



**จุฬาลงกรณ์มหาวิทยาลัย**  
**Chulalongkorn University**  
Pillar of the Kingdom

Established 1917  
@ Bangkok, Thailand

# VA/VM for Energy Conservation

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CHULALONGKORN University

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- I n t r o d u c t i o n
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- Energy Conservation Techniques
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    - ⇒ **Engineering Solution** (Technology / Equipment change)
  - Human Approach
    - ⇒ **Management Solution** (Behavior change)
- Energy conservation via VA/VM
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  - Thailand's Energy Intensity Trend

# Introduction

Thailand is one of ASEAN countries **facing an urgent need** to **conserve energy** and **diversify** away from fossil fuels:

- to enhance its energy security
- to reduce its contribution to global warming

## Energy Conservation Program: **Key National Policy**

- **Energy Efficiency Development Plan (EEDP 2010-2030):**  
“Aim to **reduce EI 25%** from 2010 base year in 2030”
- **Alternative Energy Development Plan (AEDP 2012-2021):**  
“Aim to **increase the share of alternative energy up to 25%** of final energy consumption by the year 2021”

# Thailand's Energy Conservation Approach

**AEDP**

(Alternative Energy Development Plan)



**25% Alternative Energy Share by 2021**

(compared with Total Energy Conservation)

**EEDP**

(Energy Efficiency Development Plan)

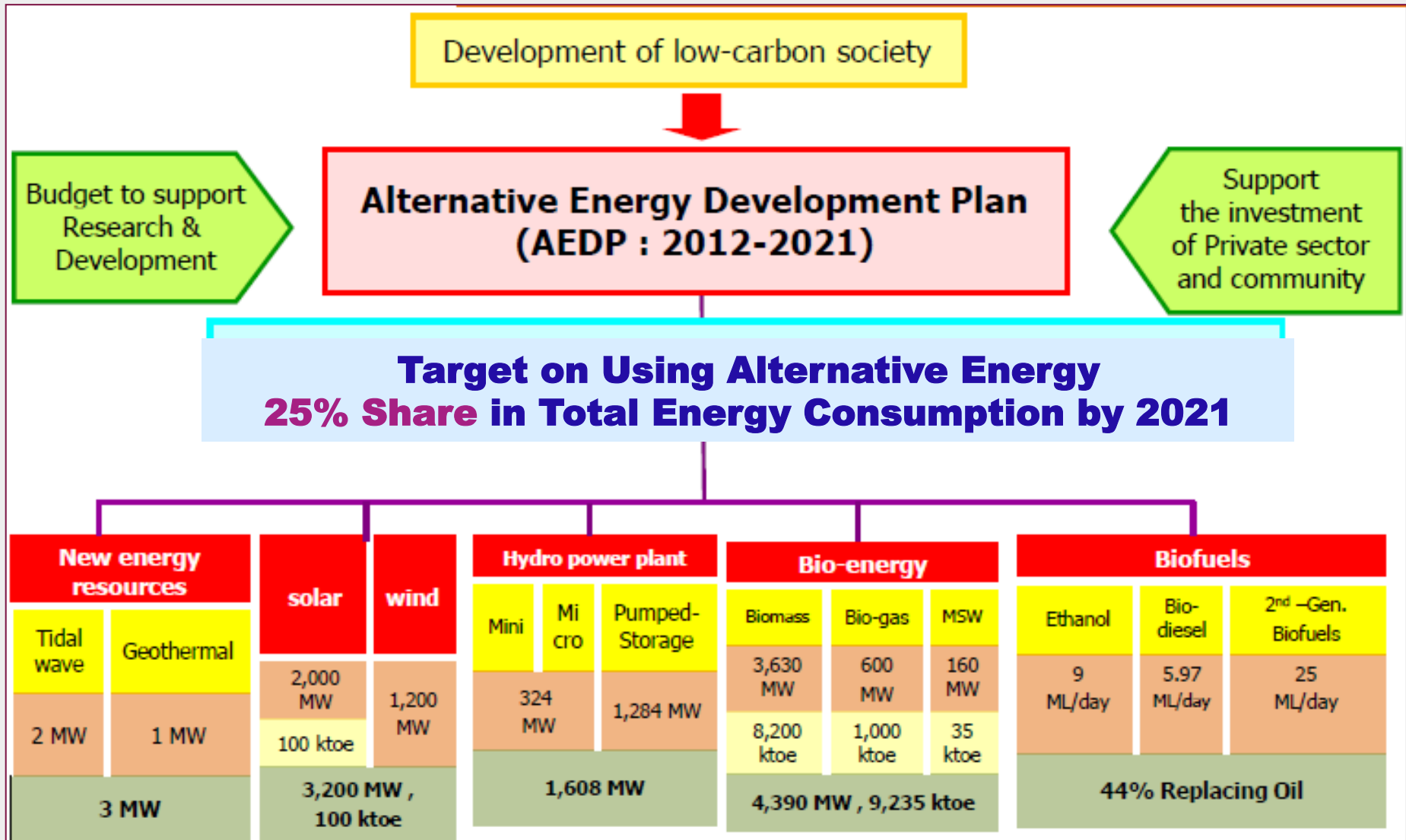


**Reduce EI by 25% in 2030**

(compared with the 2010 base year)

