



Chiang Mai World Green City

Worajit Setthapun

Chiang Mai Rajabhat University, Thailand

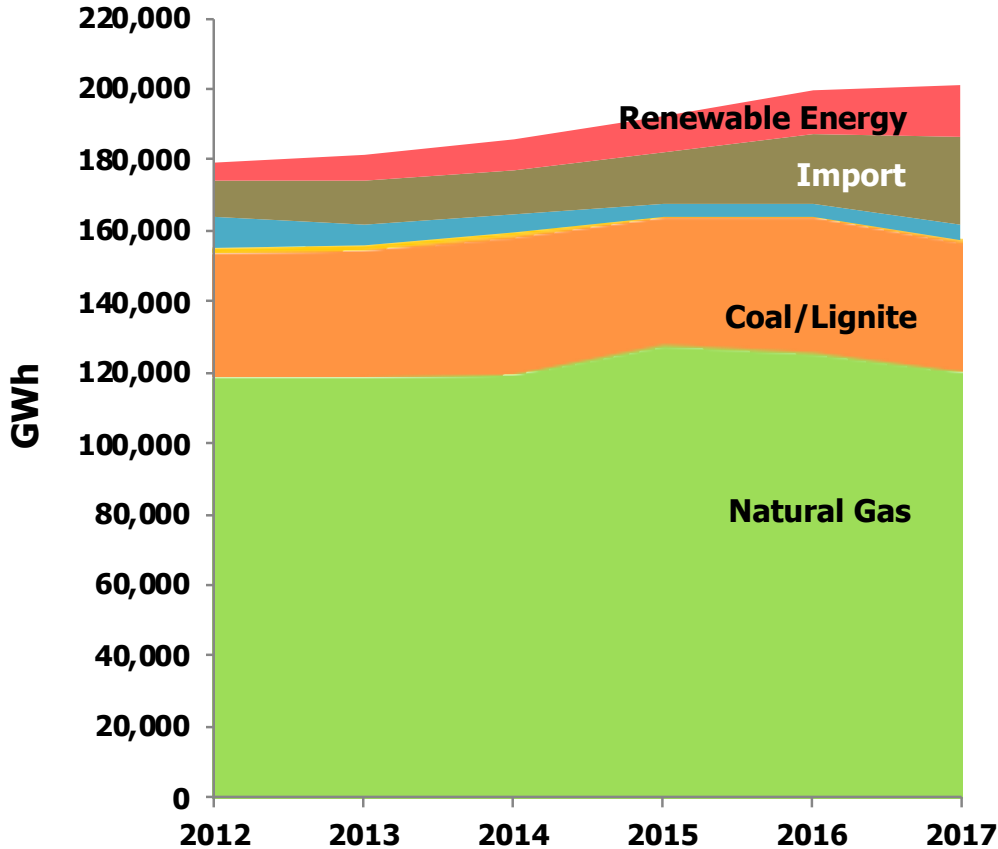
Isolated Power Systems Connect 2018

October 19, 2018

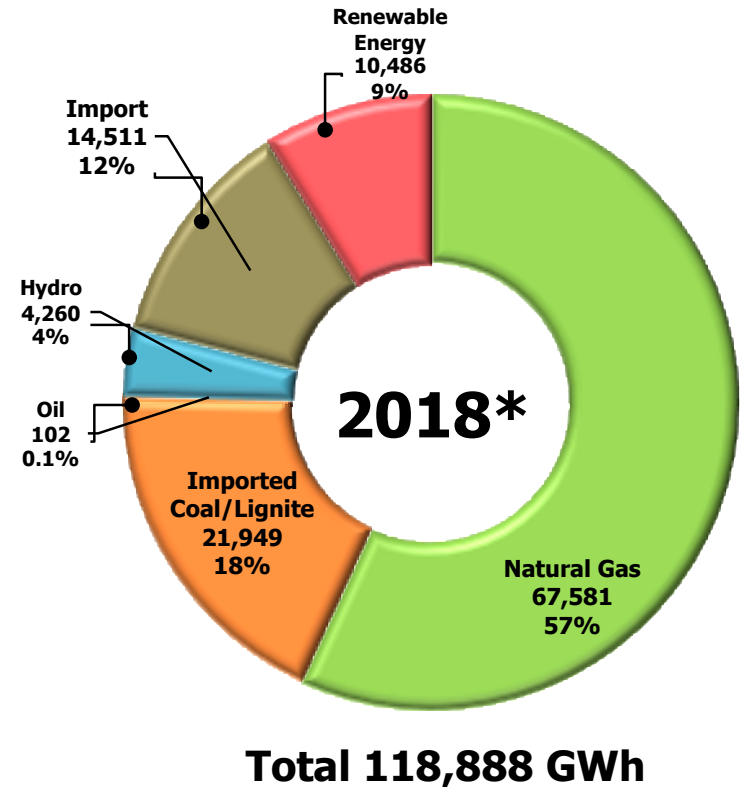
Maui, Hawaii

- Thailand Energy Situation
- Thailand Integrated Energy Blueprint
- adiCET
- Chiang Mai World Green City
 - Community Smart Microgrid
 - Zero Waste – BioEnergy Cycle
 - Smart Community
- Example of Rural Village Electrification in Chiang Mai

