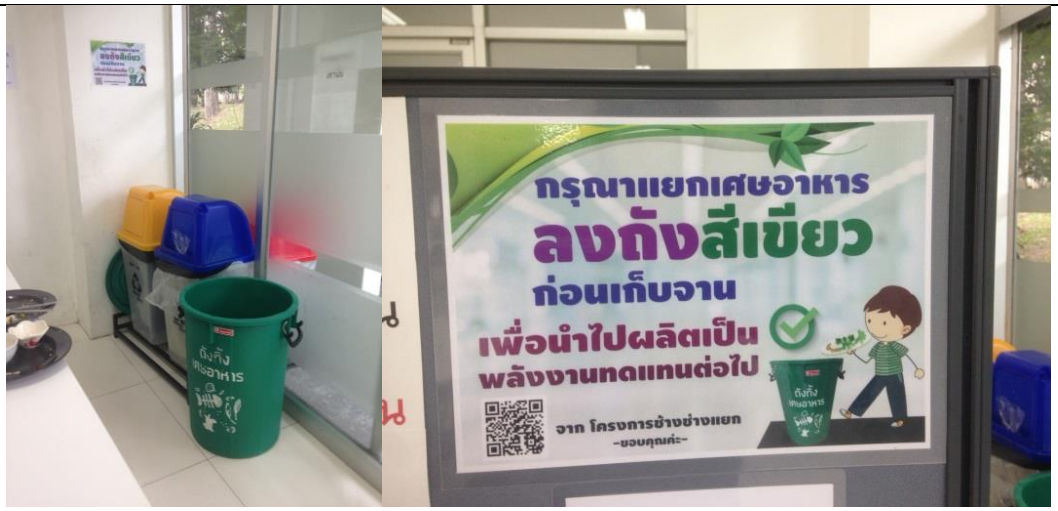
The **food scraps** are processed into biological and biodiesel gas by Nakornping CMU Energy Research and Development Institute (EDRI) by adding re-used deep-frying oil and food waste from all cafeterias (Table 2.18) into fatty residue process. These cafeterias are located in various areas including male and female dormitories, all Suan Sak's Dormitories, Office of the President Building, CMU Student association, the Faculty of Political Science and Public Administration, the Faculty of Social Sciences, the Faculty of Humanities, the Faculty of Sciences, the Faculty of Mass Communication, Social Research Institute, the Faculty of Veterinary Medicine, the Faculty of Agroindustry, the Faculty of Nursing, the Faculty of Pharmacy, the Faculty of Dentistry, S1 Parking Building, Nutrition Department of the faculty of Medicine, Mae Hea's Dormitories, Suan Dok's Dormitories, Academic Service Bureau, the Faculty of Agriculture, the Faculty of Business Administration, and the Faculty of Education. In 2018, 138 tons of food waste and 33 tons of fatty residue were collected.



Food waste Disposal Map



Garbage Disposal Map (plant waste)



An example of Food-Waste separation campaign (to the green bin) in CMU

Gas being produced from organic waste by the CMU Biomass Center in 2018 years were biodiesel and CBG gas. Bio diesel gas generated 120 KWh/day or 31,200 KWh/year of electricity energy as shown in Table 2.19. The average of 60 Kg CBG/day was produced, filling up 2 vehicles/per day (30Kg/vehicle), a NGV bus and a van, as shown in Table 2.19.

Table 2.17 Food debris, fatty residue, and reused deep-fried cooking oil collector locations

Collection point	Location	Collection point	Location
1	Male Dorm 4's cafeteria	**12**	Female Dorm 2's cafeteria
2	Male Dorm 3's cafeteria	**13**	CMU Student Association main cafeteria
3	Male Dorm 6's cafeteria	**14**	Female Dorm 4's cafeteria
4	Male Dorm 5's cafeteria	**15**	Female Dorm 6's cafeteria
5	The Faculty of engineering's cafeteria	**16**	Female Dorm 5's cafeteria
6	Male Dorm 1's cafeteria	**17**	Female Dorm 7's cafeteria
7	Fai Hin Market	**18**	Female Dorm 1's cafeteria
8	College of Arts, Media and Technology's cafeteria	**19**	40th year Female Dorm's cafeteria
9	The Faculty of social Sciences' cafeteria	**20**	The Faculty of Agriculture's cafeteria
10	The Faculty of Humanities' cafeteria	**21**	The Faculty of Business Administration's cafeteria
11	The cafeteria of Biology Department, the Faculty of Sciences	**22**	The Faculty of Education's cafeteria

Table 2.18 Sample schedule of the GEN system, generating 20KW of electrical power (June – August)

No.	Month	GEN operating hours (hours)	Electrical power production (KWh)
1	June 2018	16.25	260
2	July 2018	63.15	1,192
3	August 2018	99.92	1,841
Total		**179.32**	**3,293**

Table 2.19 CBG production samples in October-December 2018

Month	AVG. CH4 in Biogas (% v/v)	AVG. CH4 in CBG (% v/v)	Amount of CBG for cars (kg)	Remark
Oct-18	56.82	88.75	895.95	Food scrap + Cows' dung
Nov-18	55.48	87.41	1,031.08	Food scrap + Cows' dung
Dec-18	55.98	84.84	815.70	Food scrap + Cows' dung
รวม			**9,346.12**	

CMU CBG van riding invitation

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
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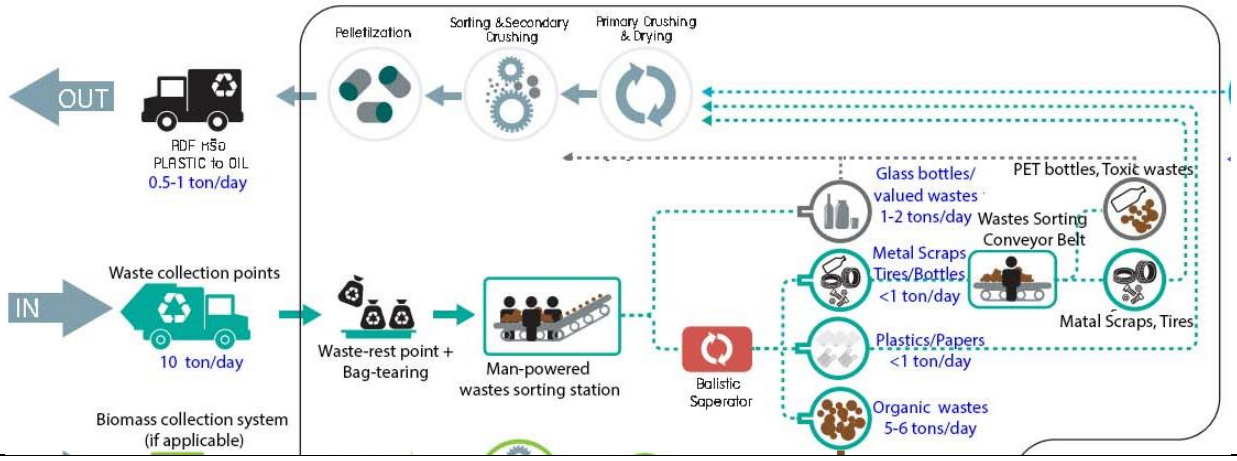
[3] Waste (WS)

[3.4] Inorganic waste treatment [WS 4]

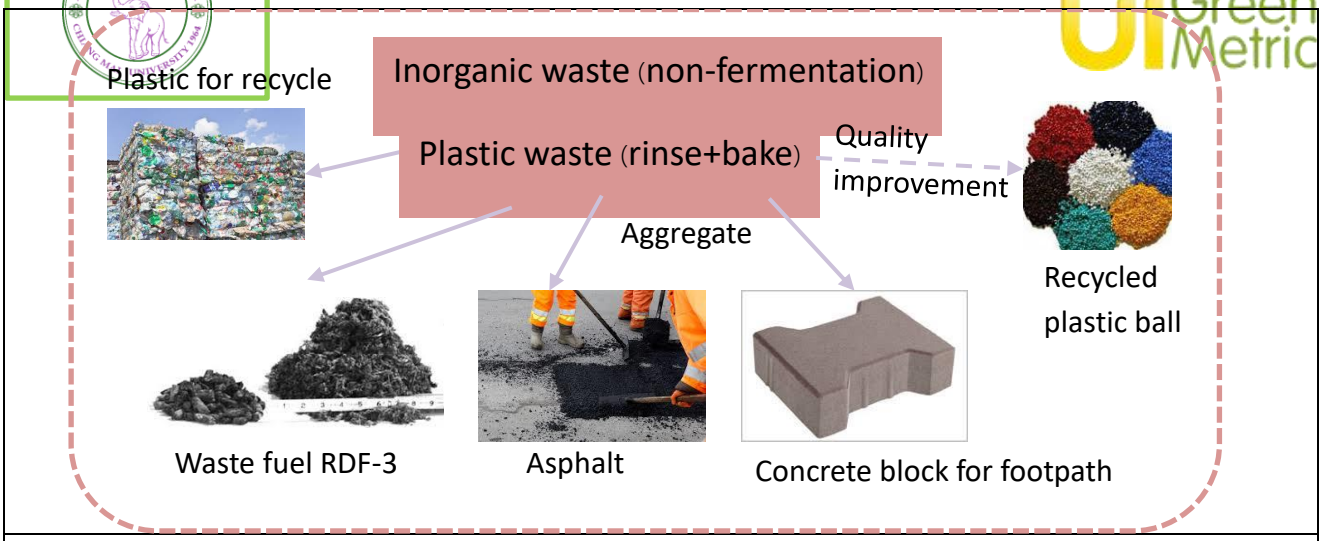
All 1,237 tons of inorganic waste in 2018 was 57.2% or 707 tons, equivalent to 1.9tons per day, of recyclable waste such as plastic, plastic bottles, paper, sorting and managed by each departmental unit and selling to Recycle Bank. Waste collection every Wednesday is operated by Building and Facilities Departments of the university. The department is responsible for the Recycle Bank to manage to sell for further reuse purposes. The 530 tons/year of the left-over inorganic waste or 42% of all inorganic waste and 19.63% of all waste disposal of the university was sorted again to clean out 17.5% organic waste used for biogas production. The organic waste will be managed through the fermentation process to produce the biogas, make fertilizer, and generate electrical power. The less of the waste such as glasses, metals, ceramics, and contaminated plastic will be eliminated in the RDF to produce composite asphalt for road construction in the next step as shown in Figures.

Table 2.20 Amount of manageable inorganic waste in 2018

Type	Amount of 2018 waste	
	(Ton)	(%)
1. Recyclable waste	707.59	57.20%
Glasses, bottles	*70.88*	*5.73%*
Plastic	*602.15*	*48.68%*
Metal	*34.56*	*2.79%*
2. Other inorganic waste	529.38	42.79%
Total inorganic waste	**1,236.97**	**100.00%**



Recycle Garbage Disposal guidelines of Biomass Management Center, Chiang Mai University



The process of non-biodegradable inorganic waste management includes sorting, plastic pellets producing, and asphalt making.

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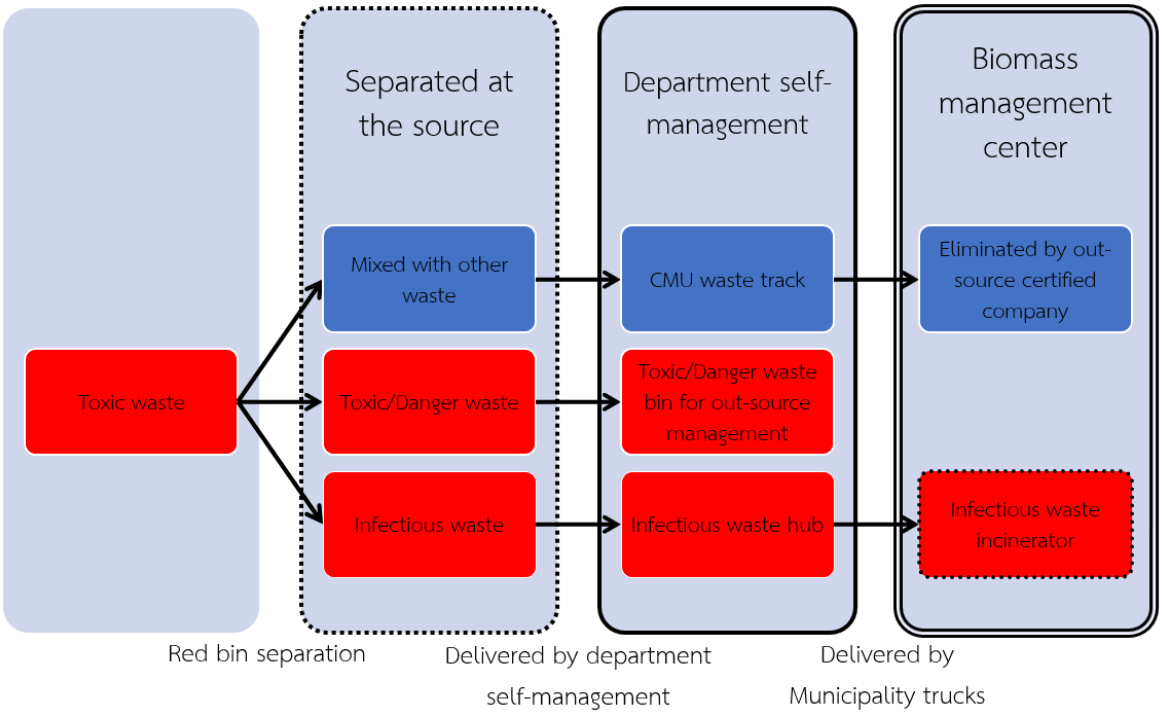
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[3] Waste (WS)

[3.5] Toxic Waste Handled



A flow chart of toxic waste management of CMU waste truck project by using a waste incinerator at the Faculty of Medicine

Example of Toxic Waste Sorting (CMU Chang-Chang-Yak campaign)

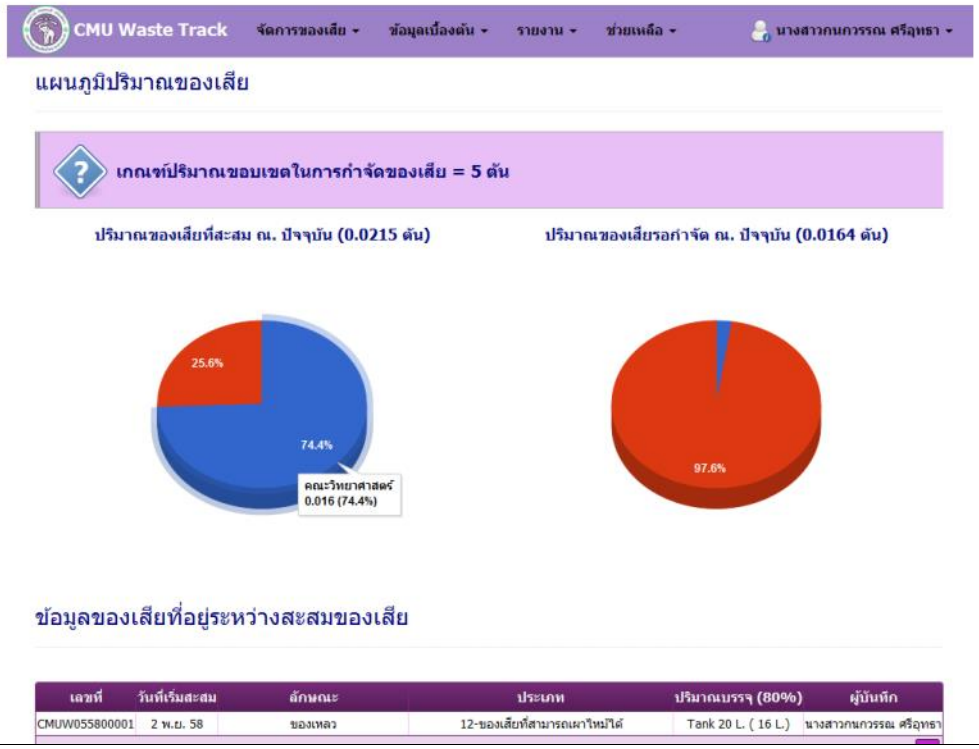
Description:

The average of 2.5 tons/day, 912 tons in 2018, of infectious wastes such as needles and sharp objects from the hospital are collected at the waste disposal spot behind the Mechanical and Maintenance Department building of the Faculty of Medicine. These wastes, including contaminated garbage from the bathrooms of the hospital, were 100% eliminated daily. For example, the average amount of waste collected from the Office of the President was 4 Kg weekly or 16 Kg per month, and 16 Kg weekly or 48 Kg per month were gathered from the Dormitories' restrooms of Suan Sak zone.

The elimination of infectious waste is by utilizing GW 1020, a non-pollution combustible incinerator, based on the standard of the Ministry of Public Health, at a temperature above 700 °c with the furnace's operating time of about 8 hours The Mechanical and Maintenance Department of the faculty of Medicine, Chiang Mai University, is in charge of the waste incinerator. Hazardous garbage and hazardous chemical substance are managed and destroyed every 6 months by a licensed company qualified for hazardous waste management. In addition, the campaign of hazardous waste separation has clearly identified that the segregated hazardous waste will be destroyed by the waste incinerator at Maharaj Nakorn Chiang Mai Hospital. (Source: Student Development Division, Chiang Mai University,

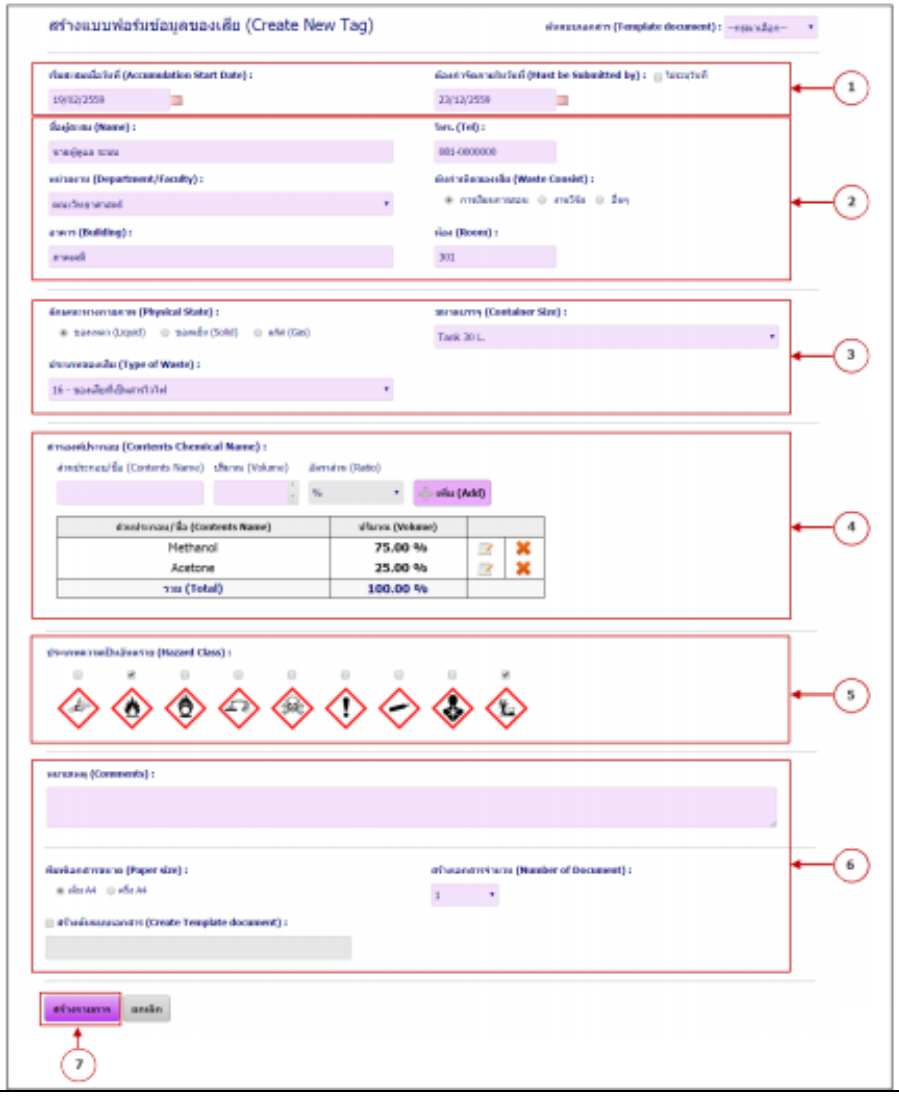
(https://prcmu.cmu.ac.th/scoop_detail.php?sco_sub_id=2366)

CMU waste track Project by the Faculty of Sciences in collaboration with Research Management Center of Chiang Mai University also encourage the correct way to remove chemical content and toxic waste from laboratories by upgrading the laboratory standard with operational guidelines for laboratory hazardous waste elimination. CMU waste track program is applied to create a statistical record of the amount of waste and the waste elimination data of each departmental unit. The program also disseminates the general knowledge regarding hazardous waste elimination.