Note: **EI** = **E**nergy **I**ntensity  
= Energy Consumption / GDP

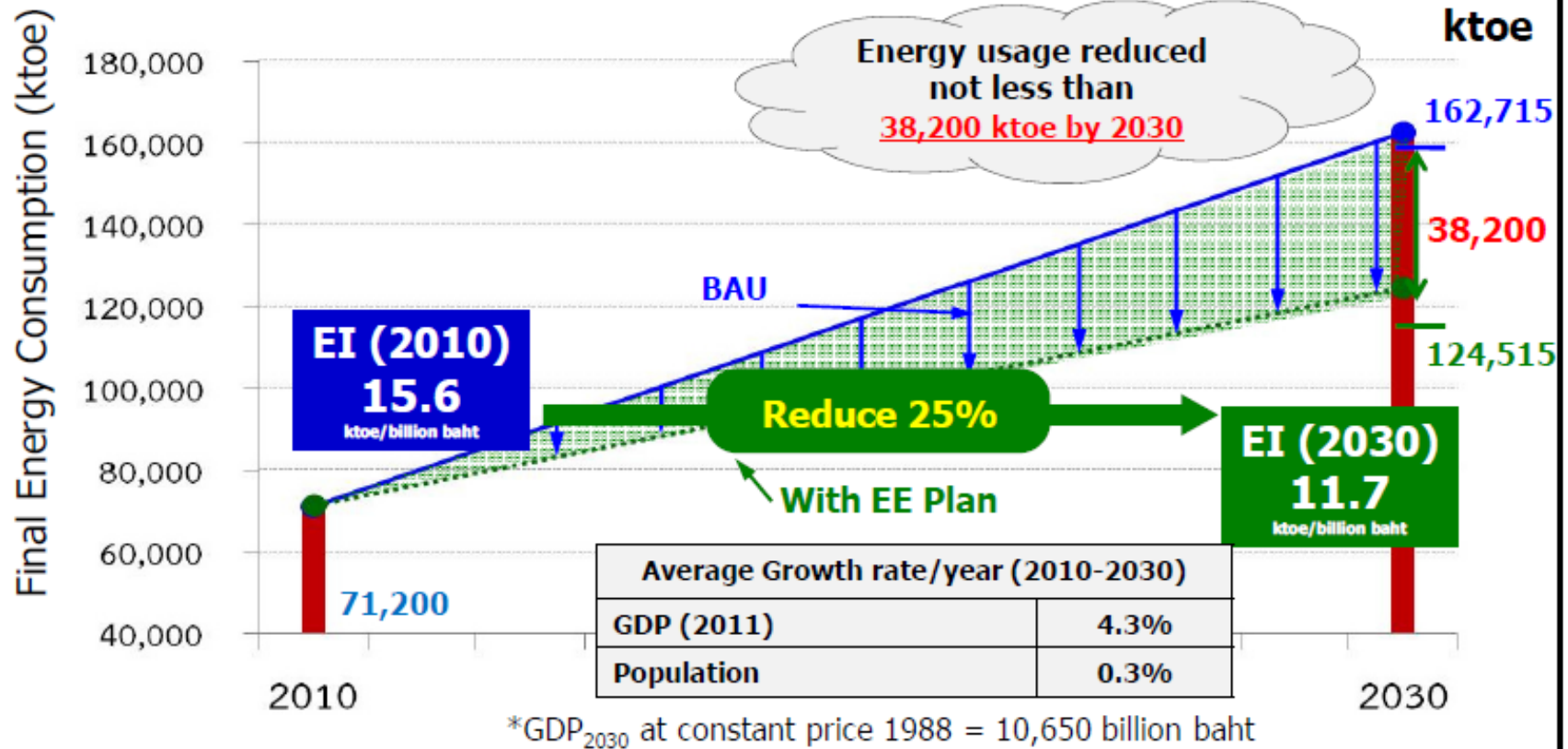
# National RE/AE Targets via AEDP





# 20-Year Energy Efficiency Development Plan

Government policy @ 23<sup>rd</sup> AUG 2011 aims to reduce Energy Intensity 25% within 20 years



## Target Groups

- Industrial sector
- Transportation sector
- Business Building
- Small Business and Residential Building

## Expected outcome in 2030

- Reduce final energy consumption at least 38,200 ktoe
- Reduce CO<sub>2</sub> emission 130 M. tons
- Reduce Energy cost 707,000 M.Bahts.

# Thailand 20-year Energy Efficiency Development Plan

Thailand has launched a 20-year Energy Efficiency Development Plan (EEDP) targeting **to reduce EI by 25% in 2030** compared with the 2010 base year.

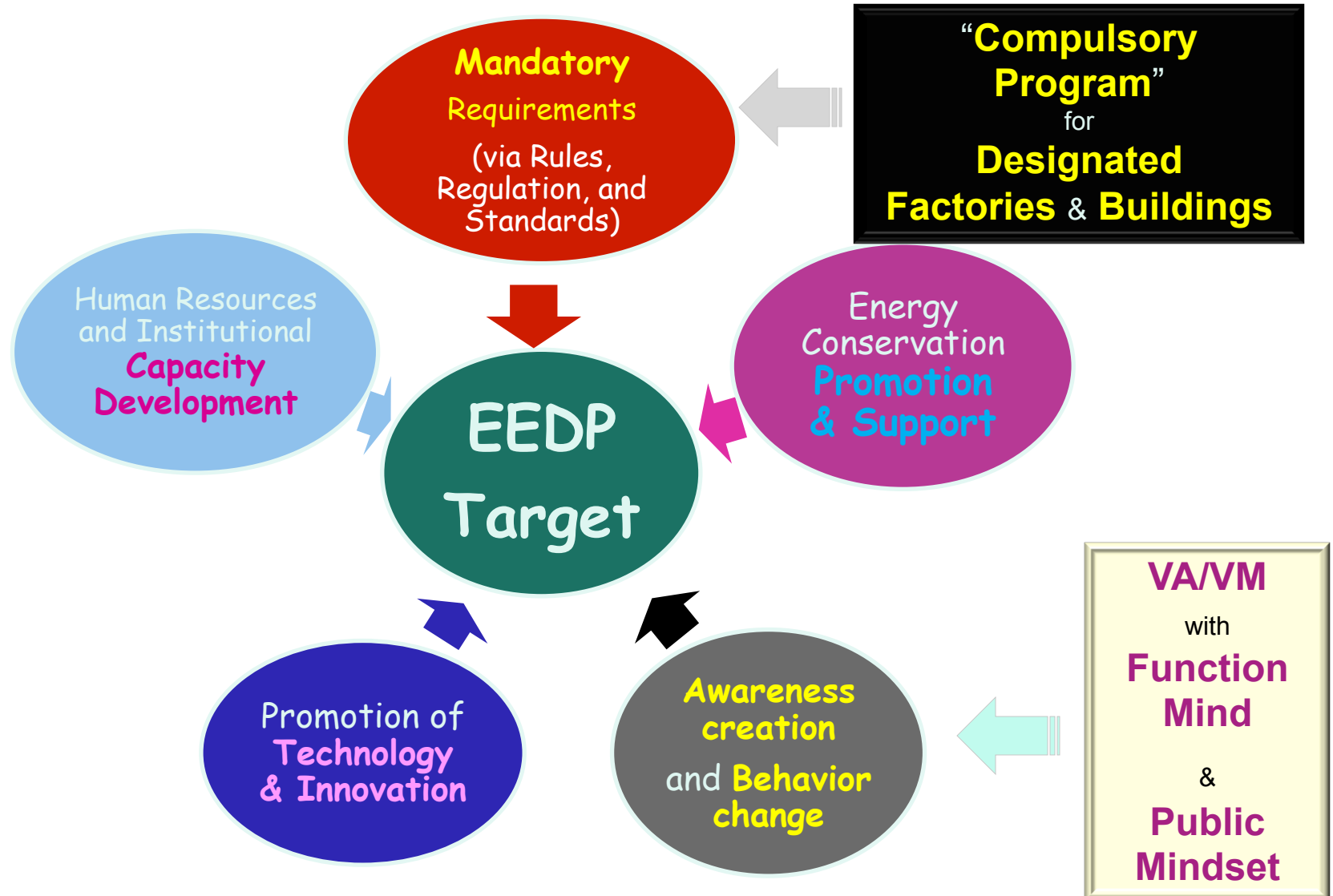
The EEDP aims **to reduce final energy consumption by 23.5%** or **38,200 ktoe** calculated from energy conserving potential from each sector.