Thailand Energy Situation



Ratio of Power Production Sources

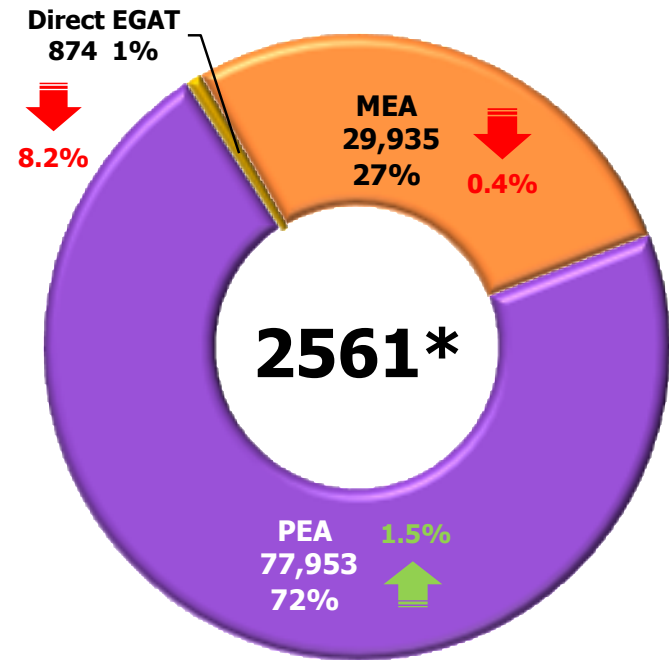
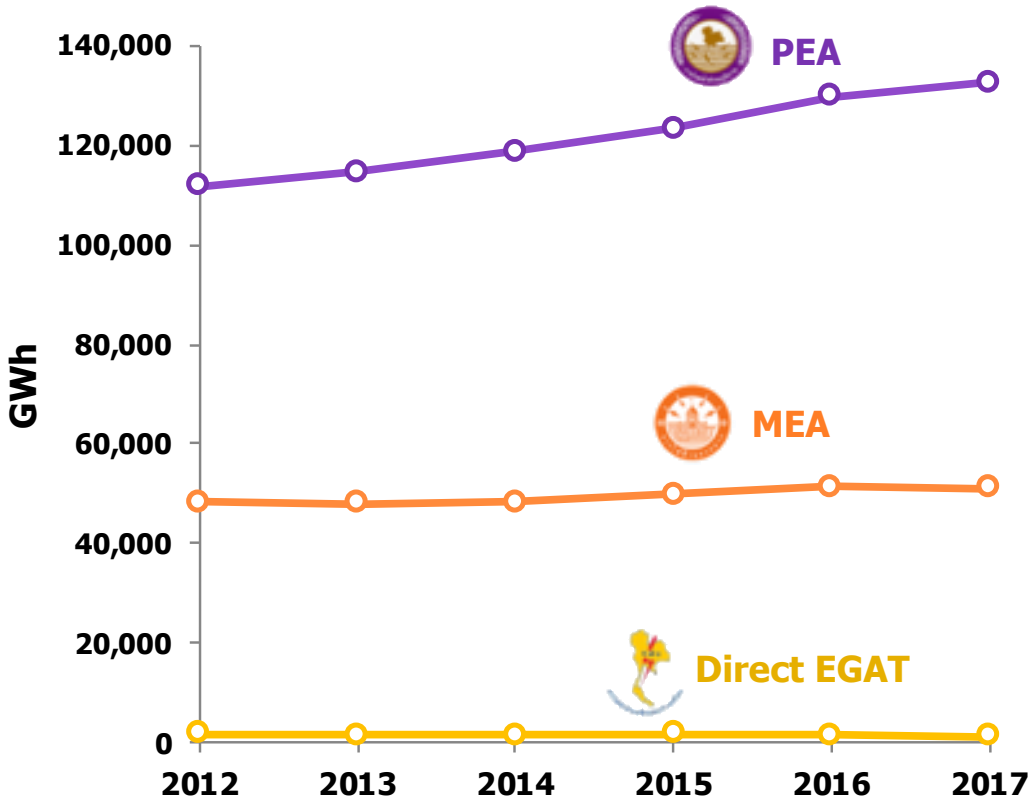