CMU Waste Track Program Home Page

CMU Waste Track list



Waste removal form in the CMU waste track program

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[3] Waste (WS)

[3.6] Sewage Disposal

Position of Sewerage Disposal (next to hospital)

Sewerage disposal plan

Description:

Chiang Mai University's wastewater treatment capacity is around 10,000 m3 per day covering the area of suan Sak and Suan Dok zones. 100% of staffs, students, and employees who reside on campus gain access to wastewater treatment services. The standard quality of treatment process is strictly controlled to ensure that water through the treatment is not exceeding the standard criteria and does not create the environmental impacts. Some of the treated water is utilized for landscaping such as plant and lawn watering at the public areas of the university. 5,000 m^3 per day is recycled and 50% of treated water is reused.

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UI GreenMetric Questionnaire

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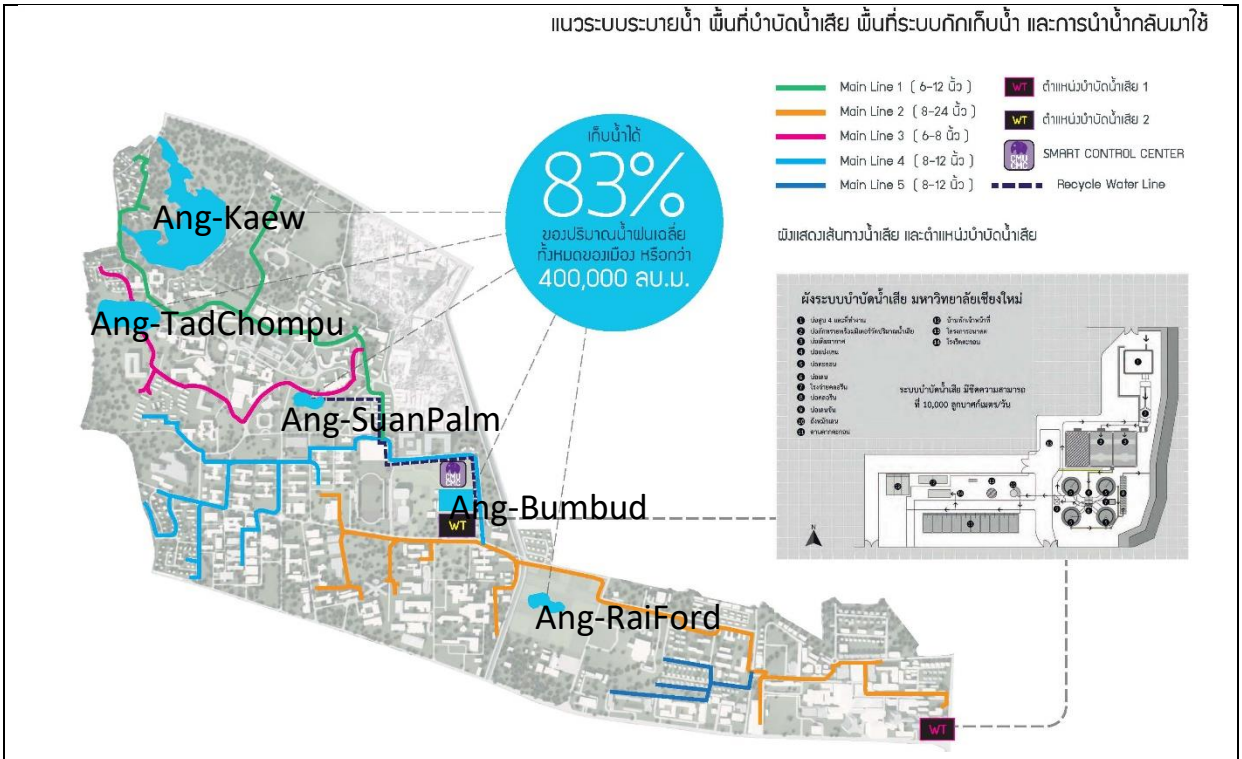
[4] Water (WR)

[4.1] Water Conservation Program Implementation



Layout plan highlighting locations of Chiang Mai University's reservoirs, the sewage pipelines, and wastewater treatment system

Ang-Kaew Reservoir

Ang Tad Chum Poo Reservoir

Ang Suan Palm Reservoir

Description:

Chiang Mai University Town produces water supply for consumption within the university by utilizing raw water from natural reservoirs holding the water from 6 creeks that flow through the university, which are Huay Kaew, Huay Koo Khao, Huay Tad Chom Phoo, Huay Mae Ra-ngong, Huay Fai Hin, and Huay Lae. These natural creeks hold the natural surface runoff and collect rainwater. The university gain benefit from these water sources by diverting them to the campus reservoirs for water retention.

By calculating the area of rainwater reservoir in accordance with hydrologic design criteria, the whole area of CMU can hold 480,000 m^3 of rainwater. The 10-years average rainfall of Chiang Mai Province is 400 mm. The capacity of five reservoirs of the university is as follows; Ang Kaew, with a capacity of not less than 300,000 m^3, Ang Tad Chom Phoo with a capacity of not less than 100,000 m^3, Ang Suan Palm with a capacity of not less than 8,000 m^3, Ang Rai Ford reservoir with a capacity of not less than 5,000 m^3, and natural treatment reservoir with a capacity of not less than 3,000 m^3. In addition, 28 departments also collect and retain rainwater for water supply in the buildings by using rainwater collecting tanks, which can hold water up to 273.5 m^3 (Table 2.20). **This can be calculated as 416,273.5 m^3 of rainwater storage, which is 86.7% of the 10-year average rainfall.**

Table 2.20 shows the amount of rainwater tanks of various departments within Chiang Mai University.

No.	Departmental unit	Size of water tank (litre)	Quantity (tank)	Total (litre)	Total (m^3)
1	The Royal Project, the Faculty of Agriculture	1,500	3	4,500	4.5
2	Botanical Building, the Faculty of Agriculture	1,500	1	1,500	1.5
3	The Faculty of Pharmacy	4,000	2	8,000	8.0
4	The Faculty of Political Science and Public Administration	4,000	1	4,000	4.0
5	Activity Building, the Faculty of Education	5,000	1	5,000	5.0
6	Cafeteria, the Faculty of Education	4,000	2	8,000	8.0
7	Building 7, the Faculty of Education	4,000	1	4,000	4.0
8	Building 1, the Faculty of Education	4,000	1	4,000	4.0

No.	Departmental unit	Size of water tank (litre)	Quantity (tank)	Total (litre)	Total (m^3)
9	Building 8, the Faculty of Education	4,000	1	4,000	5.25
		1,250	1	1,250	
10	The Faculty of Architecture	1,500	4	6,000	6.0
11	Administration Building, the CMU	2,500	2	5,000	13.75
	Demonstration School	1,250	1	1,250	
	The CMU Demonstration School	2,500	3	7,500	
12	Pink Dormitory	2,500	3	7,500	7.5
13	55 year-Nursing Building	5,000	1	5,000	5.0
14	Rujirawong Swimming Pool	2,500	3	7,500	7.5
15	The Faculty of Humanities	2,500	2	5,000	5.0
16	Ang Kaew housing village	2,500	3	7,500	7.5
17	Building 3, SCI Research Institute	2,500	4	10,000	10.0
18	Registration Office	4,000	4	16,000	16.0
19	Registration Learning Building (RB5)	4,000	3	12,000	12.0
20	Female Dormitory 1	3,000	2	6,000	6.0
21	Female Dormitory 2	3,000	4	12,000	12.0
22	Female Dormitory 3	3,000	3	9,000	13.0
		4,000	1	4,000	
23	Female Dormitory 4	3,000	2	6,000	37.0
		3,000	7	21,000	
		5,000	2	10,000	
24	Female Dormitory 6	5,000	4	20,000	20.0
25	Female Dormitory 7	3,000	4	12,000	12.0
26	Female Dormitory 8	5,000	2	10,000	19.0
		3,000	3	9,000	
27	Male Dormitory 4	5,000	2	10,000	10.0
28	Male Dormitory 5	5,000	2	10,000	10.0
	Total	**116,500**	**85**	**273,500**	**273.5**

Examples of two 5,000-litre rainwater tanks at Male Dormitory 5

Examples of three 4,000-litre rainwater tanks at Learning center Building RB5

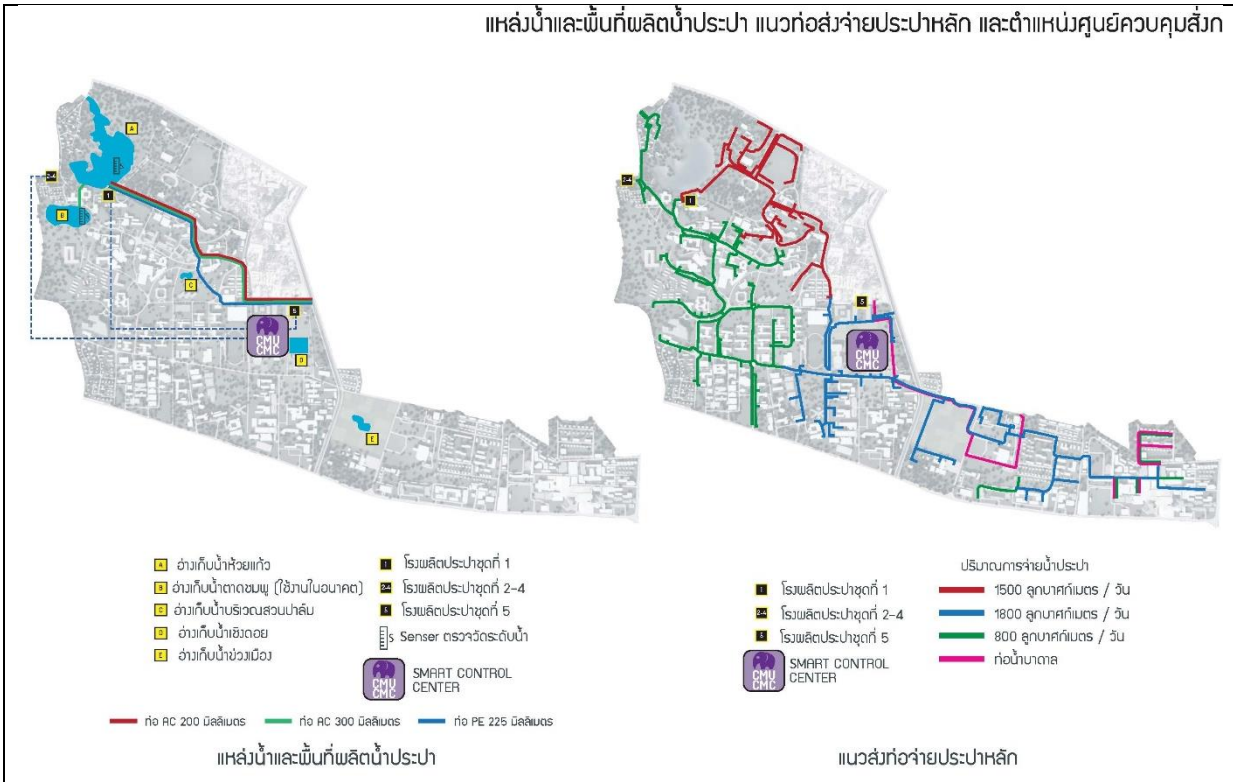
	
Examples of two 2,500- litre rainwater tanks at the Administration Building, the CMU Demonstration School	Examples of a 5,000-litre rainwater tank at the 55-year Nursing Building

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

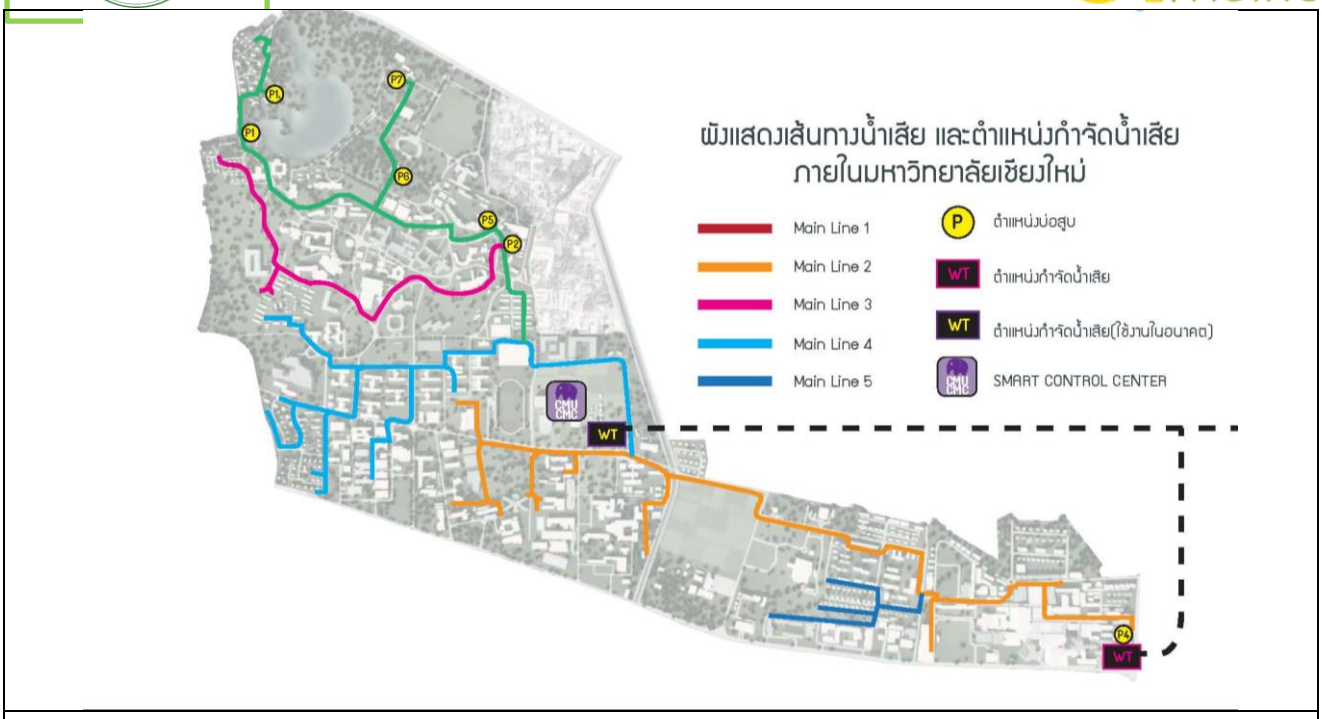
[4] Water (WR)

[4.2] Water Recycling Program Implementation



Water production (left) water supply system (right)

Chiang Mai University water treatment system layout



Sewage pipelines and wastewater disposal locations

Description:

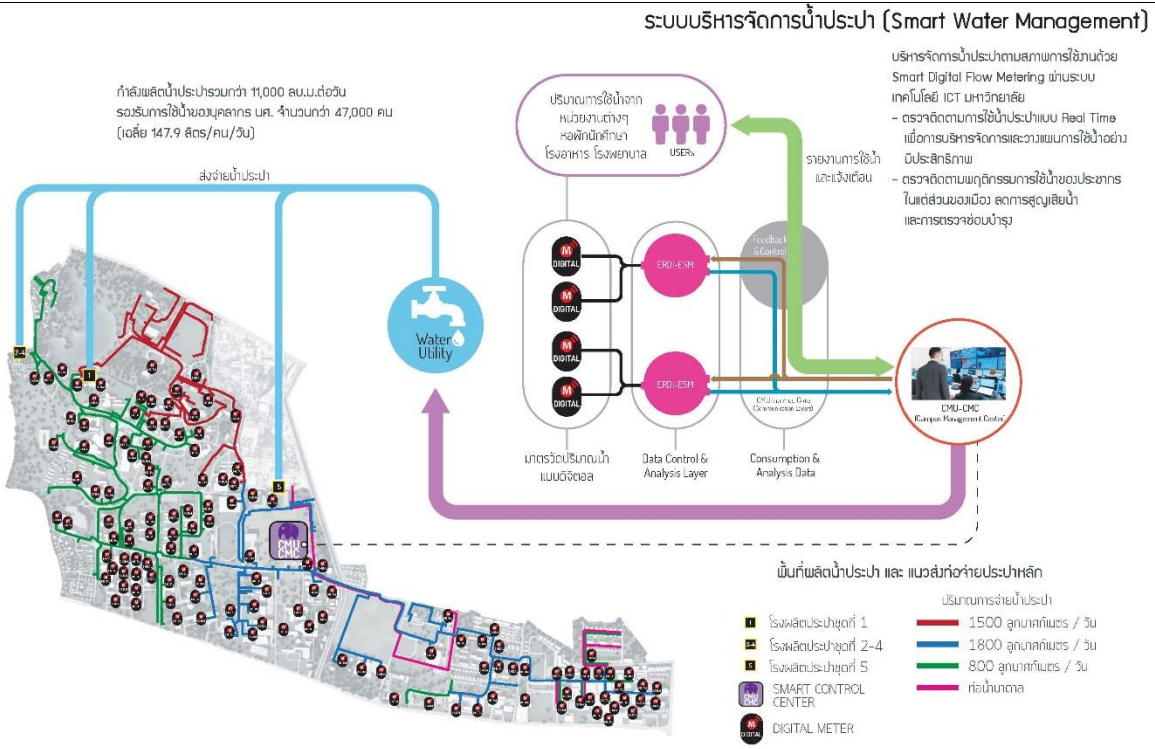
Wastewater treatment System of Chiang Mai University is capable to hold water treatment capacity of around 10,000 m^3 per day. All wastewater is treated before discharging to natural water sources. Partially, treated water is reused for gardening, and watering the lawns at the common area of the university. Approximately, **5,220 m^3 per day or 52% of treated wastewater is used**, for example, S1 Parking Building use 220 m^3 per day recycled water for plant watering. 3,150 m^3 per day of recycled water is used for gardening at the university's Administrative Building. And 1,850 m^3 of recycled water is used for the small parks at the faculty of medicine. All recycled water is utilized for landscaping.

[4.4] Treated water consumed (WR.4)

Wastewater treatment System of Chiang Mai University carries the water treatment capacity of around 10,000 m^3 per day. 5,220 m^3 per day or 1,905,300 m^3 per year of treated wastewater is reused for gardening and watering the lawn of the common areas of the university. Of 2,485,832 m^3 water usage per year in 2018, **77% is recyclable treated-wastewater**. Five reservoirs are utilized as raw water sources to produce water supply for the university.

The S1 Building reuses the treated wastewater for vertical garden watering. (WT)

The map shows the planting areas where treated wastewater has been reused. (WT)



Water utility and management system

Template for Evidence(s)
UI GreenMetric Questionnaire

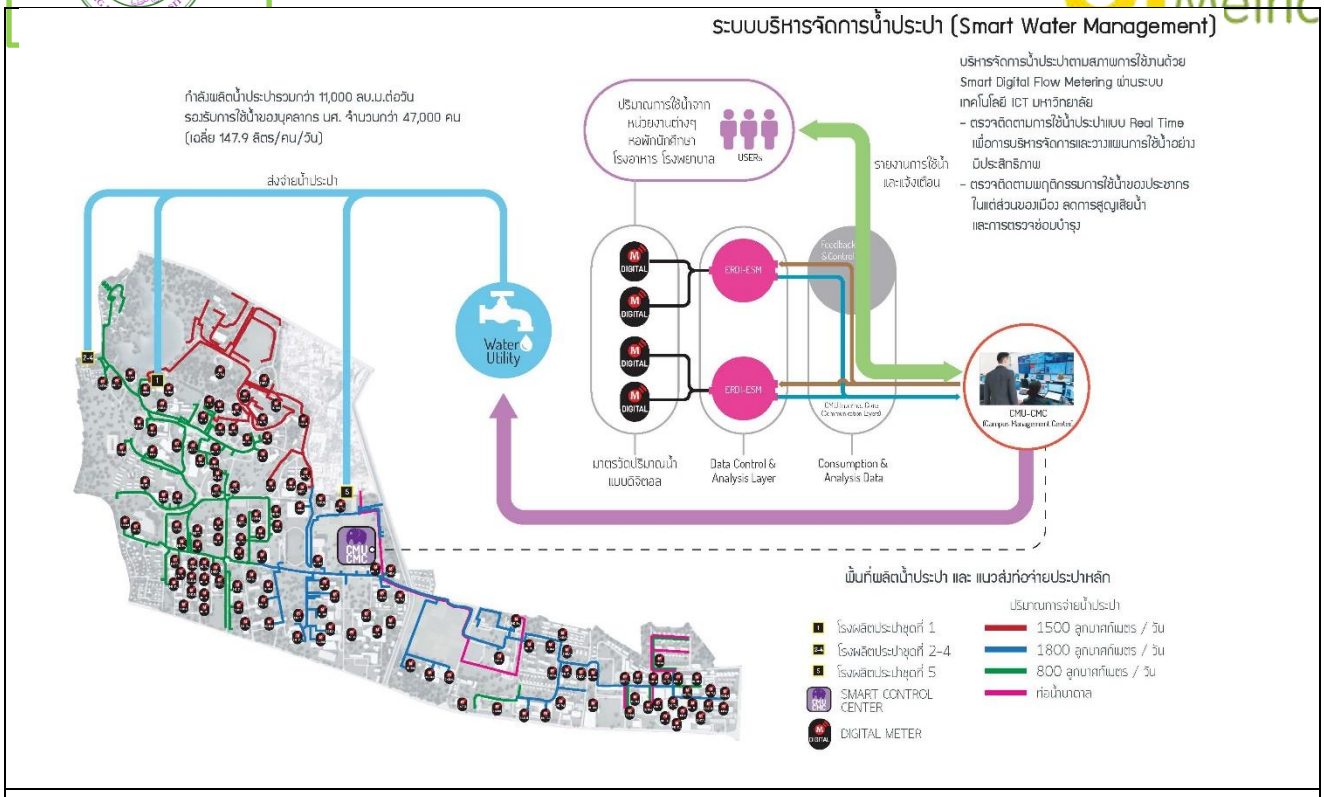
University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[4] Water (WR)

[4.3] The Use of Water Efficient Appliances (Water tap, toilet flush, etc)

Automatic urinal at the Faculty of Architecture building (left) and at the Department of Community Medicine Building [PROJECT-1] (right)

A water efficient water closet (toilet) at the Faculty of Architecture Building (left) at Faculty of Sciences Building (center) and at Art Gallery (right) [Project-1]



Water utility and management system [Project-2]

Description:

Currently, two projects regarding water-saving equipment change and water supply management system installation in accordance with the actual operating conditions include;

1.) Changing sanitary ware and water-saving equipment in 4 smart buildings and defining new building policies using sanitary ware and water saving equipment are implemented. Of 26,579, 512 pieces have already been installed, which is 1.9% in 2018. Water efficient appliances include low flow water taps, automatic water taps, low flush toilets, automatic urinals and low flow urinals. The equipment will be 100% modified in all buildings by 2021.