Sector	Energy conserving target from EEDP	Estimated conservation from sub measures	Supporting fund	
	(ktoe)	(ktoe)	million baht	Percentage
Transportation	15,100	15,323	13,010	10.1
Industry	16,100	16,257	69,066	53.6
Commercial building	3,600	3,630	19,640	15.3
Small and residential building	3,400	3,635	27,024	21.0
Total	<b>38,200</b>	38,845	128,740	100.0

Estimated energy conservation from implementing EEDP by sectors (EPPO, 2013)

# Five Strategic Approaches to Achieve EEDP Target

(with 34 measures and 67 sub-measures)







## Programme to promote EE



# Legal Framework to Promote EE in Thailand

## Energy Conservation and Promotion Act ENCON Act 1990 (revision 2007)

### Decree on Designated Building

Effective from 12/12/1995

### Decree on Designated Factory

Effective from 17/07/1997

## Ministerial Regulations

### Energy Management in Designated Facility

Effective from 20/11/2009

### Building Energy Code

Effective from 20/06/2009

### Persons Responsible for Energy (PRE)

Effective from 31/07/2009

### High Energy Performance Standard (HEPS)

for Equipment and Machinery Effective from 08/04/2009

### Energy Management Auditors

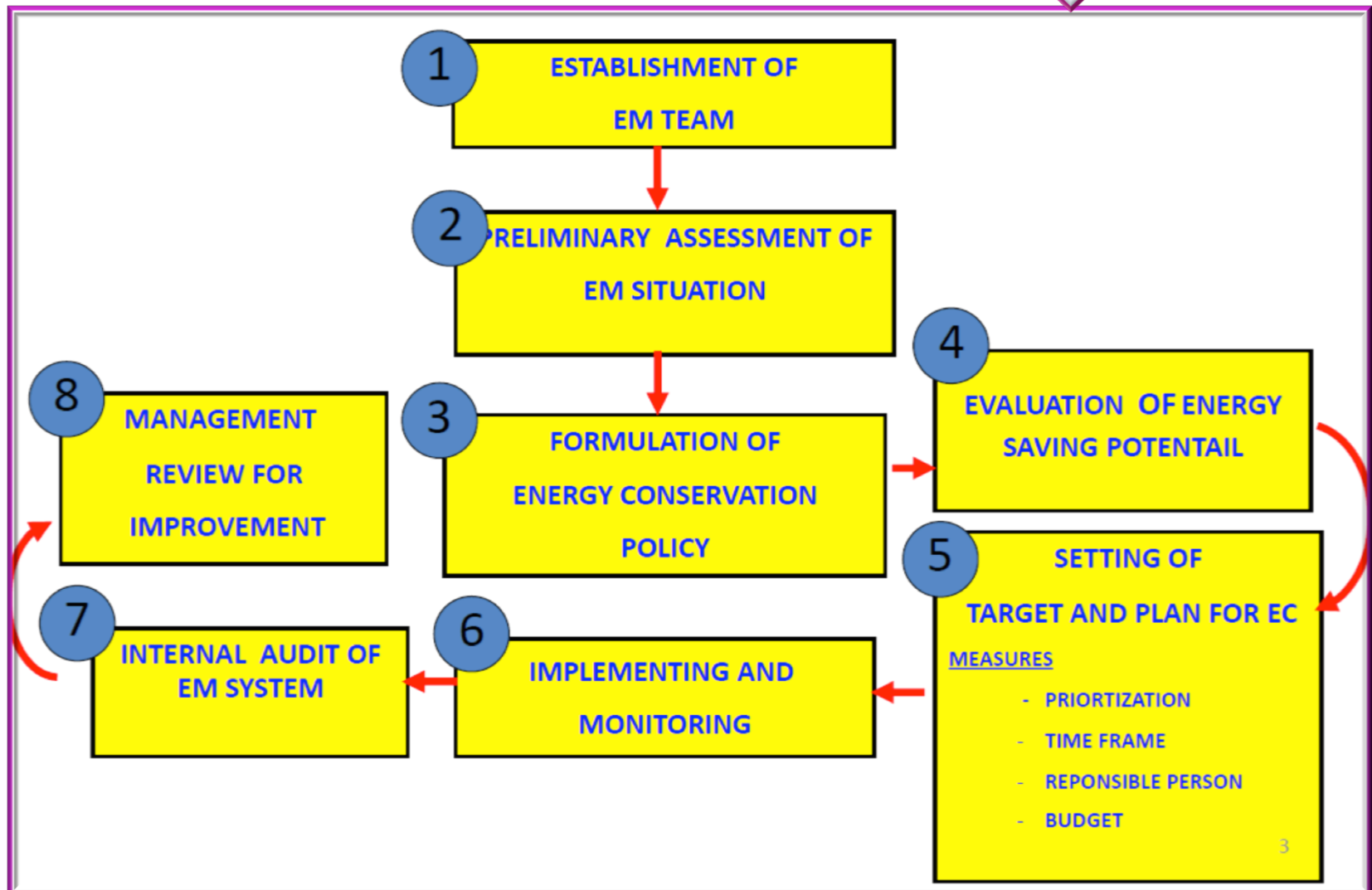
### Designated Factory & Building

- Electric power  $\geq$  1000 kW
- Total installed transformer  $\geq$  1,175 kVA
- Annual Energy Consumption  $\geq$  20 million MJ

**Designated  
Factories & Buildings**

**Mandatory**

**Energy Management  
Implementation**



# Voluntary Agreement: Energy Beyond Standards

## The Network of Energy Conservation Campaign Scheme (Initiated in 2011)

**DEDE**  
(Ministry of Energy)

Invitation

**1,000 Designated  
Factories & Buildings**

Join the Network

**Voluntary implementing** measures in their organizations  
for serious reducing energy consumption.

Enjoy **Tax privileges** and a **20% Grant**  
from the '*Energy Conservation Equipment Promotion Project*'  
to encourage investment