* Jan-July

Note: Not include IPS

Thailand Power Consumption

Power Consumption Ratio



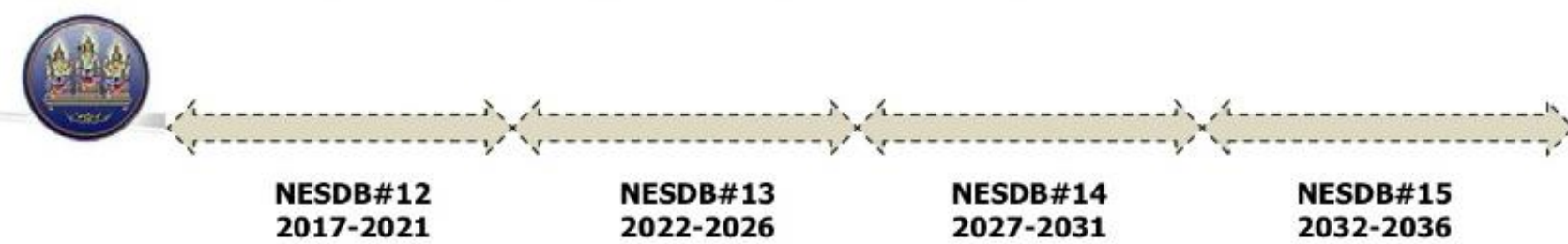
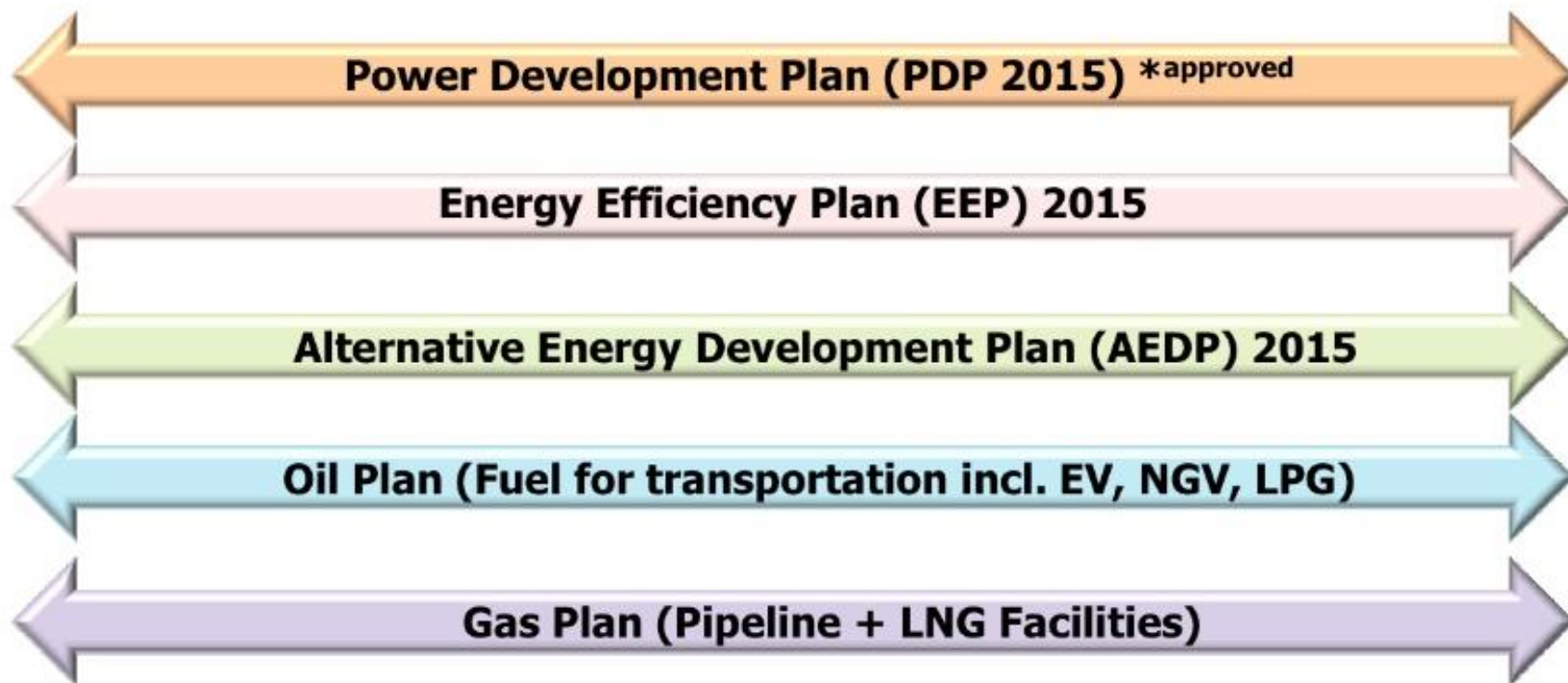
Total 108,762 GWh

Note: Not include IPS

* **Jan-July**



Thailand Integrated Energy Blueprint (TIEB)



Highlight of Thailand Integrated Blueprint

	Description	Impact
Energy Efficiency	 <ul style="list-style-type: none"> Remove subsidies to convey market price signal Accelerate EE execution via benchmarking, accountability and enforcement 	<ul style="list-style-type: none"> Achieve 30% energy intensity reduction (vs. 0.5% p.a. increase over last 10 years)
Conventional power (PDP)	 <ul style="list-style-type: none"> Rebalance power mix with clean coal technology deployment for half of all new thermal plants 	<ul style="list-style-type: none"> Reach 30% coal in power mix vs. 20% today 20% clean coal vs. only normal coal today
Renewables (AEDP)	 <ul style="list-style-type: none"> Three pronged approach for cost effective scale up of renewables: <ul style="list-style-type: none"> Drive: Biomass and waste Pace: Solar Monitor: Wind 	<ul style="list-style-type: none"> Achieve cost < LNG parity for 20% RES share in power mix (vs. ~8% today)
Biofuels (AEDP)	 <ul style="list-style-type: none"> Improve yield to limit imports and benefit rural community 	<ul style="list-style-type: none"> ~20% substitution in transport (vs. 4% today) Up to THB 50 Bln/y GDP impact
Oil & Gas	 <ul style="list-style-type: none"> Counter production decline with E&P activity stimulus policies ("Reimagine Gulf of Thailand") 	<ul style="list-style-type: none"> Limit domestic gas decline rate at ~2-5% p.a. (vs. -11% BAU)
Economics	 <ul style="list-style-type: none"> Channel subsidies directly to target segments in need 	<ul style="list-style-type: none"> Unleash THB ~380B for productive use

Foundation: Commitment to the development of a low-carbon society


Facilitator:
Private-led investment

Strategy: Alternative Energy Development Plan 2015-2036


Facilitator:
Government funded RD&D

Goal: Target 30% renewables in Total Energy Consumption by 2036


Bio-Energy

		
Biomass	Biogas	MSW + Industrial Waste
5,570 MW	600 MW	550 MW
22,100 ktoe	1,283 ktoe	495 ktoe
6,720 MW Power 23,878 Ktoe Heat		


Bio-Fuel

		
Ethanol	Biodiesel	Pyrolysis Oil
11.3 ML/Day	14 ML/Day	0.53 ML/Day
	CBG	Alt. Fuels*
	4,800 t/Day	10 ktoe