Table 2.21 Installation of water-saving equipment within Chiang Mai University

	Water taps		**Toilets**		**Urinals**		**Showers**	
	Normal	**Water saving**	**Normal**	**Water saving**	**Normal**	**Water saving**	**Normal**	**Water saving**
Quantity (pieces)	9,608	272	9,267	225	2,053	15	5,139	0
Total quantity (pieces)	9,880		9,492		2,068		5,139	
Ratio (%)	97.25	2.75	97.63	2.37	99.27	0.73	100	0
Total proportion (%)	**512 of 26,579 pieces (1.9%)**							

2.) It is expected that the use of Smart Digital Flow Metering through the ICT system of departmental units and the university, and the installation of Smart Metering equipment for water content measurement and water management in upgraded buildings, will be completed by 2021. This is a management model of water utilization in the buildings based on real-time tracking of water usage, covering the 100% of entire functional area. Measurement survey of the use of water from each source in different periods in the buildings, at least 30% water consumption is found to be reduced. Water management plans are practicable and maintenance plans are carried out efficiently and concretely.

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

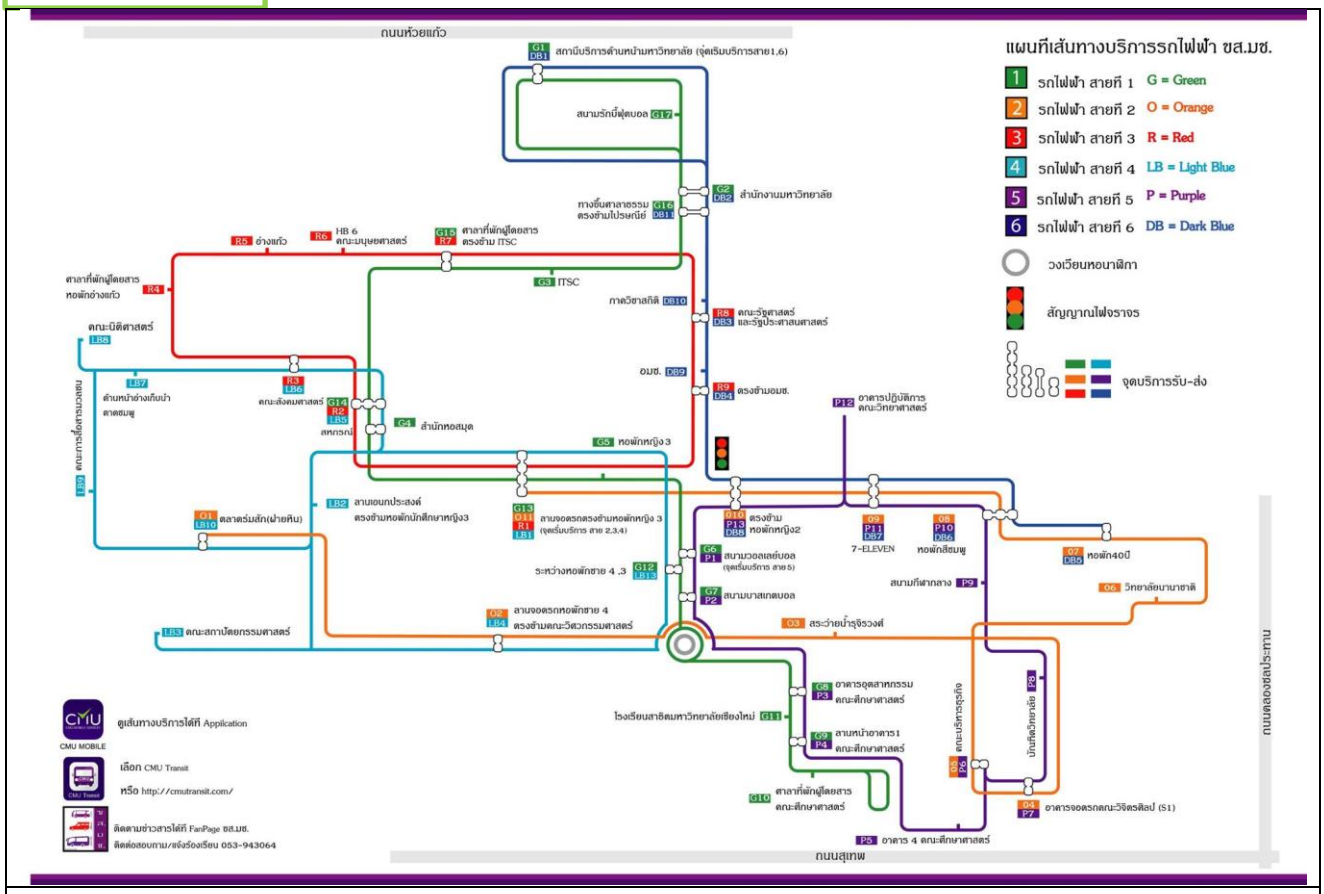
[5] Transportation (TR)

[5.5] Shuttle services

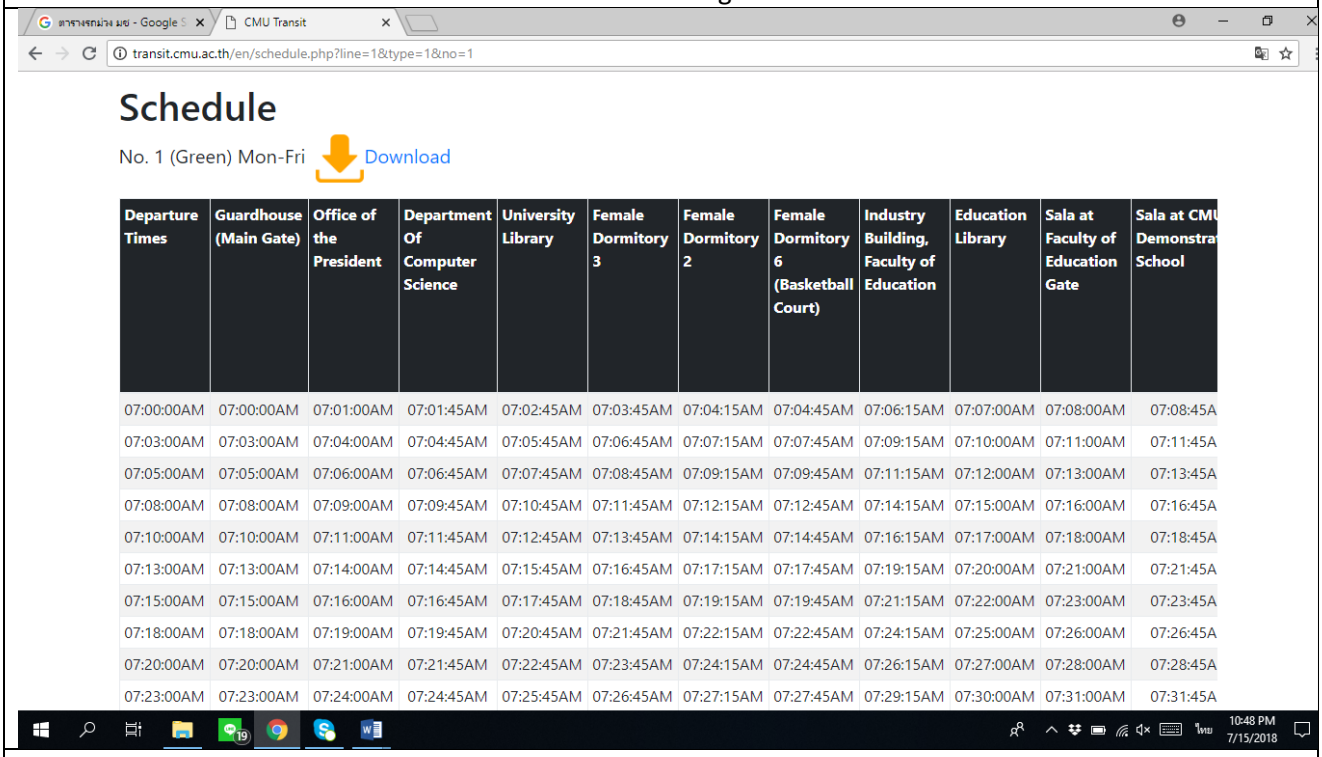
Shuttle Electric Bus

Electric charger station for shuttle buses

Example of 5 Bus routes



Bus Routes diagram

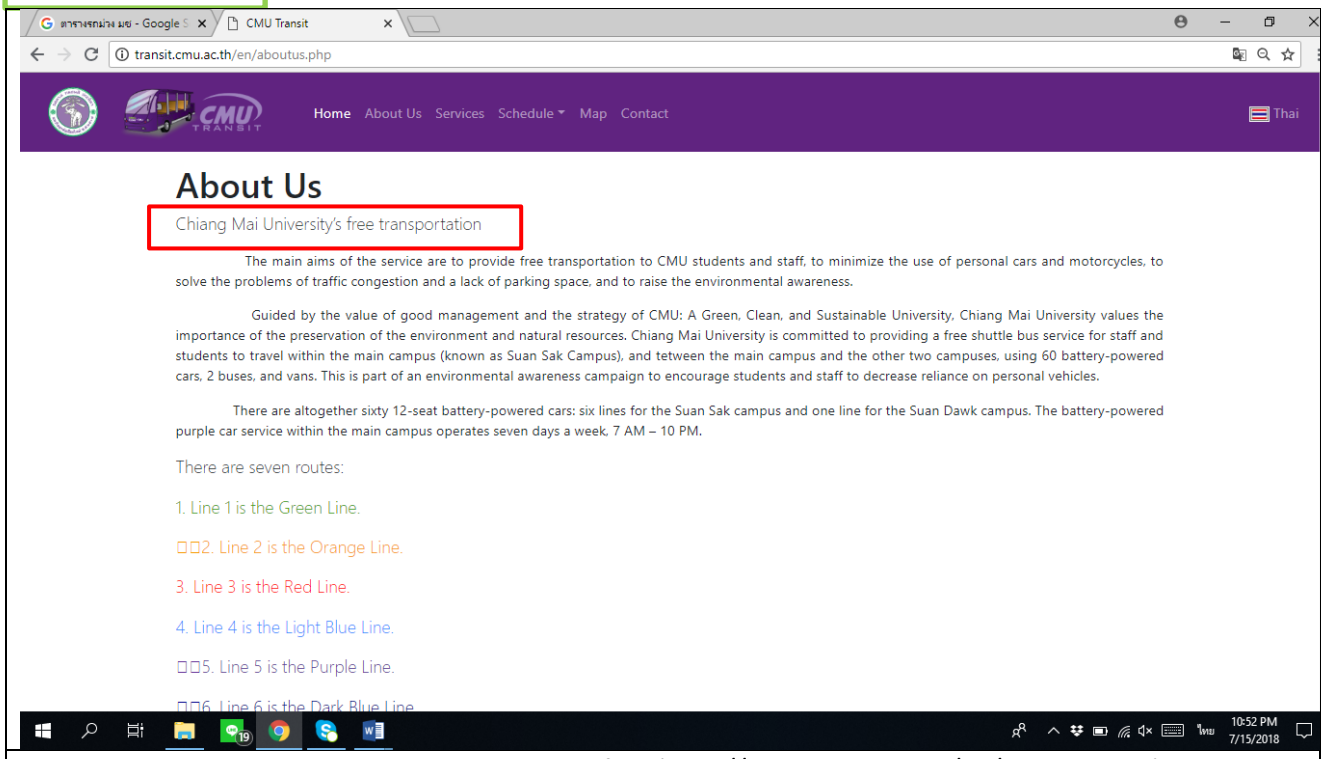


Schedule

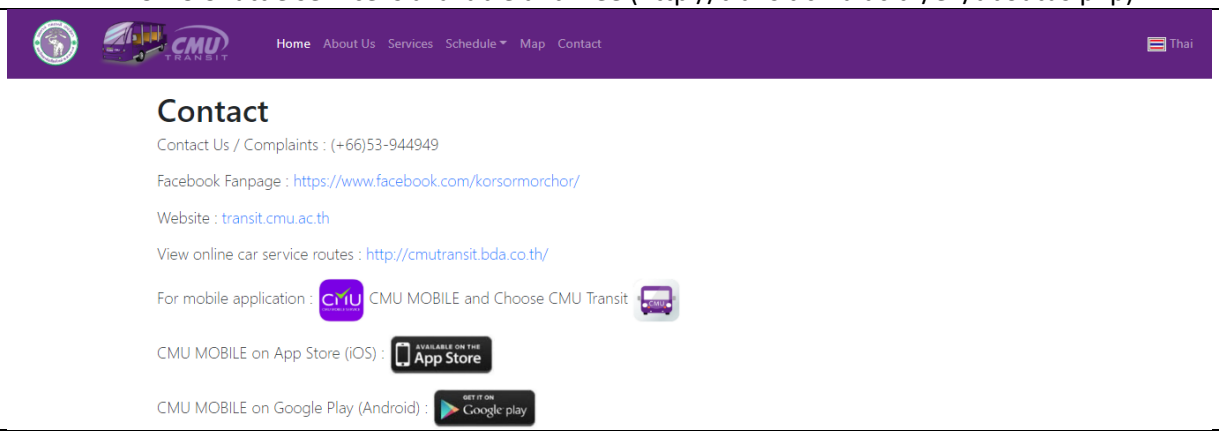
No. 1 (Green) Mon-Fri Download

Departure Times	Guardhouse (Main Gate)	Office of the President	Department Of Computer Science	University Library	Female Dormitory 3	Female Dormitory 2	Female Dormitory 6 (Basketball Court)	Industry Building, Faculty of Education	Education Library	Sala at Faculty of Education Gate	Sala at CMU Demonstration School
07:00:00AM	07:00:00AM	07:01:00AM	07:01:45AM	07:02:45AM	07:03:45AM	07:04:15AM	07:04:45AM	07:06:15AM	07:07:00AM	07:08:00AM	07:08:45A
07:03:00AM	07:03:00AM	07:04:00AM	07:04:45AM	07:05:45AM	07:06:45AM	07:07:15AM	07:07:45AM	07:09:15AM	07:10:00AM	07:11:00AM	07:11:45A
07:05:00AM	07:05:00AM	07:06:00AM	07:06:45AM	07:07:45AM	07:08:45AM	07:09:15AM	07:09:45AM	07:11:15AM	07:12:00AM	07:13:00AM	07:13:45A
07:08:00AM	07:08:00AM	07:09:00AM	07:09:45AM	07:10:45AM	07:11:45AM	07:12:15AM	07:12:45AM	07:14:15AM	07:15:00AM	07:16:00AM	07:16:45A
07:10:00AM	07:10:00AM	07:11:00AM	07:11:45AM	07:12:45AM	07:13:45AM	07:14:15AM	07:14:45AM	07:16:15AM	07:17:00AM	07:18:00AM	07:18:45A
07:13:00AM	07:13:00AM	07:14:00AM	07:14:45AM	07:15:45AM	07:16:45AM	07:17:15AM	07:17:45AM	07:19:15AM	07:20:00AM	07:21:00AM	07:21:45A
07:15:00AM	07:15:00AM	07:16:00AM	07:16:45AM	07:17:45AM	07:18:45AM	07:19:15AM	07:19:45AM	07:21:15AM	07:22:00AM	07:23:00AM	07:23:45A
07:18:00AM	07:18:00AM	07:19:00AM	07:19:45AM	07:20:45AM	07:21:45AM	07:22:15AM	07:22:45AM	07:24:15AM	07:25:00AM	07:26:00AM	07:26:45A
07:20:00AM	07:20:00AM	07:21:00AM	07:21:45AM	07:22:45AM	07:23:45AM	07:24:15AM	07:24:45AM	07:26:15AM	07:27:00AM	07:28:00AM	07:28:45A
07:23:00AM	07:23:00AM	07:24:00AM	07:24:45AM	07:25:45AM	07:26:45AM	07:27:15AM	07:27:45AM	07:29:15AM	07:30:00AM	07:31:00AM	07:31:45A

Example of Line 1 Bus Schedule (every 3 minutes)



CMU Shuttle service is available and free (http://transit.cmu.ac.th/en/aboutus.php)



CMU Shuttle service contact info (http://transit.cmu.ac.th/en/contact.php)

Description:

Chiang Mai University shuttle bus is free. The main aims of the service are to provide free transportation to CMU students and staff, to minimize the use of personal cars and motorcycles, to solve the problems of traffic congestion and parking space shortage, and to raise the environmental awareness.

Guided by the value of good management and the strategy of CMU: A Green, Clean, and Sustainable University, Chiang Mai University values the importance of the preservation of the environment and natural resources. Chiang Mai University is committed to providing a free shuttle bus service for staff and students to travel within the main campus (known as Suan Sak zone), and between the main campus and the other two campuses, using 60 battery-powered cars, 2 buses, and vans. This is a part of an environmental awareness campaign to encourage students and staff to decrease private vehicles dependency .

There are altogether sixty 12-seat battery-powered cars: six lines for the Suan Sak zone and one line for the Suan Dok zone. The battery-powered purple car service within the main campus operates seven days a week, 7 AM – 10 PM.

There are 474 vehicles actively used and managed by Chiang Mai University within 46 institutes and faculties. All vehicles could be classified into 5 vehicle types consist of 99 electric cars, 240 cars, 85 motorcycles, 41 agricultural vehicles and 9 medical unit vehicles. There are 55 electric shuttles operating with the university campus distributed into 5 routes across Suan-Sak regions. There is also one shuttle bus route that carries passenger from Suan-Sak zone to Suan-Dok zone and the hospital.

8,327 persons are using the shuttle services daily in the university on weekdays (the least passenger amount is 2,387 persons on weekends and the most user amount is 12,233 persons on weekdays). 55 shuttle buses take an average of 151 persons per day. An average number of shuttle service at the university is 951 trips per day (minimum 347 trips per day and 1,247 trips per day at the maximum); 17.3 trips per car per day when dividing all trips with all 55 shuttles.