# Energy Conservation Techniques

- High impact
- High investment
- Consultant dependency

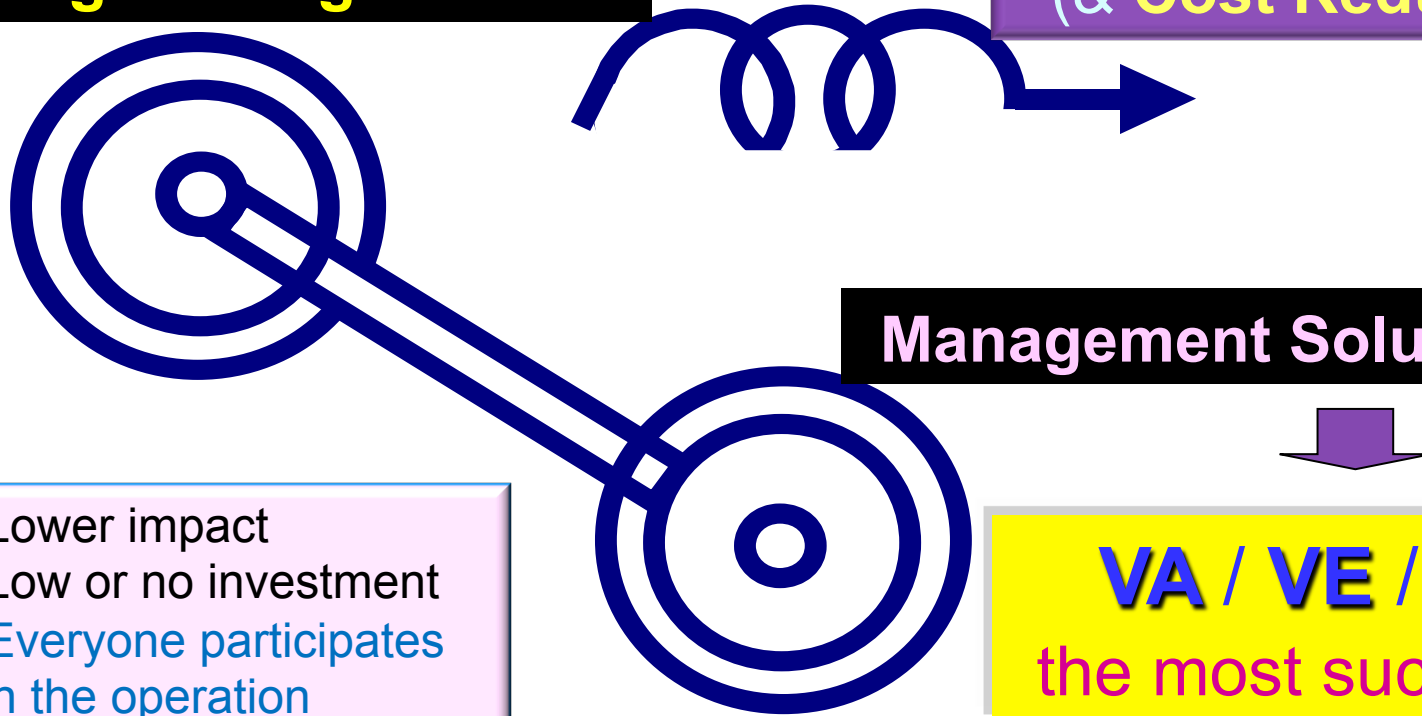
**Engineering Solution**

**Energy Conservation  
(& Cost Reduction)**

**Management Solution**

- Lower impact
- Low or no investment
- Everyone participates in the operation
  - ⇒ Self reliance
  - ⇒ More sustainable

**VA / VE / VM:**  
the most successful



# Energy Conservation in Thailand

- Started energy saving program since 1973, but only temporary measures
- Established ENCON Act 1992
  - ⇒ Started **mandatory energy audit program** for
    - Designated Buildings since 1995
    - Designated Factories since 1997

Note: **Emphasized mainly on Engineering Solution**

⇒ Not completely implemented  
due to Thailand's economic crisis in 1997

In 1994, Mr. Cheowet Yimsirikul successfully introduced **VE/VM** for energy conservation in Thai SMEs.

# Energy Conservation in Thailand (cont.)

- Since 1994, Mr. Cheowet successfully implemented **VE/VM** for Energy Conservation in Thai SMEs
- Mr. Cheowet found that “**Man**” is a **Key Success Factor**;  
⇒ Introduced “**DSM by HAT**” (**D**emand **S**ide **M**anagement  
by **H**uman **A**pproach **T**echnique)
- In 1998, Mr. Cheowet successfully introduced **VE/VM** for Energy Conservation in designated industries

Since then, **VE/VM** has become **very much well-known** for Energy Conservation in Thailand.

# Energy Conservation via Value Management

## What's Value Management (VM)?

- A popular management technique used for **cost reduction**
- A **function approach** technique
- Defined as **F/C (Value = Function / Cost)**
- Successfully applied for energy conservation
  - ⇒ Reduce energy consumption
  - ⇒ Reduce cost and increase competitiveness
  - ⇒ Reduce air pollution and global warming



# How to create or increase value?

$$V = F / C$$

- **Increase Function (F ↑)** quality ↑ while maintain cost
- **Reduce Cost (C ↓)** while maintain function & quality
  - Removing of **over-function** or **malfunction**
  - Reducing **loss due to 5M's: Man, Machine, Materials, Method, Management**
    - ⇒ **Loss due to "Man": the most important**
    - ⇒ **Need 'Public Mindset' and 'Function Mind'**

**Human: key success factor**

# Examples of Energy Conservation

via **VAVE/VM**



Mercury Vapor Lamp

## Before:

Used mercury vapor lamp 16 x 400 W  
or 6400 W for 15 h / day

⇒ **Electricity Bill 96,000 THB/year**

Installing transparent roof  
to reduce electricity lamps  
during daytime.

Replace 16 x 400 W mercury  
vapor lamps with 48 x 36 W  
fluorescence lamps.

## After:

- Use fluorescence lamp 48 x 36 W  
or 1728 W for 15 h / day  
⇒ **Electricity Bill 14,000 THB/year**
- Investment 115,000 THB  
⇒ **Payback Period 1.3 Years**

# Examples of Loss Due to 5Ms

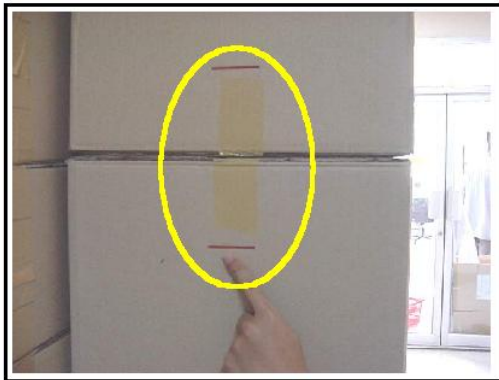
## Reduce loss due to over function

Before



Light weight product in the box

After



Design the box with exact red mark

Low or No Investment

## Lack of Awareness

Before



Remove Barrier

After



# Examples of Loss Due to 5Ms

**Lack of Management  
& Awareness**



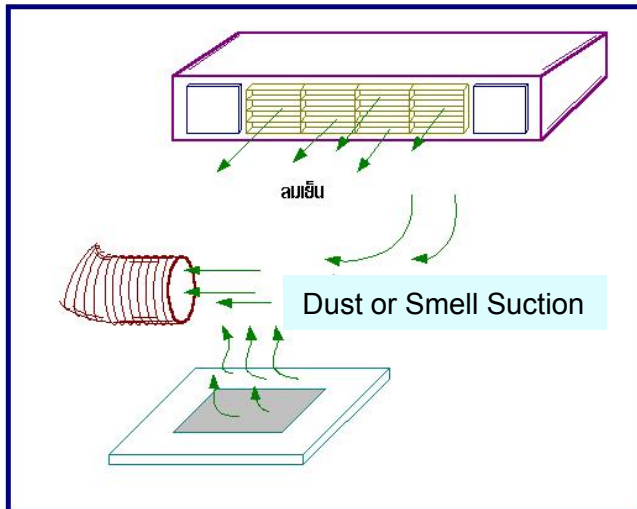
**Shield the suction head  
if not using**



