



# Digital Industrial Automation Control System Towards Smart Society

David Banjerdpongchai  
Dept. of Electrical Engineering  
Chulalongkorn University  
Email: [bdavid@chula.ac.th](mailto:bdavid@chula.ac.th)

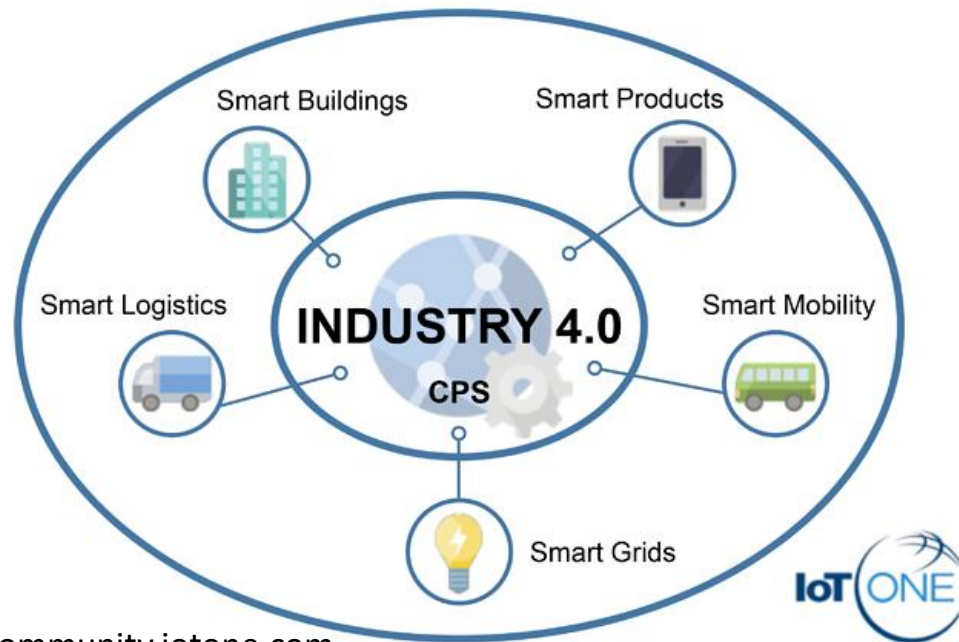
September 11, 2019  
SICE 2019 @ Hiroshima



## Contents

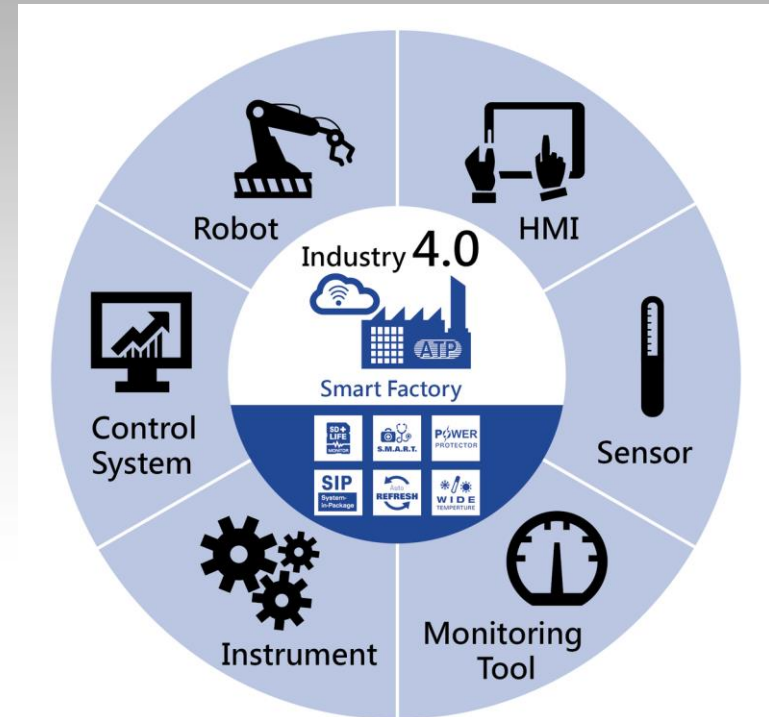
- Industry 4.0 vs. Japan Society 5.0
- Thailand 4.0 and Eastern Economic Corridors
- Research related to Energy Efficiency
- IEC TC 65 Thailand National Committee
- Control Systems Society Thailand

# Industry 4.0

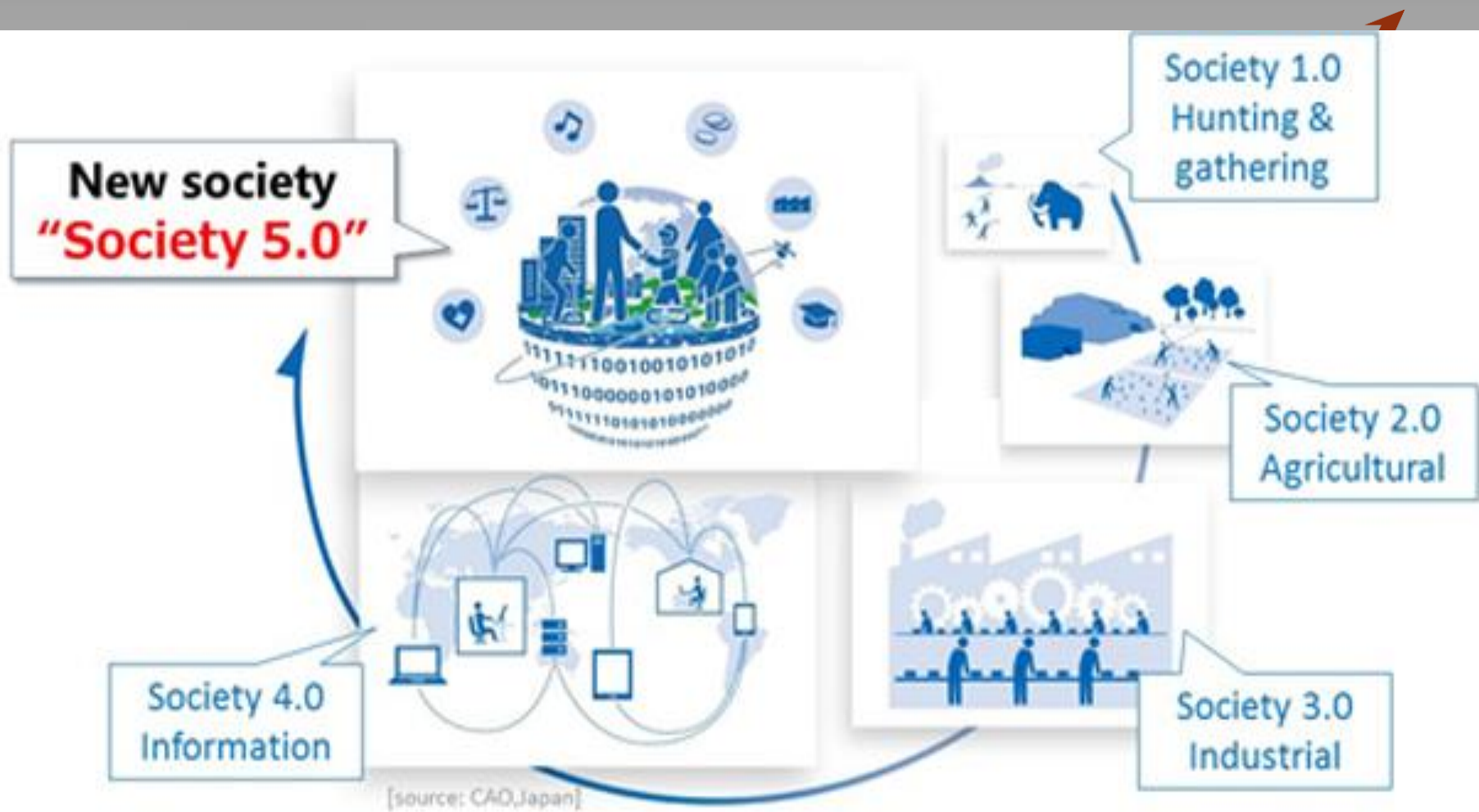


community.iotone.com

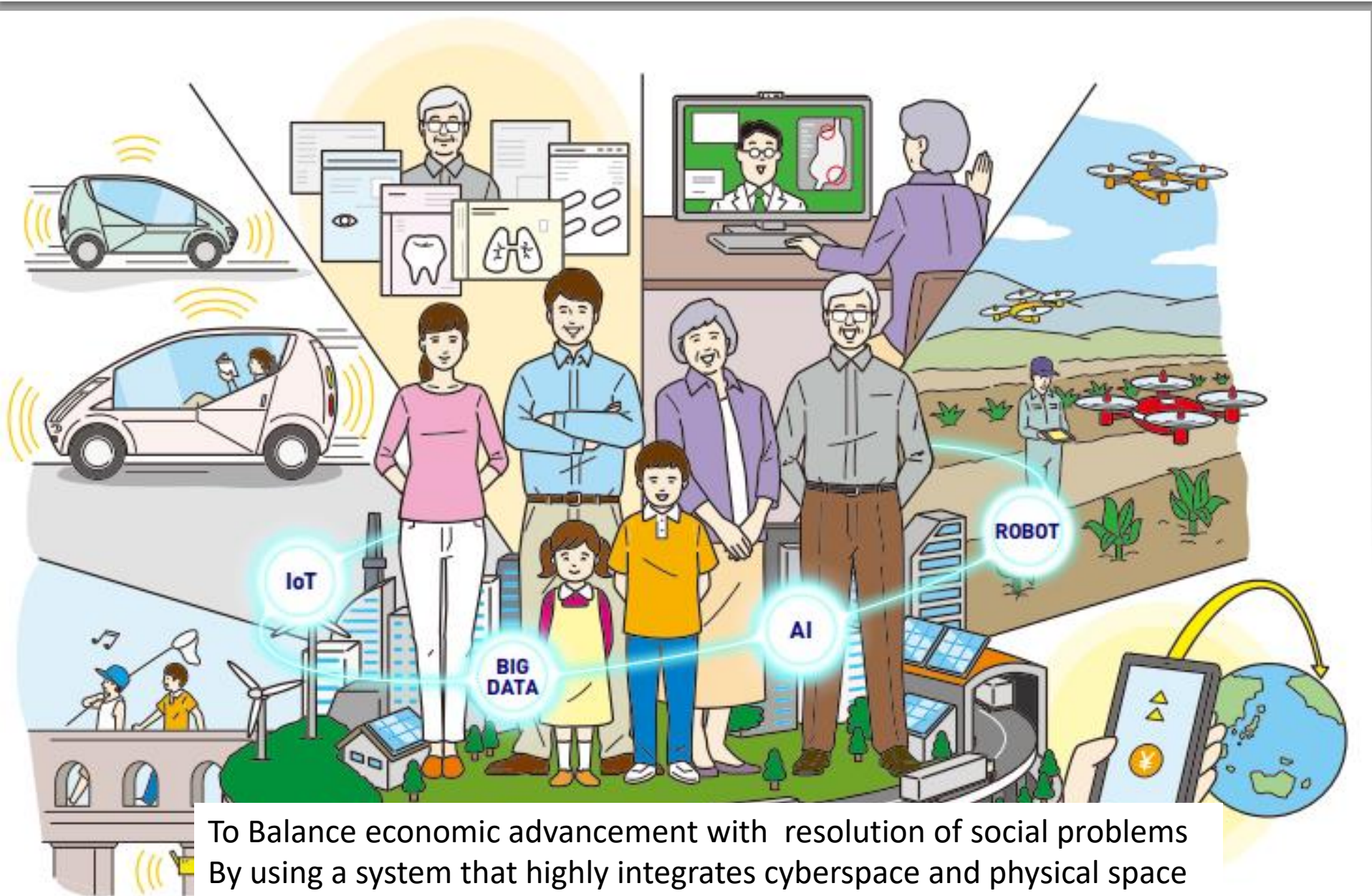
- data acquisition and processing
- assistance systems
- networking and integration
- decentralization and service orientation
- self-organization and autonomy



embedded-computing.com



# Society 5.0 Human-Centered Society



# AI in Cucumber Farm

- cucumber farm in Shizuoka
- cucumbers are sorted into 9 grades by their colors, length and shapes
- developed Machine Learning method to help in grading process



[themomentum.co/japan-cucumber-farm-ai/](http://themomentum.co/japan-cucumber-farm-ai/)

# Impact to Japan Society



Coexistence  
with nature

Hunting Society



Development of irrigation  
techniques  
Firm establishment of  
settlement

Agrarian Society



Invention of steam  
locomotive  
Start of mass production

Industrial Society



Invention of a computer  
Start of distribution of  
information

Information Society

Society 5.0

Super Smart  
Society

- Mobility
- Medical Services
- Manufacturing
- Agriculture
- Food
- Disaster Prevention

The birth of human  
beings

13000 BC

End of 18th century

End of 20th century

From 21st century



## Contents

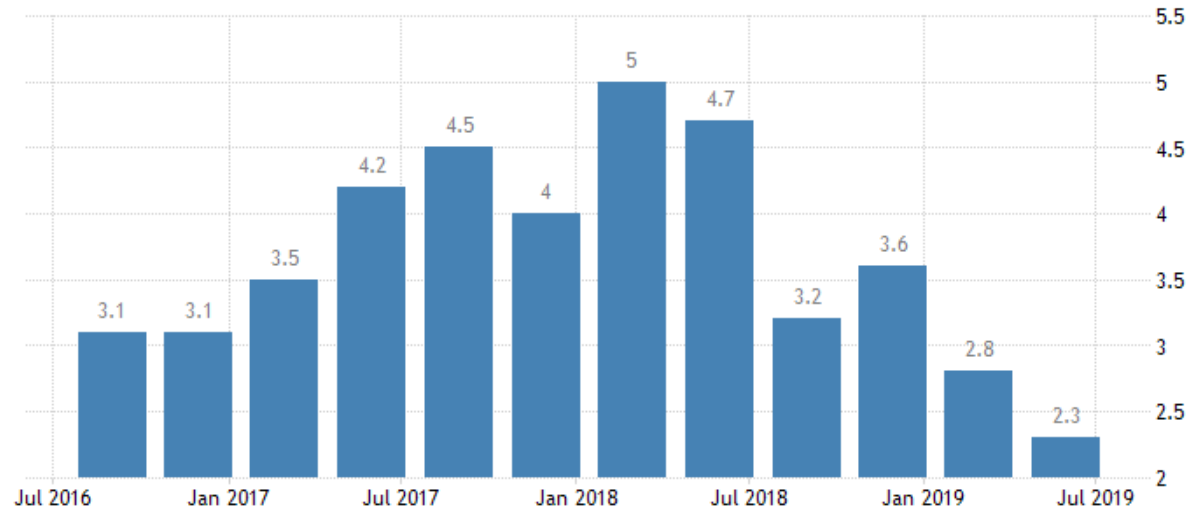
- Industry 4.0 vs. Japan Society 5.0
- **Thailand 4.0 and Eastern Economic Corridors**
- Research related to Energy Efficiency
- IEC TC 65 Thailand National Committee
- Control Systems Society Thailand