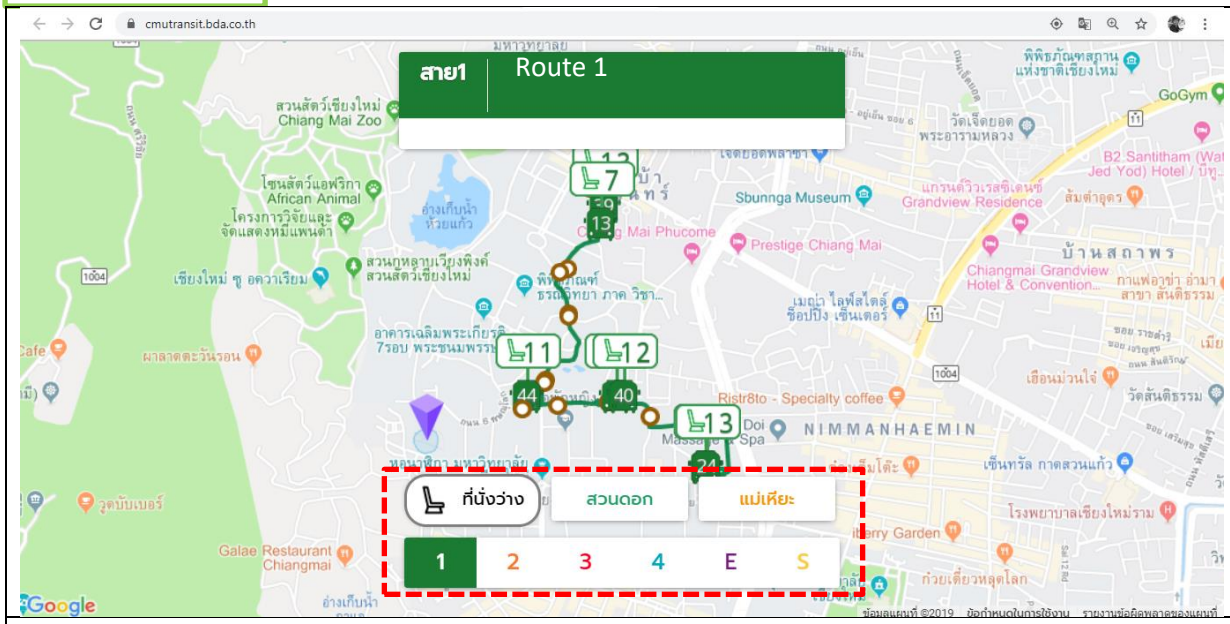
[5.5] Shuttle services (TR.2)

The proportion between 21,677 vehicles accessing the university and 48,431 population on campus is 2.2 persons per vehicle. The number of vehicles is counted from the students' and staff's cars that obtain the university's permission for vehicular access through registration. RFID stickers and a smart gate system are utilized to restrict accessibility.

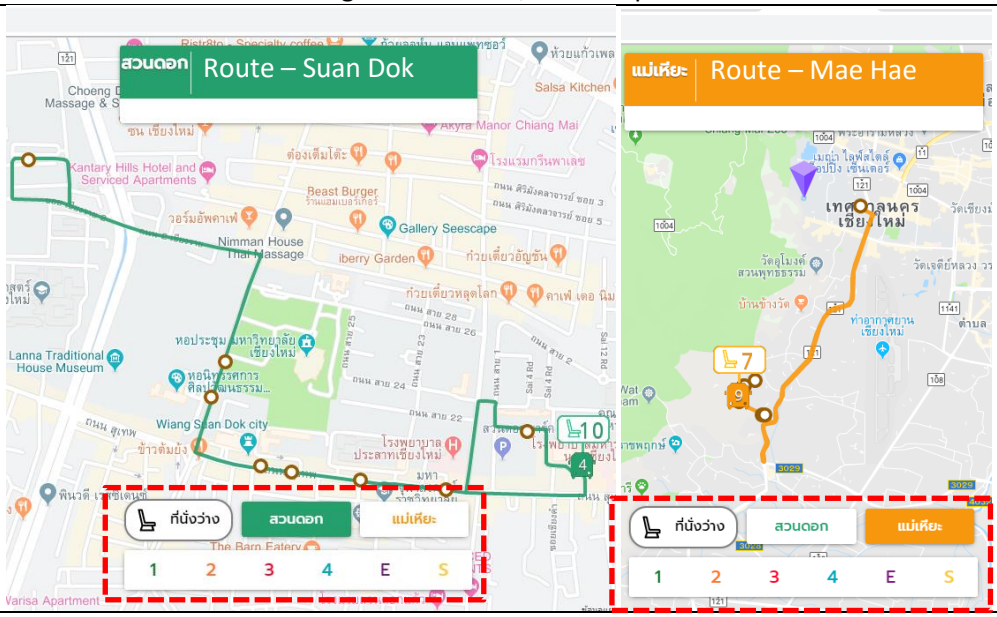
Putting RFID stickers on windshields, showing the university's permission for vehicular access

[5.6] Number of shuttles operated in your university

Ninety-nine shuttle trolleys running within the university are zero emission, all of which are operated by the university (http://transit.cmu.ac.th/en/index.php). The services are divided into 8 routes, which are the 1-4 and E-S lines available in the Suan Sak zone, Suan Dok line connecting Suan Sak to Suan Dok , and Mae Hea line connecting the main campus to Mae Hea zone. Real-time information regarding the number of active trolleys, available seats, routes, locations can be acquired from https://cmutransit.bda.co.th/ or via https://www.facebook.com/korsormorchor/. 99 active shuttle trolleys within the university are divided into 6 lines, serving the Suan Sak area (line 1-4, E, S). There also are 2 additional shuttle lines, making 8 lines in total, connecting Suan Dok area to the Suan Dok Hospital then continuing to Mae Hea zone.



Realtime tracking shuttle buses, an example of Line 1 route



Six lines routes realtime tracking map, Line 1-4, E and S. (Left - Suan Dok route, right – Mae Hae route)

[5.7] The average number of passengers of each shuttle

The ridership during weekend is at the minimum average of 2,387 person per day and at the maximum average of 12,233. 99 of 12-seated shuttle trolleys provide 8 lines of services around the university, serving 6 routes in Suan Sak area every day from 7 AM-10PM. with 2,208 trips per day during weekdays and 720 during weekends as shown in Table 2.12-2.13. The average number of the passengers is 8,311 per day and 83.9 passengers per shuttle per day comes from the shuttle services of Suan Sak-Suan Dok line operating from 7AM to 9PM and Suan Sak-Mae Hea line serving from 7AM to 8.30PM.

Table 2.10 Examples of the average number of passengers per each shuttle line in March 2018.

Date	Number of passengers								Total number of passengers
	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6	Suan Dok Line	Mae Hea Line	
2018-03-01	927	318	142	89	659	166	86	77	2464
2018-03-02	2204	426	968	218	1712	1285	758	717	8288
2018-03-03	1439	339	370	204	1120	608	201	183	4464
2018-03-04	1515	323	303	245	991	620	213	325	4535
2018-03-05	1328	257	644	306	1184	651	819	278	5467
2018-03-06	1741	4641	2271	1067	590	185	328	501	11324
2018-03-07	1412	3915	1280	772	623	265	358	308	8933
2018-03-08	2078	5173	2330	1373	579	282	139	199	12153
2018-03-09	2272	5395	2484	1057	606	245	350	257	12666
2018-03-10	1245	1945	687	246	261	20	98	87	4589
2018-03-11	744	1936	656	398	148	0	93	68	4043
2018-03-12	2011	4753	2281	1250	800	122	67	97	11381
2018-03-13	2240	5282	2423	1065	840	302	81	122	12355
2018-03-14	1522	4231	1605	676	744	395	34	47	9254
2018-03-15	1983	4851	2534	1069	757	3	193	111	11501
2018-03-16	2104	4593	2687	1047	747	320	25	71	11594
2018-03-17	1130	2265	932	307	222	42	63	54	5015
2018-03-18	754	2223	666	328	218	77	2	17	4285
2018-03-19	1847	4716	2423	1243	915	39	49	37	11269
2018-03-20	2041	5136	2072	1247	984	228	0	19	11727
2018-03-21	1592	3363	1506	679	1110	136	52	48	8486
2018-03-22	2242	4006	1990	1220	898	78	69	76	10579
2018-03-23	2328	4422	2036	843	939	150	89	99	10906
2018-03-24	633	1961	650	406	240	43	1	12	3946
2018-03-25	1126	1518	809	389	87	68	41	35	4073
2018-03-26	1933	4938	2155	1183	661	75	115	87	11147
2018-03-27	2528	4927	2088	1211	689	175	34	98	11750
2018-03-28	1945	3443	1391	728	829	301	41	41	8719
2018-03-29	2008	5103	2130	1173	571	272	199	278	11734
2018-03-30	1130	2265	932	307	222	42	63	71	5032
2018-03-31	633	1961	650	406	240	43	1	23	3957
Average	**1634**	**3246**	**1487**	**734**	**684**	**234**	**151**	**144**	**8311**

[5.8] Total trips of each shuttle services each da

The number of shuttle trips that serve at least every 3 minutes per service line is 225 per day and 1,800 of 8 lines. Trips during rush hours are operated every 1 minute, which make the actual number of trips is 2,415

per day. The average number of trips, calculated from 99 shuttle trolleys, is 960 per day and 9.7 trips per shuttle per day.

Table 2.11 Example of the average number of service cycles per shuttle line in March 2018

Date	Number of trips								Number of trips
	Line1	Line2	Line 3	Line 4	E Line	S Line	Suan Dok Line	Mae Hea Line	
2018-03-01	72	55	51	32	45	31	61	45	392
2018-03-02	234	100	129	128	207	194	109	99	1200
2018-03-03	115	81	91	79	99	101	84	77	727
2018-03-04	101	102	86	105	114	120	91	95	814
2018-03-05	128	96	96	76	136	30	79	84	725
2018-03-06	269	164	276	196	0	36	35	36	1012
2018-03-07	302	161	246	200	0	0	34	15	958
2018-03-08	306	212	262	212	85	16	31	28	1152
2018-03-09	321	190	298	161	90	33	31	34	1158
2018-03-10	155	75	141	118	107	40	26	24	686
2018-03-11	161	94	165	157	106	0	24	14	721
2018-03-12	254	171	273	207	98	16	8	11	1038
2018-03-13	354	217	276	255	105	32	7	21	1267
2018-03-14	305	193	299	243	103	40	2	12	1197
2018-03-15	291	194	308	244	135	0	24	4	1200
2018-03-16	278	196	281	261	115	35	3	13	1182
2018-03-17	116	104	210	147	92	0	13	7	689
2018-03-18	116	101	200	154	104	26	0	3	704
2018-03-19	337	220	273	207	134	9	13	23	1216
2018-03-20	363	222	250	201	121	27	0	3	1187
2018-03-21	331	197	265	228	126	0	4	7	1158
2018-03-22	344	199	252	192	130	13	5	15	1150
2018-03-23	327	198	271	129	114	18	5	8	1070
2018-03-24	95	126	175	166	95	0	0	9	666
2018-03-25	144	105	207	198	44	28	2	12	740
2018-03-26	284	255	255	163	97	15	7	3	1079
2018-03-27	322	254	246	151	94	15	3	8	1093
2018-03-28	307	286	251	160	111	24	2	7	1148
2018-03-29	306	212	262	212	85	14	7	5	1103
2018-03-30	322	190	270	119	117	16	5	4	1043
2018-03-31	81	59	61	32	43	0	0	3	279
Average	**240.03**	**162.23**	**216.97**	**165.58**	**98.45**	**29.97**	**23.06**	**23.52**	**959.81**

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[5] Transportation (TR)

[5.9] Zero Emission Vehicles (ZEV) policy on campus

Description:

Zero Emission Vehicles (ZEV) used within Chiang Mai University are consisted of bicycles, electric shuttles and minibuses with compressed Bio-Methene (CBG) fuel.

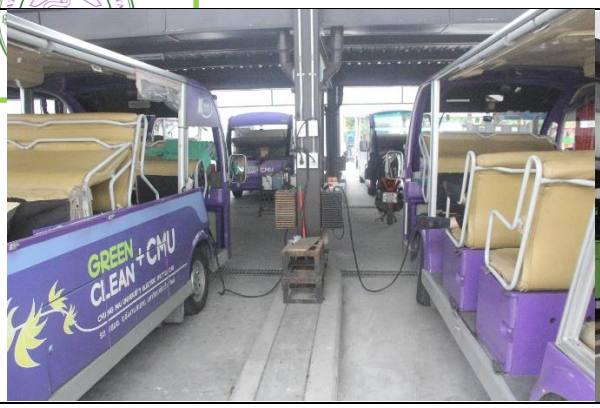
Chiang Mai University provides a free shuttle service for staff and students to travel within the main campus (known as Suan Sak Campus), using battery-powered cars, buses, and vans. This is a part of an environmental awareness campaign to encourage students and staff to use energy-saving vehicles. The aim of the service is to minimize the use of personal cars or motorcycles, which will in turn alleviate the traffic congestion within the university.

Battery-powered cars: The battery-powered purple car service within the main campus operates seven days a week, 7 AM – 10 PM. The service between the main campus and the Suan-Dok area (the Faculty of Medicine) operates seven days a week, 7 AM – 9:30 PM., 15 minutes frequency. The service between the main campus and the Mae Hea campus (the Faculty of Veterinary Medicine Medicine and the Faculty of Agro-Industry) operates seven days a week, 7 AM – 8:30 PM., 30 minutes frequency.

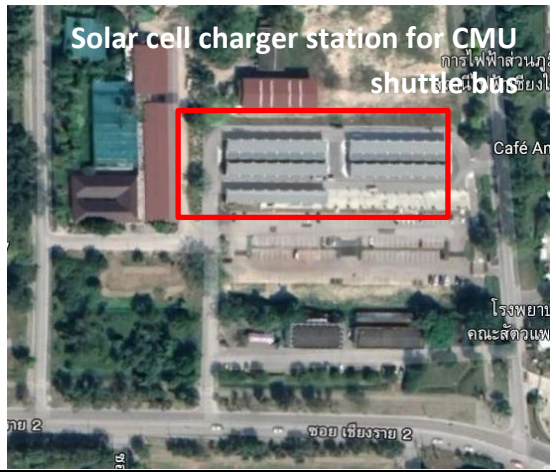
The CMU Mobile Application (CMU Mobile) can be downloaded in order to access the location of the car and the expected time of arrival or Real Time Map.

The university's ZEV vehicles include 99 electric shuttle trolleys, and 400 shared-bikes, which can be real-time tracked via https://cmutransit.bda.co.th/ (as shown in below Figures).

Electric shuttle trolleys on campus



Electric shuttle trolleys charger stations



Electric shuttle trolleys charger stations and free bus station

เส้นทางจักรยาน เส้นทางเดินเท้า

Shared-Bike Project

Bike Way on campus

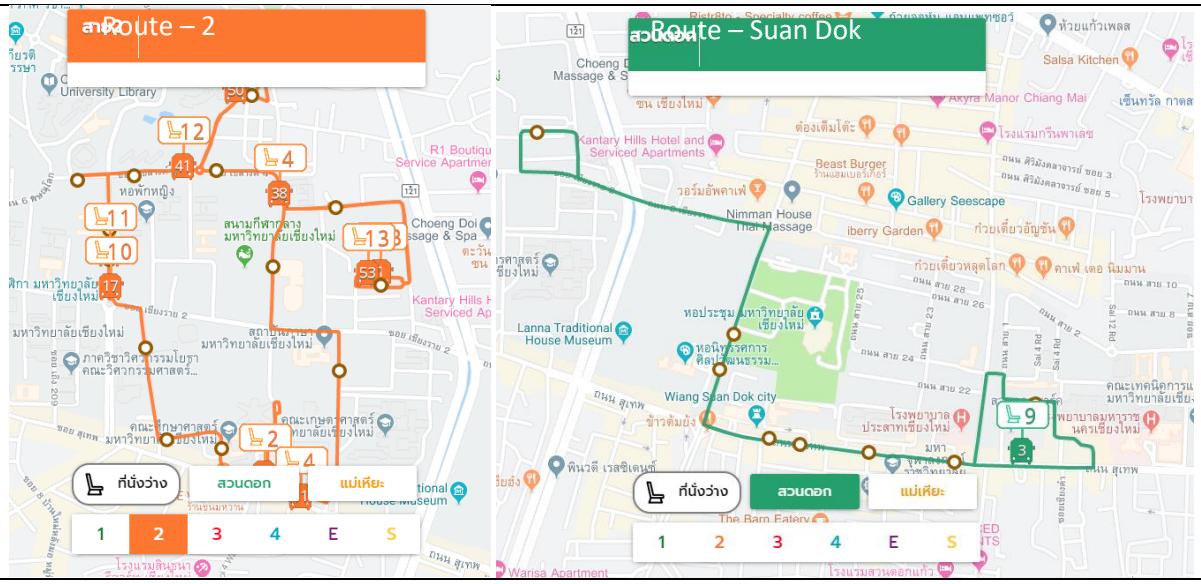
Shared-bike on campus

[5.10] The average number of Zero Emission Vehicles (ZEV) on campus per day

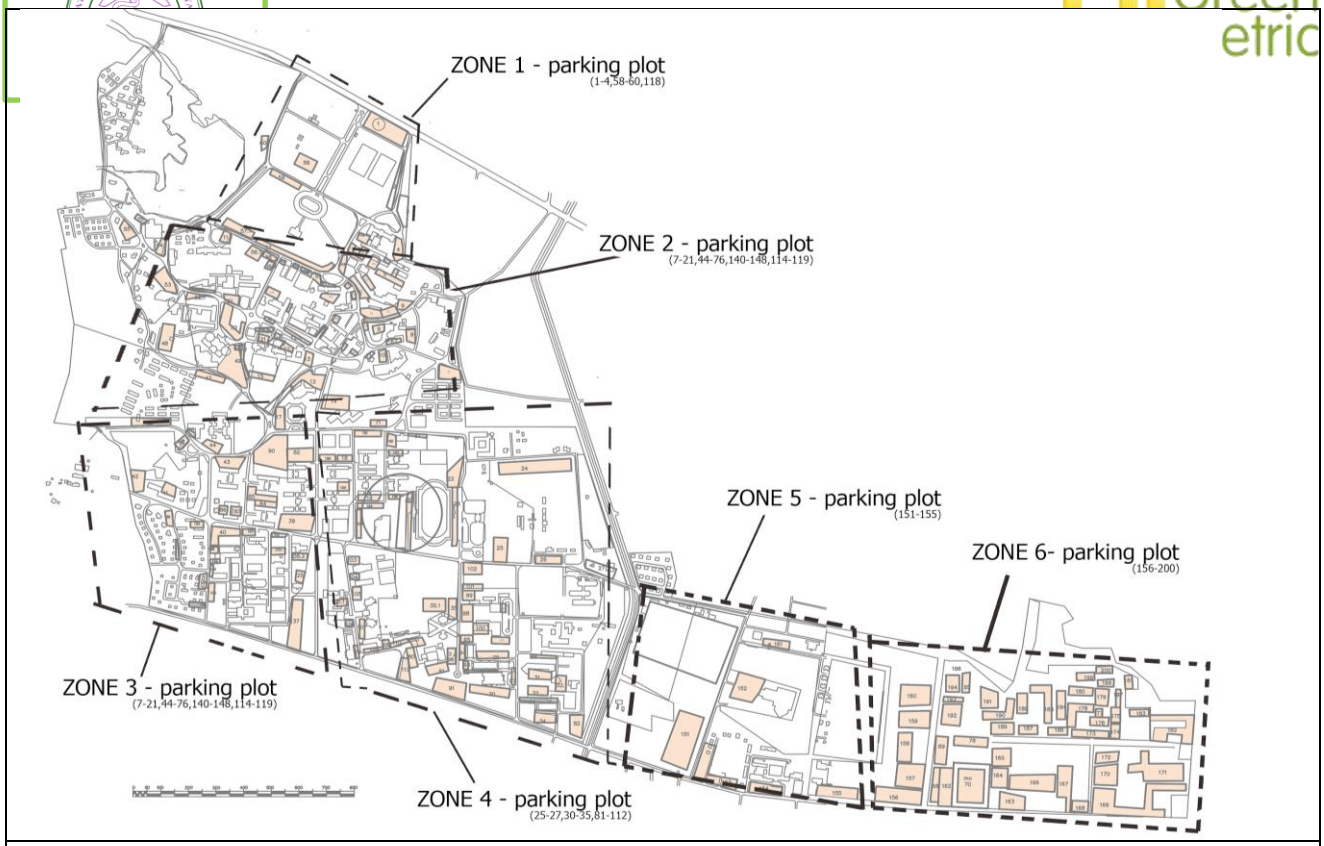
The university's electric shuttles are 99 in total. 400 shared-bike (Mobike) and 619 bicycles are used at the university per day. Electric vehicles are utilized every day all year round. In total the university has 1,718 ZEVs. The average use of the university's ZEV is 1,431.7 vehicles per day, considering 100% use during 8 months of the semesters and 50% use during 4 months of semester break.