ทำฝาปิดหัวดูดกลิ่น ในกรณีไม่ใช้งาน

**Low or No  
Investment**

**Redesign**



**Design suction head  
with specific using area.**

# Examples of Loss Due to 5Ms

## Reduce loss due to over function

Before



8 Bars Setting

After



7 Bars Setting

After setting more appropriate steam pressure (**Reduce Over Function**):  
⇒ Reduce fuel oil consumption 900 L/year

## Install Insulation



Before



After

Before



วาล์วไม่ได้หุ้มฉนวน

After



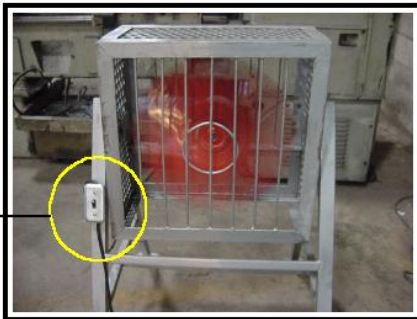
# Examples of Loss Due to 5Ms

## Loss due to Malfunction



ใช้มอเตอร์พัดลมเป่าให้พนักงาน แบบ 3 เฟส ขนาด 3 แรงม้า  
และเปิด-ปิด ด้วยการดึงปลั๊กออก พนักงานจึงไม่สะดวก เลยมีการลืมหรือเกียจคร้าน

หลังปรับปรุง



เปลี่ยนมอเตอร์เป็น 1 เฟส ขนาด 1/4 แรงม้า  
และแยกสวิตช์เพิ่มความสะดวกในการเปิด-ปิด



สามารถประหยัดเงินได้ประมาณ 2 แสนบาทต่อปี

**Before:** Use 3 phase electricity  
for worker's electric fan (3 HP)

**After:** - Change to 1/4 HP electric fan  
- Use 1 phase electricity  
- Install switch for comfortable  
on-off.



Save electricity Bill  
**200,000 THB/Year**

# Conclusion

**Energy conservation** can be implemented either by

- **energy saving** (reduce consumption),
- **energy efficiency** (reduce EI or energy consumption per GDP)
- use more **renewable** or **alternative energy**

**Energy Conservation Techniques:**

- **Specific Technique / Engineering Solution**

- **Change Technology or Equipment**

- ⇒ High impact, but high investment

- ⇒ Rely on consultant or expert

- **Management Technique / Human Approach**

- **Change Human Behavior → More sustainable**

- ⇒ Lower impact, but low or no investment

- ⇒ Everyone participates and brainstorming

- under consultant suggestion

- ⇒ **Knowledge Transferred** ⇒ **Self reliance**

There are many **management techniques** useable for energy conservation and/or cost reduction.

⇒ **VA** (Value Analysis) / **VE** (Value Engineering) / **VM** (Value Management)  
which emphasizes on '**Value Creation**'  
by either **Function / Quality** ↑ while maintain **Cost**  
or **Cost** ↓ while maintain **Function / Quality**

**Value** ↑ via **Cost** ↓

- Reduce consumption (of energy and/or raw materials)
- Reduce or Remove Over Function / Malfunction
- Reduce Loss due to **5Ms**

Note: Some measures can be implemented with high impact  
but low or no investment ⇒ **Suitable for Developing Nations**

**Function Mind / Public Awareness / Public Mindset**  
⇒ **Key Success Factor**





Thank you

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# **Appendixes**



# Energy Research Institute (ERI)

Chulalongkorn University

Established 1991

# People



**Director**  
Associate Prof. **DAWAN**  
Wiwattanadate, PhD

ดาวัลย์ วิวรรณะเดช



**Deputy Director**  
บริหาร/แผน/ประกันคุณภาพ  
ผศ. ดร. จิรวัดน์ ชีวรุ่งโรจน์  
Assistant Prof. **JIRAWAT**  
Chewaroungroj, PhD



**Deputy Director**  
วิจัย/บริการวิชาการ  
ผศ. ดร. กุลยศ อุดมวงศ์เสรี  
Assistant Prof. **KULYOS**  
Audomvongseree, PhD