Solar


6,000 MW
1,200 Ktoe
9,002 MW Power 1,200 Ktoe Heat

Wind


3,002 MW

Hydro

	
Large Hydro	Small Hydro
2,906.40 MW	376 MW
3,282.40 MW	

New-Energy


Geothermal, Used Tire Oil, etc.
10 ktoe

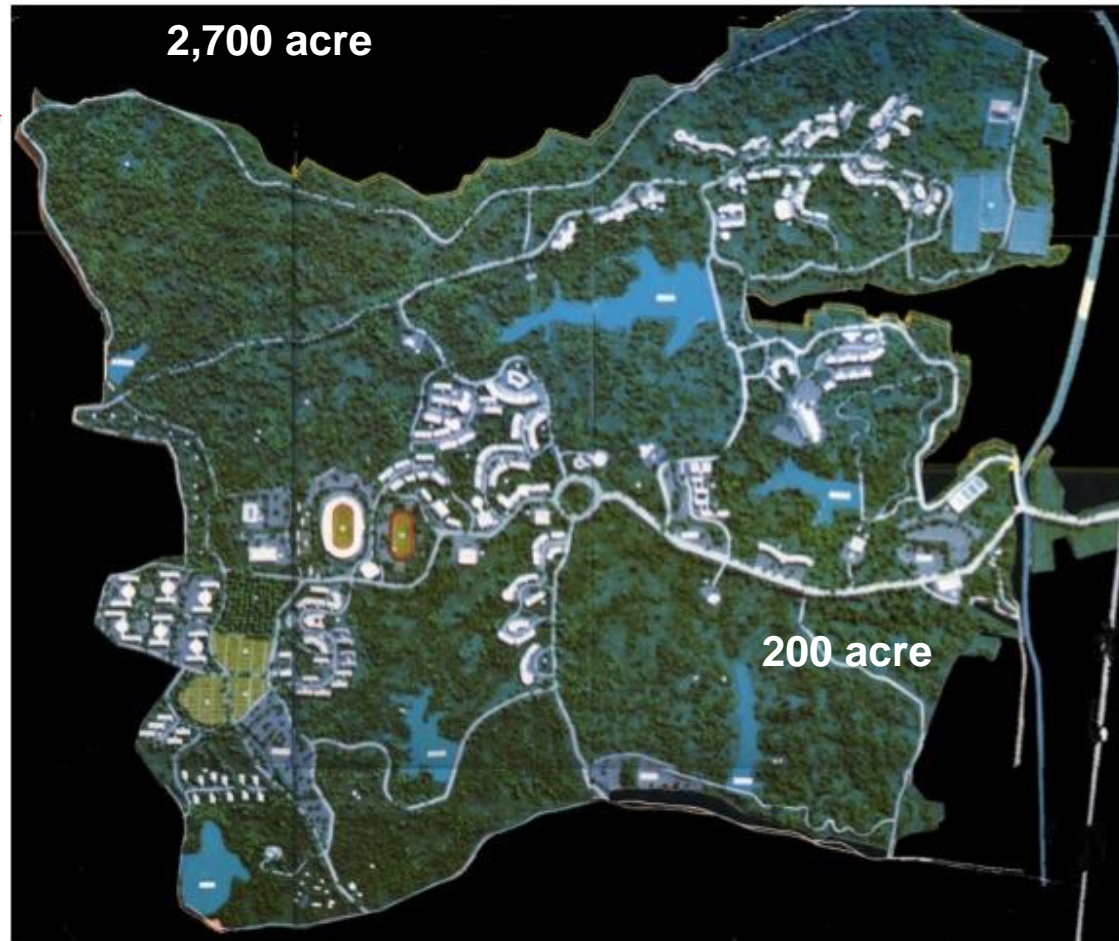
* Alternative fuels = Bio-oil, Hydrogen

Alternative Energy Production & Target

Electricity (MW)	2013	2014	2015	2016	2017	June 2018	Target in 2036
Solar Energy	823	1,299	1,420	2,446	2,697	2,697	6,000
Wind Energy	223	224	234	507	628	748	3,002
Small Hydro	109	142	172	182	182	188	376
Biomass	2,321	2,452	2,727	2,815	3,157	3,217	5,570
Biogas	265	312	373	435	475	487	1,280
MSW	47	66	132	145	191	298	550
Large Hydro	-	-	2,906	2,906	2,906	2,906	2,906
Total (MW)	3,788	4,494	7,963	9,437	10,238	10,542	19,684

Asian Development College for Community Economy and Technology, Maerim Campus

- 30 km north of Chiang Mai City
- 700 km from Bangkok
- 1 hr flight from Bangkok