[5.11] The total number of Zero Emission Vehicles (ZEV) divided by total campus population (TR.4)

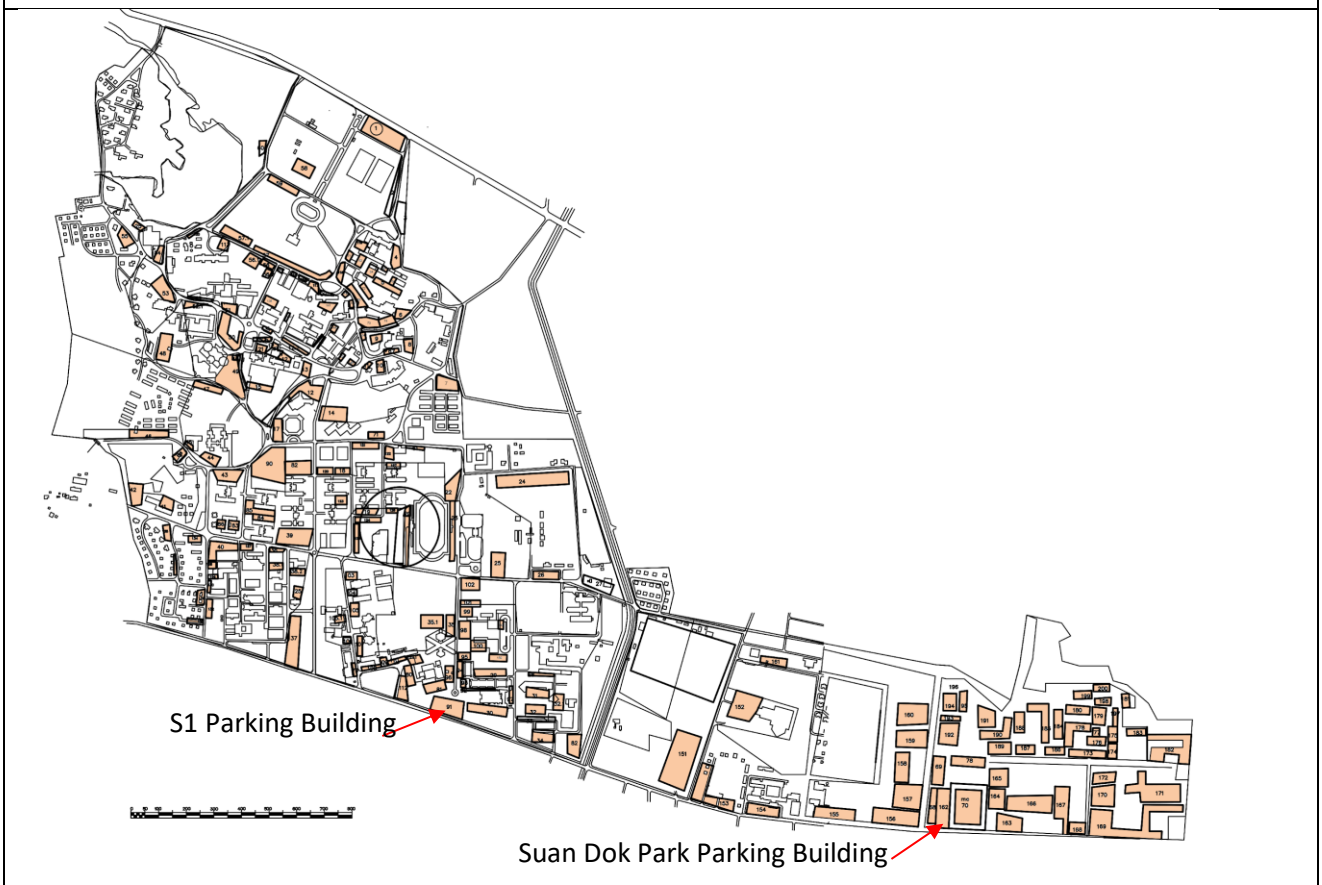
1,718 electric shuttle trolleys of the university are zero emission vehicles (ZEV). Based on 5.10, the average number of ZEV cars utilized by the university is 1,431.7 per day, which equals to 0.0297 by calculating from 48,120 campus population.



Examples of real-time tracking of shuttle services in terms of location, routes, and available seats in each trolley via https://cmutransit.bda.co.th/, such as Line 2 shuttles (left), Suan Dok Line (right).



The location of 6 parking zones at Chiang Mai University



216 Chiang Mai University parking spots

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[5] Transportation (TR)

[5.13] Ratio of parking area to total campus area

The parking area of Chiang Mai University is 391,274 sq.m., which is calculated as 13.50% of the total area of the university, 2,899.200 sq.m. The parking buildings are constructed to limit the access of private cars in campus area.

Six locations of parking zones at Chiang Mai University

216 parking spots throughout the campus

Description :
Total Parking area = 391,274 m^2
Ratio parking area : 13.5%

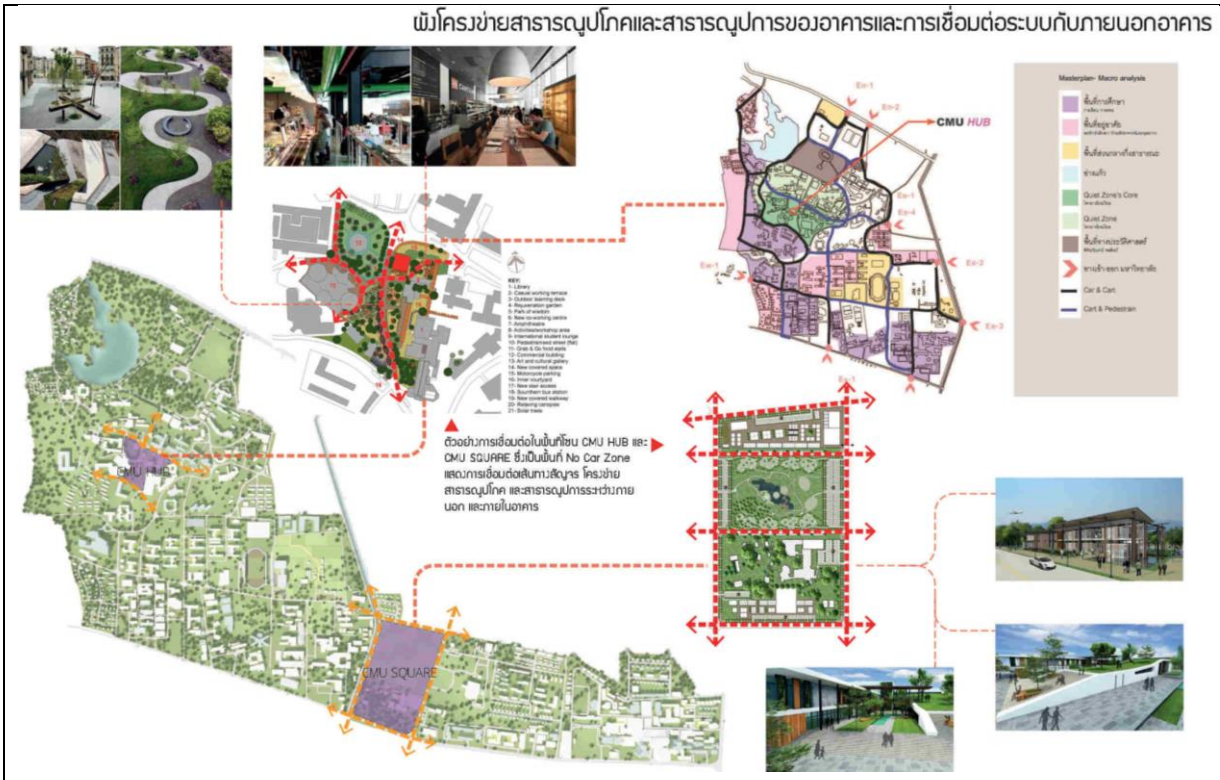
All parking areas of Chiang Mai University consist of open-ground areas and spaces under buildings. All 391,274 square meters of parking areas are allocated across 216 spots within 6 zones as shown in above pictures. Parking area of 391,274 square meters is considered to be 13.5% of the university area compared to 2,899,200 square meters of total campus area.

[5.14] Transportation program designed to limit or decrease the parking area on campus for the last 3 years (from 2016 to 2018) (TR.6)

Chiang Mai University has set up 3 projects to limit private cars access since 2016, including CMU Hub, parking restrictions in all faculties' areas, and reducing the number of parking vehicles in the dormitory area. This has limited the parking spots to 200, approximately 2,000 sq.m., 0.5% of all parking areas. Although the parking areas are not physically decreased, the number of private vehicles accessing the campus significantly reduce. The private vehicles decrease from 19,462 cars in 2017 to 12,243 cars in 2018 (37% reduction) and from 37,970 motorcycles in 2017 to 8,560 motorcycles (77% reduction) in 2018. Therefore, the private vehicle protocols are apparently successful, in terms of a decrease of private vehicles.

1) The CMU Hub project has restricted private cars access and reduced the number of parking areas in the center of university's campus. Since its inception in 2017, CMU HUB covers the university's central area, characterized by an open space connecting the Learning Center Building zone, the Central Library zone, the Central Cafeteria zone, and the Convenience stores zone. Only bicycles and public electric shuttles are allowed

in these areas. In 2018, university staff's parking spaces are also restricted within the CMU Hub area. Access to university staff's parking is permitted outside the CMU Hub zone.



Internal connection network layout of the CMU Hub (1)

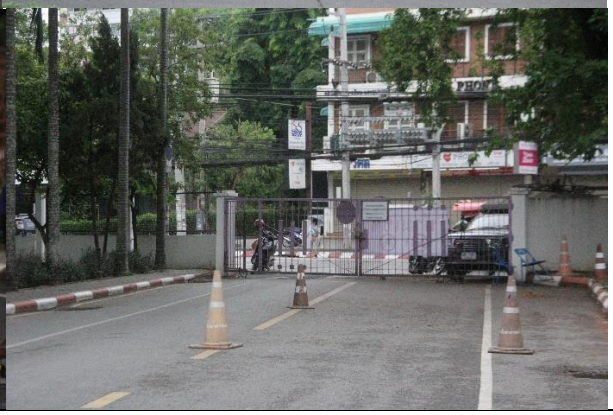
Photos of the plaza in front of the Central Library in the CMU Hub Project Area (1)

2) Restricted parking area project, started in 2017, is to limit access to private cars and reduce private vehicle parking spaces in all faculties' areas. The installation of limited access instruments is completed in 2018. Parking spaces are available only for registered cars of the university's staff. Twenty-two operational departments participate in the project. Five faculties from Suan Dok zone include the Faculty of Medicine, the Faculty of Dentistry, the Faculty of Pharmacy, the Faculty of Nursing, and the Faculty of Associated Medical Science. Seventeen faculties from Suan Sak include Faculty of Humanities, Faculty of Education, Faculty of Fine Arts, Faculty of Social Sciences, Faculty of Science, Faculty of Law, Faculty of Agro-Industry, Faculty of Veterinary Medicine, Faculty of Agriculture, Faculty of Business Administration, Faculty of Mass Communication, Faculty of Economics, Faculty of Political Science and Public Administration, Faculty of Engineering, Faculty of Architecture, and College of Art, Media and Technology (CAMT).

Examples of restricted parking spaces in Suan Dok zone (left- Faculty of Medicine, right- Faculty of Nursing) (2)

Examples of restricted parking spaces in Suan Sak zone (left-Ang Keaw reservoir, right- Tad Chom-phoo reservoir) (2)

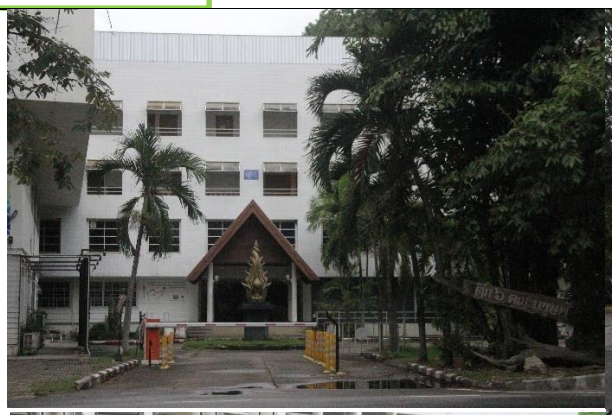


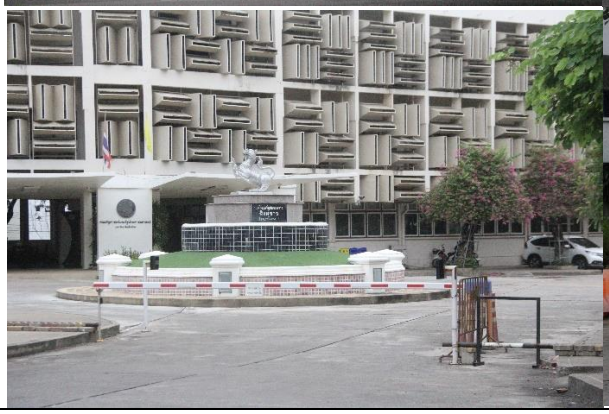


Examples of restricted parking spaces in Suan Sak zone (upper-the Faculty of Business Administration, lower-the Faculty of Education) (2)

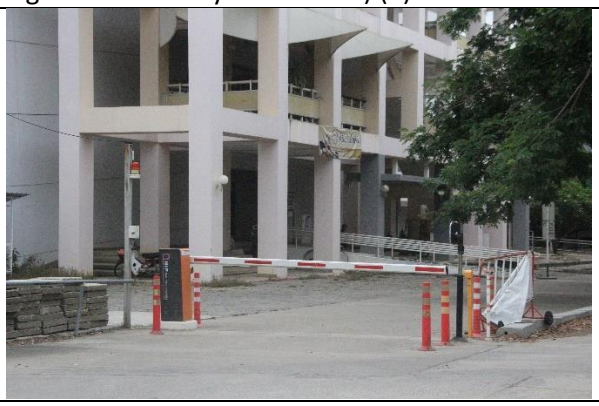



Examples of restricted parking spaces in Suan Sak zone (upperleft-S1 Parking Building, upperright-College of Art, Media and Technology (CAMT), lower – the Faculty of Engineering) (2)






Examples of restricted parking spaces in Suan Sak zone (upper-the Faculty of Humanities, lower left-the Faculty of Sciences, lower right – the Faculty of Sciences) (2)

Examples of restricted parking spaces in Suan Sak zone (left-the Faculty of Social Sciences, right-the Faculty of Fine Arts) (2)

3) The reduction of parking vehicles in dormitory zone has operated since 2018, prohibiting the use of private cars in the dormitory areas. Car parking spaces are available outside the residential areas. Only motorcycle access is allowed in the dormitory zone, by enforcing in the areas of the Pink Dorm, Dorm4, and Female Dorm 8. Chiang Mai University set up CMU electric shuttle bus campaign by increasing the bus stops and the number of trips. It also reduces the accumulation of noise and air pollution in the residential area.

Examples of restricted parking spaces in dormitory area (upper-Parking prohibition at the Pink Dorm, lower-Parking prohibition at Dorm 4amd Female Dorm8) (3)

The enforcement of electric public transport at the stop in front of the Pink Dorm (3)

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[5] Transportation (TR)

[5.15] Number of transportation initiatives to decrease private vehicles on campus (TR.7)

Chiang Mai University is carried out the public transportation project to reduce the use of private vehicles by limiting the access to the university staff's private cars and promoting the use of public transport. The number of private vehicles accessing the campus significantly reduce. Total private vehicles decrease from 19,462 cars in 2017 to 12,243 cars in 2018 (37% reduction) and from 37,970 motorcycles in 2017 to 8,560 motorcycles (77% reduction) in 2018. Therefore, the private vehicle protocols are apparently successful, in terms of a decrease of private vehicles. Seven measures implemented as follows:

1.) Limiting the number of private cars in the campus by not allowing the non-registration cars to gain access into the university. They are not allowed to park in all faculties' areas in the campus. Using RFID cards also limit access to the parking areas of each operational departments.

Examples of the use of automatic RFID enclosure systems at the Faculty of Medicine (left) and the Faculty of Political Sciences and Public Administration (right) (1)

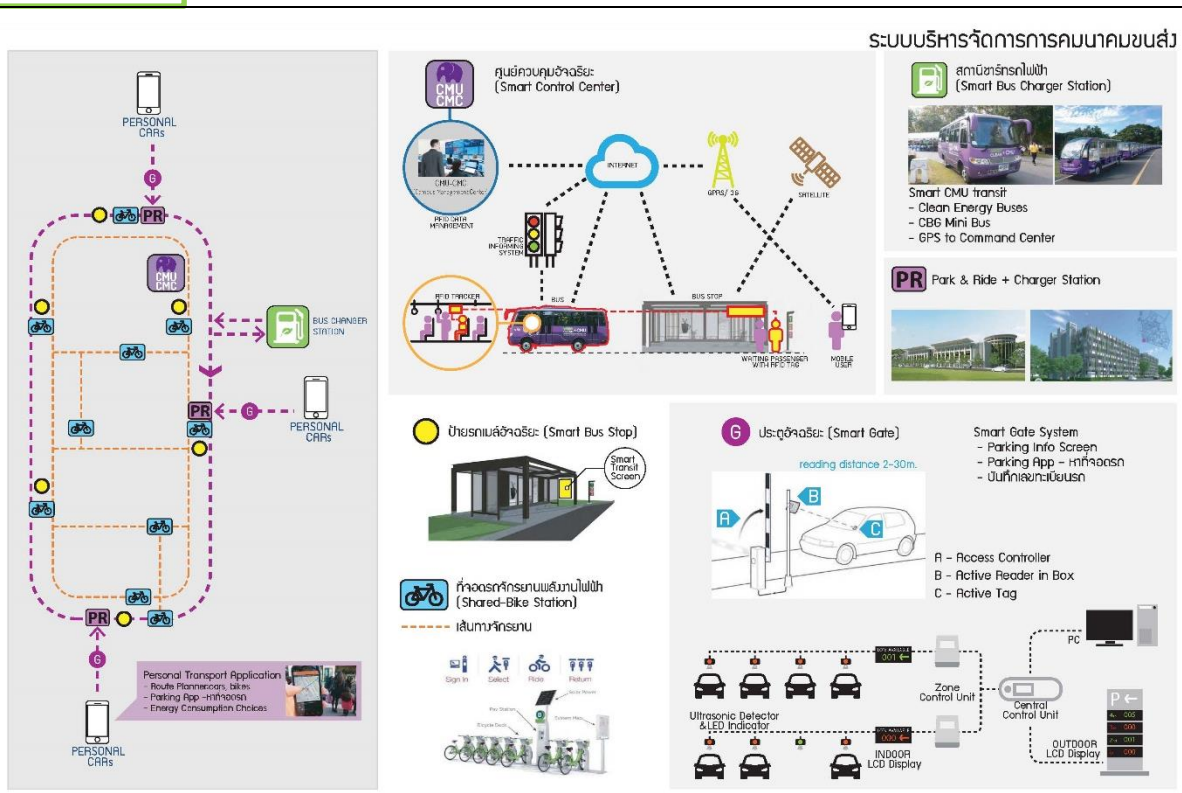
2.) Park and Ride Project is to limit access of private vehicles to get inside the university by emphasizing the use of parking buildings then walking or using clean energy public transportation services within the university. Instead of using private cars, other means of transportation include walking under the covered walkways, riding shared-bike bicycles, using CMU electric shuttle buses. At present, two parking buildings are available, SuanDok Park parking building with 8-storey high in Suan Dok zone and S1 Parking Building with 5-storey high in Suan Sak area. Both cannot cover provide parking services across the whole area of the university. The goal of the project is to construct three additional parking buildings to completely limit access of the private vehicles into the university in the future.

Suan Dok Park parking building (2)

S1 Parking building (2)

S1 parking building and Express Line electric shuttles at the stop in front of S1 Parking building (lower right) (2)

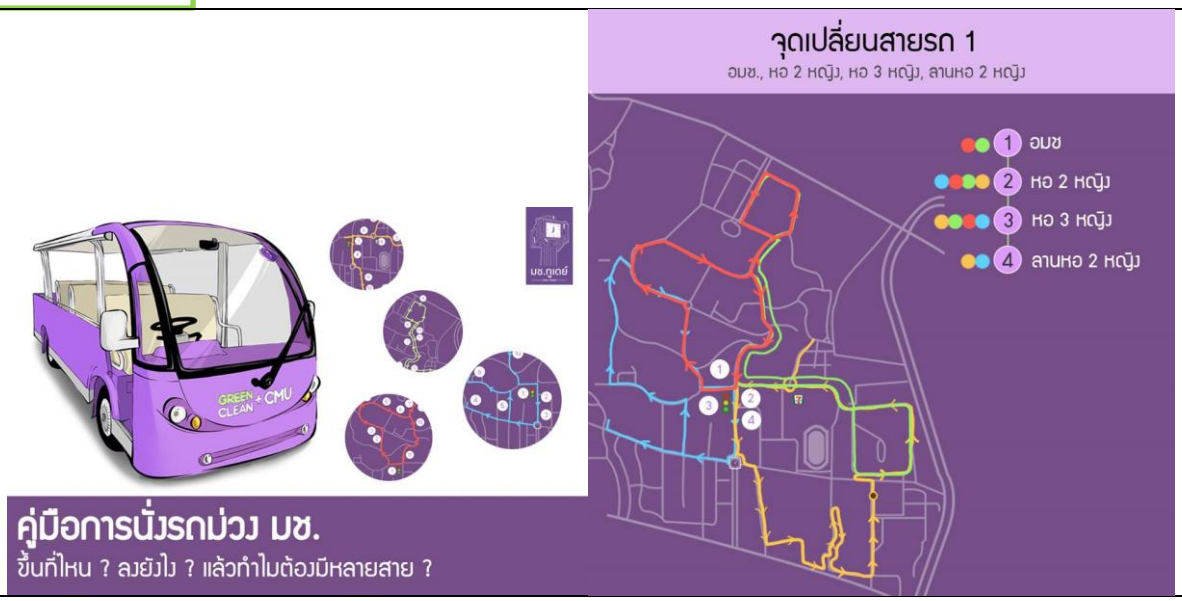
3) The university's Shared-bike project offers a free bicycle rental via online system using identification cards. Chiang Mai University provides online services through Mobike system with 400 bicycles. 617 bicycles are also available at the students' dormitories for lending. In total 1,017 bicycles are accessible in the project. In the future, electric bikes will be added due to the hilly terrain of the university.