Dr. Weerin



Dr. Sopitsuda



Dr. Suthee



Dr. Watana



Dr. Supawat

## Researchers



Ms. Walairat

**RA**

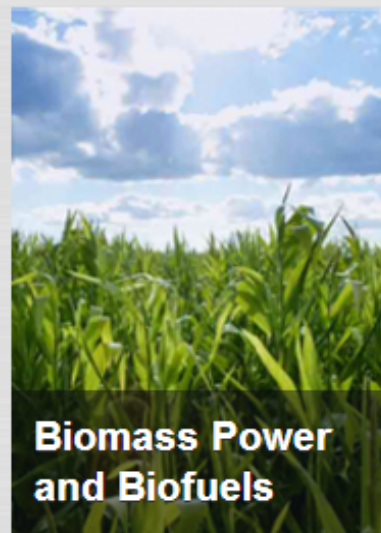
# Research Activities

ENERGY POLICY & MODELING

SOLAR THERMAL & PV POLICY

BIOMASS POWER & BIOFUELS

ENERGY EFFICIENCY



## Policy Research

- Energy Policy and Modelling
- Power and Energy Systems
- RE Policy

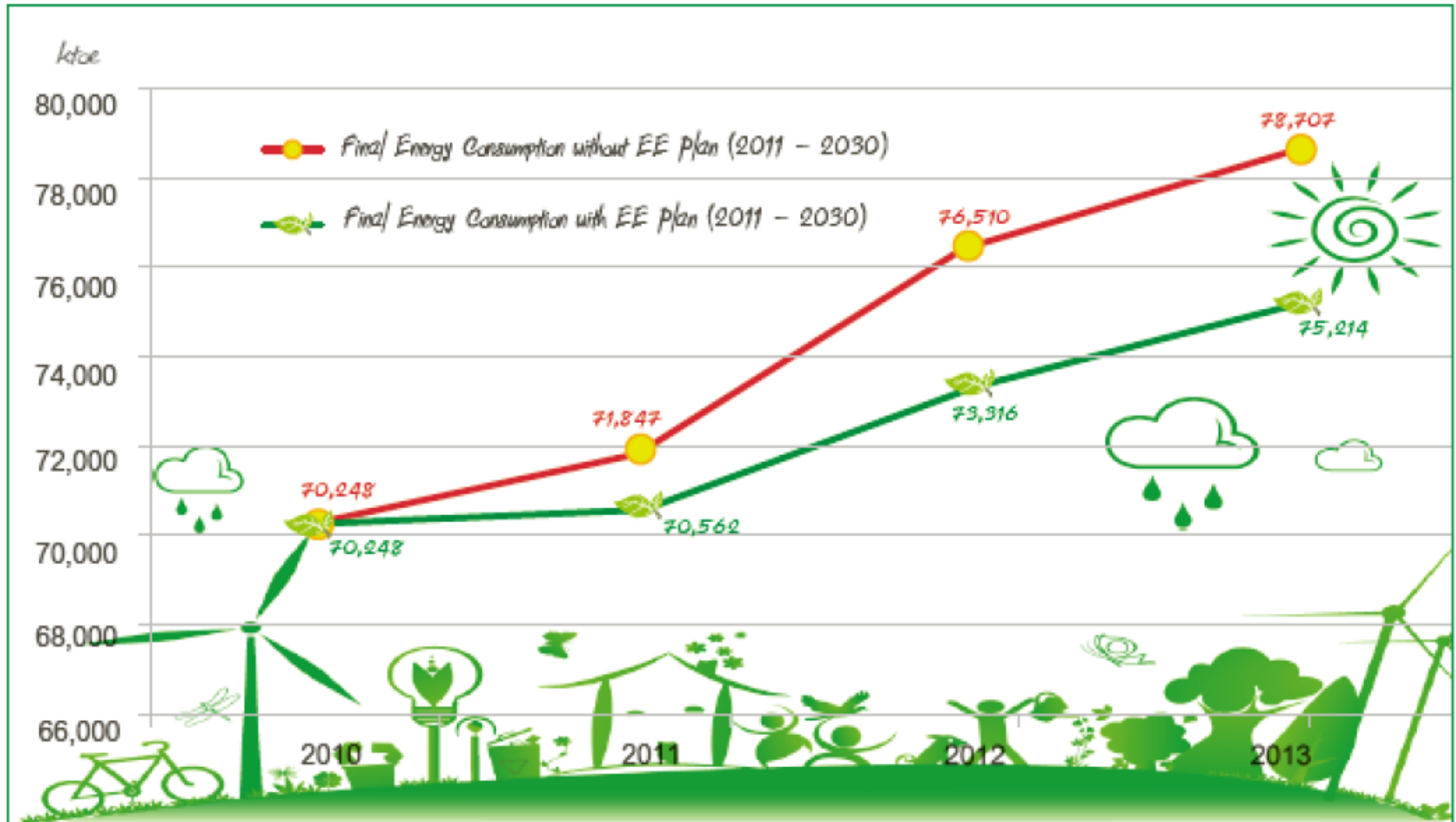
## Technology Research

- Solar Thermal
- Bio Energy: Biomass, Biogas and Waste to Energy
- Energy Efficiency

# Thailand's EI with and without EEDP

## ENERGY SAVING RESULTS

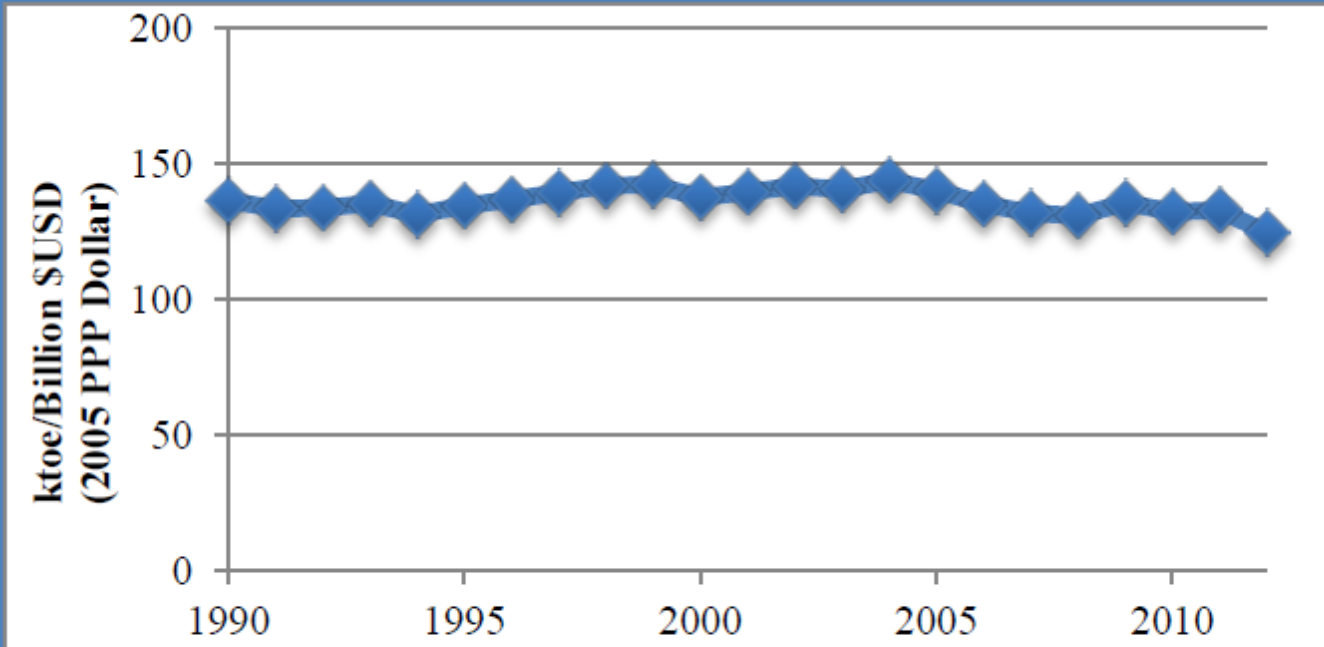
BASED ON THAILAND 20-YEAR ENERGY EFFICIENCY DEVELOPMENT PLAN (2011-2030)





- Being a long term plan to promote EE in Thailand (20 years from 2011 -2030)
- Master Plan was approved by National Energy Policy Committee in April 2011
- Target to reduce Energy Intensity by 25% in 2030 (based on 2010)
- Action Plan has been approved by the Cabinet in March 2013 for full implementation
- Result from EEDP will contribute to;
  - 38,200 ktoe energy reduction from BAU in 2030
  - Saving energy expense up to 707 billion Baht
  - Reduce CO<sub>2</sub> emission around 130 million ton

# Thailand's EI during 1990-2012



El for final energy consumption between years 1990 – 2012  
(Calculated from NESDB, 2012 and DEDE, 1995-2012)