# Drivers to Thailand 4.0



## Thailand GDP Growth Rate



SOURCE: TRADINGECONOMICS.COM | NESDB, THAILAND

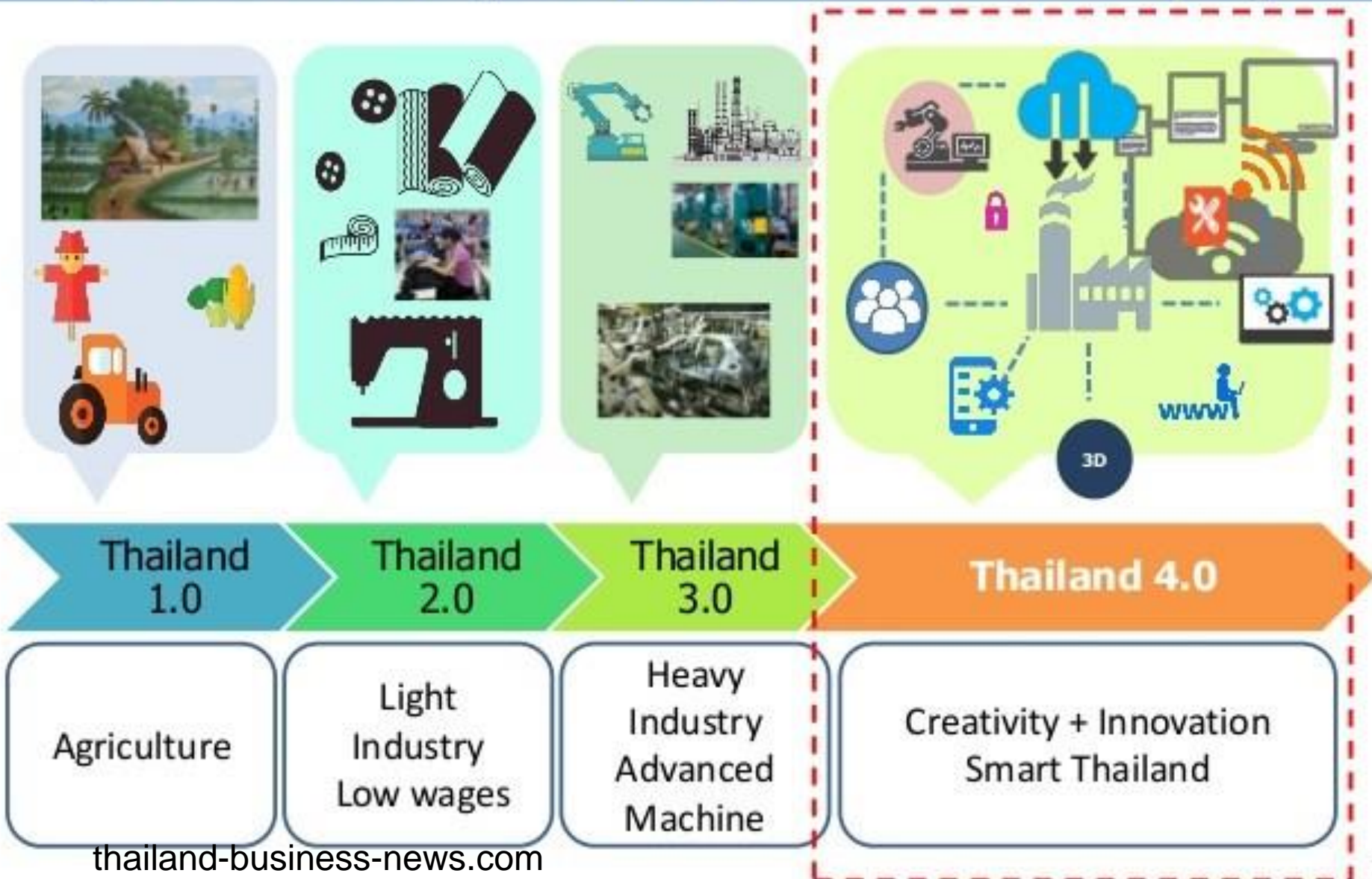
## Thailand GDP Manufacturing

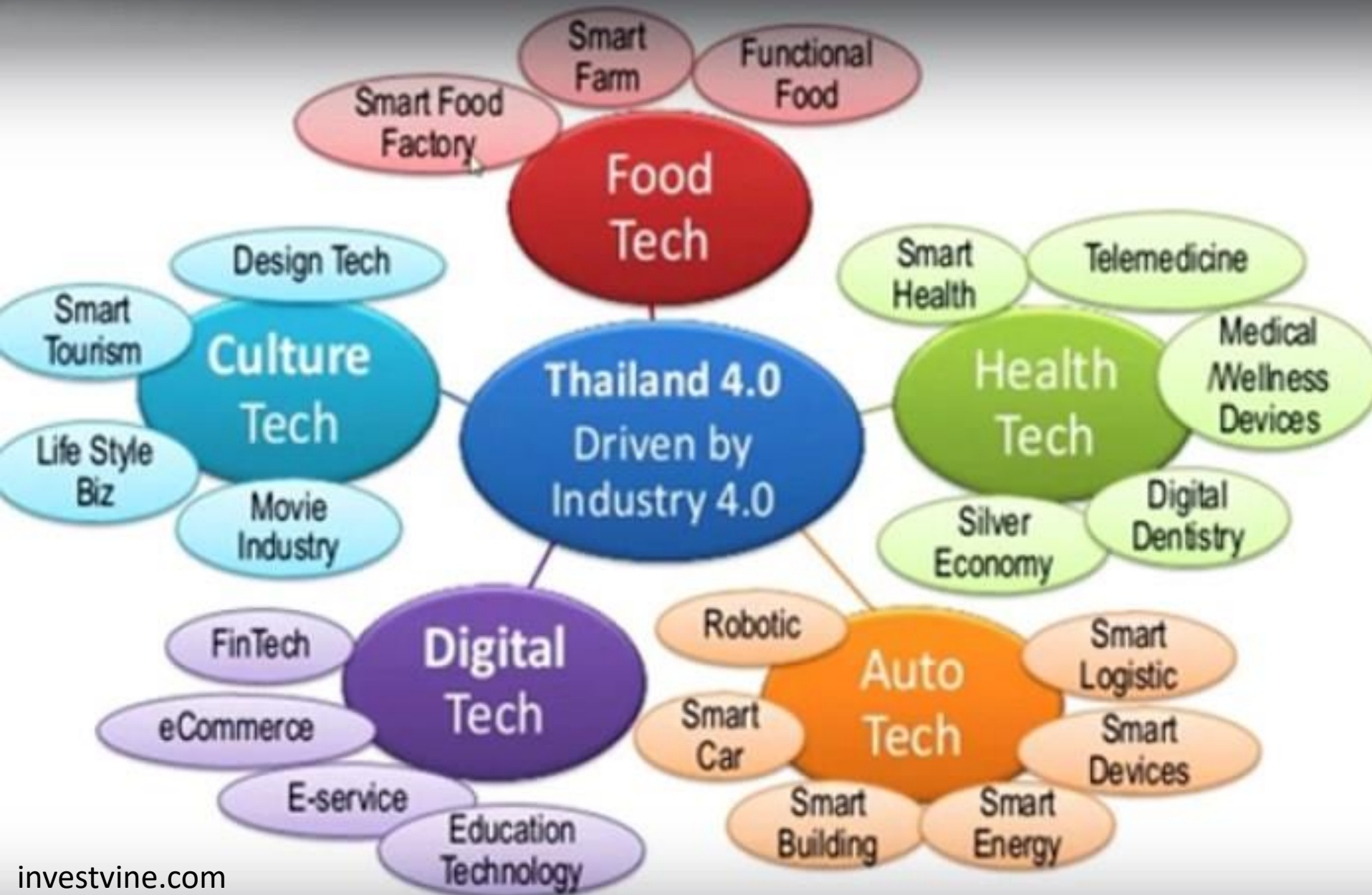


SOURCE: TRADINGECONOMICS.COM | NESDB, THAILAND

# Thailand 4.0

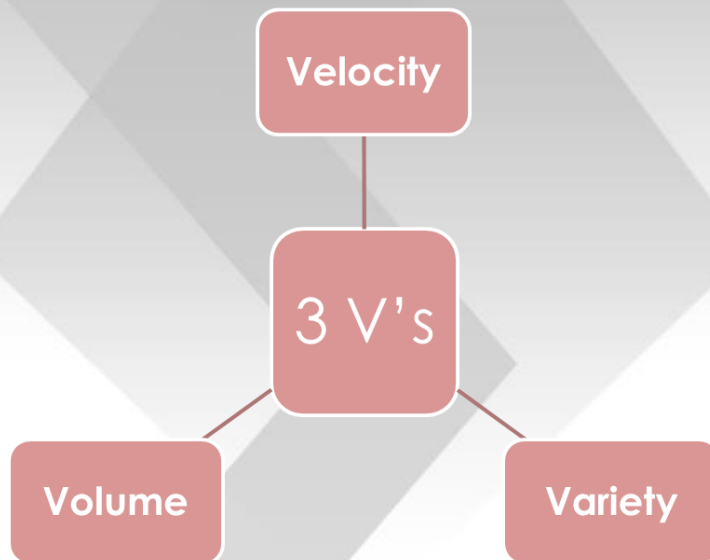
(Smart Industry + Smart City + Smart People)



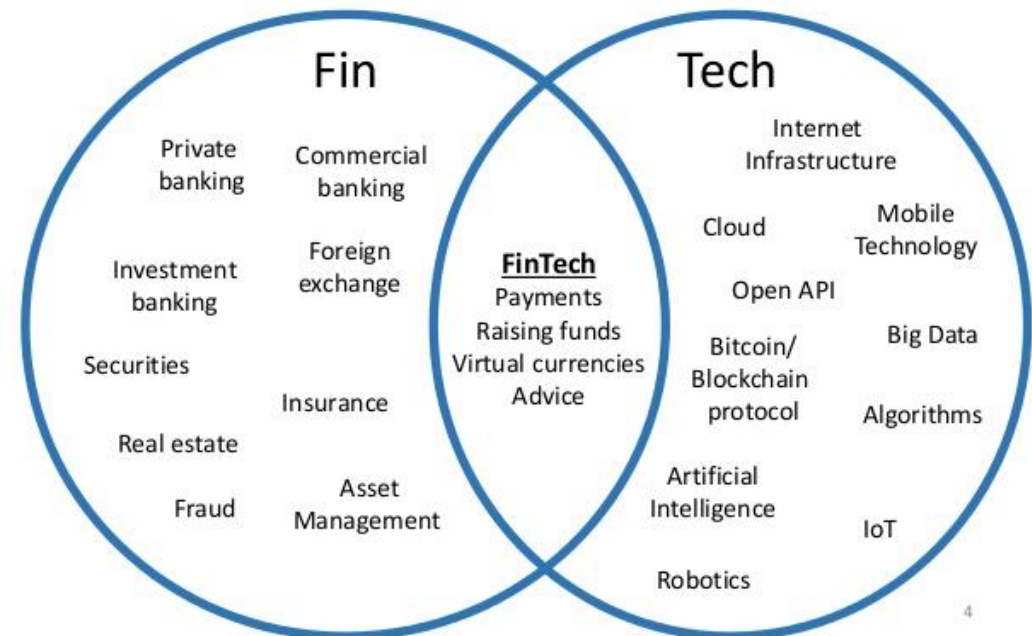


# Automation for Digital Tech

## Big Data Analytics



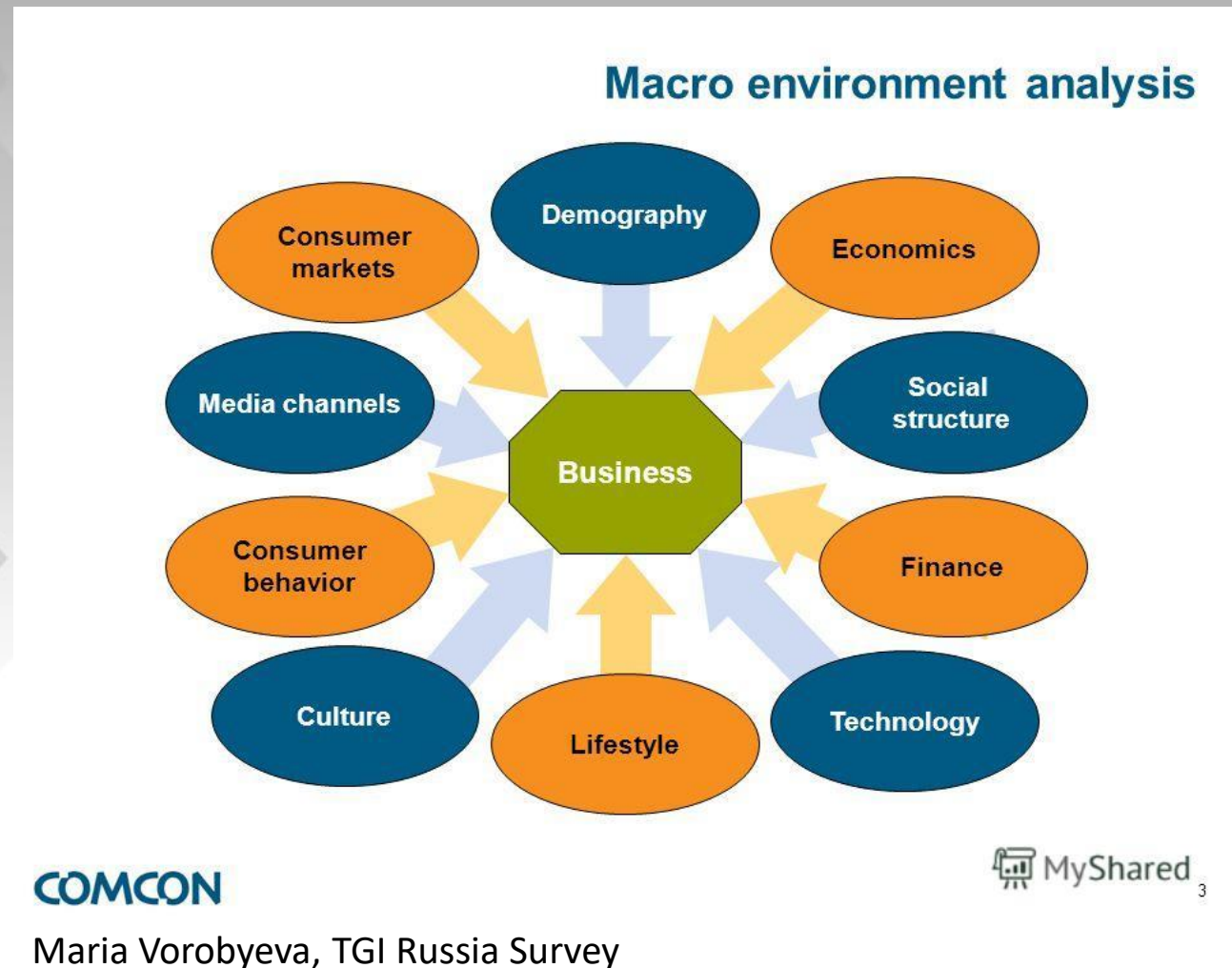
The FinTech space is growing....



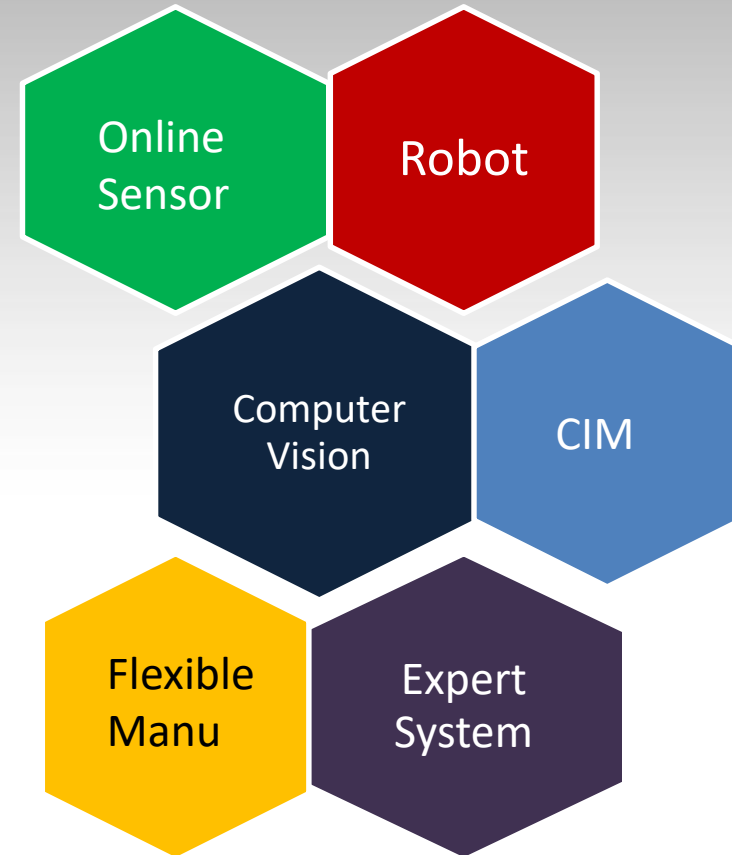
ClaireBarrattIngram/launch-of-sthlmfintech

# Automation for Culture Tech

movies  
 broadcasting  
 games  
 animation  
 performances  
 exhibitions  
 entertainment  
 education  
 medical  
 national defense  
 manufacturing  
 robotics  
 automobile

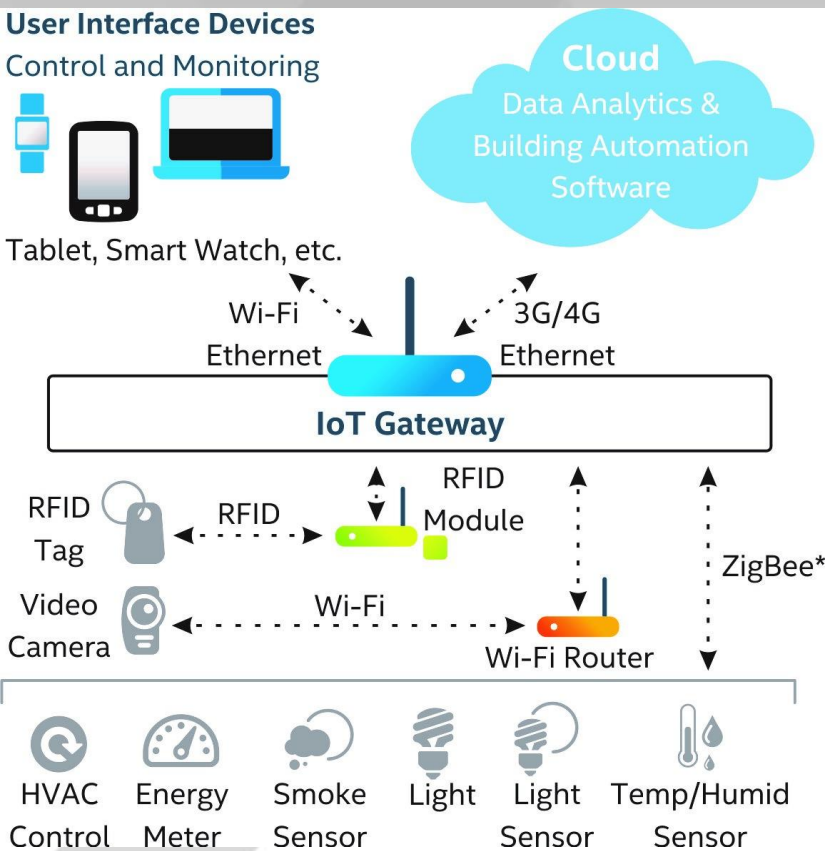


# Automation for Food Tech

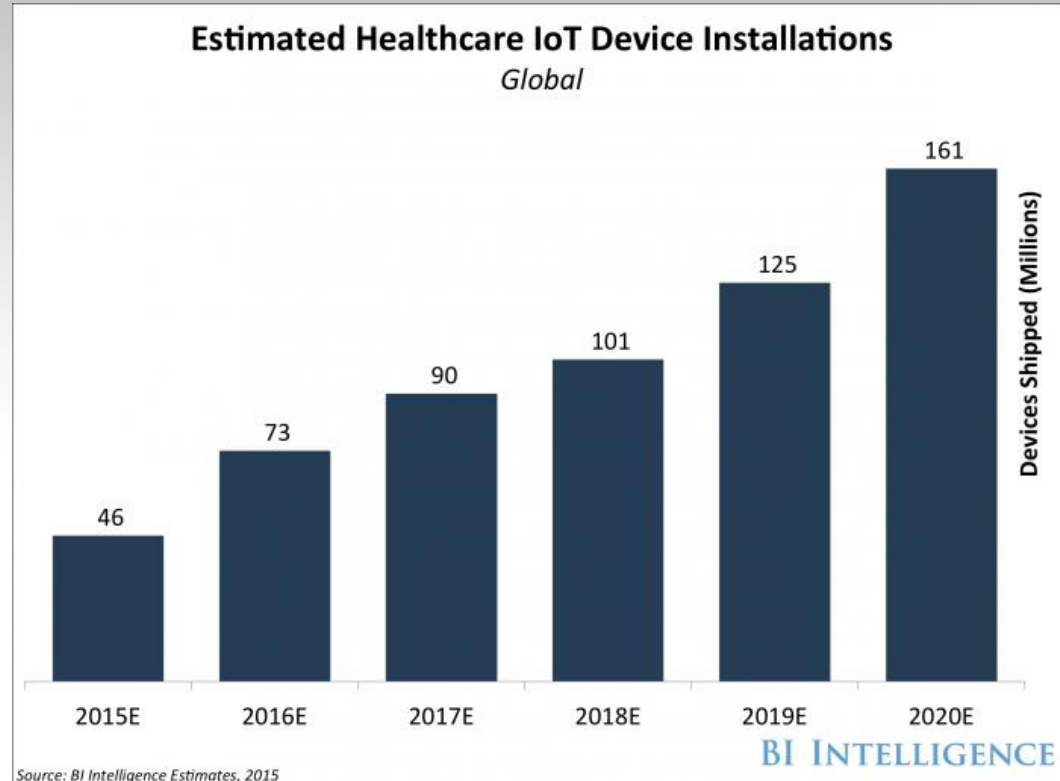


# Automation for Health Tech

The global market for IoT healthcare tech will top \$400 billion in 2022

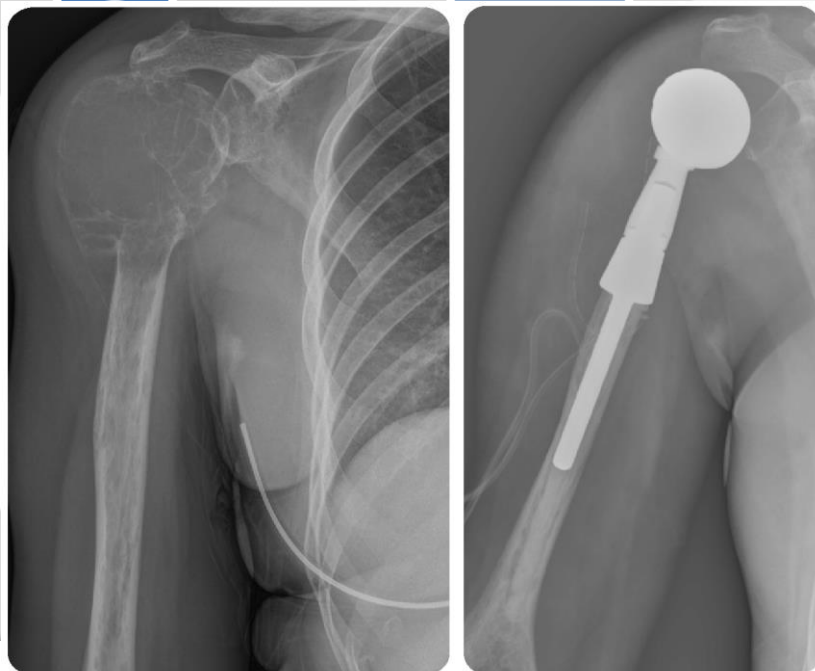
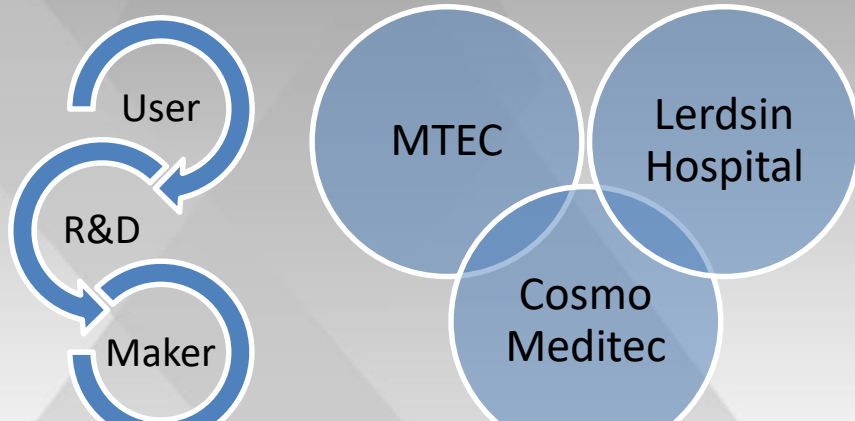