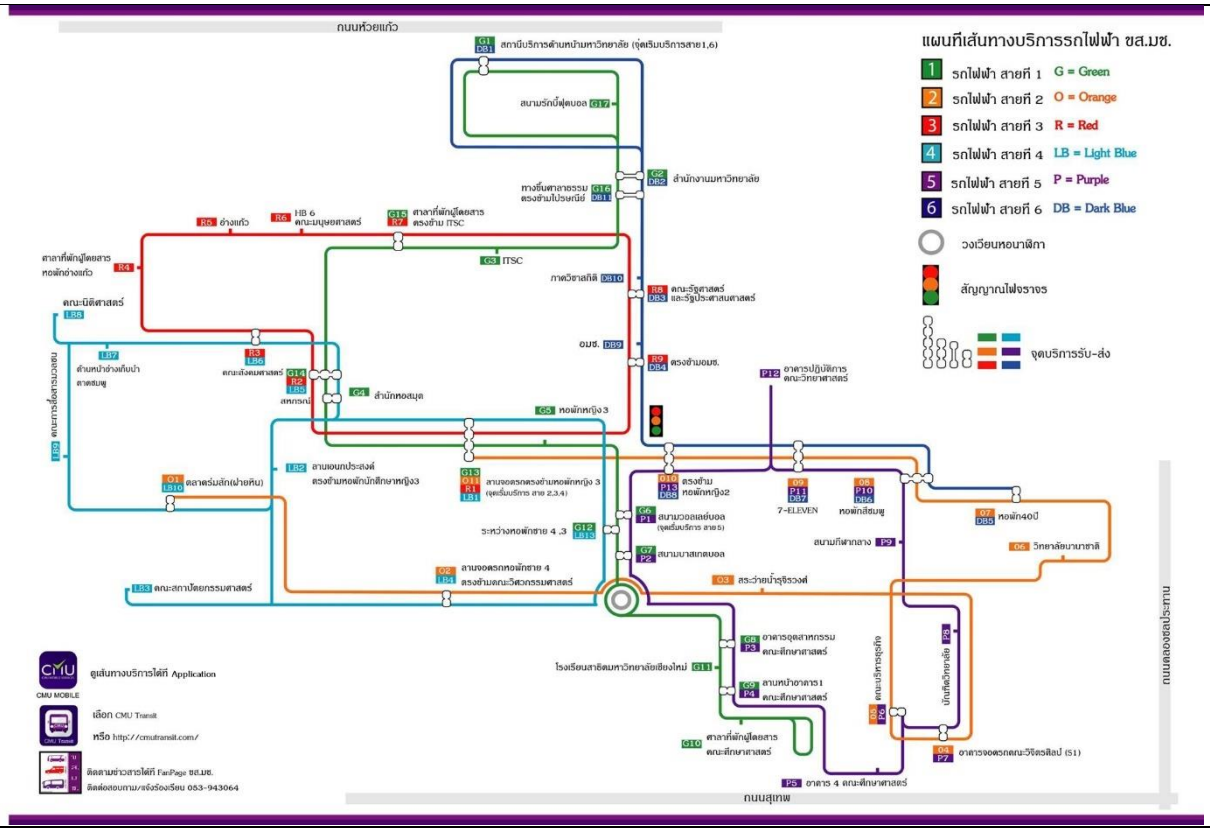
Shared-bike Project (3)

Lending Mobike (left) White Dorm's lending bicycles (right) (3)

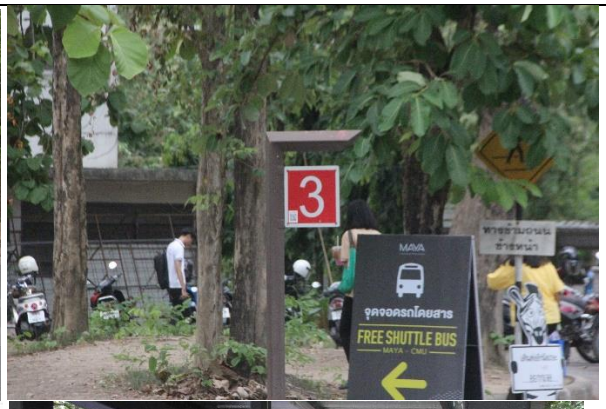
4) CMU electric shuttle bus service (as shown in lower Figures) is a free bus system in the campus area. 99 shuttle trolleys serve 7 lines with 3-minute frequency regularly and 1-minute frequency during rush hours from 7Am to 10PM every day, nonstop. With no more than 3-minute waiting time, the university's population do not need to use private vehicles, thus reducing the use of private cars and reducing the pollution arising from traffic within the university.



CMU electric shuttle bus (left) Routes and transfer points of Line 1-4 (right) (4)



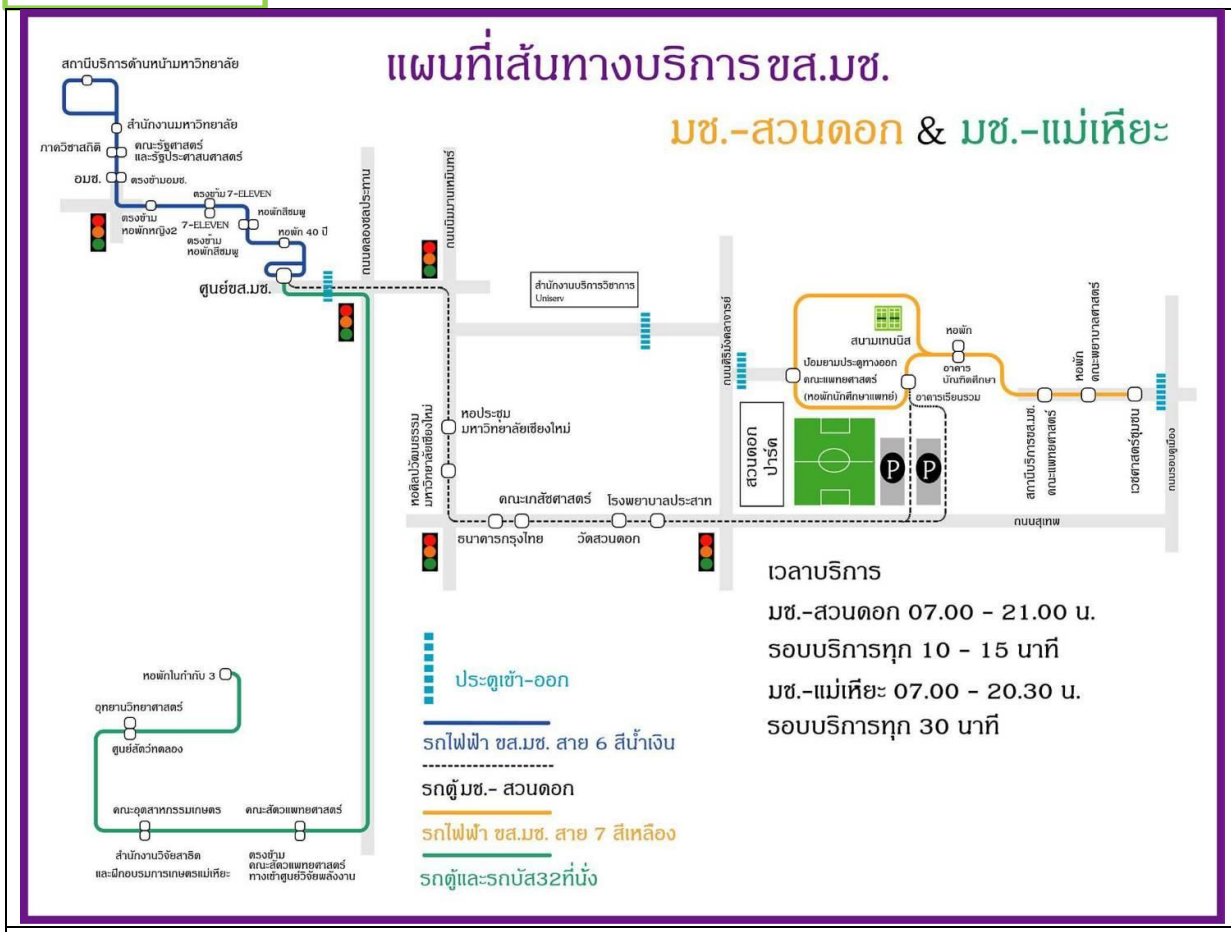
Map of 6 lines of electric public transportation operating in Suan Sak zone. (4)



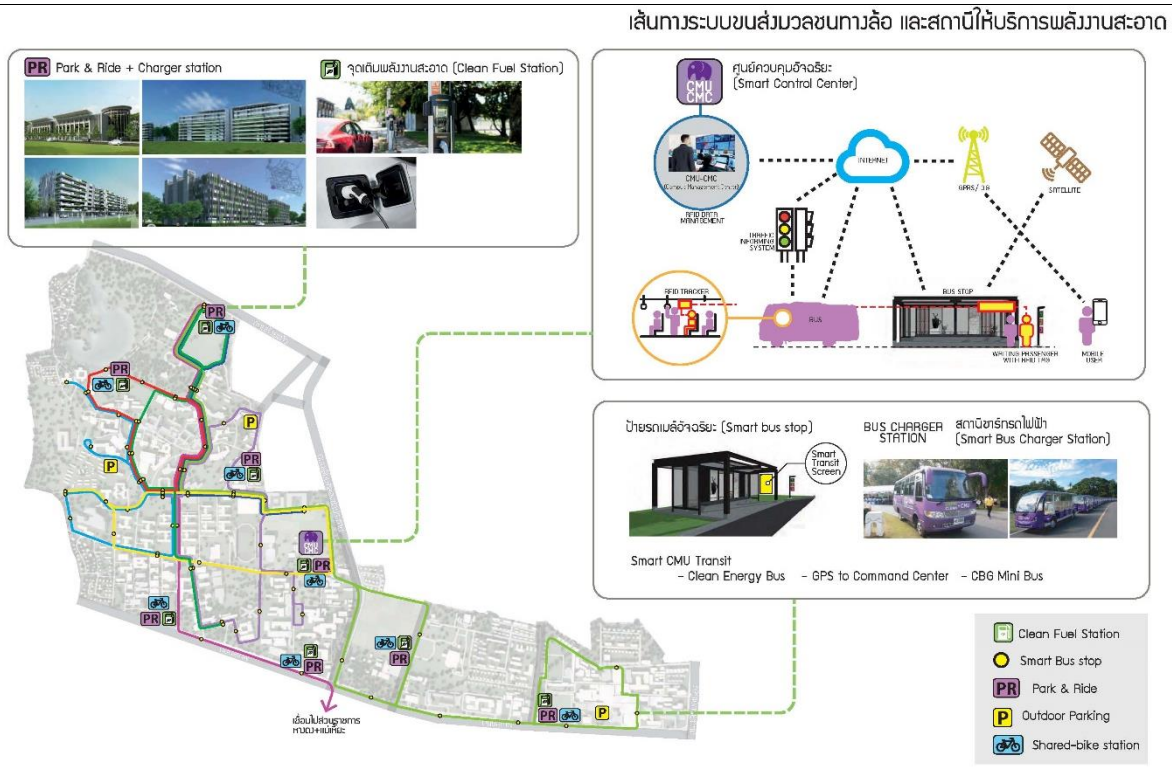

The electric shuttle bus stops (4)

5) CMU clean energy vans use the compressed bio-methane (CBG) energy from organic waste fermentation, serving the staffs and students to travel between Suan Sak zone and Suan Dok zone and between Suan Sak main campus and Mae Hea zone.

A CBG bus station from, Suan Sak main campus zone, to Suan Dok main campus zone, and to Mae Hea zone (left), A CBG transit van between zones (right) (5)



Map of CBG vans' routes, serving Suan Sak-Suan Dok and Suan Sak-Mae Hea (5)



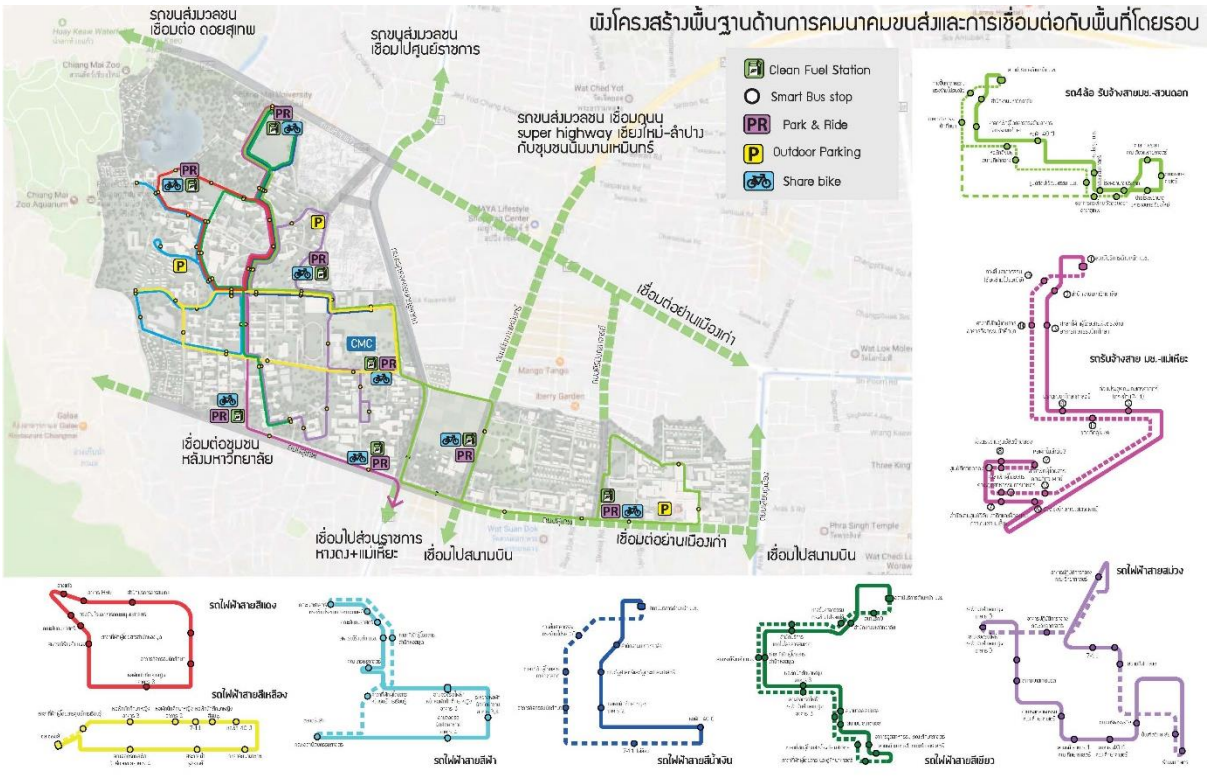
Park and Ride project and CBG vans (5)

6) CMU Transit Project connects all campuses. The university's daily transportation utilizes electric shuttle on campus. The connection between zones uses CBG vans and the connection between campuses uses two 32 seated buses. Line 1 buses connects the main campus of Chiang Mai University, Suan Sak zone, to Hariphoonchai campus, Lamphoon Province. Line 2 buses links the main campus, Suan Sak zone, to Mae Hea zone and Mae Hea Agricultural Research and Training Center.

Campus shuttle bus Project (6)

Suan Sak - Mae Hea public transportation station (6)

CMU Transit Project connecting the routes of electric shuttles, CBG vans, and Minibus (6)



CMU Transit Project (6)

7) Car Free Day Project aims to encourage the university's population to reduce the use of private cars by increasing the use of public transports and bicycles. This will reduce air and noise pollution, traffic congestion and accidents, including energy consumption reduction such as the Faculty of Architecture's Car Free Day.

FACMU Car Free Day Project (7)

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[5] Transportation (TR)

[5.16] Pedestrian path policy on campus

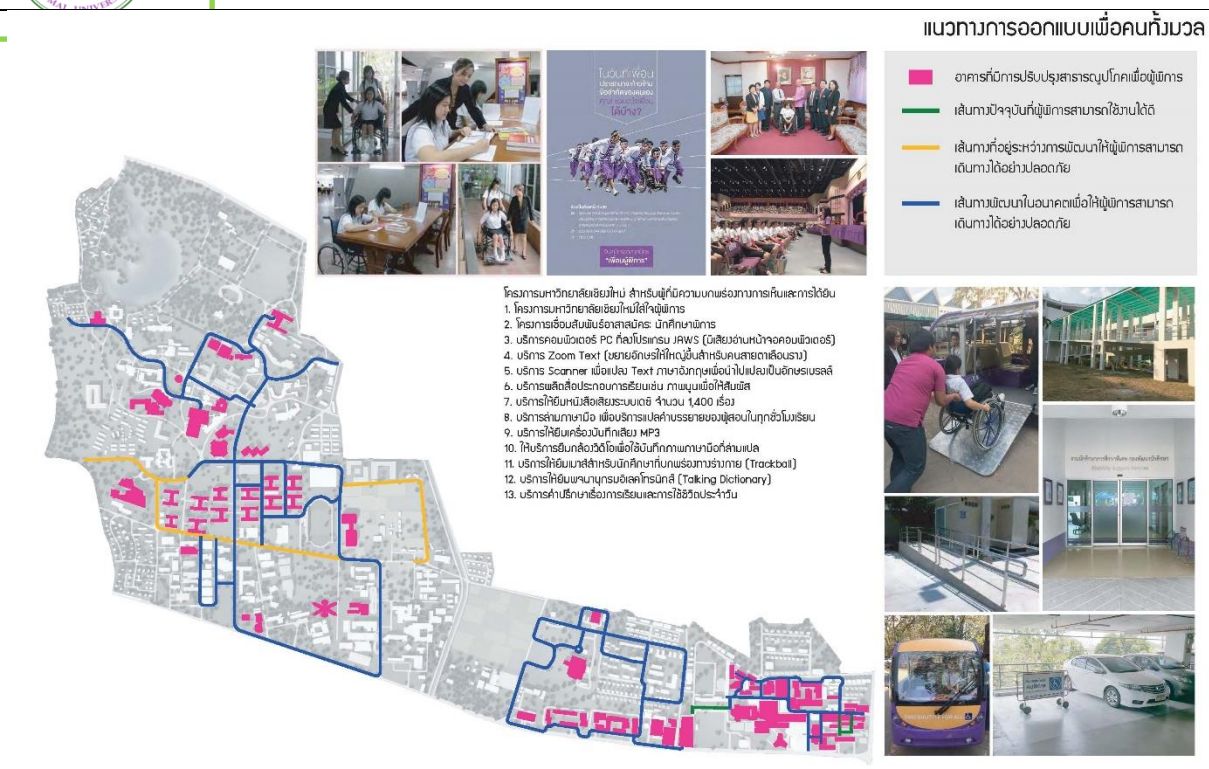
Description:
The university establish a convenient, safe and universally designed pedestrian network plan. Some activities have been implemented such as pedestrian crossing sound signals. Four measures include the followings:

1) Ramps and guiding blocks with suitable pedestrian design for people having physical disabilities.
2) Shuttle Buses for people with physical disabilities
3) Crossing light for deaf and blind people
4) Street lamps for pedestrian at night
5) Healthy CMU (detail below)

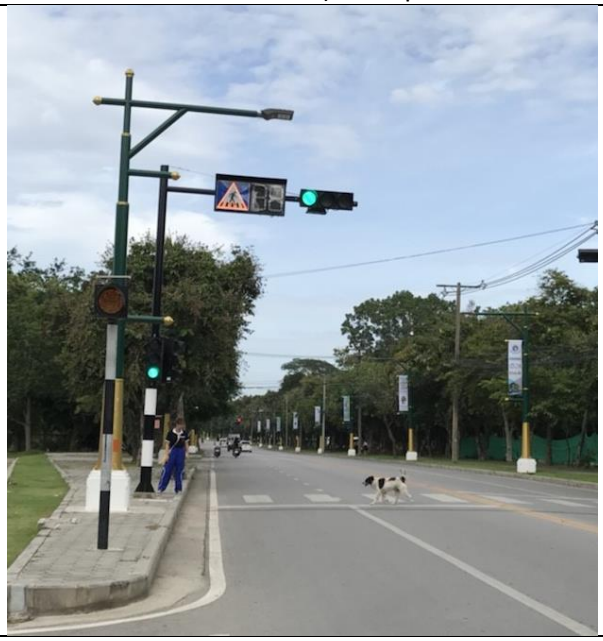
Chiang Mai University has laid down plans for convenient, safe and disabled-friendly pedestrian ways throughout Chiang Mai University and have been partially executed. Voice-activating crossing (see below image) and Walking and Cycling Encouragement Research and Development Project are also in consideration.