## Energy intensity (EI) in Thailand:

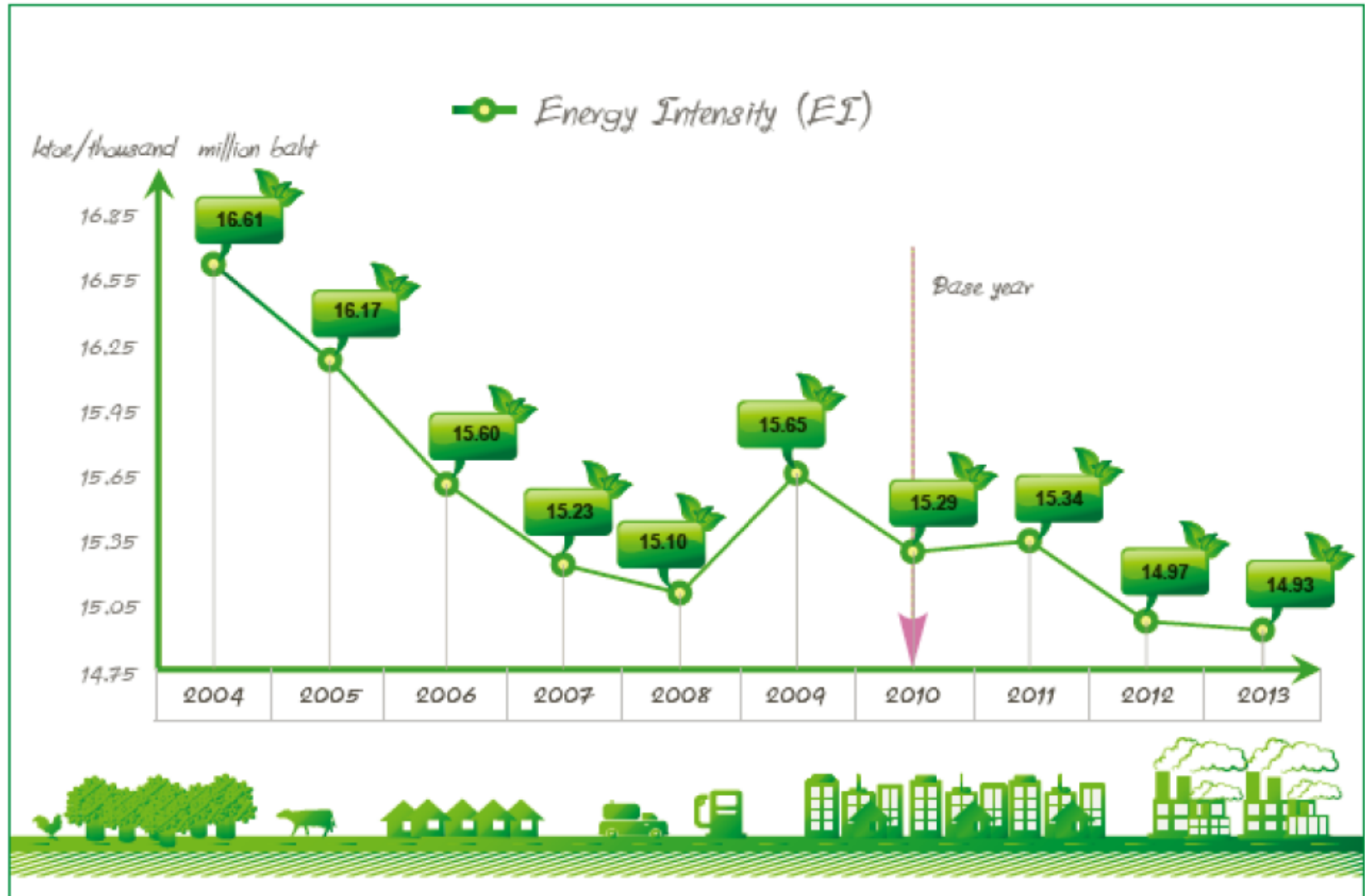
- A steady trend for the last 20 years
- EI for final energy consumption varied around 131 – 143 ktoe/Billion USD
- Peak EI (143.94 ktoe/Billion USD) in 2004, and then steady declined to 124.73 ktoe/Billion USD in 2012.