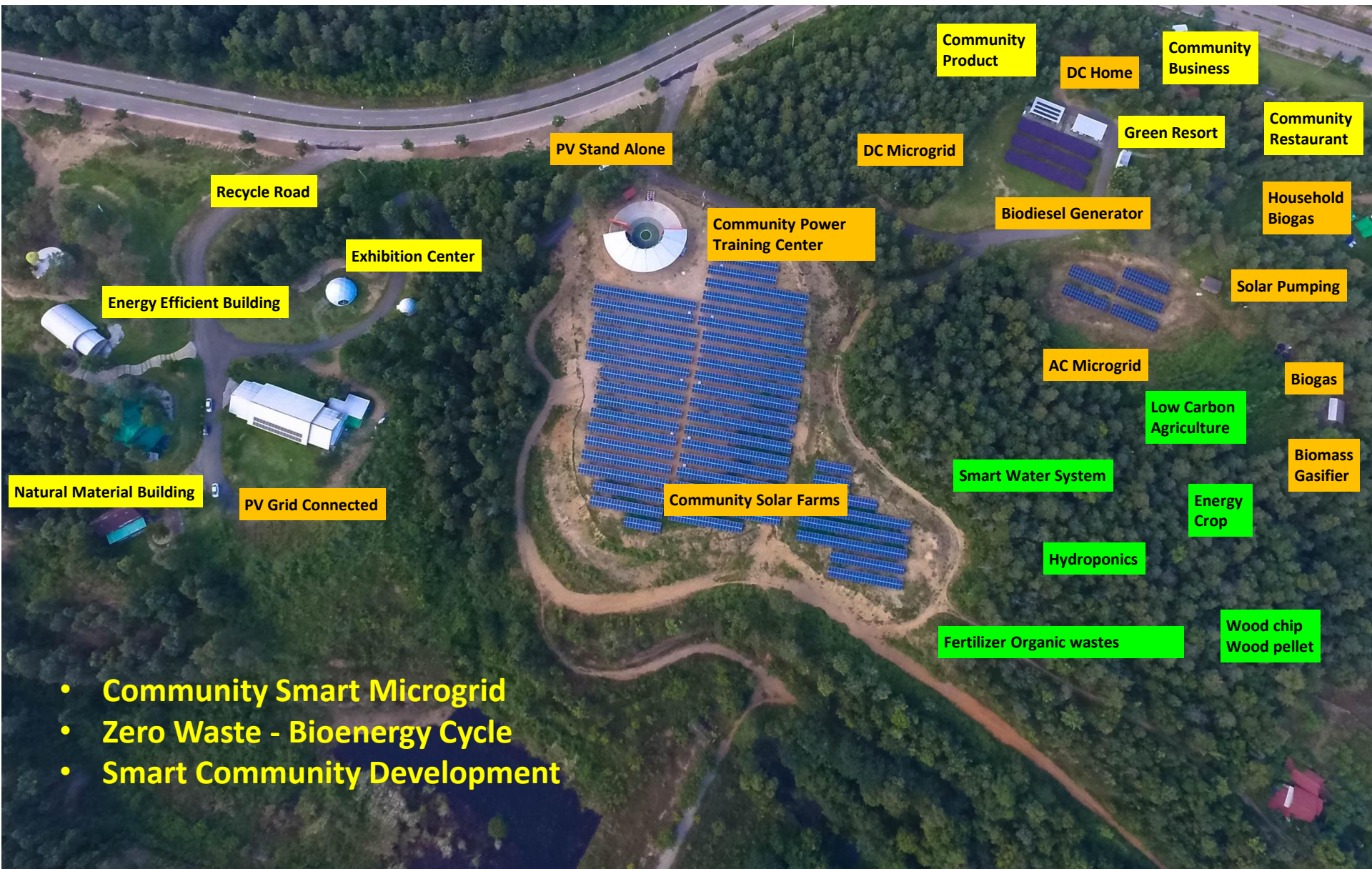
- Established in 2010
- Academic – R&D – Training institution for the well-being of the community by using green technologies.
- adiCET campus is on Chiang Mai World Green City (CMGC).
 - Build from 60 research and academic service projects
- Smart Community – Model Community uses 100% renewable energy.



Goal

Sustainable Community via integration of Renewable Energy & Green Technology with Smart Grid Infrastructure





- Community Smart Microgrid
- Zero Waste - Bioenergy Cycle
- Smart Community Development