There is also a research program to promote walking and riding bicycles in the campus as shown in Table 2.14.

1) Disable friendly design pedestrian Project



2) Transportation Development for Disabilities Project



3) Crossing light for deaf and blind people

4) Covered walkways with lighting at night

5) Healthy CMU activities such as Promoting walking and short-range running for health are taking turn organized by each faculty to create an activity that encourage walking with all the university's population. Walking and running activities include 5 Km short-range walking and running and mid-range running in the university. Covered walkways are all connected throughout the university.

5) Healthy CMU - Short-range running project by CMU Transport

5) Healthy CMU - Short-range try-running project by the Faculty of Veterinary Medicine (left) CMU Sport Club (right)

5) Healthy CMU - Walking and Running Charity Project by the Faculty of Mass Communication and Chiang Mai-Lamphoon Radio&TV Club

Table 2.14 - Research projects promoting the pedestrian use and bicycle way

Research projects		Department
1	Walking and bicycling promotion for everyday life Promote daily walking and bicycling	The Faculty of Architecture
2	Green design route in the area of Chiang Mai University.	The Faculty of Engineering
3	Light helmet for bicycle	The College of Art, Media and Technology

[5.17] The approximate daily travel distance of a vehicle inside your campus only (in Kilometers)

Average travel distance per day is calculated from the distance that 6 lines of public shuttles travel per day (only the main campus is counted) The total distance from Monday to Friday is 6,608 Km, and Saturday and Sunday is 3,402 Km. Public shuttles' travel details are demonstrated in Table 2.15. Due to the lack of information and the installation of motion tracking devices of private cars in the university, for travel distance of private vehicles, cars and motorcycles, the university estimates the possible longest distance of CMU's public shuttles as the travel distance of private cars, which is 1.92 Km per shuttle per day. Traveling back and forth is 3.84 per shuttle per day.

Car distance = number of 12,243 cars x 1.92 x 2 x 240 = 11,283,148.8 kilometers per year Motorcycle distance = number 8,560 cars x 1.92 x 2 x 240 = 7,888,896 kilometers per year.
CMU Public bus distance = Total 10,010 km per week x 52 weeks = 520,520 kilometers per year

Note: Number of cars entering your University x 2 x approximate travel distance of a vehicle each day inside campus only (in kilometers) x 240 day as number of working days per year

Table 2.15 Average travel distance/day of vehicles on campus

Line	Number of vehicles	Distance (km)	Number of trips	Total distance (km)
Monday - Friday				
1	10	2.55	362	1,902
2	17	4.23	162	1,554
3	8	3.21	328	1,062
4	8	3.51	328	1,051
5	5	1.92	181	300
6	7	2.00	200	747
Total	**55**	**17.42**	**1,761**	**6,608**
Weekend				
1	6	4.55	120	709
2	4	3.23	120	761
3	6	2.71	234	751
4	6	3.01	234	821
5	4	1.00	130	249
6	2	2.92	90	110
Total	**25**	**17.42**	**1,761**	**3,402**

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[6] Education and Research (ED)

[6.1] Number of courses/modules related to environment and sustainability offered

Table 2.28 Twenty-one Courses/Modules Related to Environment and Sustainability Offered

	Degrees	Programs	Faculty/ College
1	Doctor's	Doctor of Philosophy Program in Sustainable Land Use and Natural Resource Management	Social Sciences
2	Master's	Master of Science Program in Sustainable Land Use and Natural Resource Management	
3	Master's	Master of Science Program in Environmental Science (International Program)	Sciences
4	Master's	Master of Science Program in Environmental Science	
5	Doctor's	Doctor of Philosophy Program in Environmental Science	
6	Doctor's	Doctor of Philosophy in Environmental Science (International Program)	
7	Bachelor's	Bachelor of Engineering Program in Environmental Engineering	Engineering
8	Master's	Master of Engineering Program in Environmental Engineering	
9	Master's	Master of Engineering Program in Energy Engineering	
10	Doctor's	Doctor of Engineering Program in Environmental Engineering	
11	Doctor's	Doctor of Philosophy Program in Energy Engineering	
12	Bachelor's	Bachelor of Science Program in Agriculture [Eng] 7) Soil Science and Natural Resources Management	Agriculture
13	Master's	Master of Science Program in Soil Science and Natural Resource Management	
14	Master's	Master of Science Program in Agricultural Extension and Rural Development	
15	Master's	Master of Science Program in Sustainable Agriculture and Integrated Watershed Management (International Program)	
16	Doctor's	Doctor of Philosophy Program in Soil Science and Natural Resource Management	
17	Doctor's	Doctor of Philosophy Program in Agricultural Extension and Rural Development	
18	Doctor's	Doctor of Philosophy Program in Sufficiency Economy (International Program/ Interdisciplinary)	Economics
19	Master's	Master of Arts Program in Man and Environment Management (Interdisciplinary Program)	The Graduate School
20	Master's	Master of Nursing Science (Gerontological Nursing Practitioner)	Nursing
21	Master's	Master of Nursing Science (Adult and Gerontological Nursing)	

Description:

From **284 academic programs**, **10.56%** or 30 of which from twenty-seven faculties, concentrate profoundly on Environment, Sustainability, Social development, Community, Local wisdom and Local economic (as shown in tables 2.28-29). **Of 13,417 courses across the university, 13.8% or 1,852 provide contents concerning sustainability.** In 2019, 49 on-line courses also offer course contents related to sustainability, thus making 2.71% or 364 courses in total.

Table 2.29 Courses or subjects related to sustainability (from 9 keywords)

	Keywords	Number of subjects	%
1	Social	488	3.738
2	Community	291	2.229
3	Economy	207	1.585
4	Economic	385	2.949
5	Wisdom, Local knowledge	41	0.314
6	Rural sustainable development	2	0.015
7	Social development	22	0.169
8	Sustainability	82	0.628
9	Environment	334	2.558
	Total	**1,852**	**13.803**

These new on-line courses, created and operated by Teaching & Learning Innovation Center (TLIC) (https://tlic.itsc.cmu.ac.th/), not only allow students to get access to these courses from anywhere and everywhere but also open equal opportunities for lifelong learning to everyone. This effort can be counted as a constructing process toward sustainability. There is no registration fee, no age limits and gender discrimination. For transportation, it is cost and energy saving since students do not need to come to attend classes at the university. At present, the university offer 49 on-line courses related to sustainability. Detailed description for all CMU's on-line courses can be found from two different websites, which are https://thaimooc.org/site/CMU_MOOC/ and https://elearning.cmu.ac.th/course/.

Number of courses/modules related to environment and sustainability offered in 2018 = **21 programs/284 total programs (10.56%) OR 1,852 courses/13,417 total courses (13.8%)**

https://thaimooc.org/site/CMU_MOOC/

https://elearning.cmu.ac.th/course/

Online course websites

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[6] Education and Research (ED)

[6.2] Total number of courses/modules offered

Table 2.30 Total number of courses/programs offered in 2018 (Chiang Mai University)

	Faculty/College		Degrees			Total
			Bachelor's	Master's	Doctor's	
1	Faculty of	Humanity	14	11	1	26
2	Faculty of	Education	12	5	2	19
3	Faculty of	Fine Arts	10	2	1	13
4	Faculty of	Social Sciences	5	6	4	15
5	Faculty of	Sciences	13	21	10	44
6	Faculty of	Engineering	10	13	7	30
7	Faculty of	Medicine	2	11	12	25
8	Faculty of	Agriculture	2	11	7	20
9	Faculty of	Dentistry	1	4	2	7
10	Faculty of	Pharmacy	1	4	2	7
11	Faculty of	Associated Medical Sciences	4	6	1	11
12	Faculty of	Nursing	2	8	-	10
13	Faculty of	Agro-Industry	6	3	2	11
14	Faculty of	Veterinary Medicine	1	3	1	5
15	Faculty of	Business Administration	2	4	1	7
16	Faculty of	Economics	2	2	1	5
17	Faculty of	Architecture	3	3	-	6
18	Faculty of	Mass Communication	1	1	-	2
19	Faculty of	Political Science and Public Administration	4	4	-	8
20	Faculty of	Law	1	1	-	2
21	College of Arts, Media and Technology		3	0	1	4
22	The Graduate School		-	5	0	5
23	Faculty of	Public Health	-	-	-	0
24	Biomedical Engineering Institute		-	1	1	2
25	College of Marine Studies and Management		-	-	-	0
26	International College of Digital Innovation		-	-	-	0
27	Chiang Mai University School of Public Policy		-	-	-	0
Total			**99**	**129**	**56**	**284**

Table 2.31 Total number of subjects offered in 2018 (Chiang Mai University)

	Faculty/College		Subjects
1	Faculty of	Humanity	1,191
2	Faculty of	Education	1,358
3	Faculty of	Fine Arts	484
4	Faculty of	Social Sciences	538
5	Faculty of	Sciences	1,719
6	Faculty of	Engineering	1,237
7	Faculty of	Medicine	1,126
8	Faculty of	Agriculture	804
9	Faculty of	Dentistry	565
10	Faculty of	Pharmacy	522
11	Faculty of	Associated Medical Sciences	434
12	Faculty of	Nursing	554
13	Faculty of	Argo-Industry	458
14	Faculty of	Veterinary Medicine	248
15	Faculty of	Business Administration	416
16	Faculty of	Economics	201
17	Faculty of	Architecture	206
18	Faculty of	Mass Communication	179
19	Faculty of	Political Science and Public Administration	252
20	Faculty of	Law	147
21	Faculty of	Public Health	31
22	College of Arts, Media and Technology		377
23	The Graduate School		216
24	Biomedical Engineering Institute		38
25	College of Marine Studies and Management		11
26	International College of Digital Innovation		69
27	Chiang Mai University School of Public Policy		36
		Total	13,417

Description:

Chiang Mai University (CMU) has established 27 academic units, both faculties and colleges, offering **284 degree programs**, which are 99 Bachelor's, 129 Master's and 56 Doctoral degree programs with the total of **13,417 courses or subjects** as shown in Table 2.30-2.31.

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[6] Education and Research (ED)

[6.4] Total research funds dedicated to sustainability research (in US Dollars)

	2016	2017	2018
Total research funding ($US)	38,821,948	41,115,431	117,456,270
Total 3-year research funding ($US)			**158,610,522**
Total sustainability research funding ($US)	5,227,173	7,173,751	25,451,048
Total 3-year sustainability research funding ($US)			**37,851,972**
change rate (Baht/$US)	32.133	32.521	30.86
The ratio of sustainability research funding towards total research funding (%)	13.46	17.45	21.65
Number of research projects (projects)	2,242	1,666	1204
Number of sustainable research projects (projects)	149	137	205
The ratio of sustainability research projects towards total research projects (%)	6.65	8.22	17.02
The ratio of 3-year sustainability research projects towards total research projects (%)			**23.86%**

Research fund dedicated to sustainability research 2016-2018 (Chiang Mai University)

Note: Exchange rate from https://www.poundsterlinglive.com/best-exchange-rates/us-dollar-to-thai-baht-exchange-rate-on-2015-06-30

Description:
Total research fund dedicated to sustainability research in 2016 = 5,227,173 US Dollars
Total research fund dedicated to sustainability research in 2017 = 7,173,751 US Dollars
Total research fund dedicated to sustainability research in 2018 = 25,451,048 US Dollars

Option 1: Average funding the last three year per annum
The average of research fund across the last 3 years = 65,797,883 US Dollars per annum.
Average research fund dedicated to sustainability research in 2016-2018 = 12,617,324 US Dollars

Funding for sustainability-related research projects were 168 million baht ($5.2M) in 2016, 233 million baht ($7.1M) in 2017, and 785 million baht ($25M) in 2018. They could be apportioned to 13.46%, 17.45% and 21.65% respectively, with an average fund of 17.52% across three years. The number of research projects concerning sustainability was 149 in 2016, 137 in 2017, and 205 in 2018.

Option 2: Average funding of the three-year period

The average of funding dedicated to sustainability research should be calculated for a 3-year period rather than average from the ratio of funding per annum. It may lead to mathematical error of calculation.

The 3-year research fund = 158,610,522 US Dollars.
The 3-year research fund dedicated to sustainability research in 2016-2018 = 37,851,972 US Dollars

Funding for sustainability-related research projects were 168 million baht ($5.2M) in 2016, 233 million baht ($7.1M) in 2017, and 785 million baht ($25M) in 2018. They could be averaged to **23.86%** over the three- year period.

Example of research projects dedicated to sustainability in 2016-2018

No	Code	Title	Fund (Baht)
Examples of research projects for sustainability in 2016			
17	R000009261	Selection and Improvement of PoultryBreedlines as New Sustainable Alternative Economic Animalsin Highland	594,214.76
50	R000010145	Promoting Small Scale Biomass Power Plants in Rural Thailand for Sustainable Renewable Energy Management and Community Involvement in Thailand	1,889,825.64
66	R000010603	An Ecohealth Approach to Develop a Strategy for the Prudent Use of Antimicrobials to Control Antimicrobial Resistance in Human, Animal, and Environmental Health in Asia	1,308,809.75
98	R000011384	An Ecohealth Approach to Develop a Strategy for the Prudent Use of Antimicrobials to Control Antimicrobial Resistance in Human, Animal and Environmental Health in Asia	1,839,416.06
2160	R000016409	Development on Biogas and Bio-Fuel Upgrading under Friendly Environmental Menagement	997,264.02
2210	R000016867	Towards a healthier and environmentally sustainable edible oil consumption profile for Asia: Palm Oil: Sustainability, Health and Economics (POSHE)	13,618.42
145	R000011608	The Impacts of Climate Change on Hydrology and Water Resources of the Upper Ping River Basin	120,246.41
274	R000012352	Study on Climate Change Affecting on Impacts of Fruits Production in Highlands	116,666.67
Examples of research projects for sustainability in 2017			
21	R000010145	Promoting Small Scale Biomass Power Plants in Rural Thailand for Sustainable Renewable Energy Management and Community Involvement in Thailand	717,720.67
121	R000012557	Development of Famer and Community Capacity Building for Sustaiable Agricultrual Production and Related Resource Management in Nan Province	3,966,570.89
993	R000016409	Development on Biogas and Bio-Fuel Upgrading under Friendly Environmental Menagement	1,497,948.02

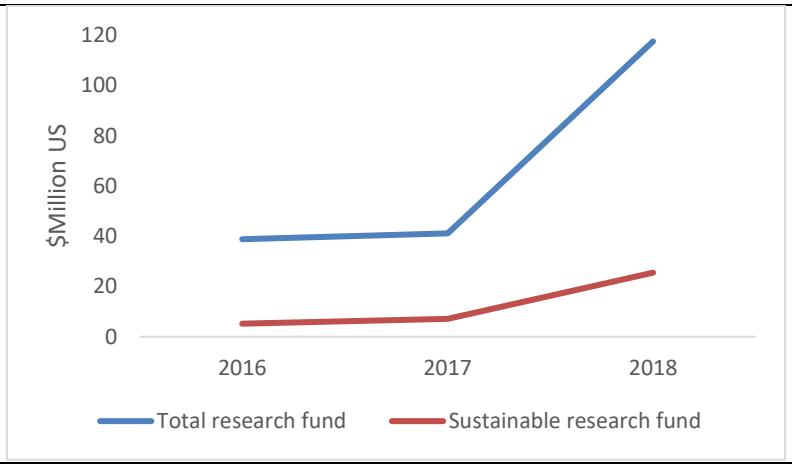
1008	R000016428	Create a Safer Urban Environment for Tourist Cyclists- A Design Study in Chiang Mai, Thailand	124,590.16
1232	R000016825	Enhancement and Encouragement of Logistics ant Transport Management Application ; LTMA2	224,000.00
Examples of research projects for sustainability in 2018			
1328	R000019539	Innovative utilization of Miang for increase economic value and sustainable community development	8,500,000
6	P000018503	Climate Change adaptation to Protect Public Health for Sustainable Development: A Examination of Impacts of Natural Background Radiation and Polluted Skies in Chiang Mai Province	3,159,689
1135	R000018923	Sustainable tilapia culture – Functional feed additives vs bacteriophage and oral vaccine	7,644,500
11	P000018585	Innovations of commercial pineapple utilization for value-add products through sustainable value chain	727,860
15	P000018591	Development of functional feeds from pineapple and their by-products for sustainable fish farming	1,692,000
271	P000018709	Wellness Tourism Development in Lanna area forward sustainable tourism	984,400
1068	R000018634	Selection of plant species for sustainable restoration of forest using data diversity of isoprene-degrading bacteria	1,200,000
277	P000018717	Enhancement the value added of local plant: Hom (Baphicacanthus cusia) for sustainable commercial success	2,003,670
1132	R000018905	Materials Innovation for Industry to Sustainably Enhance Life Quality	58,000,000
1468	R000019901	Industrial Production of Functional Feed Additives from Red Yeast (Sporidiobolus pararoseus) for Sustainable Animal Production	9,460,200
196	P000018503	Climate Change adaptation to Protect Public Health for Sustainable Development: A Examination of Impacts of Natural Background Radiation and Polluted Skies in Chiang Mai Province	3,159,689

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[6] Education and Research (ED)

[6.5] Total research funds (in US Dollars)



CMU total research fund compared to sustainable research fund in 2016-2018

Description:

Total research fund in 2016 = 38,821,948 US Dollars
Total research fund in 2017 = 41,115,431 US Dollars
Total research fund in 2018 = 117,456,270 US Dollars

The average of annual research fund in the past three years is 65,797,883 US Dollars.

Recognized as a research university, Chiang Mai University has obtained research grants for more than one billion baht from various institutions both within and outside the university to support 2,000 research projects each year. However, the university has never classified sustainability-related research projects as a specific research category. The way in which these research projects are categorized in this report is based on their keywords, which are Sustainable, Sustainability, Environment, and Environmental. Therefore, only the projects that address their major research objectives explicitly on sustainability are counted, excluding many research projects along the same lines but do not state their objectives on sustainability directly. There is a high possibility that the actual number of sustainability-related research projects and funding is higher than that can be counted in this report. Official definition of Sustainability determined by the university will be necessary for the next evaluation on sustainability research projects and funds.

From research projects data from year 2016 to 2018, Chiang Mai University had 1,247 million baht ($38,821,948), 1,337 million baht ($41,115,431) and 3,627million baht ($117,456,270) for research projects consecutively. The averaged annum last 3 years of research fund = 65,797,883 US Dollars.

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[6] Education and Research (ED)

[6.8] Number of events related to environment and sustainability

<table>
<tr>
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<tr>
<td>Seminar on Smog Issue in Chiang Mai and how to adapt by Natural and Environmental conservation Club</td>
<td>Conservation Youth Camp 2017 by Natural and Environmental conservation Club</td>
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<tr>
<td>Conservation Youth Camp 2016 by Natural and Environmental conservation Club</td>
<td>The 9th Becoming a Teacher Camp: “Follow the Father’s Step: Being Sufficient Teacher”, the educational guidance and inspiration camp organized by the Faculty of Education, chiang mai university. The camp is full of friendliness and various of fun activities.
For more details please see https://www.camphub.in.th/tag/chiangmai/page/13/</td>
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<td>Veterinary Conservation Camp: The 10th Youth Camp for Wildlife and Natural Conservation WEYC.
The camp was created for high school students nationwide to enhance their learning experience and appreciation of natural conservation, as well as discover the meaning of friendship. This camp opened opportunities to gain knowledge, impressive memory, happiness and new friends.
For more details please see
https://www.camphub.in.th/tag/chiangmai/page/7/</td>
<td>Forest Restoration Technology Camp (for students)
The camp is organized by Forest Restoration Research Unit, Chiang Mai University, addressing the issue of the complexity and vulnerability of ecological system in forest restoration by using structural trees technique.
For more details please see
https://www.camphub.in.th/tag/chiangmai/page/7/</td>
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<td>Students in Department of Chemistry, Chiang Mai University visited Nakornphing Energy Research Institute on Wednesday 19th September 2018, learning about full cycle of biomass management and attending a special lecture on “Biogas Production from Food Waste” by Chumanus Maneesiri and Sathit Ngao-ngeon.</td>
<td>Better Breathing Campaign by Environmental Science Research Center, Faculty of Science, Chiang Mai University.
ESRC CMU gave out dust protection masks to Chiangmai residents.</td>
</tr>
<tr>
<td colspan="2">Total Events Related to Environment and Sustainability (Chiang Mai University)</td>
</tr>
</table>

Description:

Every year, there are **over 1,600** events related to sustainability organized by student organization in CMU. The projects concerning sustainability are 99 in 2016, 51 in 2017, and 84 in 2018, **an average of 78 projects per year across three years**. Such projects are, for example, Toxic haze campaign, Youth Natural Conservation Camp Project (see above pictures), and Volunteer Camp for Check Dam Construction.