intel.com



www.businessinsider.com

# Proximal Humeral Prosthesis



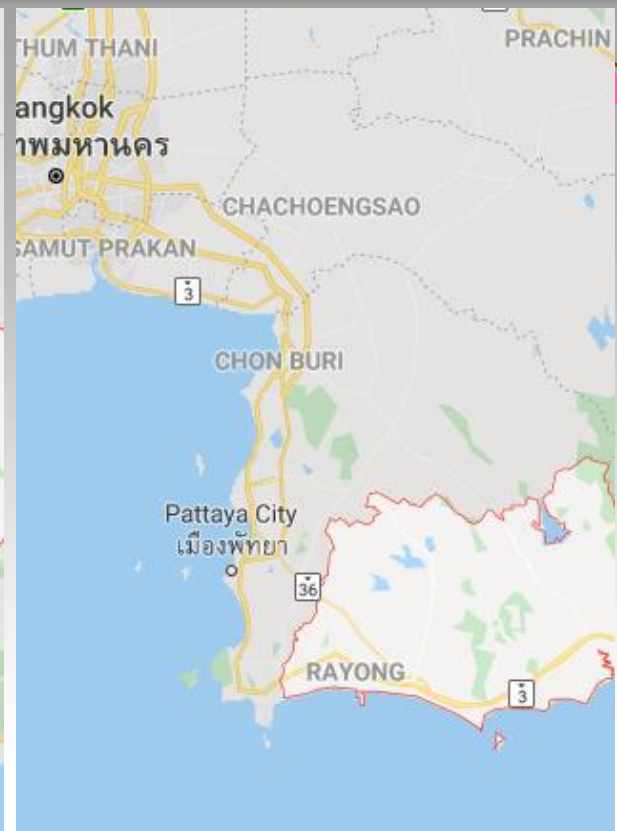
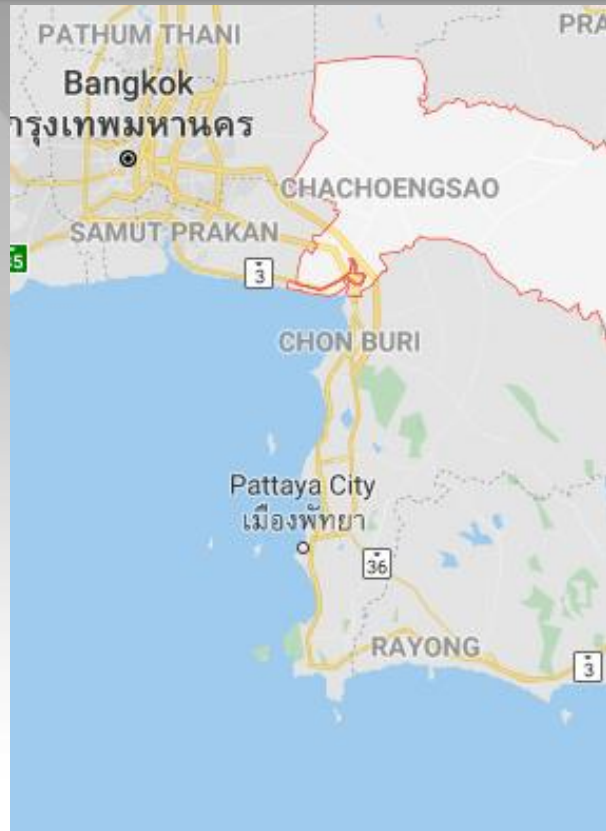


# Automation Tech



## IoT and smart manufacturing

- Supply chain Management
- Operation Efficiency
- Predictive Maintenance
- Inventory Optimization

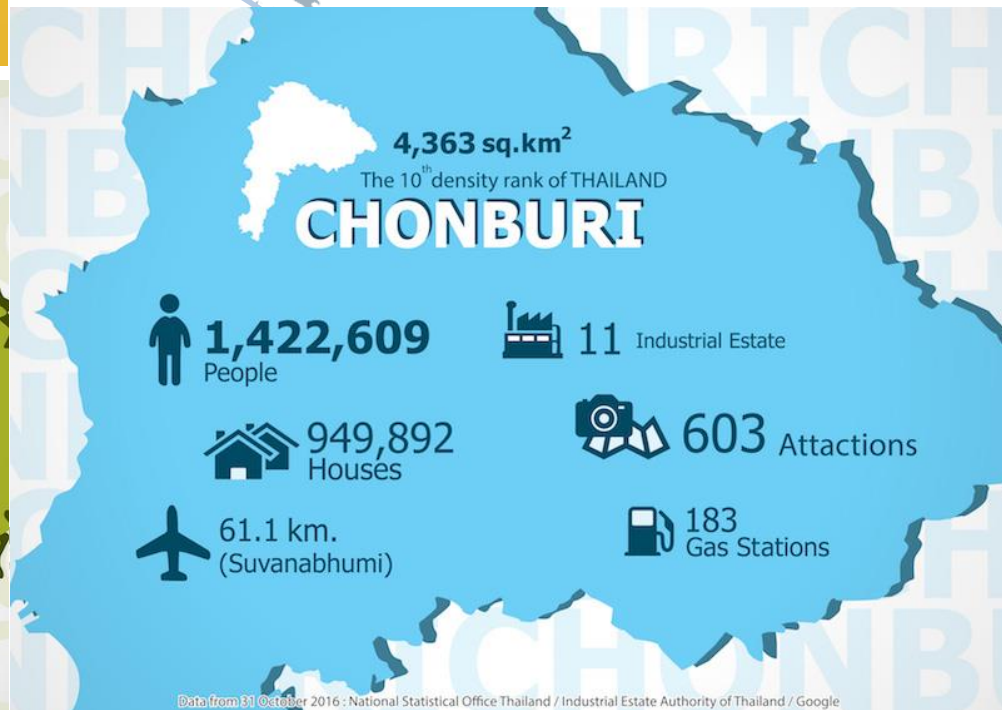


# Eastern Economic Corridor

# Development Plan 'Thailand 4.0'

- Growth Engine of Thailand
- ASEAN Center of Economy
- World-Class Economic Zone

[www.eeco.or.th](http://www.eeco.or.th)



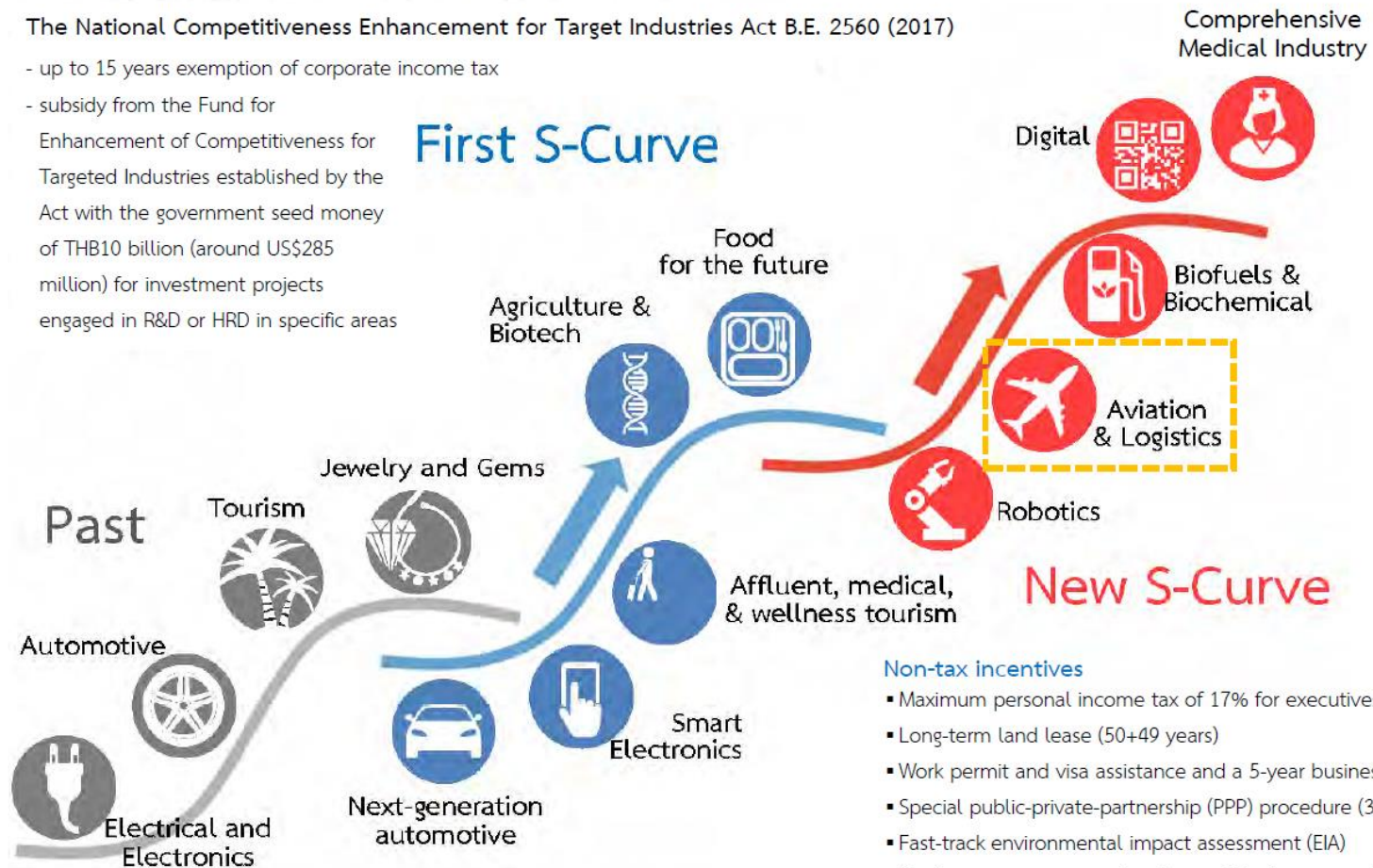
# First S-Curve vs. New S-Curve

Attractive tax and non-tax incentives are provided to investment in New S-Curve business in EEC.

The National Competitiveness Enhancement for Target Industries Act B.E. 2560 (2017)

- up to 15 years exemption of corporate income tax
- subsidy from the Fund for

Enhancement of Competitiveness for Targeted Industries established by the Act with the government seed money of THB10 billion (around US\$285 million) for investment projects engaged in R&D or HRD in specific areas



## Non-tax incentives

- Maximum personal income tax of 17% for executives and experts
- Long-term land lease (50+49 years)
- Work permit and visa assistance and a 5-year business visa
- Special public-private-partnership (PPP) procedure (3-month approval)
- Fast-track environmental impact assessment (EIA)
- Foreign currency account and use of foreign currencies without exchanging into Thai baht

Source: Krungsri Exclusive Economic and Investment Outlook 2018










## EEC: Focused project and investment plan in 5 years

### EASTERN ECONOMIC CORRIDOR (EEC)

#### 4 Core Areas 15 Projects & 5 High Priority Projects

- |    |   |
|----|---|
| 1  | Aerotropolis: U-Tapao International Airport     |
| 2  | High speed train linking 3 airports             |
| 3  | Laem Chabang Port Phase 3                       |
| 4  | Map Ta Phut Port Phase 3                        |
| 5  | Sattahip Commercial Port                        |
| 6  | Dual Track Rails linking 3 seaports             |
| 7  | Highways & Motorway                             |
| 8  | Next generation Automotive (EV/AV)              |
| 9  | Aviation Industry, Robotics & Smart Electronics |
| 10 | Advanced Petrochemical & Bioeconomy             |
| 11 | Medical Hub                                     |
| 12 | Tourism   |
| 13 | Global Business Hub / Free Trade Zone           |
| 14 | New cities: Chachoengsao Pattaya Rayong         |
| 15 | Public Utilities                                |

#### 5 High Priority Projects +++

- |   |   |
|---|---|
|  Infrastructure    |  + EECi              |
|  Business/Industry |  EEC of Innovation   |
|  Tourism           |  + EECd              |
|  New Cities        |  EEC of Digital Park |
|   |  + Education         |

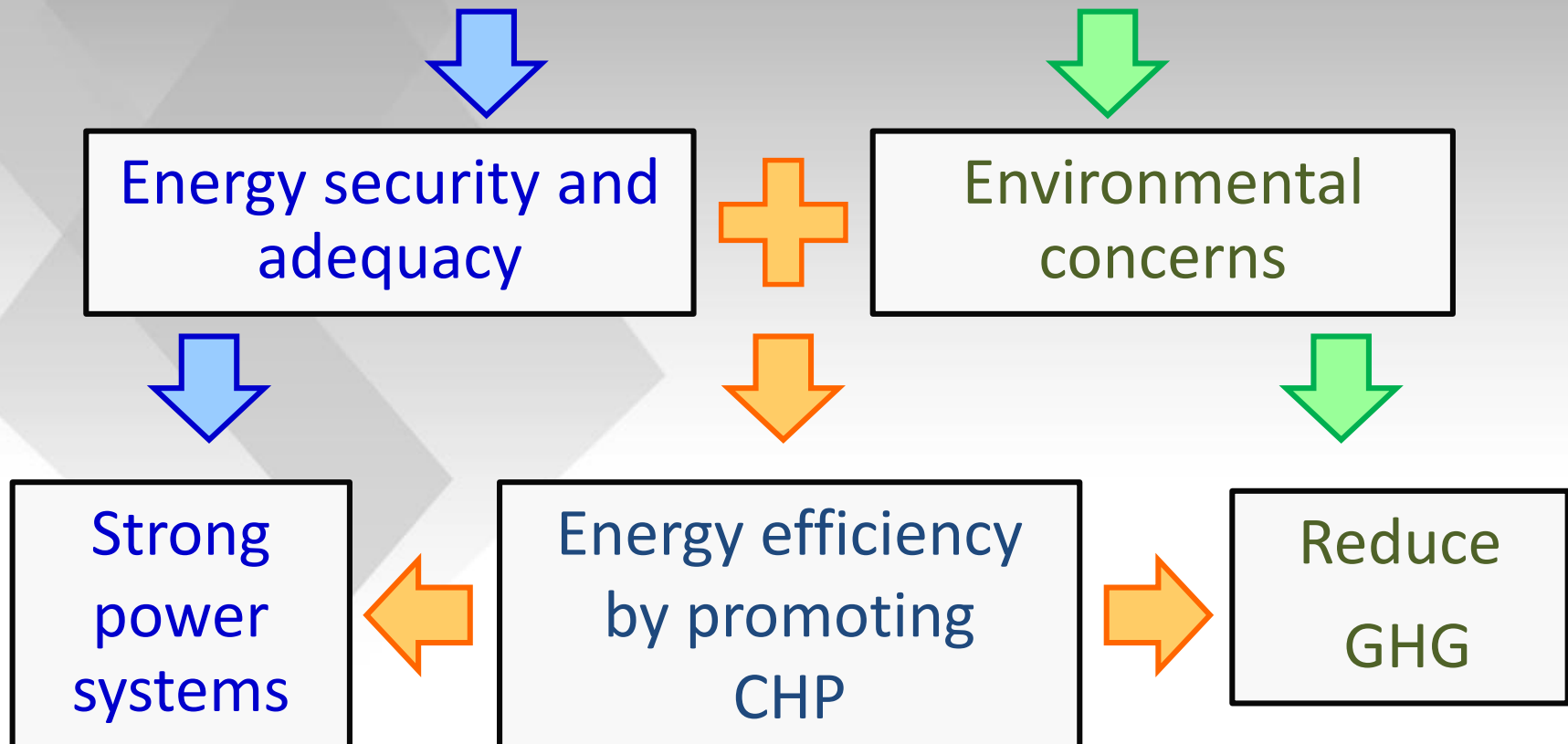




## Contents

- Industry 4.0 vs. Japan Society 5.0
- Thailand 4.0 and Eastern Economic Corridors
- **Research related to Energy Efficiency**
- IEC TC 65 Thailand National Committee
- Control Systems Society Thailand

# Thailand PDP 2018





# Key Energy Efficiency Policies

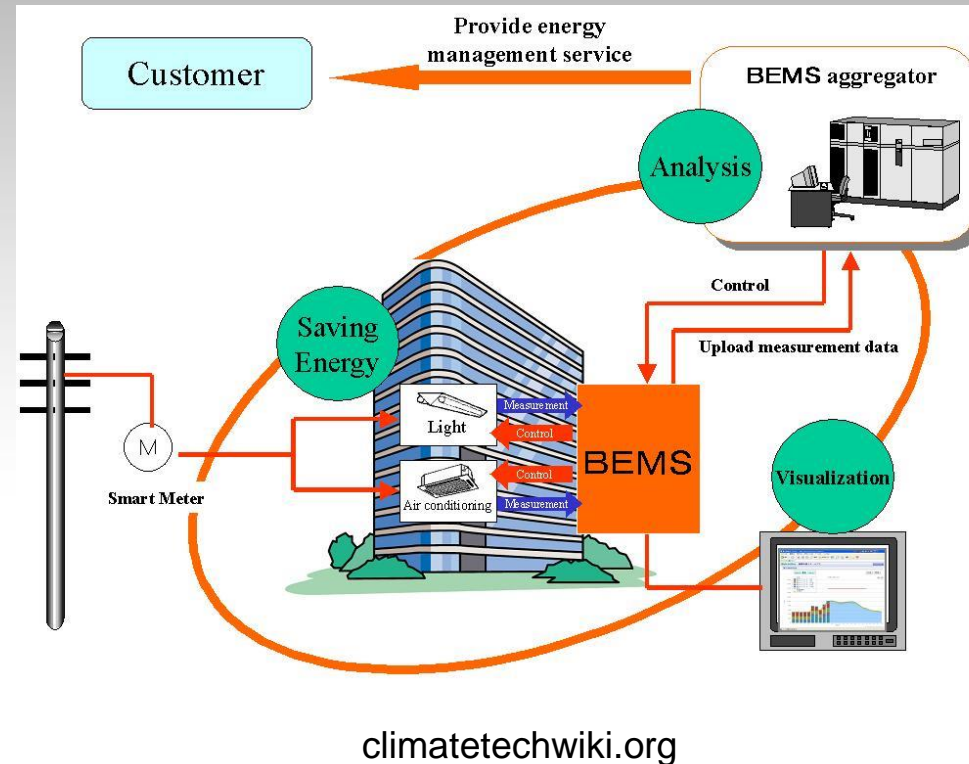
- In the industry sector, **mandatory energy management programs for large energy users** are in place in Indonesia, Malaysia, Singapore, **Thailand** and Vietnam.
- Factories in Thailand with energy capacity over 1000 kilowatts (kW), or with annual consumption exceeding 20 terajoules (TJ), are **required to implement energy management programs** and to make progress reports available for external auditing.