Community Product

DC Home

Community Business

Green Resort

Community Restaurant

Household Biogas

Solar Pumping

Biogas

Biomass Gasifier

AC Microgrid

Low Carbon Agriculture

Energy Crop

Hydroponics

Wood chip
Wood pellet

Fertilizer Organic wastes

Smart Water System

PV Stand Alone

DC Microgrid

Community Power Training Center

Biodiesel Generator

Community Solar Farms

AC Microgrid

Smart Water System

Hydroponics

Fertilizer Organic wastes

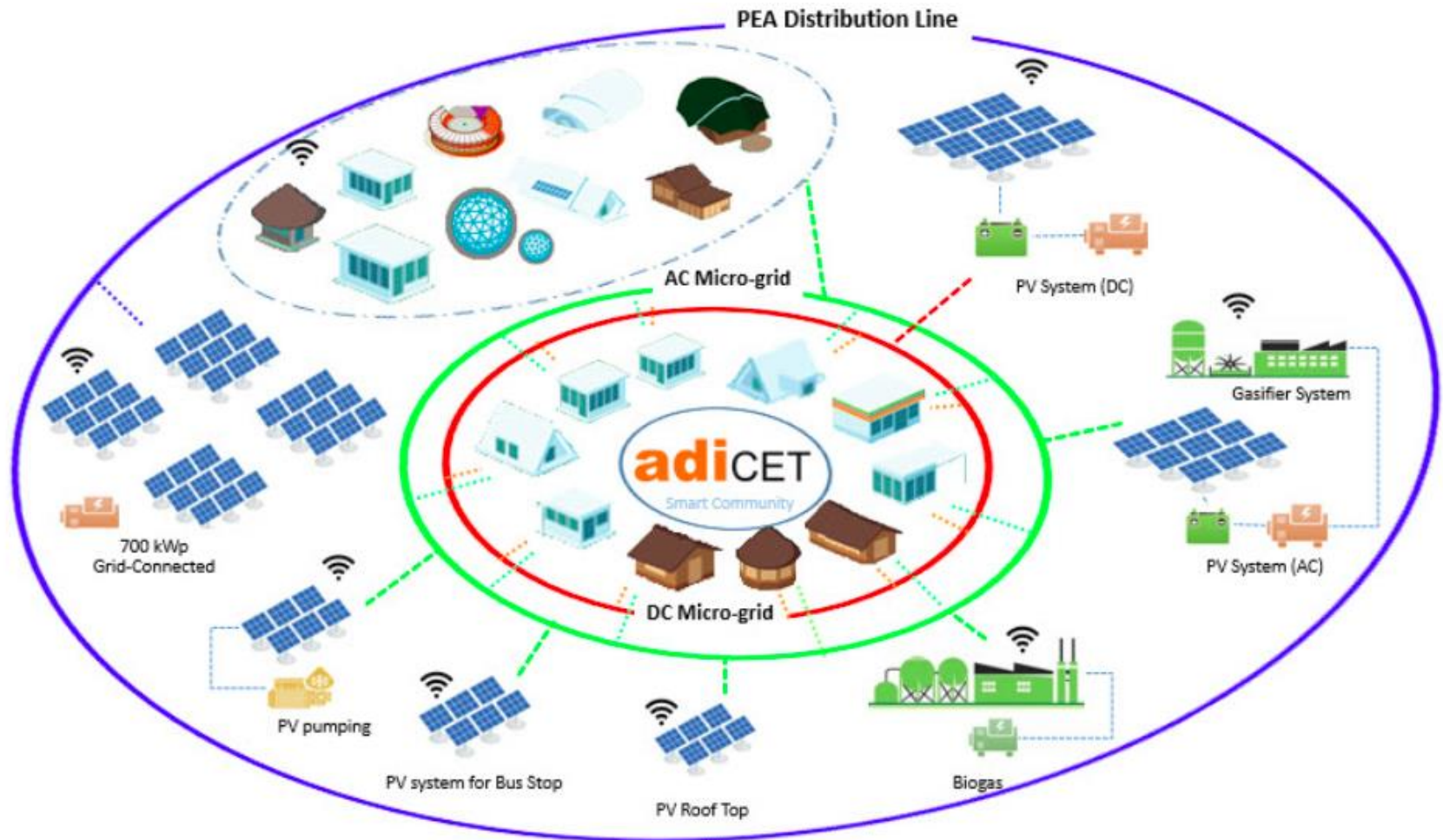
Recycle Road

Exhibition Center

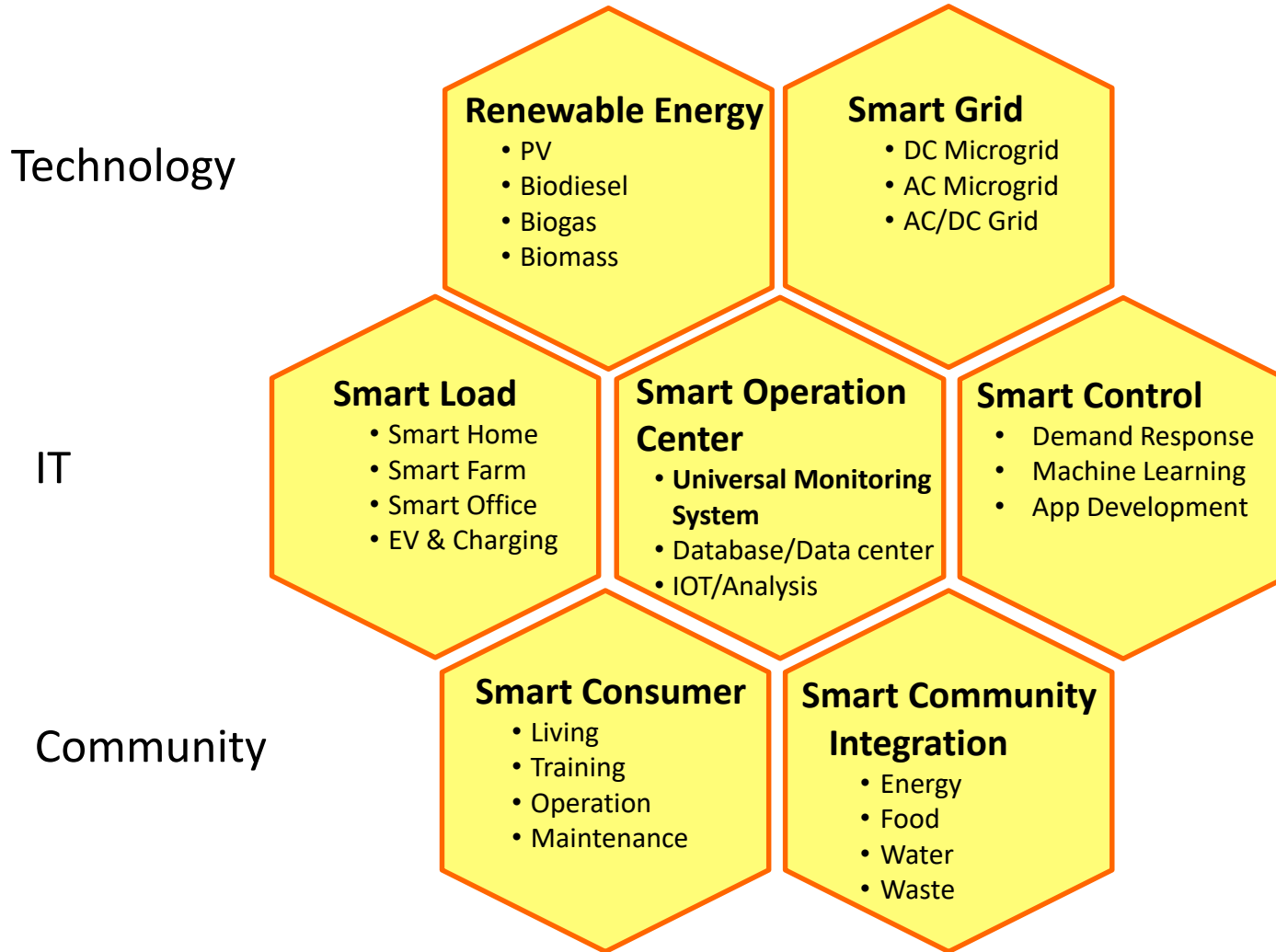
Energy Efficient Building

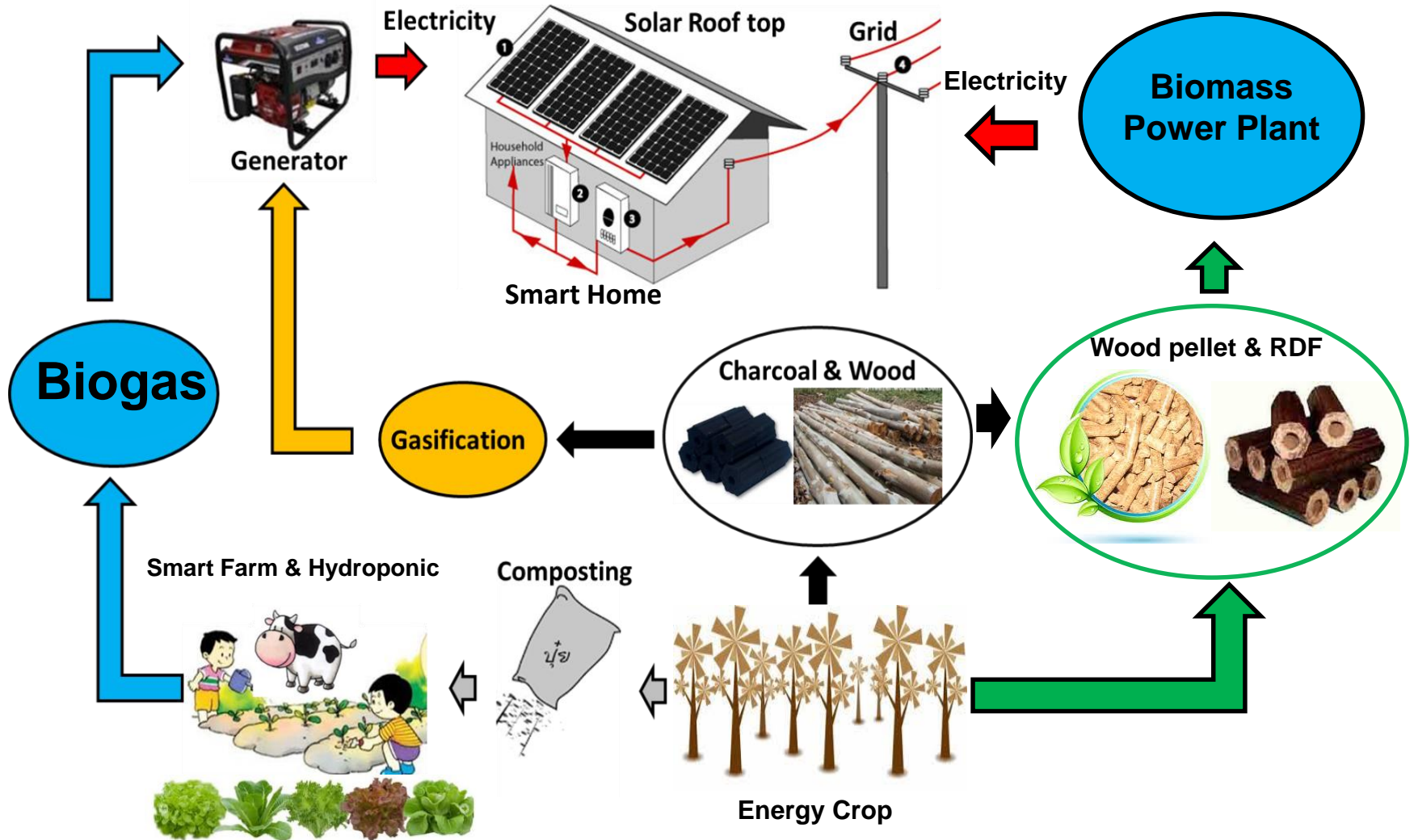
Natural Material Building

PV Grid Connected



Phase 1: Building Microgrid → **Phase 2: Monitoring** →
Phase 3: Data Analysis & Integration → Phase 4: Control → Phase 5: Optimize