Table 2.35 The projects concerning sustainability in 2016 - 2018

Year		2016	2017	2018
Number of activities concerning environment and sustainability	Promote an abundance of natural resources and the use of community resources	56	4	30
	Natural resource conservation	7	8	9
Outreach Volunteer Activities		36	39	45
Total activities concerning environment and sustainability		**99**	**51**	**84**
Total Activities		1,724	1,894	2,179
Proportion of activities (percent)		5.74	2.69	3.85

Table 2.36 Example of activities concerning sustainability organized in 2018

No.	Code.	Activities
2018		
1	ACT201800738	Health Marketplace Project
		Administration Committee, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
2	ACT201800690	Relationship integration: Sharing dreams through constructing dams
		Faculty of Education Student Club, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
3	ACT201800619	2018 Big Cleaning Day
		Faculty of Education Student Club, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
4	ACT201800934	2018 " Ton Kla" build a Dam Project
		Faculty of Political Science and Public Administration Student Club, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)

No.	Code.	Activities
5	ACT201800755	Chiang Daw Survey and Learning Camp, Chiang Mai
		Administration Committee, Faculty of Medicine Student Club, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
6	ACT201801288	Forest Protection Volunteer
		Outreach and Volunteer Club, Extra Curricular Committee, Faculty of Science Student Club, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
7	ACT201800974	New students' coral cultivation voluntary service
		Administration Committee, Faculty of Pharmacy Student Club, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
8	ACT201800798	Training and making waste and environment management media
		Herbs and Thai Traditional Medicine Club, Academic Committee, Faculty of Pharmacy Students Club, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
9	ACT201801404	Turn waste into wealth
		Dormitory Central Board, CMU Students Dormitory Committee (appointed 2018)
10	ACT201800361	2018 "Pli Bai" Camp at Chiang Daw Youth Camp
		Natural and Environment Conservation Club, Outreach and Volunteer Group, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
11	ACT201800382	2018 CMU Environmental Literature Competition
		Natural and Environment Conservation Club, Outreach and Volunteer Group, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
12	ACT201800383	"Palang Ton Kla" Camp 2018 (Village Camp) at Ban Huay Lad Community
		Natural and Environment Conservation Club, Outreach and Volunteer Group, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
13	ACT201800348	The 1st Water, Fish, and Ping River Protection (Ping-Ping Cleaning Day)
		Volunteer Club, Outreach and Volunteer Group, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
14	ACT201800333	"Rak Kaew" 2018 , the 1st Community Outreach Project, Project Theme: Water
		"Rak Kaew" Club, Outreach and Volunteer Group, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
15	ACT201801579	28th Natural and Environment Conservation Youth Camp
		Natural and Environment Conservation Club, Outreach and Volunteer Group, Chiang Mai University Student Club, Chiang Mai University Student Organization (appointed in 2018)
16	ACT201801760	Good Kids as Clean and Livable Community Developers
		Good kids Good education Club, Outreach and Volunteer Group, Chiang Mai University Student Club (appointed in 2018)
17	ACT201802278	"Ton Nam" Camp
		Lumpang student club, Outreach and Volunteer Group, Chiang Mai University Student Club (appointed in 2018)

Chiang Mai University composed of 81 student organizations which is a collection of 23 student unions, 28 student clubs and 30 sport clubs. There are **23 sustainability-related student organizations** among mentioned groups, such as Community Development Voluntary Service, Natural and Environmental Conservation Club and Community Voluntary Service – the Faculty of Architecture (trees and forest plantation, dikes and dams construction). Detailed groups are as follows;

Table 2.38 All student organizations

No.	Sustainability-related student organizations
1	Natural and Environment Conservation Club, Outreach and Volunteer Group, Chiang Mai University Student Club

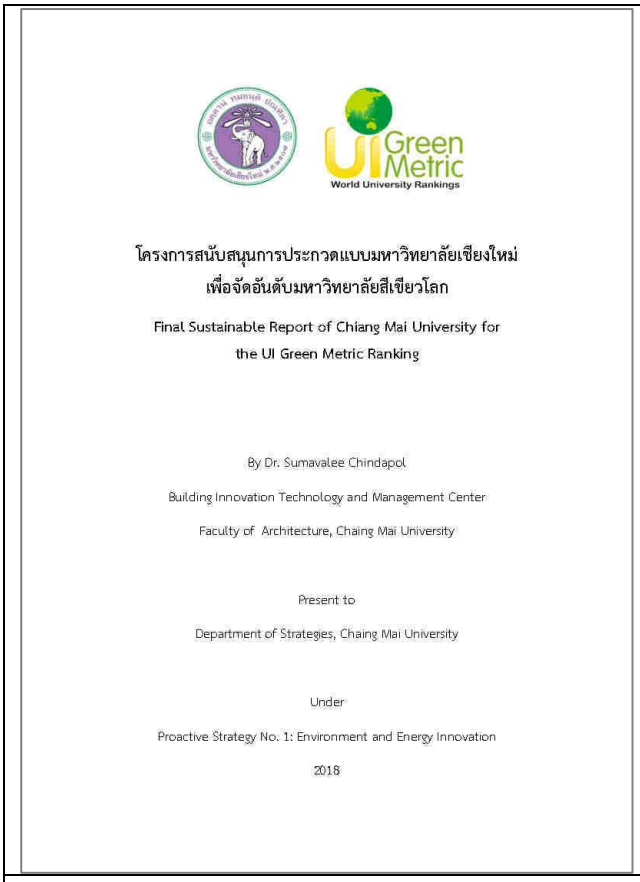
No.	Sustainability-related student organizations
2	Outreach and Volunteer Club, Extra Curricular Committee, Faculty of Science Students Club, Chiang Mai University Student Club
3	Herbs and Thai Traditional Medicine Club, Academic Committee, Faculty of Pharmacy Students Club, Chiang Mai University Student Club
4	Natural Conservation Club, Committee of Arts and Culture Outreach, Faculty of Pharmacy Students Club, Chiang Mai University Student Club
5	Natural Conservation Club, Outreach and Volunteer Committee, Faculty of Medicine Students Club, Chiang Mai University Student Club
6	Community Knowledge Integration Club, Faculty of Education Students Club, Chiang Mai University Student Club
7	Bird Watching Club, Extra Curricular Committee, Faculty of Science Students Club, Chiang Mai University Student Club
8	Volunteer Club, Outreach and Volunteer Group, Chiang Mai University Student Club
9	Committee of Art and Culture Outreach, Faculty of Law Students Club, Chiang Mai University Student Club
10	Herbs and Thai Traditional Medicine Club, Academic Committee, Faculty of Pharmacy Students Club, Chiang Mai University Student Club
11	Faculty of Fine Arts Outreach and Volunteer Club
12	Faculty of Engineering Outreach and Volunteer Club
13	Faculty of Nursing Outreach and Volunteer Club
14	Faculty of Political Science and Public Administration Outreach and Volunteer Club
15	CMU Volunteer Center
16	Community Development Club, Faculty of Engineering, CMU
17	“Lok Chang” Volunteer Club 57
18	CMU Ambassador Camp: Rural Development Volunteer
19	Rotary Club , CMU and USAC (University Studies abroad consortium)
20	Wildlife’s Friend Club, Faculty of Veterinary Students Club
21	Community Development Voluntary Service Club
22	Natural and Environmental conservation Club
23	Community Voluntary Service – Faculty of Architecture Club

Template for Evidence(s)
UI GreenMetric Questionnaire

University : Chiang Mai University
Country : Thailand
Web Address : www.cmu.ac.th

[6] Education and Research (ED)

[6.12] Sustainability Report



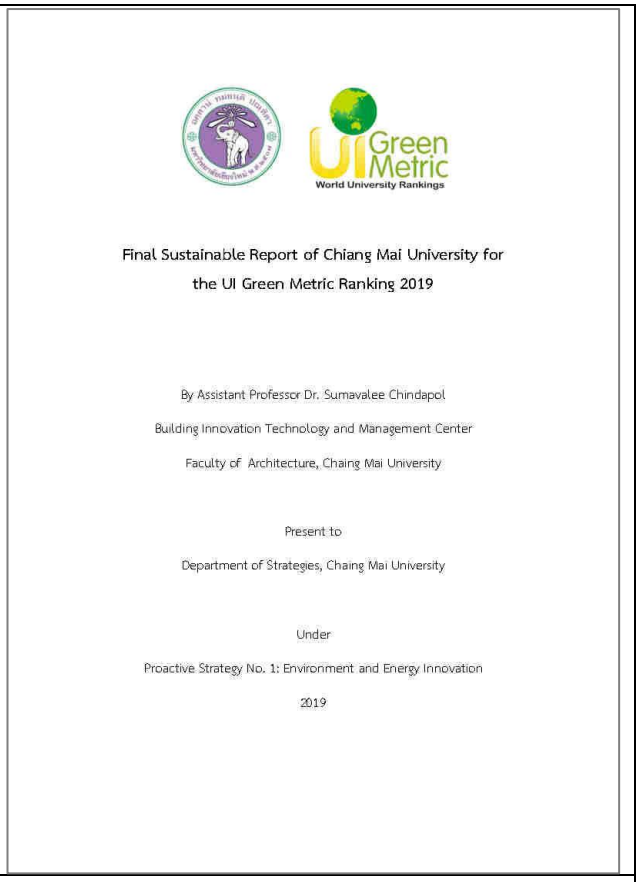
โครงการสนับสนุนการประกวดแบบมหาวิทยาลัยเชียงใหม่
เพื่อจัดอันดับมหาวิทยาลัยสีเขียวโลก

Final Sustainable Report of Chiang Mai University for
the UI Green Metric Ranking

By Dr. Sumavalee Chindapol
Building Innovation Technology and Management Center
Faculty of Architecture, Chaing Mai University

Present to
Department of Strategies, Chaing Mai University

Under
Proactive Strategy No. 1: Environment and Energy Innovation
2018



Final Sustainable Report of Chiang Mai University for
the UI Green Metric Ranking 2019

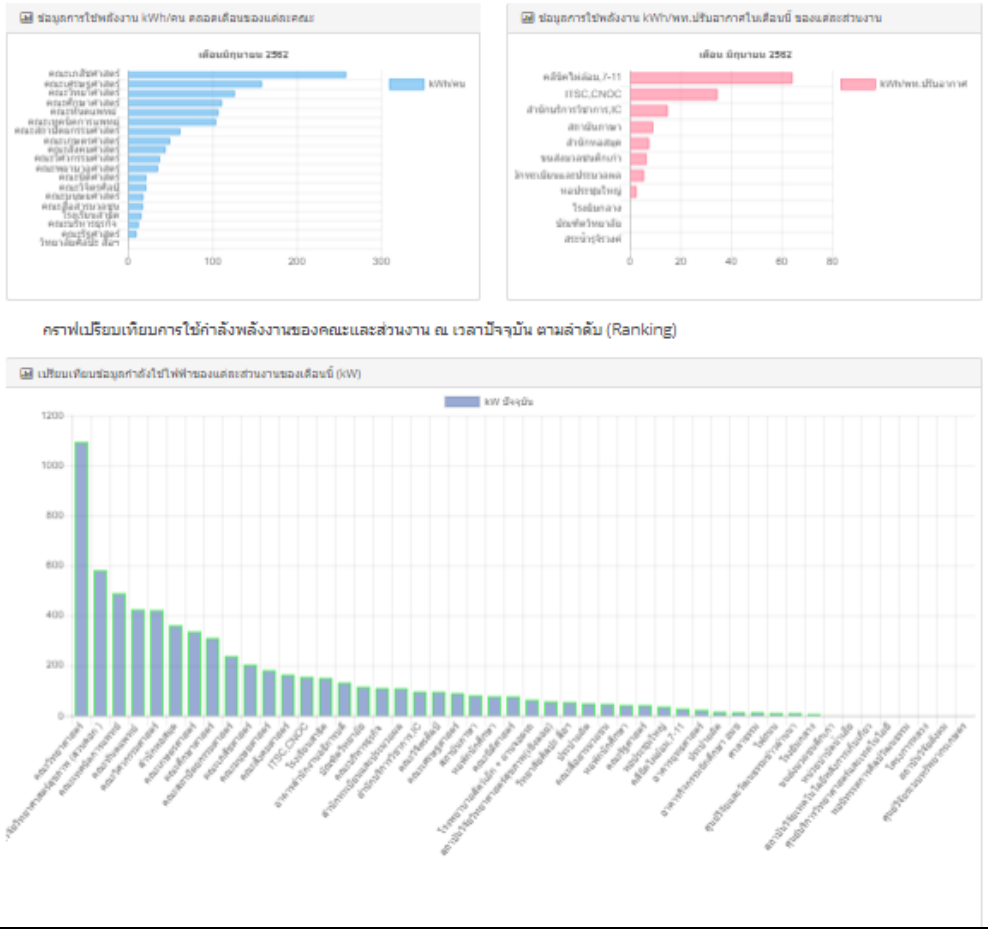
By Assistant Professor Dr. Sumavalee Chindapol
Building Innovation Technology and Management Center
Faculty of Architecture, Chaing Mai University

Present to
Department of Strategies, Chaing Mai University

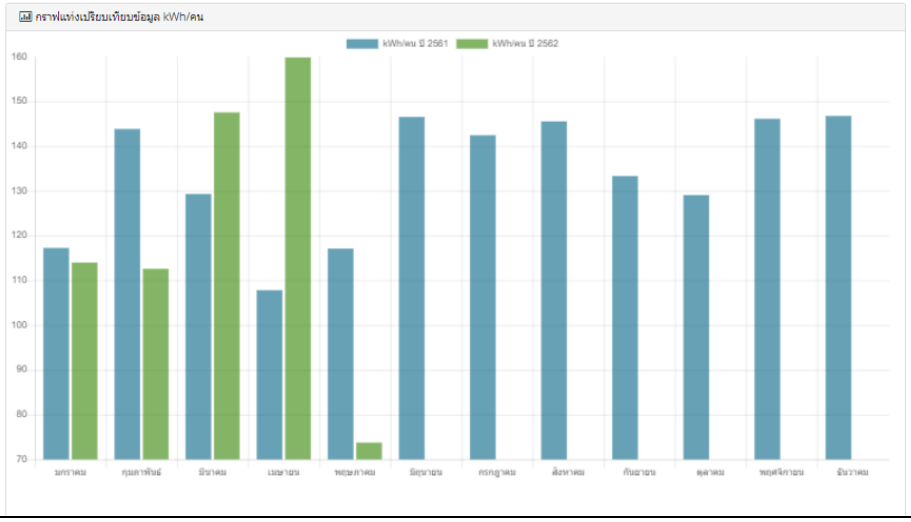
Under
Proactive Strategy No. 1: Environment and Energy Innovation
2019

Examples of sustainability report (2018-2019)

Real-time monitoring of electric power consumption by using Easy Smart Meter as shown on the website

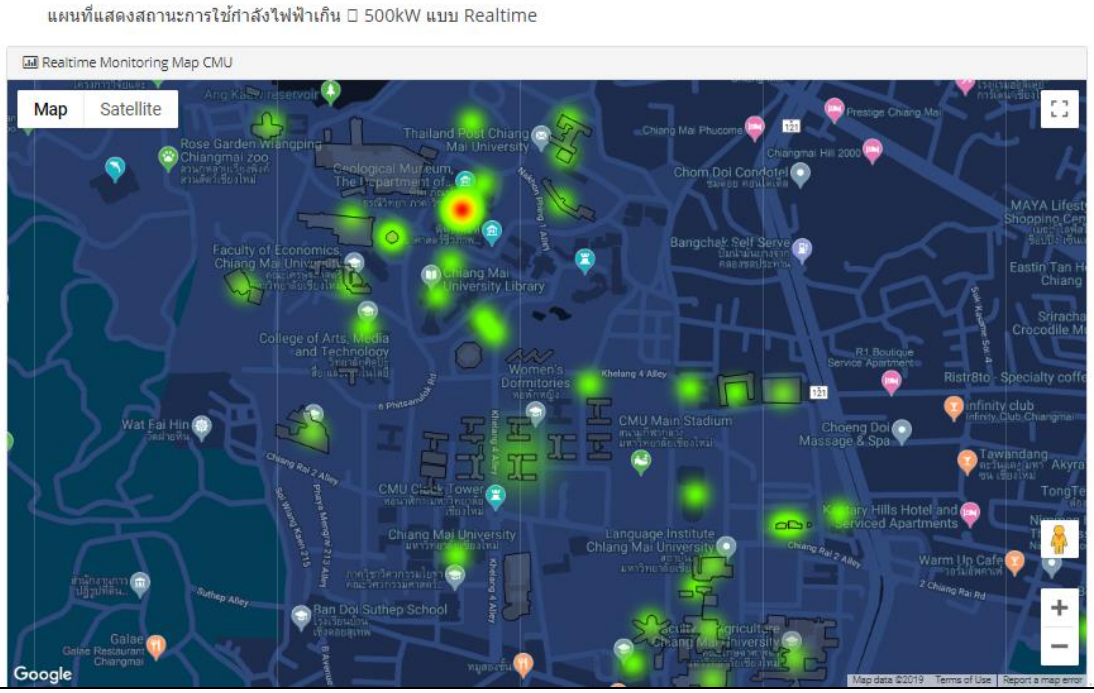


The electricity consumption comparison chart of all CMU Departments and Divisions, monitoring via enis.cmu.ac.th web page



The monthly electricity consumption comparison chart between 2018 and 2019, monitoring via enis.cmu.ac.th web page

Detailed information on maximum electric power consumption of the month (On Peak) is reported and the electric power consumption is on display every 15 minutes. These electricity consumption data can be used for analysis, as well as efficient energy management. For example, classrooms are scheduled in accordance with electric power consumption to reduce energy consumption.



The map shows real-time situation of electric power uses exceeding 500 kW.

Description:

Chiang Mai university uses the UI green metric 2018 report as a sustainable initiative report since 2017. The energy consumption data are available at http://enis.cmu.ac.th. The environmental and energy innovation plan is one of the main proactive strategies that the Strategic Plan Section, Planning Division has implemented for CMU sustainable policy (see detail via http://planning.oop.cmu.ac.th/?page_id=68).

The Section provides policies co-operated with subdivisions in CMU such as CMU Smart city – Clean energy co-operated with Smart Campus Management Center (SCMC-CMU, see detail via https://www.youtube.com/watch?v=SWlHmAmetsg), smart grid solar system and zero waste management campus co-operated with Energy Research and Development Institute (ERDI, see detail via http://erdi.cmu.ac.th/index_main.php). For upcoming year, Chiang Mai University is expecting to be a capital of the Northern Medical Hub. The smart health and wellbeing for holistic food and medical services strategy will be managed for not only CMU community but also for Chiang Mai people. To be sustain, the strategy co-operates between the committee of the CMU Proactive strategy No.2 : Food, Health and Aging Society and the Chiang Mai municipality committee.

Chiang Mai University has established a policy on energy management, environmental protection, and sustainable education development, which can be directly monitored, developed, and supported in terms of policy by the central authorities. Sustainable education management has been initiated as 21st – century Teaching and Learning Project since 2015, in which the faculty and students participated in digital active learning and were socially responsible as global citizens. Since 2018, the university's sustainable development report has been made in a form of 2018 UI Green Metric Report. The report outlined an overview and developed an easy access of examinable energy consumption data from all parts of the university, allowing the university's executive to monitor and evaluate the policy's outcomes. Nakornping Energy Research Institution has updated its website, http://www.enis.cmu.ac.th/, to display the sum of monthly electric power consumption of the whole 120 measuring spots. The website was made easier to understand by clearly showing the electric flow graph (kWh) including the electric power (kW) utilization of each feeder, and graphs displaying the latest information online such as the followings;

- Electric power consumption kW/person
- Electric power consumption kW/ air-conditioned area
- Electric power consumption comparison chart of each operational segments' usage data this month
- A map showing real-time situation of electric power uses exceeding 500 kW

Complete text of Chiang Mai University's 2018-2019 Sustainable Report is available on this link: http://green.cmu.ac.th

Energy monitoring system for sustainability is available on this link : https://enis.cmu.ac.th