# Building Energy Management System

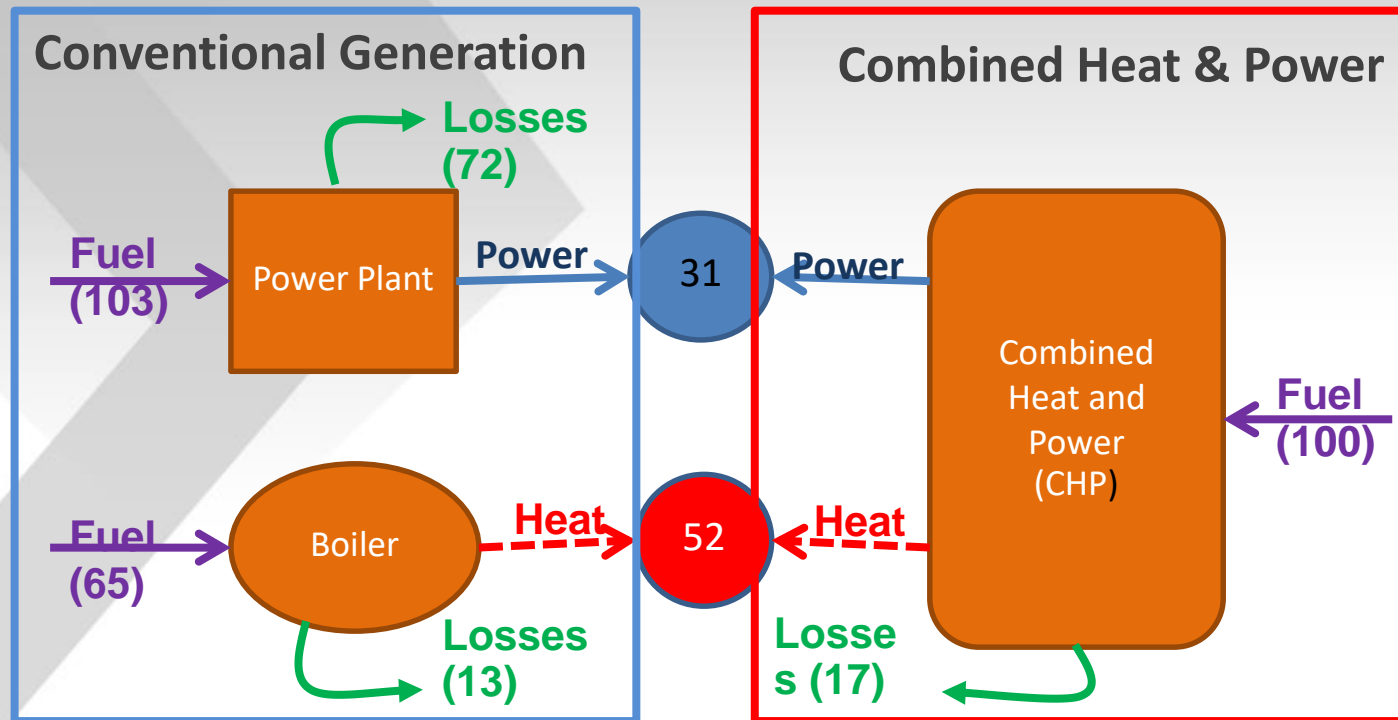
**BEMS** is a computer based control system for engineering services

- Manages and controls energy needs and supplies in buildings
- Monitors energy efficiency and safety.



# Combined Heat and Power System

**CHP** is simultaneous production of heat and power from a single source.



www.arb.ca.gov (Data for conventional generation and CHP comparison)



# Optimal Dispatch Strategy of Cogeneration with Thermal Energy Storage and Battery Energy Storage for Building Energy Management System

Kebsiri Manusilp and David Banjerdpongchai

"Analysis of Multi-objective Optimal Dispatch of Cogeneration with Thermal Energy Storage for Building Energy Management System," *Engineering Journal*, vol. 21, no. 5, pp. 67-79, September 2017.

"Optimal Dispatch Strategy of Cogeneration with Thermal Energy Storage for Building Energy Management System," *ECTI Trans. on Computer and Information Technology*, vol. 10, no. 2, pp. 156-166, November 2016.



# HVAC and Industrial Boilers

- HVAC controls temperature, humidity, and quality of air in buildings for comfort.
  - Decentralized air-conditioning
  - Centralized air-conditioning
- Industrial boilers produce additional steam to absorption chillers in CHP applications
  - Efficiency and CO<sub>2</sub> emissions depend on fuel types.

“Heating, Ventilation and Air Conditioning,” Carbon Trust, Oct. 2011.

# Energy Usage in Buildings

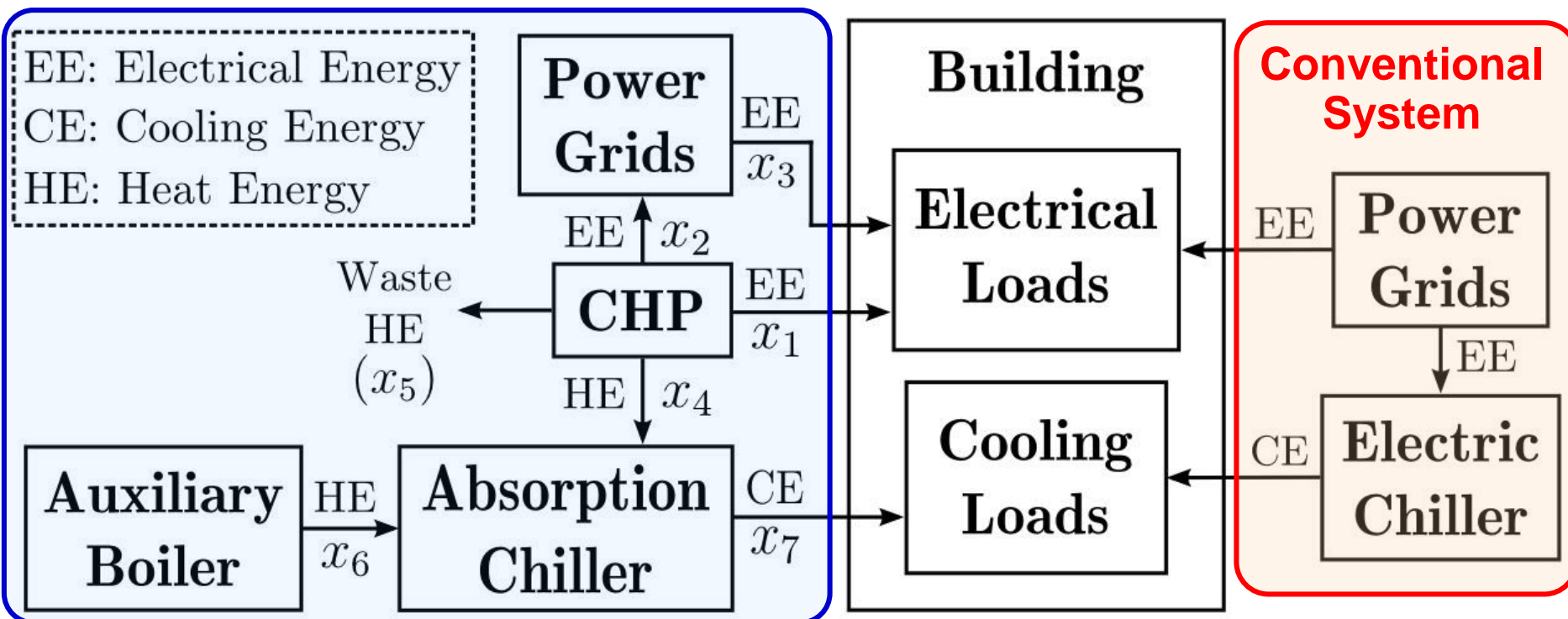
Building Types	HVAC (%)	Lighting (%)	Others (%)
Shopping mall	43%	25%	32%
Office	52%	20%	28%
Hospital	65%	17%	18%
Hotel	66%	20%	14%
Educational Institution	66%	15%	19%

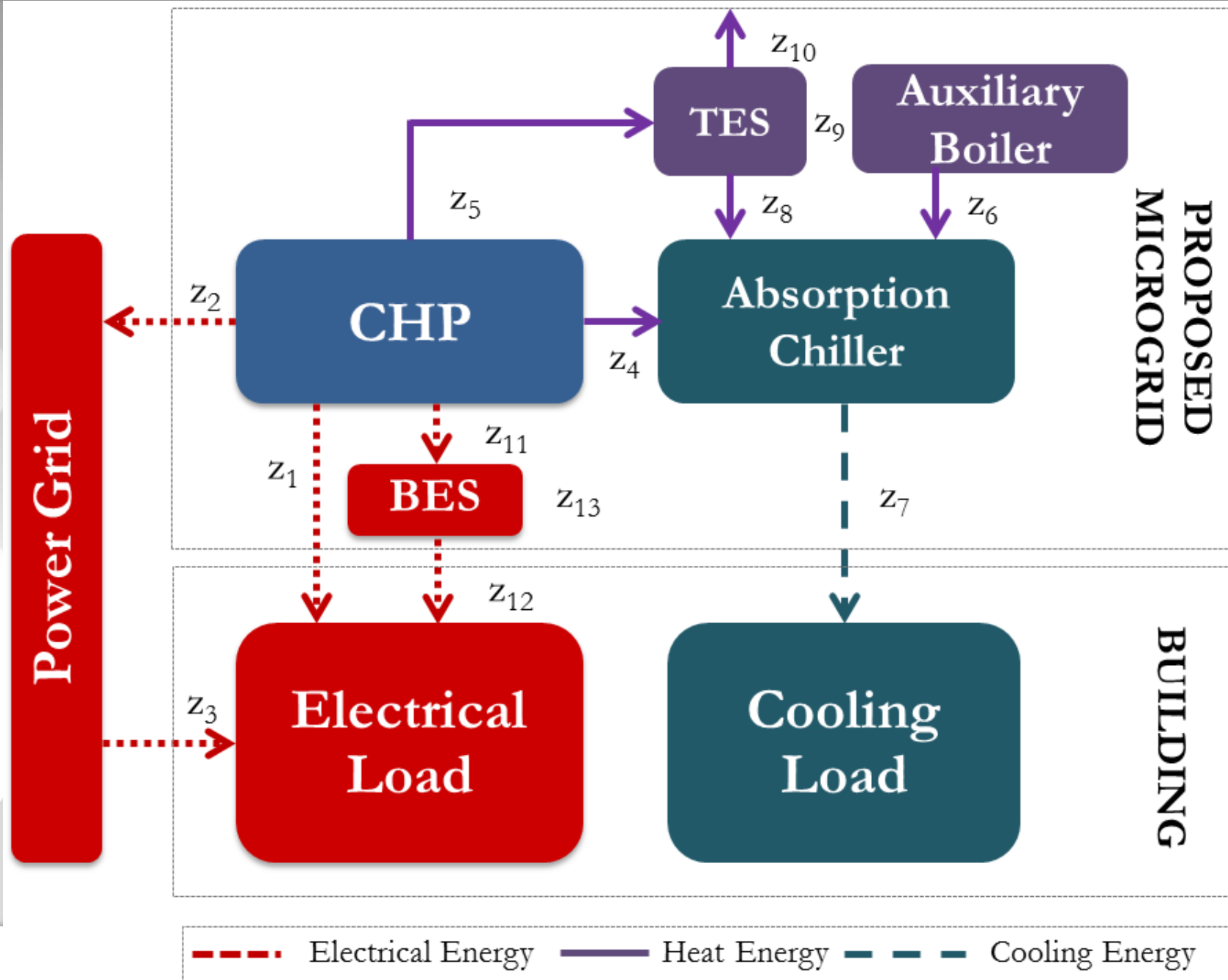


**HVAC is the largest proportion of energy use in buildings.**

# BEMS using CHP and boiler

- CHP and power grids supply EE to electrical loads.
- CHP and auxiliary boiler generate HE to absorption chiller.
- Absorption chiller produces CE to cooling loads.





# Problem formulation

## Economic optimal operation

Total Operating Cost (TOC)  
= Energy Costs (EC) +  
Demand Charge Cost (DCC)

**EC of CHP**

$$EC = \sum_{k=1}^{nxd} [C_{CHP}(z_{1,k} + z_{2,k} + z_{11,k}) - q_k z_{2,k} + p_k z_{3,k} + c_{AB} z_{6,k}]$$

**EE trading  
with grid**

**EC of  
AB**

$$DCC = \frac{d_{PG}}{\Delta t} \max_{h=1, \dots, nxd} x_{3,k} \quad \text{max power}$$

$c_{CHP}$  and  $c_{AB}$  depend on Fuel Price

## Environmental optimal operation

Total CO<sub>2</sub> Emission (TCOE)

**COE CHP**

$$TCOE(tCO_2) = \sum_{k=1}^{nxd} [EF_{CHP,CO_2}(z_{1,k} + z_{2,k} + z_{11,k}) + GEF x_{3,k} + \frac{EF_{AB,CO_2}}{\eta_{AB}} x_{6,k}]$$

**COE grid**

**COE AB**

$EF_{CHP,CO_2}$  and  $EF_{AB,CO_2}$  depend on Fuel Price





# Constraints of TES

## Constraint of Charge and Discharge rate (Hashemi, 2009)

HE charge to TES:  $\varepsilon(z_{5,k}) \leq R_{charge}$

HE discharge from TES:  $\frac{1}{\delta}(z_{8,k}) \leq R_{discharge}$

## Heat energy stores in TES up to time $k$ as equation:

$$Sto_k = init(1 - \mu)^k + \sum_{j=1}^k \left( (\varepsilon z_{5,j}) - \left( \frac{1}{\delta} z_{8,j} \right) \right) (1 - \mu)^{k-j+1}$$

$$S_{min} \leq Sto_k \leq S_{max}$$



# Constraints of BES

EE Charge and discharge constraints (Mazidi, 2014)

$$0 \leq z_{11,k} \leq d_{sc} \quad , \quad 0 \leq z_{12,k} \leq d_{sd}$$

BES state of charge limitations:

$$S_{\min} \leq z_{13,k} \leq S_{\max}$$

State of charge of BES ( $z_{13,k}$ ):

$$z_{13,k} - z_{13,k-1} - z_{11,k} \eta_c \eta_i + \frac{z_{12,k}}{\eta_d \eta_i} = 0$$

# BEMS for Large Shopping Mall

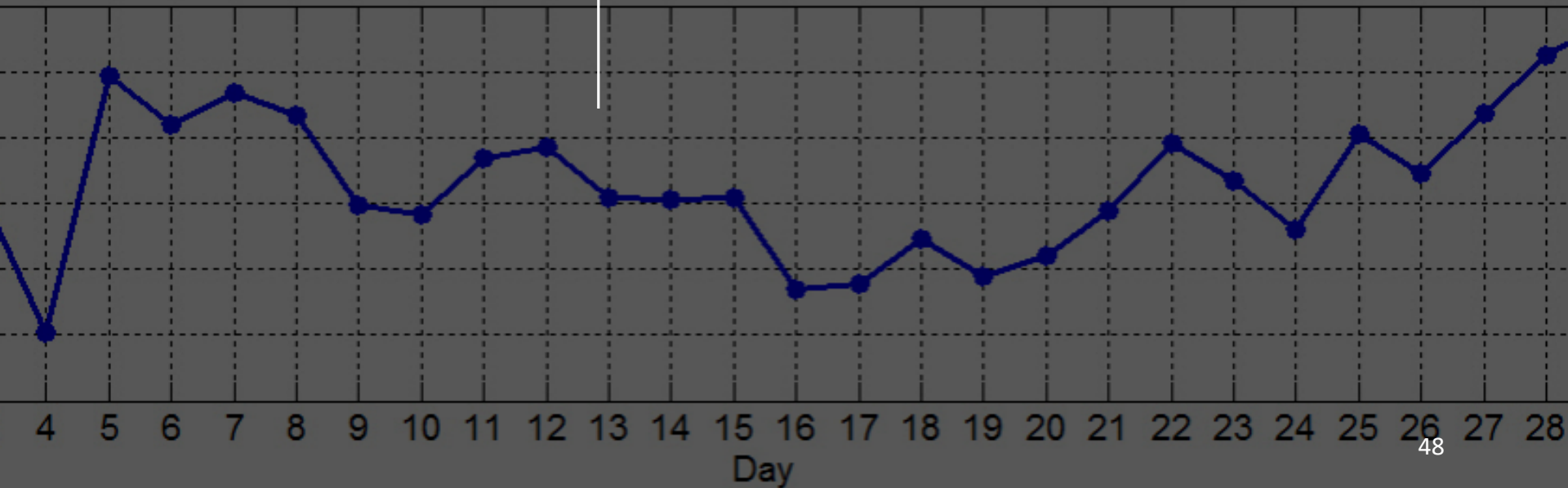
- BEMS is applied to a selected large shopping mall in Bangkok, Thailand.
- Actual electrical load profiles are modified to electrical and cooling load profiles to test optimal operations.
- Type and capacity of equipment are designed based on load profiles to find the best combination for BEMS.