Self-Sustaining Community in Remote Area

ENERGY

WATER

Energy

Economy

Environment

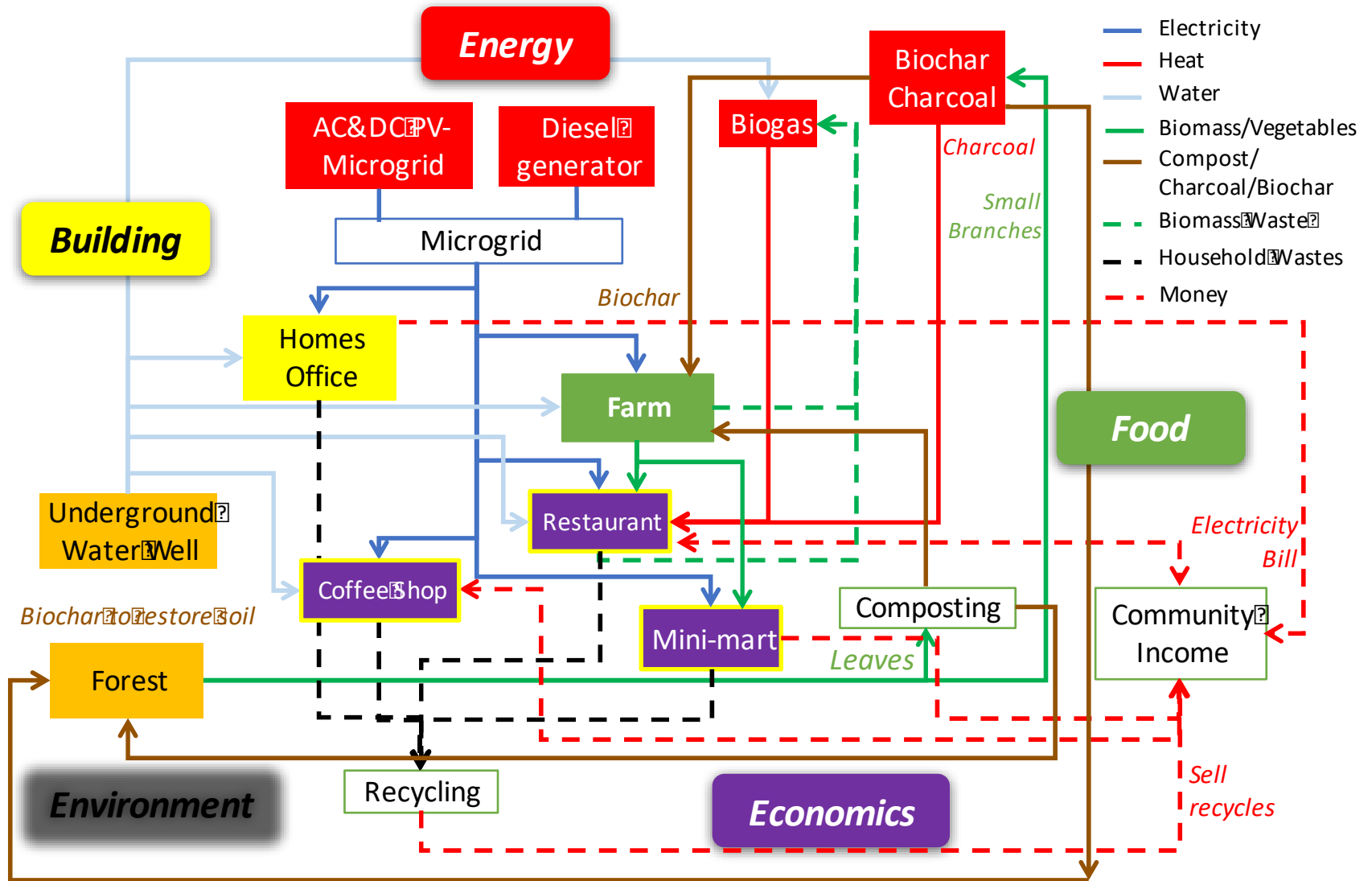
Food

Home

FOOD



“Flagship Project 3: Smart Community”



Environmental



Recycle waste (kg)
Organic waste (kg)
Hazardous waste (kg)
The frequency of dumping waste (time)
Date/time

Energy



Production (kwh)
Consumption (kw)
Raw material of biogas and charcoal production (kg)
Biogas and charcoal yield/consumption (kg)
Fuel consumption in transportation (L)
Date/time

Building



Indoor/Outdoor temperature ($^{\circ}$ C) and humidity (%)
Outdoor solar intensity (W/m²) and wind velocity (m/s)
Water consumption (L) / Water flow rate average (L/min) and quality (Nephelometric Turbidity Units, pH, Coliform, BOD)
Particulate in the air (PM)
The frequency of using water (Time)
Date/Time

Food

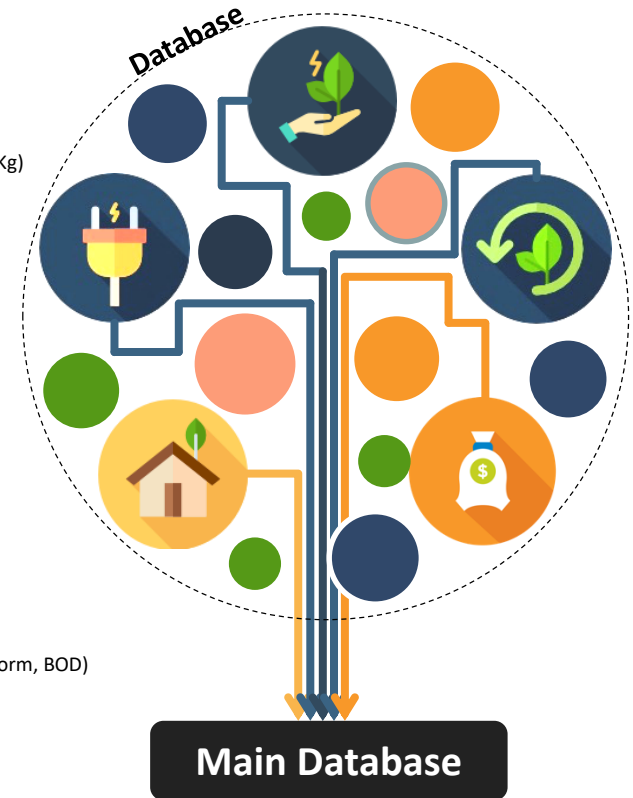


Vegetable production (Kg)
Using fertilizer (Kg)
Another material in cultivation (Kg)
Consumption and sale of vegetable (Kg)
Date/Time

Economic



Expenses (Baht)
Income (Baht)
Date/Time



“Analyze Community Context → Balanced Community”

LIVING LABORATORY - FOR GREEN COMMUNITY

We live here...





Reuse material house

We live here...



We study here...