# Electrical Load Profiles on June 2-29, 2012

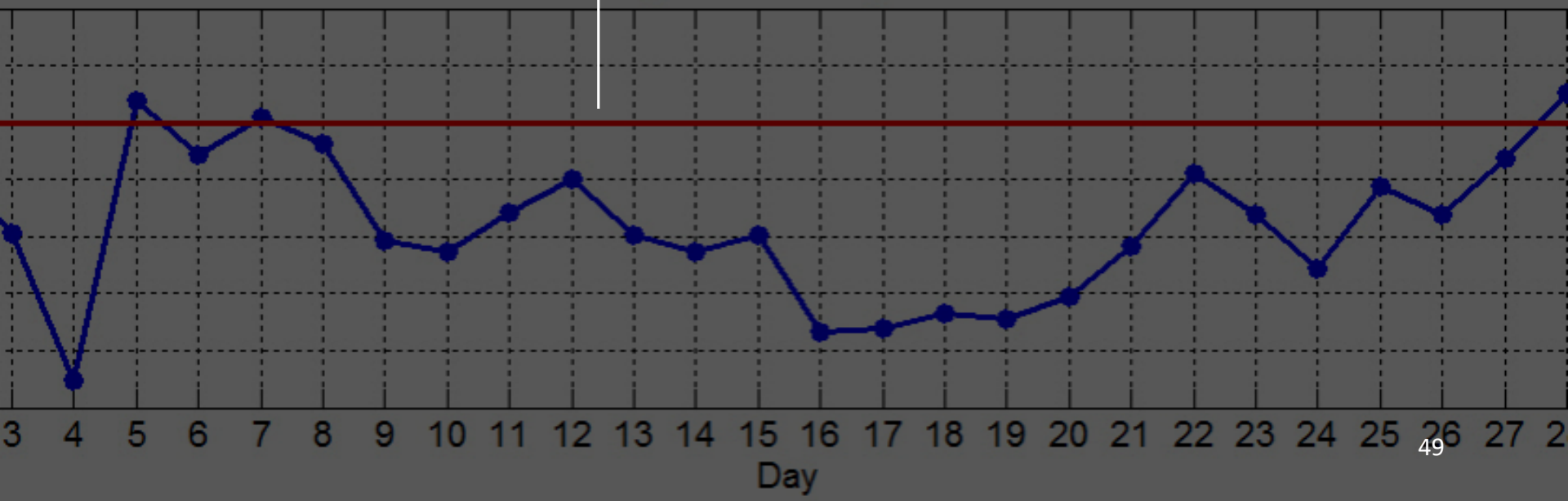
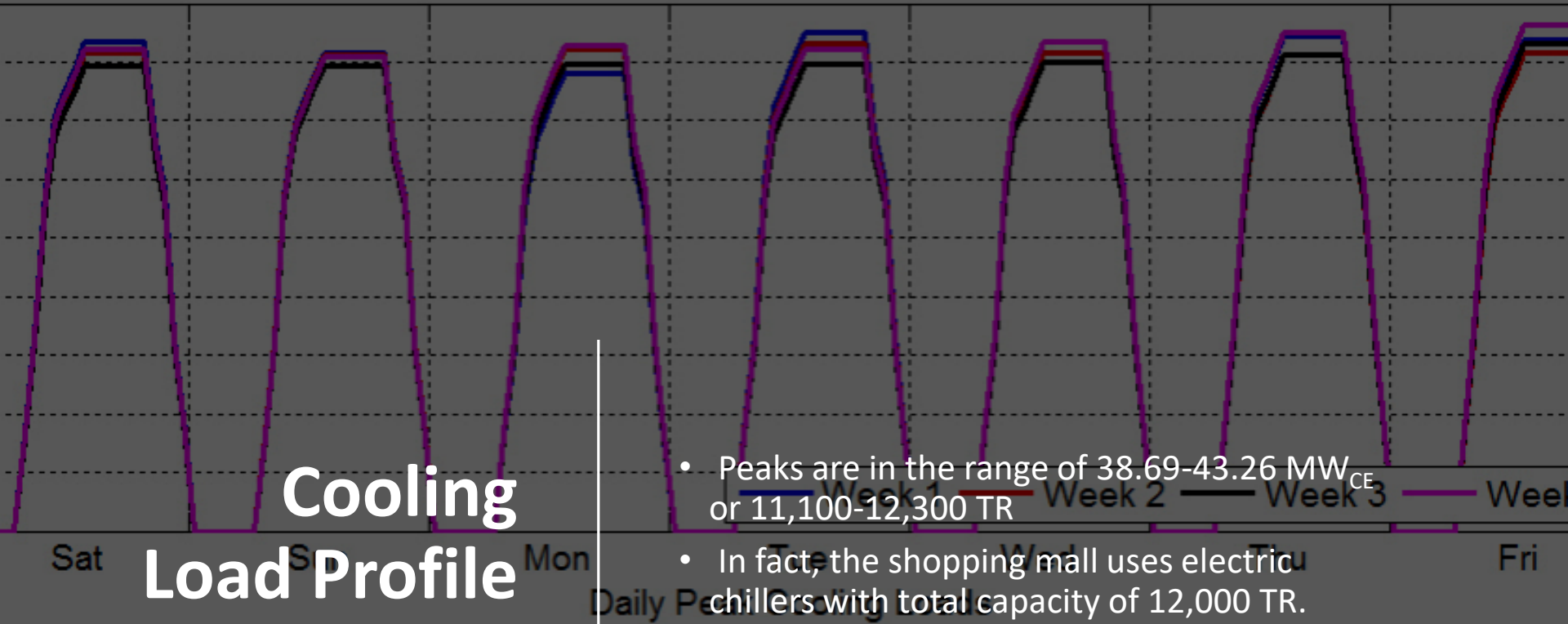


## Electrical Load Profile

- Daily pattern looks similar in shapes
- Different in peaks ranging from 22-24.5 MW



# Cooling Load Profiles on June 2-29, 2012



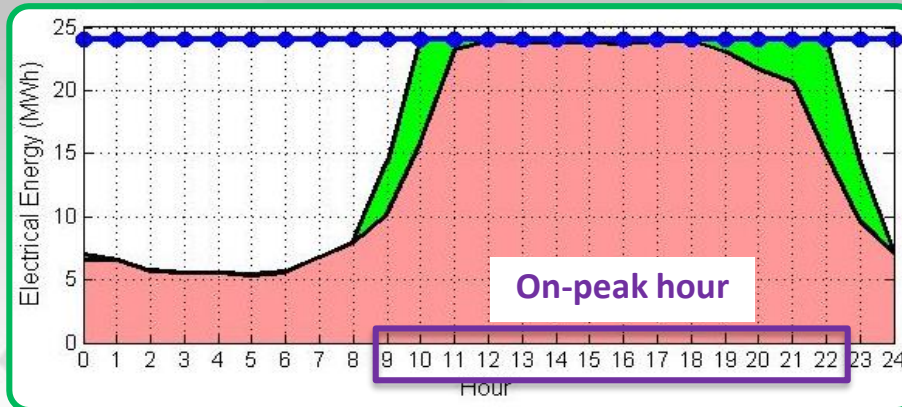


# Numerical Results

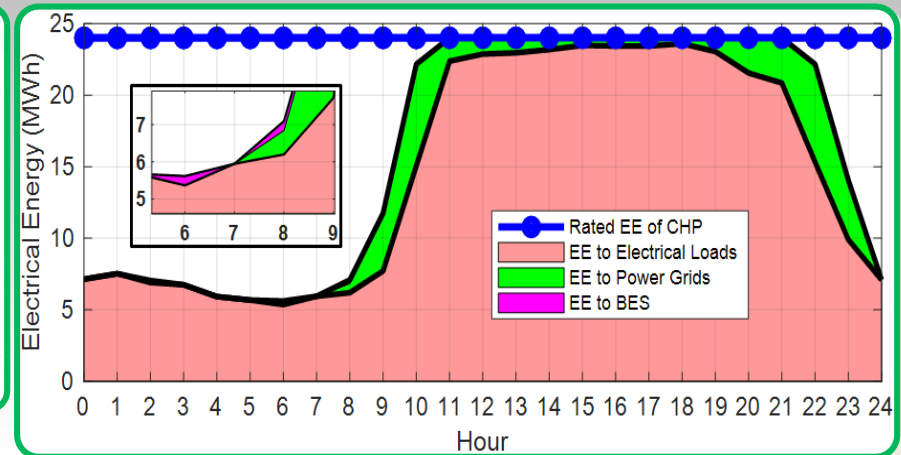
	Objective Functions	BEMS w/o TES, BES	BEMS with TES	BEMS with TES & BES
Economic Optimal Operation	Total Operating Cost (TOC) (THB)	27,034,927	25,905,948 ( -4.18% )	25,822,260 ( -4.49% )
	Total CO2 Emission (TCOE) (tCO <sub>2</sub> )	7,240	6,863 ( -5.21% )	6,873 ( -5.07% )
Environmental Optimal Operation	Total Operating Cost (TOC) (THB)	28,461,519	28,323,630 ( -0.48% )	27,737,884 ( -2.54% )
	Total CO2 Emission (TCOE) (tCO <sub>2</sub> )	7,006	6,569 ( -6.24% )	6,567 ( -6.27% )

# Optimal Operation of CHP

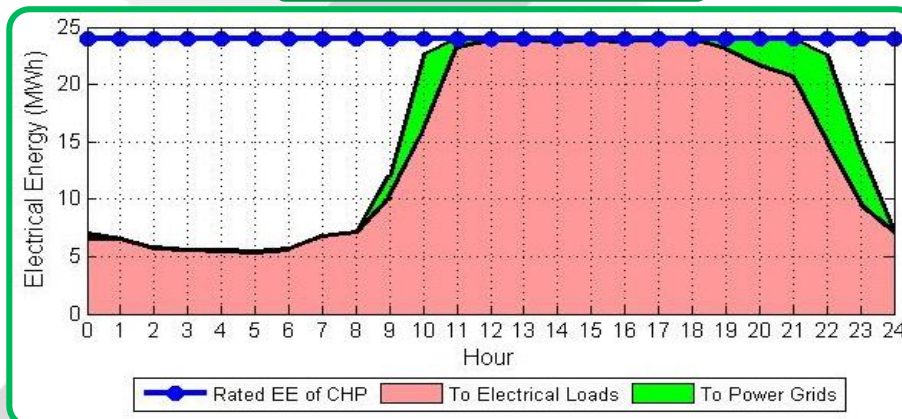
## BEMS



## BEMS with TES & BES



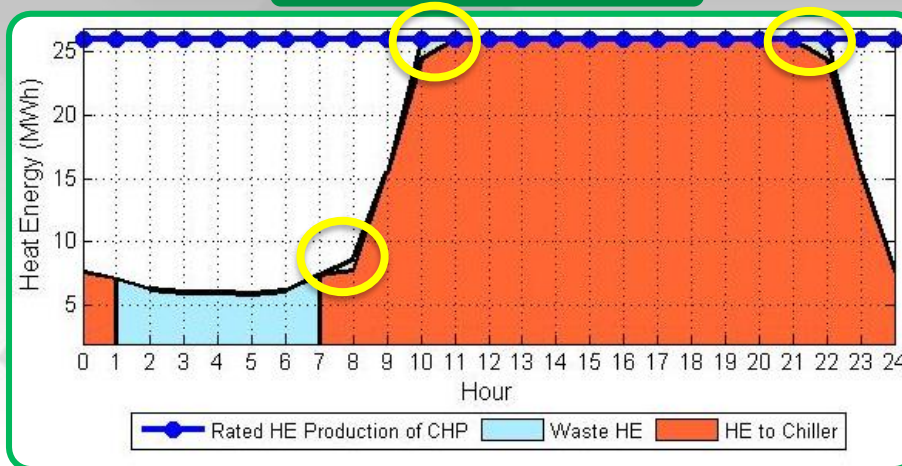
## BEMS with TES



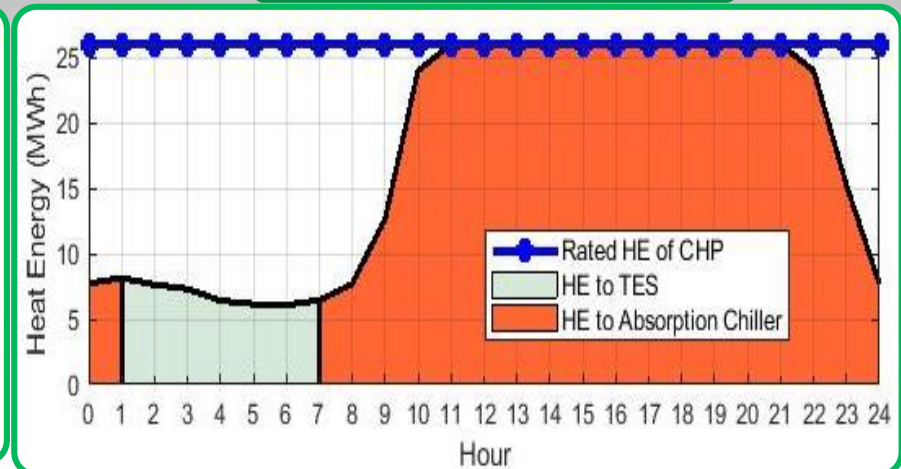
- Economic optimal operation tries to earn profit from selling EE, especially during on-peak time.
- BEMS with BES, there is excessive EE store in BES during off-peak hours to utilize in on-peak hours.

# Optimal Operation of CHP

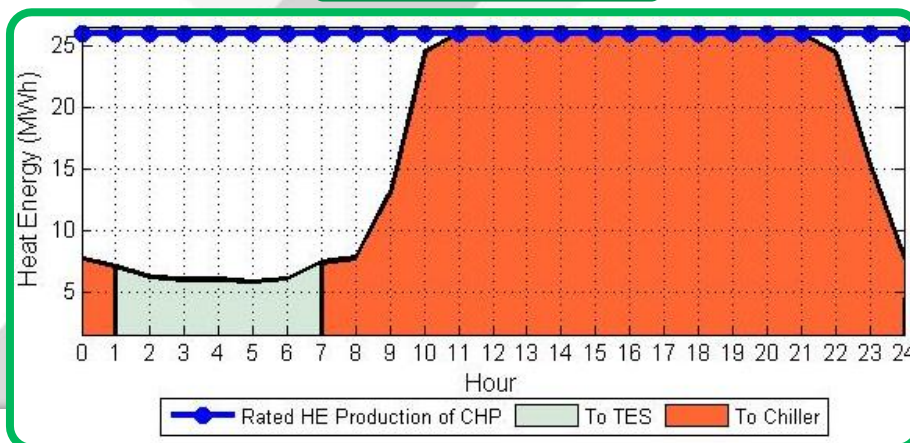
## BEMS



## BEMS with TES & BES



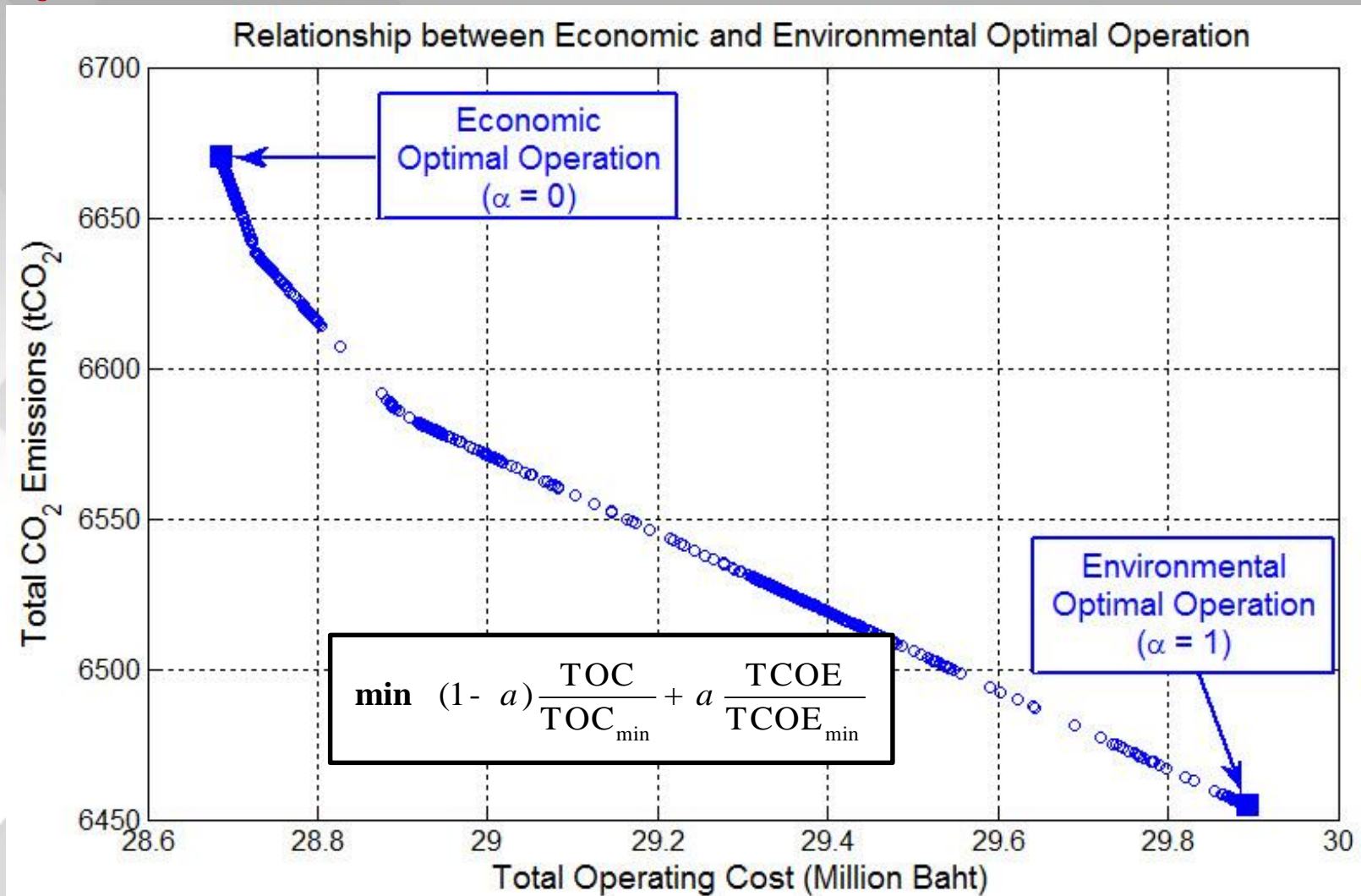
## BEMS with TES



- With TES, excessive HE from CHP operation charges to TES during 01.00-07.00.
- BEMS w BES provides the similar optimal operation of CHP for HE.



# Trade-off between Economic and Environmental Operation

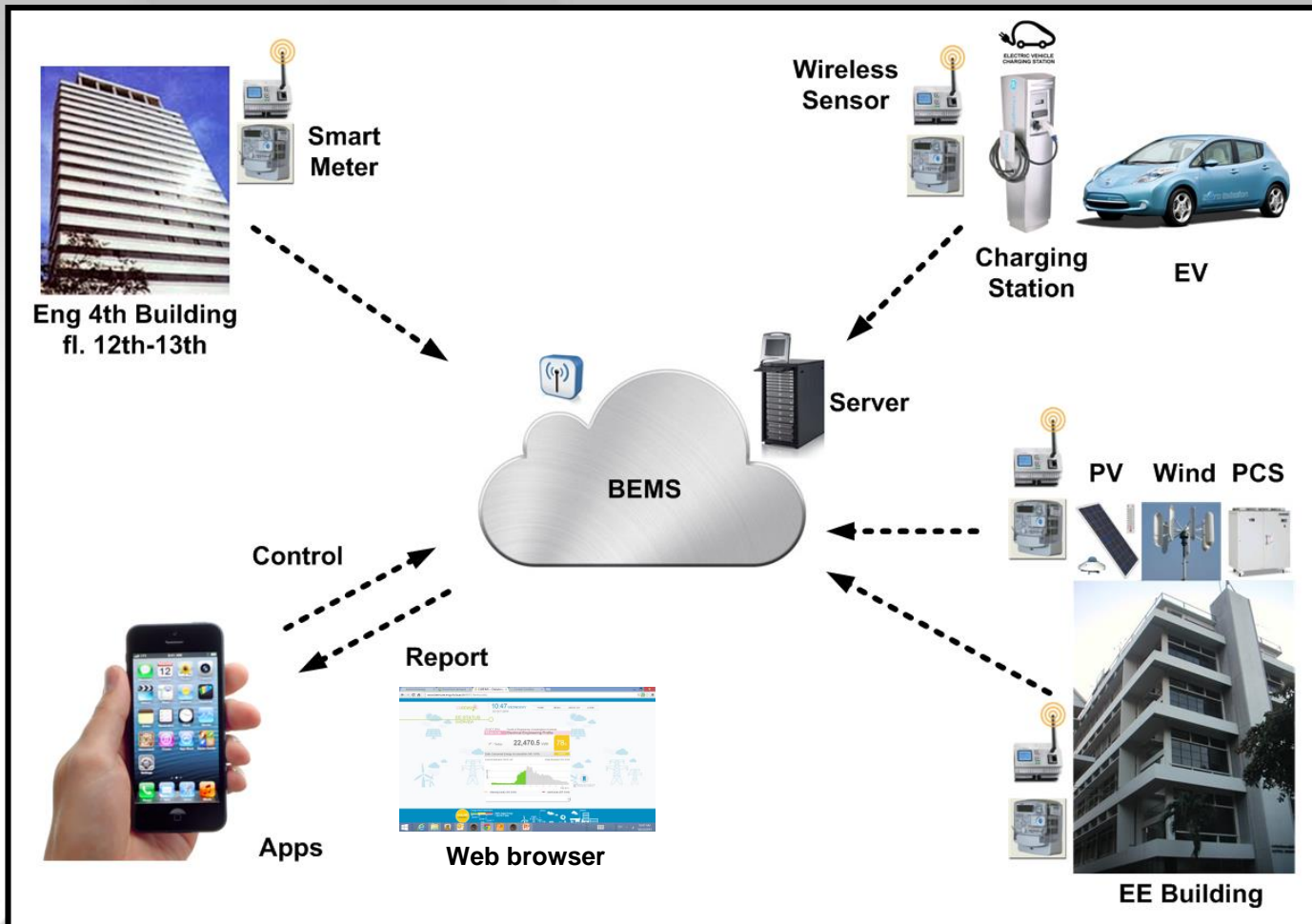


# Main results

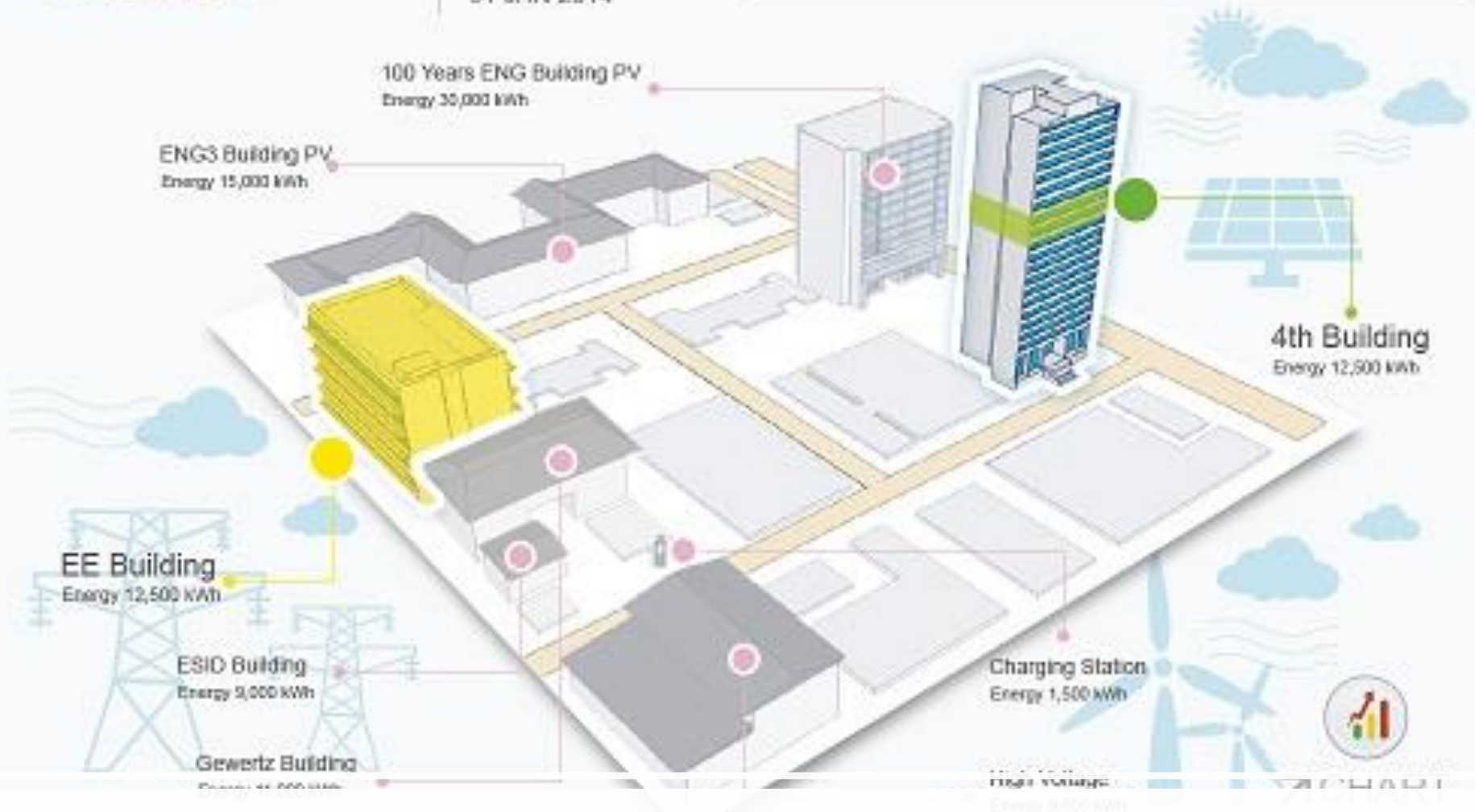
TES and BES can be efficiently incorporated with CHP and boiler to dispatch heat energy as part of BEMS.

BEMS with TES and BES can significantly reduce TOC and TCOE compared to that of BEMS w/o TES and BES.

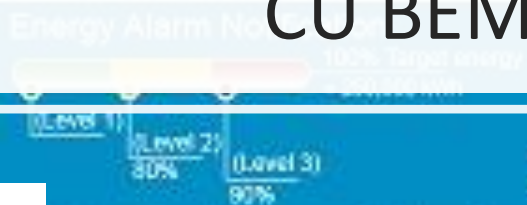
# Smart Building CU BEMS



- IEEE1888 Protocol
- Collaboration with University of Tokyo
- Smart Meters Designed by Chula EE
- Renewable Energy Showa Shell Sekiyu K.K. supported Copper Indium Selenide (CIS) -PV Module



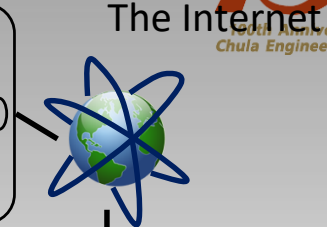
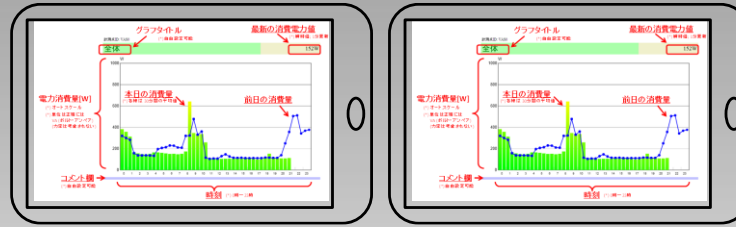
# CU BEMS EE Dept Bldg.





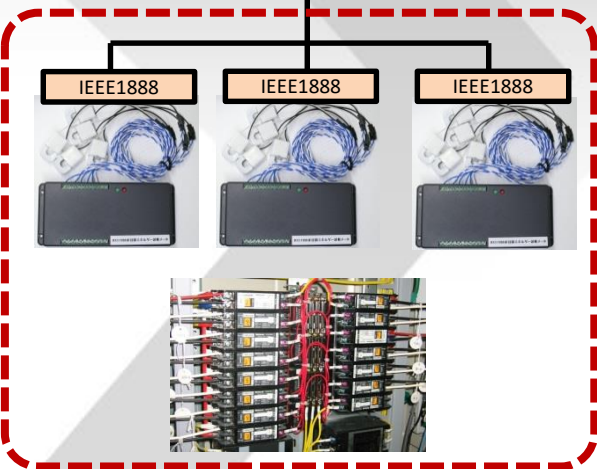
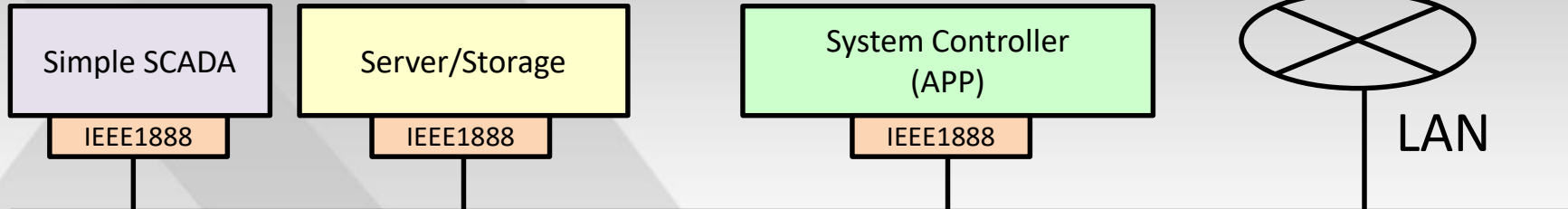
# Network Architecture

Facility Status and Control on your smartphones/Tablet

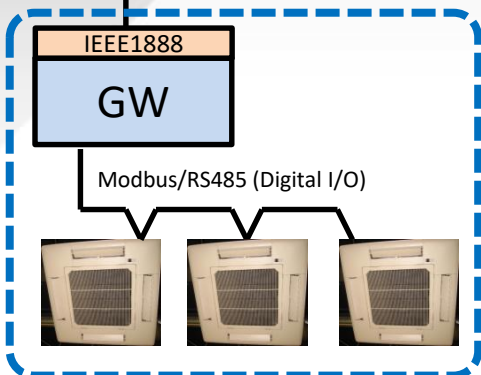


Installation by Chula with UT

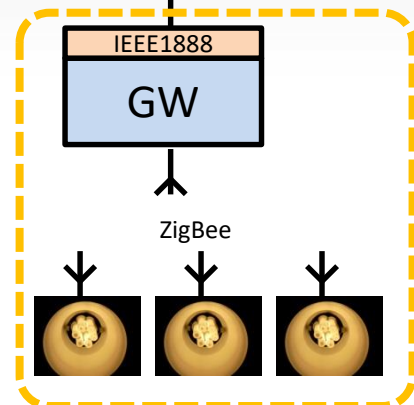
Designed by Chula/NDRS



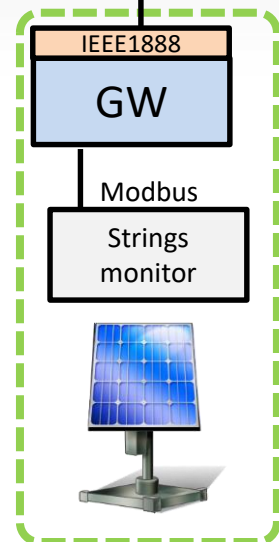
IEEE1888 Power Meters (50A,300A)  
@ Power Distribution Boards



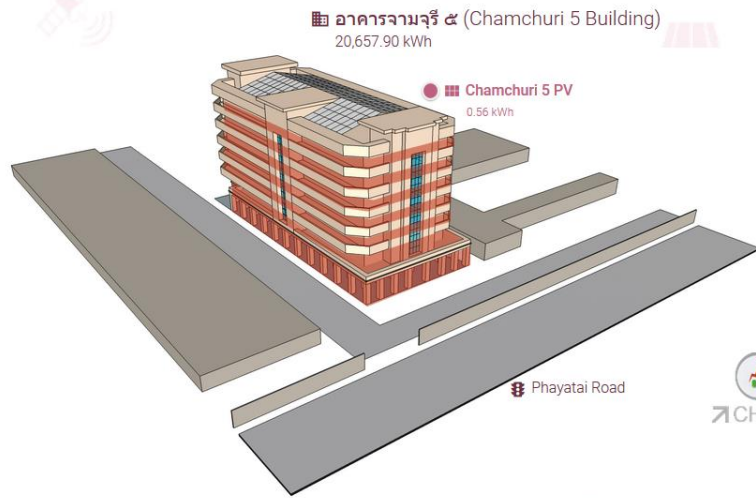
HVAC  
(Air Conditioner)



Sensors

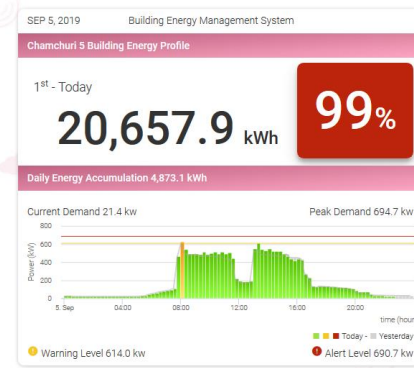


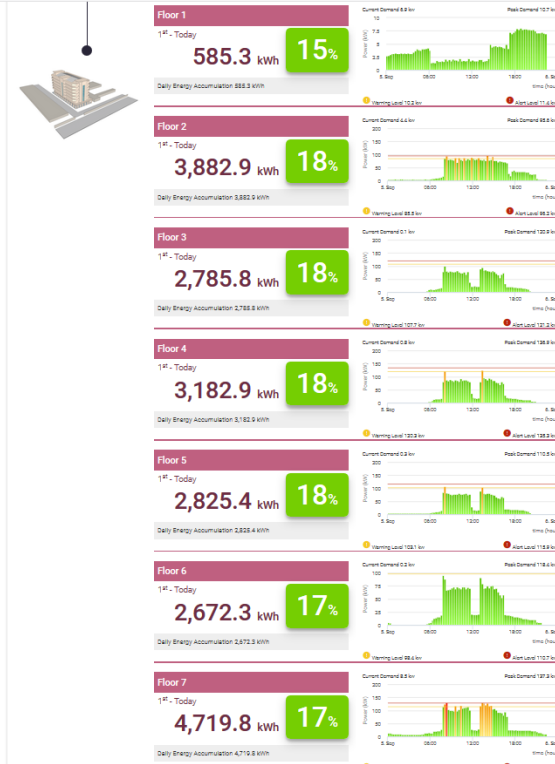
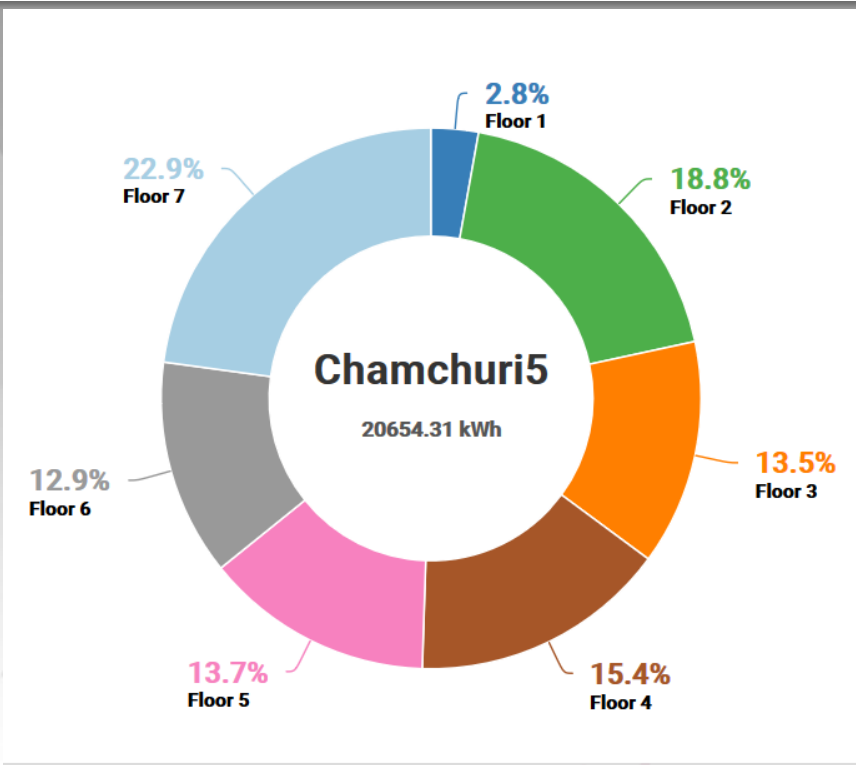
PV, Wind, Battery



<https://www.bems.chula.ac.th/web/cham5/#/> 50%

OVERVIEW





# CU BEMS Chamchuri 5

# CHAMCHURI 5 ENERGY AWARDS

## Current Ranking [1 Sept - Yesterday] ?



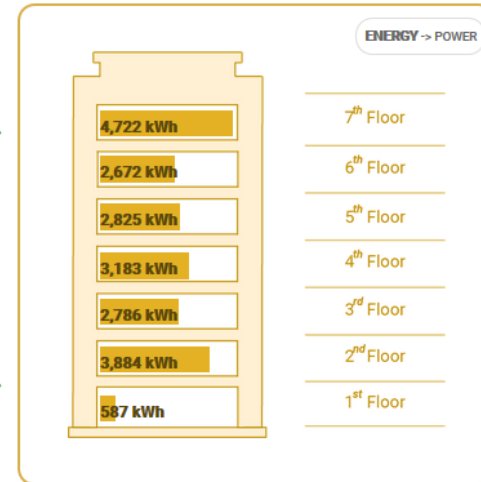
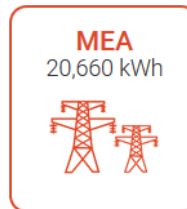
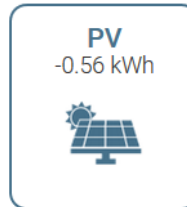
สำนักบริหารงานวิชาการ 2  
(19.34%)



นิตินทรนสาร คลังและจัดเก็บ  
พืชสด (17.48%)



สำนักบริหารงานวิจัย  
(10.55%)



## Best Energy Saving Award (August 2019) ?



สำนักบริหารงาน  
วิชาการ 2 (11.65%)



กลุ่มภารกิจ  
ราชการและลูกค้า  
(8.48%)



สายงานการเงิน  
(8.22%)

## Best Improvement Award (August 2019) ?



สำนักทะเบียนและ  
ประมวลผล (15.26%)



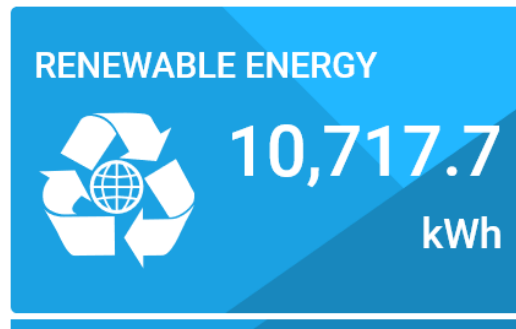
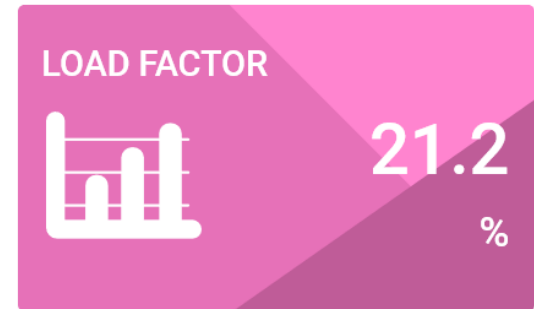
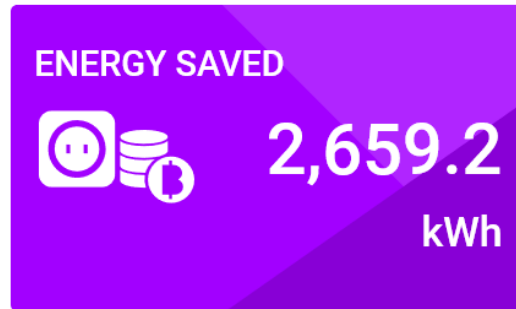
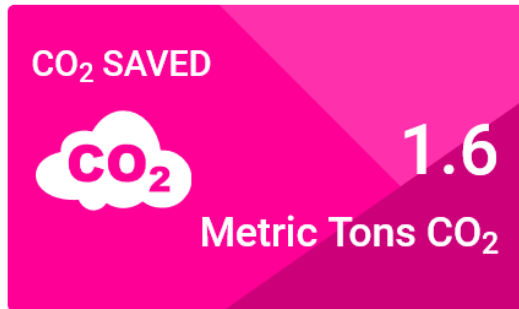
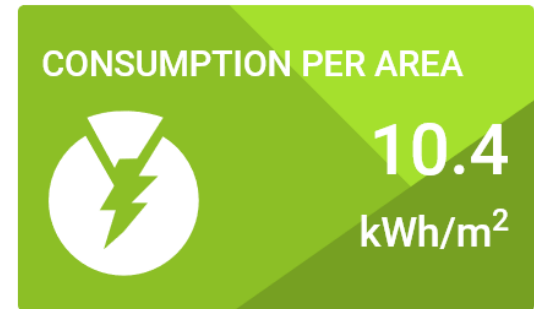
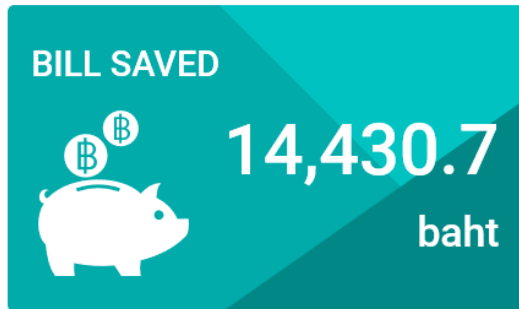
กลุ่มภารกิจ  
ราชการและลูกค้า  
(12.67%)



ฝ่ายวางแผน ออก  
แบบและสารสนเทศ  
ระบบกายภาพ  
(11.95%)



HEALTH PAD of August 2019



# Performance Assessment of Solar Energy Generation Using Artificial Intelligence

---

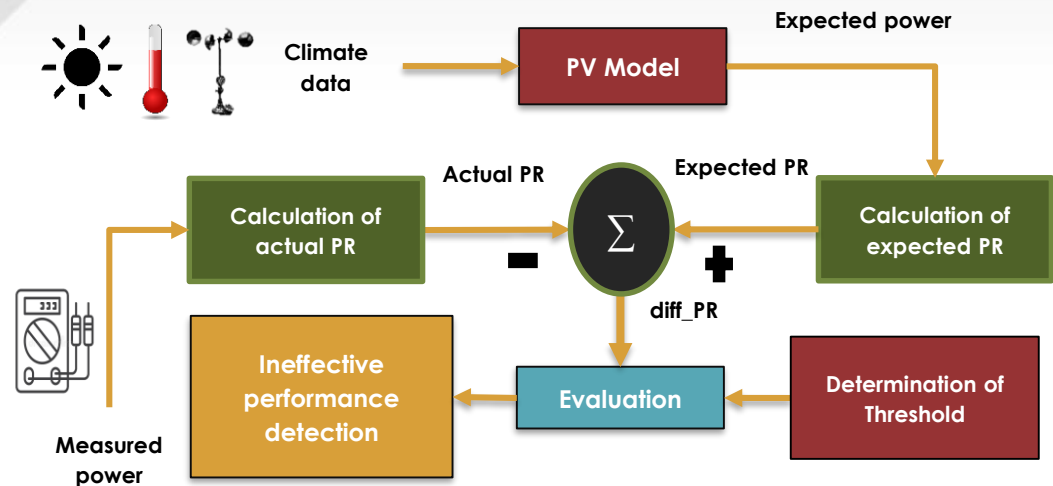
Janenarong Klomklao and David  
Banjerdpognchai

## Objectives

- To develop a methodology in order to assess performance of photovoltaic (PV) systems
- To investigate the effect of state-of-day (rainy and non-rainy day) on causing ineffective performance.



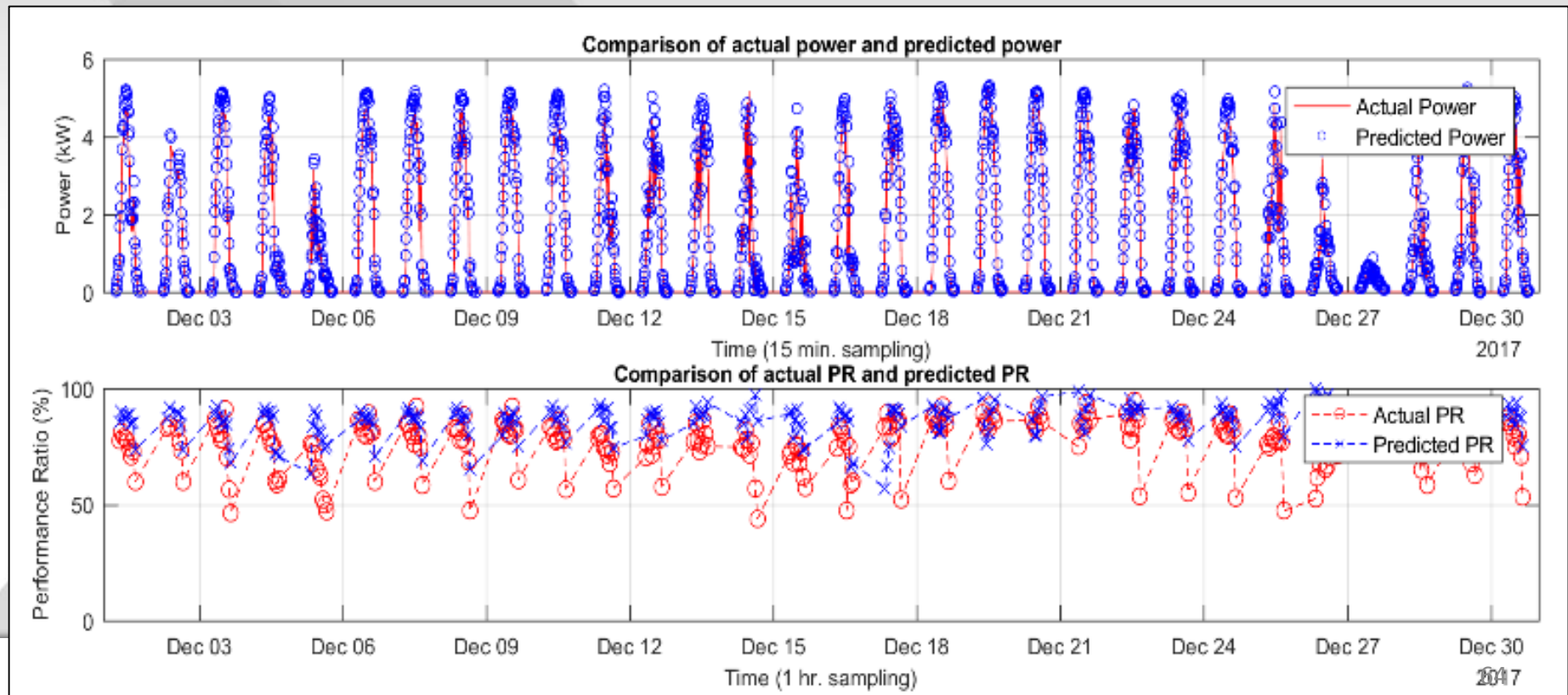
## Data Acquisition & Preprocessing



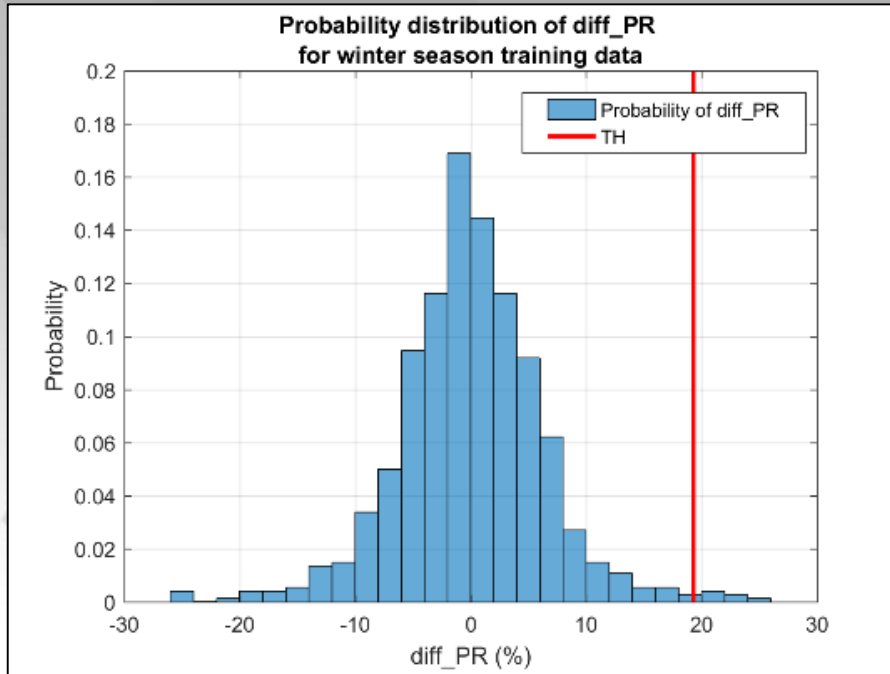
# 1. Modelling power generation with Neural Network



Season	Winter	Summer	Rainy
RMSE (kW)	0.3019	0.2253	0.2014
R-squared	0.9700	0.9777	0.9851



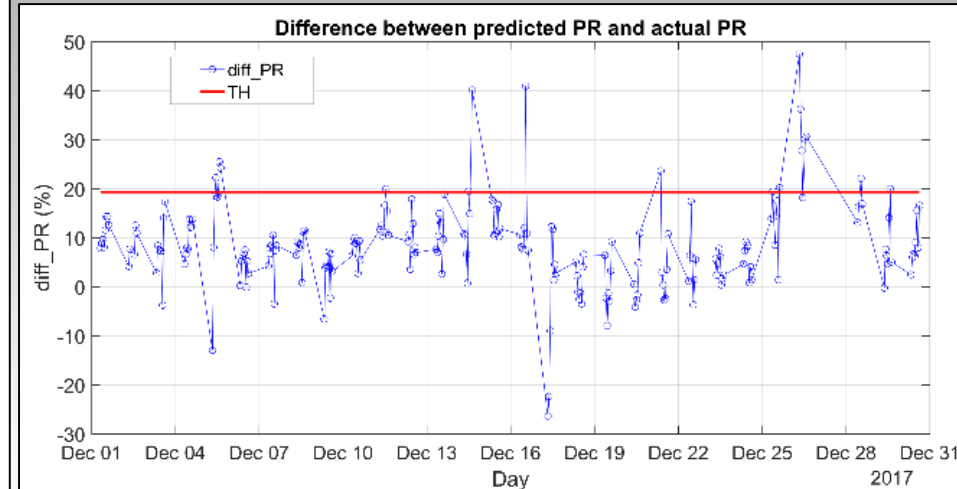
## 2. Determination of the threshold



$$P(\text{diff\_PR} < \text{TH}) = 0.99$$

Season	Winter	Summer	Rainy
Threshold	19.28%	22.20%	19.03%

## 3. Evaluation on the effect of state-of-day



Probability	Winter	Summer	Rainy
$P(\text{diff\_PR} > \text{TH})$	7.87%	0.49%	3.70%
$P(\text{rainy}   \text{diff\_PR} > \text{TH})$	64.71%	100.00%	10.00%
$P(\text{non-rainy}   \text{diff\_PR} < \text{TH})$	77.89%	65.02%	65.77%



# An Interoperable Building Energy Management System with IEEE1888 Open Protocol for Peak-Load Shaving

**Phanumat Saatwong and Surapong Suwankawin**

Power Electronic Research Laboratory

Smart Grid Research Unit

In Proceeding of 2019 IEEE PES Innovative Smart Grid Technologies ASIA, May 2019

# Peak-Load Shaving Application

## Peak-Load Shaving Application

Load Forecast

BESS Optimized Control

### Historical Load-Demand Data:

- 18-month load data is gathered (April 2015 – October 2016)
- Sampling rate of raw data => 1 min
- Averaged load demand => 15 min

### Load-Forecasting Model: SARIMA

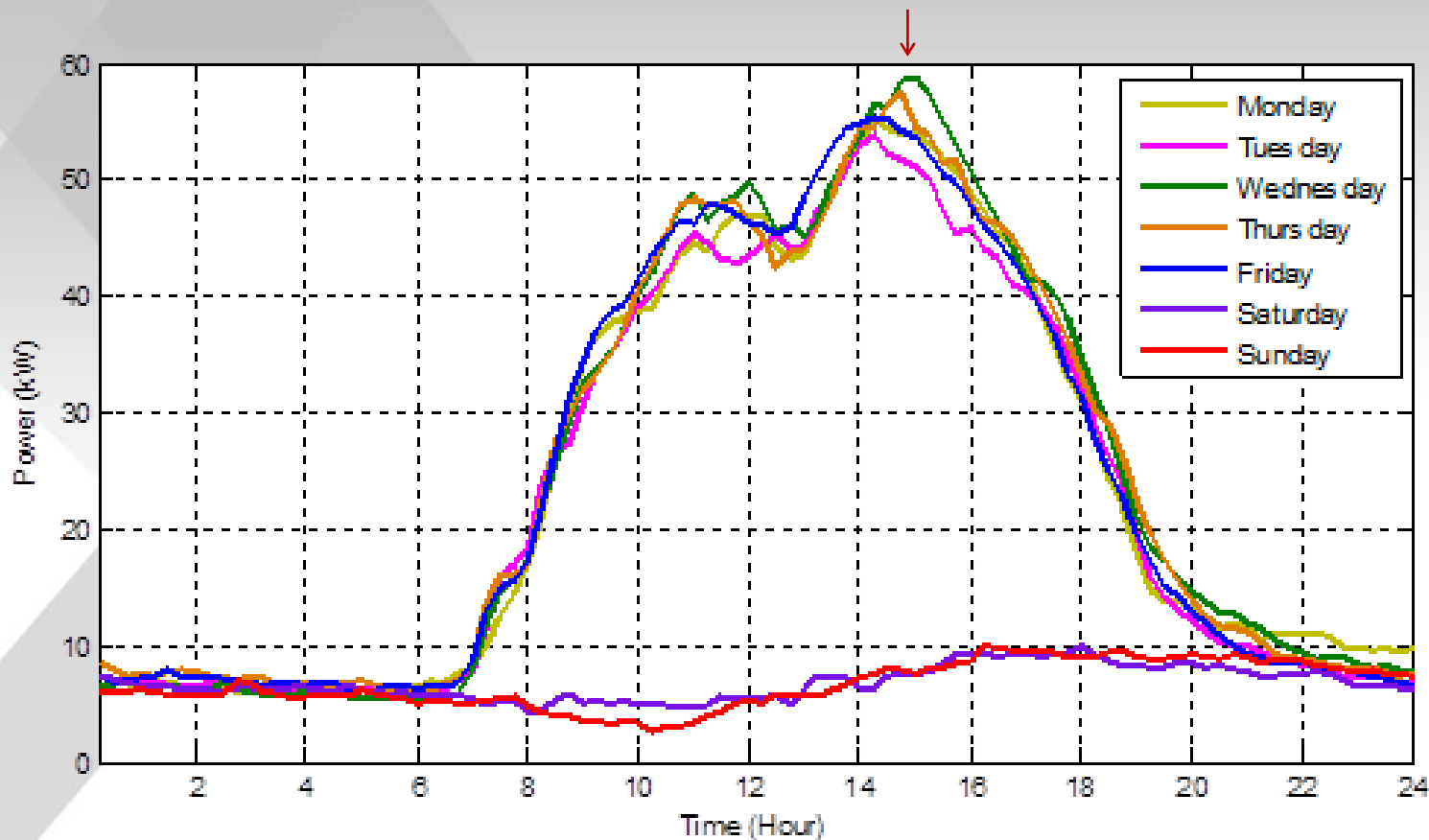
*(Seasonal Autoregressive Integrated Moving Average)*

### BESS Optimized Control:

- Load-forecasting model
- Constrained by power/energy rating of battery
- Power-usage application

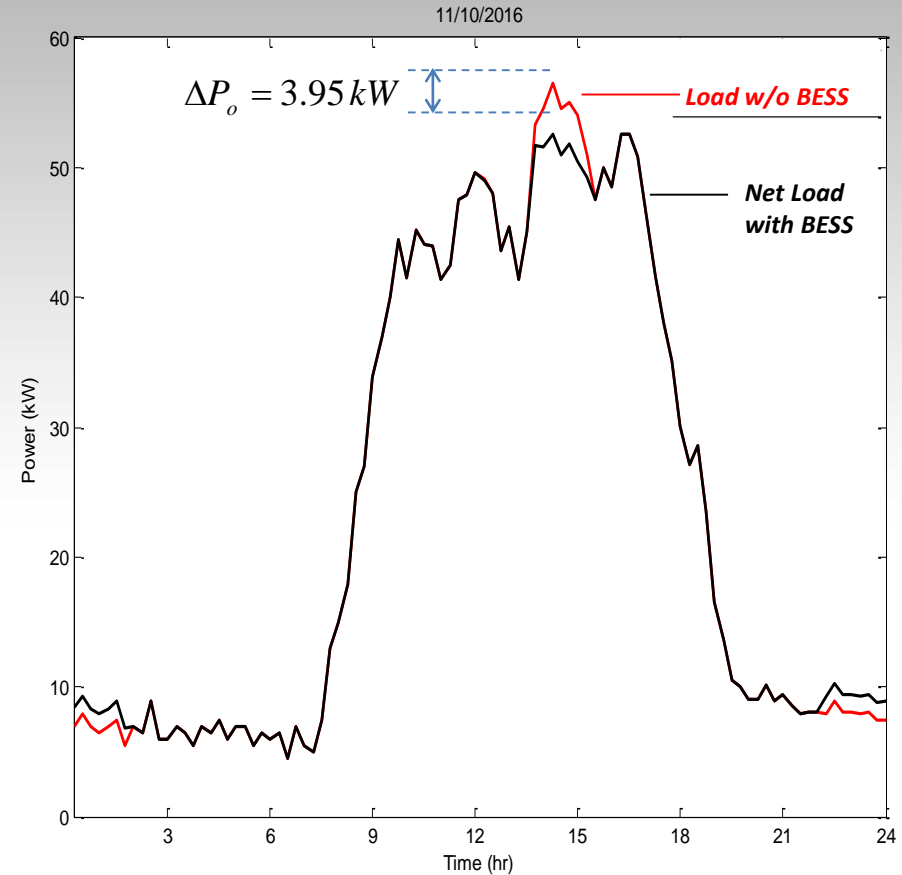
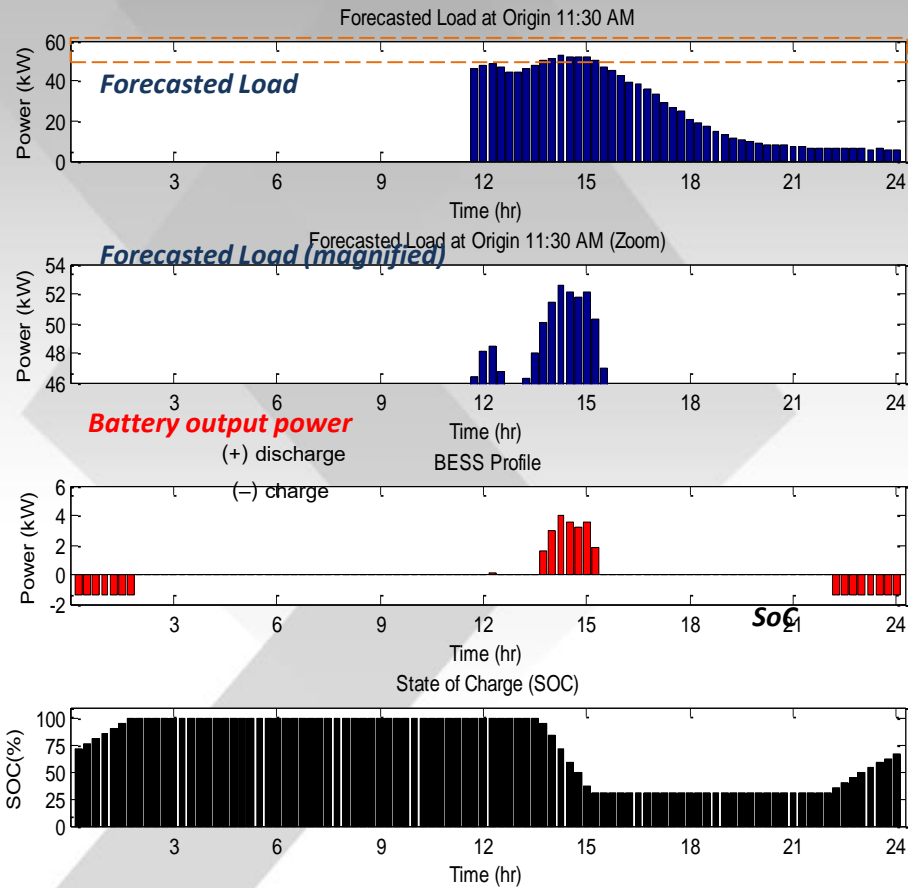
# Averaged-Load Profile in a Week

- Global peak load occurs around 2.00-3:00 pm
- Peak demand is about 50-60 kW
- Distributed packaged air-condition units are dominant loads.

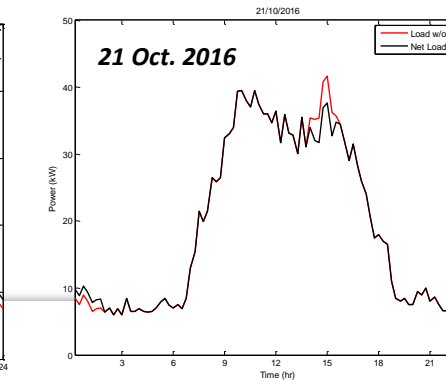
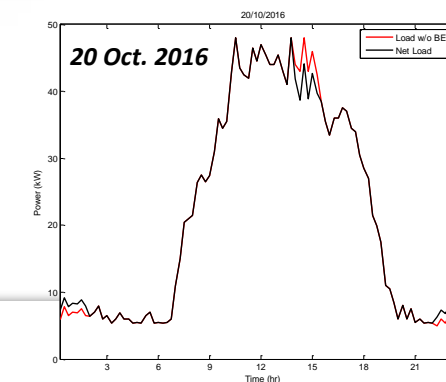
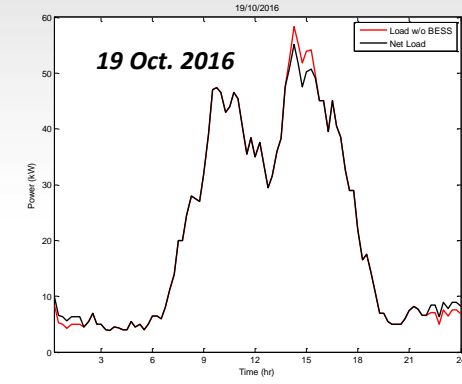
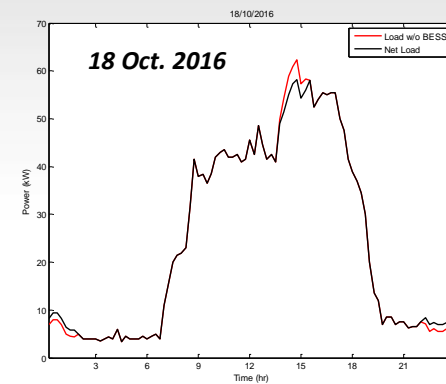
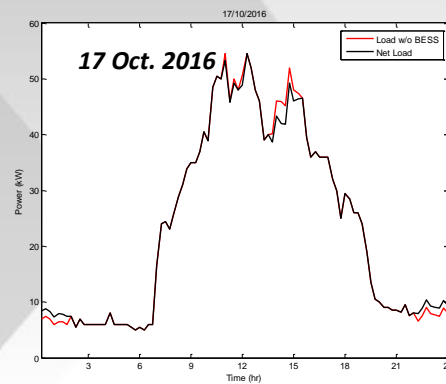
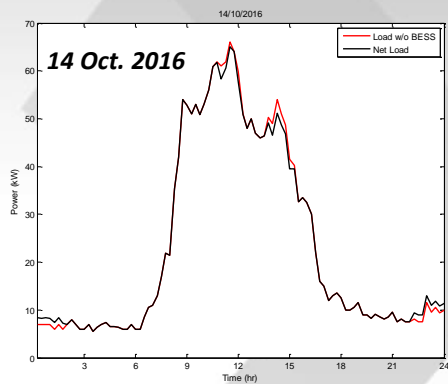
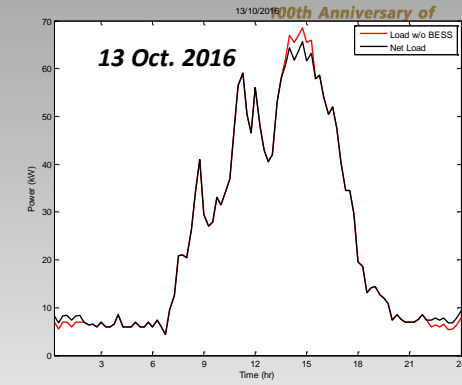
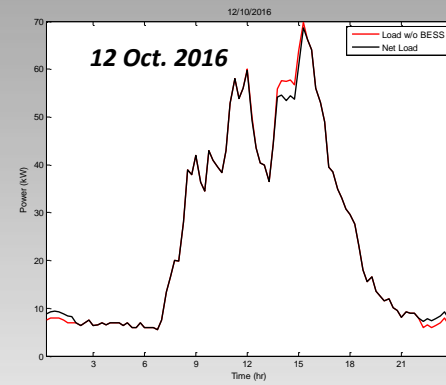
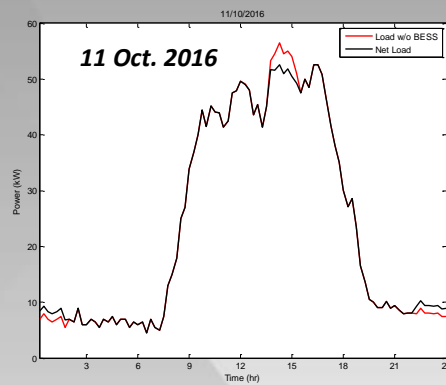
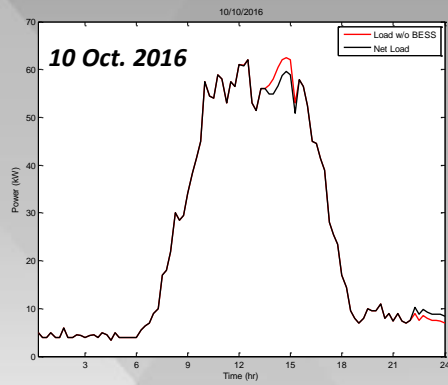




# Evaluation of CU-BEMS with Load-Shaving Application



# Evaluation of CU-BEMS with Load-Shaving Application





# Conclusion

- **Real-world BEMS** with peak-load shaving application is implemented.
- **Interoperability** among *data storage*, *peak-load shaving application* and *BESS* is conducted by **IEEE1888 open protocol**.
- **BESS optimized control** is based on the load-forecast model.
- Up to **7.5 % of peak demand** is shaved out .



## Contents

- Industry 4.0 vs. Japan Society 5.0
- Thailand 4.0 and Eastern Economic Corridors
- Research related to Energy Efficiency
- **IEC TC 65 Thailand National Committee**
- Control Systems Society Thailand



# IEC TC65 Industrial Process Measurement, Control and Automation Thailand National Committee

Standards Division

Thai Industrial Standards Institute

Ministry of Industry

Acknowledgements:

Associate Prof. Sawai Pongswatd, King Mongkut's Institute of Technology Ladkrabang  
Srinakorn Nontanakorn, Azbil (Thailand)  
Puttipong Kongcharoen, TISI, Ministry of Industry

## IEC TC65 Structure



**TC65**

**Advisory Group**

**Product Safety Requirements**

**Energy Efficiency & FEMS**

**Digital Factory**

**SC65A**

System Aspect

EMC/EMF

Functional Safety

Magmt. of Alarms

Cont. System Model

**SC65B**

Devices & Process Analysis

Measuring Devices

- Flow/Temperature
- Pressure/Level
- Valves

PLC

Process Analytics

**SC65C**

Industrial Networks

Fieldbus & Safety

Real-Time Ethernet

Wireless Networks

**SC65E**

Devices & Integration

List of Property

Enterprise/Control  
System Model

Function Block(PA)

Integration Tools



# Standards Developed in IEC TC65

TC/SC	Technology area	IEC number
TC65	Terminology	60050-351
	Security	62443
SC65A	Operating Condition	60654
	EMC	61326
	Functional Safety	61508, 61511
	Batch control	61512
	Alarm management	62682
SC65B	Transmitter, temperature	60770, 60584
	PLC	61131
	Valve, Analyzer	60534, 61831
SC65C	Fieldbus	61158
	Industrial Ethernet	61784
	Industrial Wireless	62591,62734
	Wireless coexistence	62657
SC65E	Product property, PLIB	61987
	Enterprise-control system integration	62264
	Function Block	61499, 61804
	EDDL, FDT, FDI	62453,62769
	OPC-UA	62541

## Fundamental Standard

Terminology, chart, unit, etc.

## Management Standard

Management system

## Environment, Safety

Environment condition, Safety

## Procedure or measurement

Test, Analysis, Certification

## Product standard

Shape, Function, Calibration

## Interoperability standard

Communication, Data format

# IEC TC65 Thailand National Committee

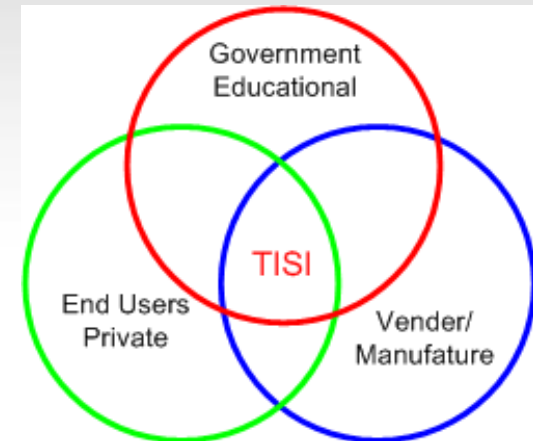
## Working Groups

Group 1: Safety Aspects, Functional Safety and Product Safety

Group 2: Industrial Networks/Integration

Group 3: Control System Security

Group 4: Energy Efficiency and Energy Management

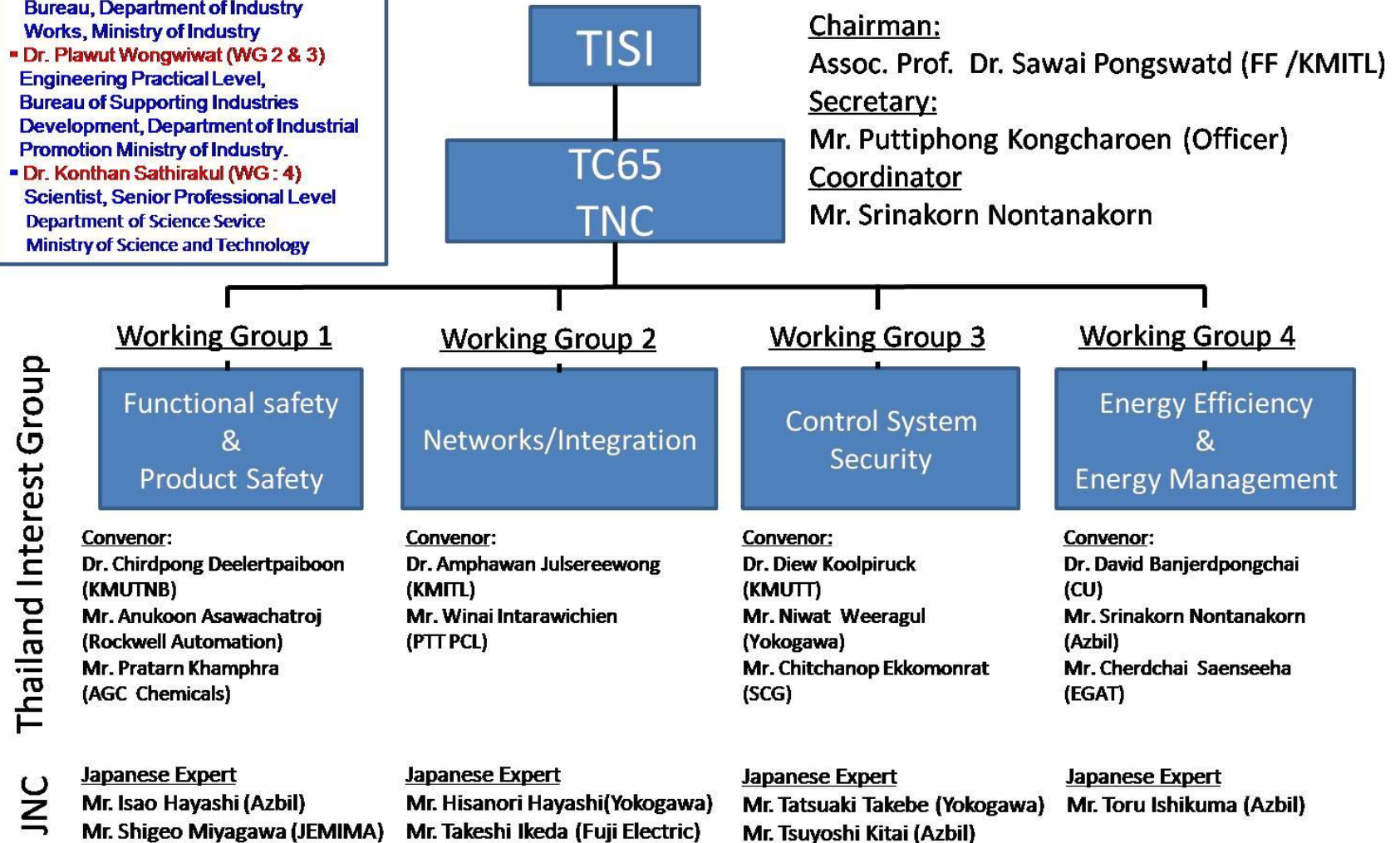




### Government Sector

- **Mr. Prasong Norajit, (WG 1&4)**  
Director of Safety Technology  
Bureau, Department of Industry  
Works, Ministry of Industry
- **Dr. Plawut Wongwiwat (WG 2 & 3)**  
Engineering Practical Level,  
Bureau of Supporting Industries  
Development, Department of Industrial  
Promotion Ministry of Industry.
- **Dr. Konthan Sathirakul (WG : 4)**  
Scientist, Senior Professional Level  
Department of Science Service  
Ministry of Science and Technology

## IEC TC65 Thailand National Committee (TISI SC1015-1)



# Thailand National Committee



TISI Committee 69 Industrial Process Measurement, Control and Automation	Year	# STD	Title of Standard
	2016	7	Functional Safety of electrical/ electronic/programmable electronic safety- related systems
TISI Subcommittee 69/1 Industrial Instrumentation and System Integration in Automation	2017	9	Energy efficiency through automation systems Functional safety –safety instrumented system for the process industry sector Industrial communication networks Security for industrial automation and control systems
	2018	15	Industrial communication networks Enterprise-control system integration Automation systems in the process industry Control systems in the process industry




# Strong Collaboration of Japan and Thailand



## Contents

- Industry 4.0 vs. Japan Society 5.0
- Thailand 4.0 and Eastern Economic Corridors
- Research related to Energy Efficiency
- IEC TC 65 Thailand National Committee
- **Control Systems Society Thailand**

# IEEE Thailand Control Systems Society



## Activity 2019

Activity	Date
2 <sup>nd</sup> IFAC ASEAN School of Advanced Control (IFAC ASAC 2019)	15-16/01/2019
1 <sup>st</sup> International Symposium on Instrumentation, Control, Artificial Intelligence, and Robotics (ICA-SYMP 2019)	16-18/01/2019
10th Instrumentation, Control, and Automation Senior Project Conference (ICA SP-CON 2019)	30/04/2019
ECTI-SICE Special Session @ ECTI-CON 2019 “Latest Trend on Systems and Control”	12/07/2019
Control Systems Special Seminar on Digital Transformation by Hisashi Sasajima	23/07/2019
SICE-ECTI Organized Sessions @ SICE Annual Conf. 2019 “Advances on Control Engineering and Applications”	13/09/2019
ECTI-ICROS Special Session @ ICCAS 2019 “Control System Design and Applications”	16-18/10/2019



# 2<sup>nd</sup> IFAC ASEAN School of Advanced Control (IFAC ASAC 2019)

*From Fundamental Theory to Robust and  
Networked Control Technologies towards Smart Cities*

Chulalongkorn University, Bangkok, Thailand  
15-16 January 2019





**Organizing Committee**

**General Chair**

Shinji Hara, Chuo University

**Main Coordinator**

David Banjerdpongchai, CU

**Registration Chair**

Napasool Wongvanich, KMITL

**Local Arrangement Chair**

Jitkomut Songsiri, CU

**Publication Chair**

Supahai Vorapojpisut, TU

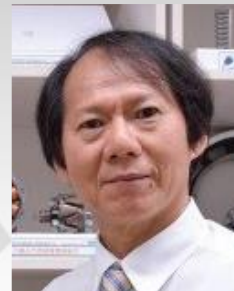
**General Secretary**

Sungwan Boksuwan, KMITL

**Lecturers**



Prof. Dr. Shinji Hara,  
Chuo University



Prof. Dr. Mi Ching Tsai, National  
Cheng Kung University



Assoc. Prof. Dr. Su Rong, NTU



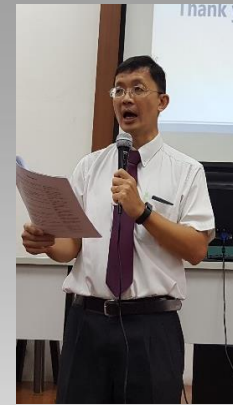
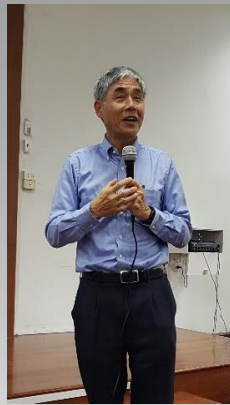
Prof. Dr. Hyunbo Shim, Seoul  
National University



Asst. Prof. Dr. Itthisek  
Nilkhamhang, SIIT

**8 lectures and 12 posters  
50+ participants  
9 nationalities**











# 1<sup>st</sup> International Symposium on Instrumentation, Control, Artificial Intelligence, and Robotics (ICA-SYMP 2019)

IEEE Conference Record Number #45470

Chulalongkorn University, Bangkok, Thailand  
16-18 January 2019











Itsukushima Shrine, Hiroshima



Giant Swing, Bangkok



# SICE 2020

September 23-26, 2020

The Empress Chiang Mai Hotel  
and Empress Convention Center  
Chiang Mai, Thailand

## CALL FOR PAPERS

The Society of Instrument and Control Engineers (SICE) Annual Conference 2020

### SICE 2020

The SICE Annual Conference 2020 (SICE 2020), organized by the Society of Instrument and Control Engineer (SICE) and the Electrical Engineering / Electronics, Computer, Telecommunications and Information Technology (ECTI) Association, will be held on September 23 - 26, 2020, in Chiang Mai, Thailand. The SICE Annual Conference 2020 is an international conference covering a broad range of fields from control theory and applications, mechatronics, industrial automation, transportation and communication, biological and medical systems, artificial Intelligence, cyber-physical systems, smart grids, educational and social contributions. The technical program of SICE 2020 will consist of plenary and invited talks, tutorial courses, and workshops, as well as oral and interactive sessions.

### Conference Venue

SICE 2020 will be held at The Empress Hotel and Convention Center, located at the heart of the city of Chiang Mai, Thailand. Chiang Mai is a Northern Thai city known for its rich history, Lanna culture, and numerous tourist attractions of great historical and religious significance. In walking distance to the hotel lie the iconic Night Bazaar Market and the Old City.



### Important Dates (Tentative)

Paper Submission Webpage Open  
: December 1 (Sunday), 2019