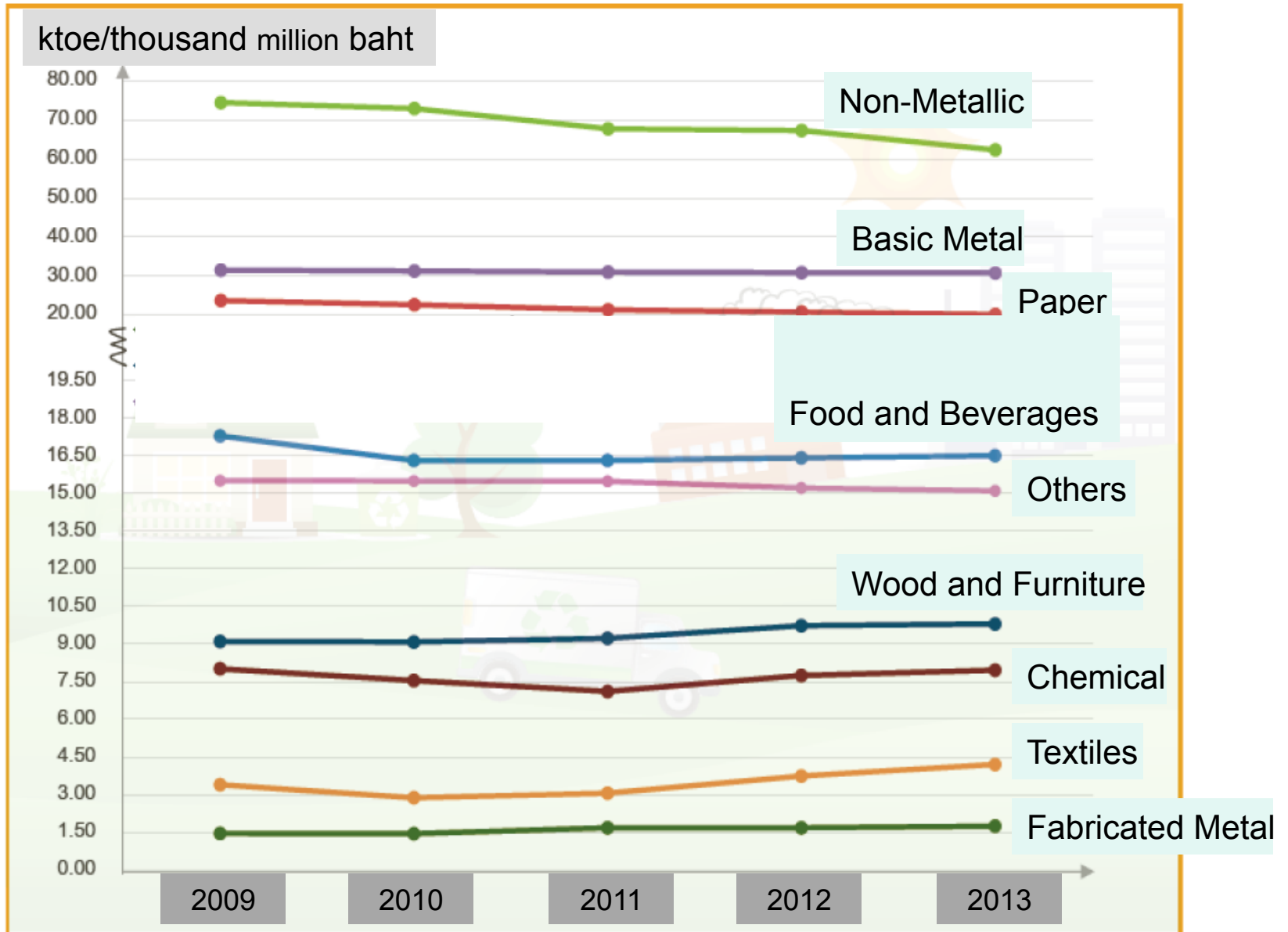
# Thailand's EI during 2004-2013

DECREASING OF ENERGY INTENSITY

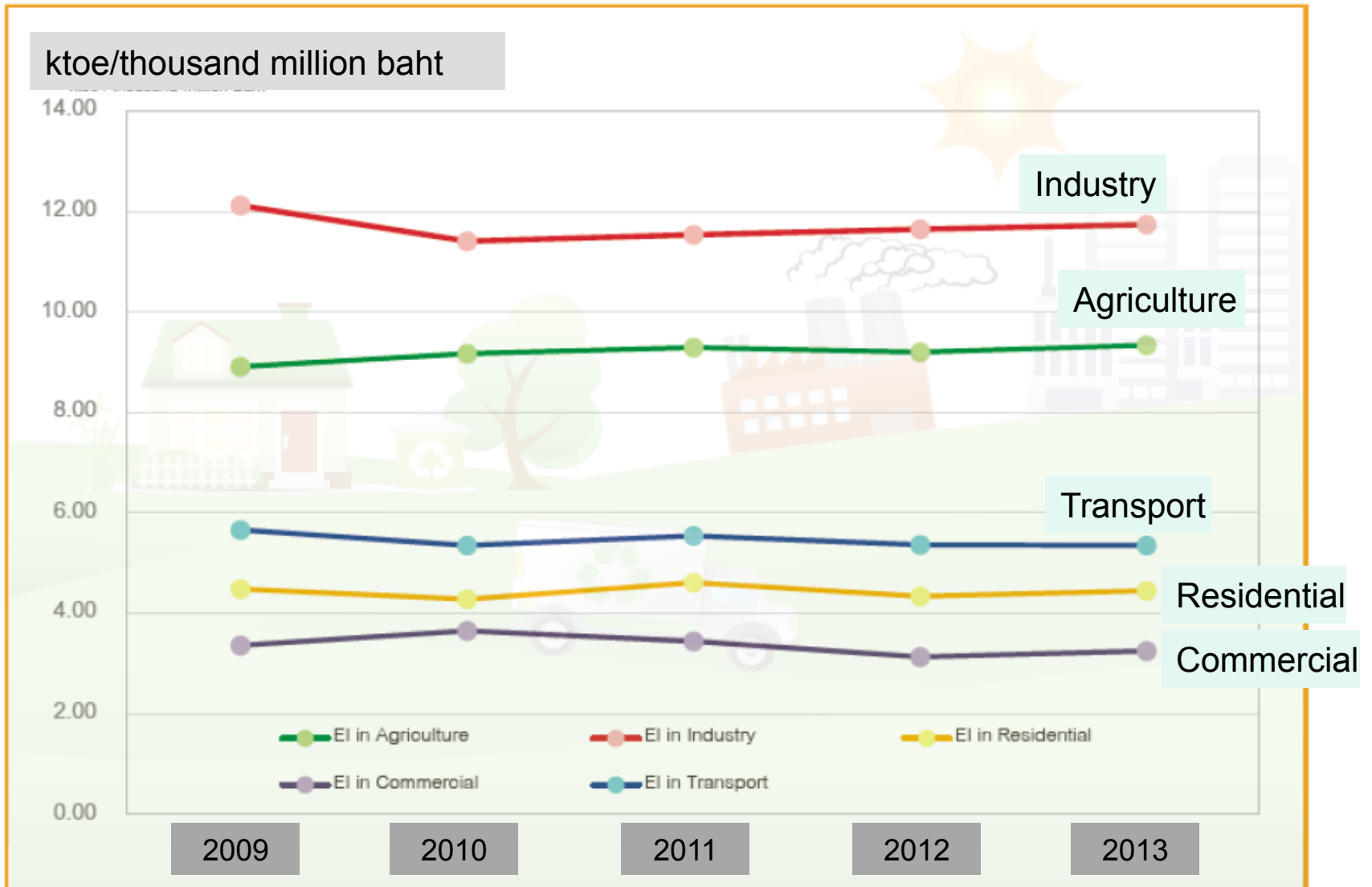
BASED ON THAILAND 20-YEAR ENERGY EFFICIENCY DEVELOPMENT PLAN (2011-2013)



# Thailand's EI by Manufacturing Sector



# Thailand's EI by Economic Sector



## **Step 6 : Implementing & Monitoring**

- Strictly Implementing according to all plans
- Monitored and evaluated by EM Team
- Result analysis with suggestions to be reported to top management

## **Step 7 : Internal Auditing of EM system**

- Appointing internal Auditing Committee by facility owner
- Consisting of at least two individuals with EM knowledge
- Evaluating of EM implementation within organization to compile with the law
- Making a summary report for EM team and top management



# VM: Challenges and Opportunities

Inefficient use of materials



Huge Waste

Opportunity Loss

**More efficient use of materials**  
(also maximize recycling)



**Waste  
Reduction**



**Natural Resources  
Conservation**



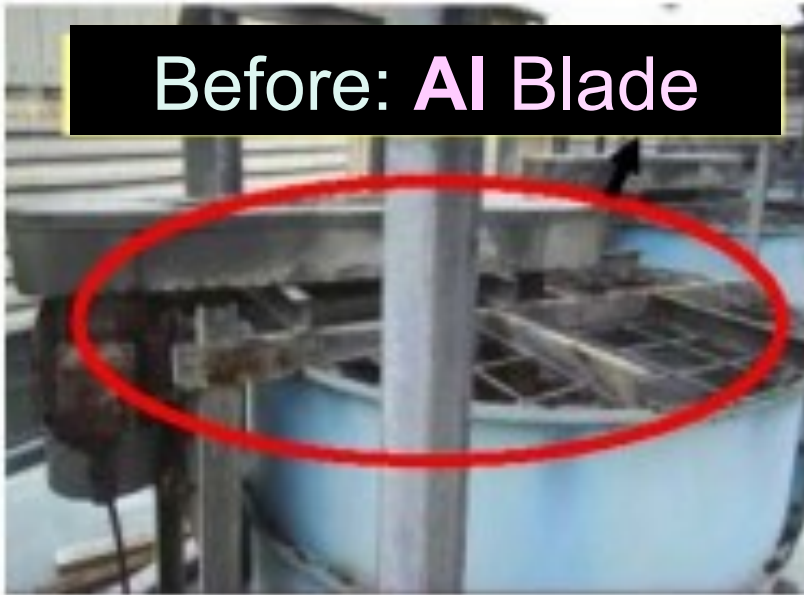
**Profit  
Increasing**



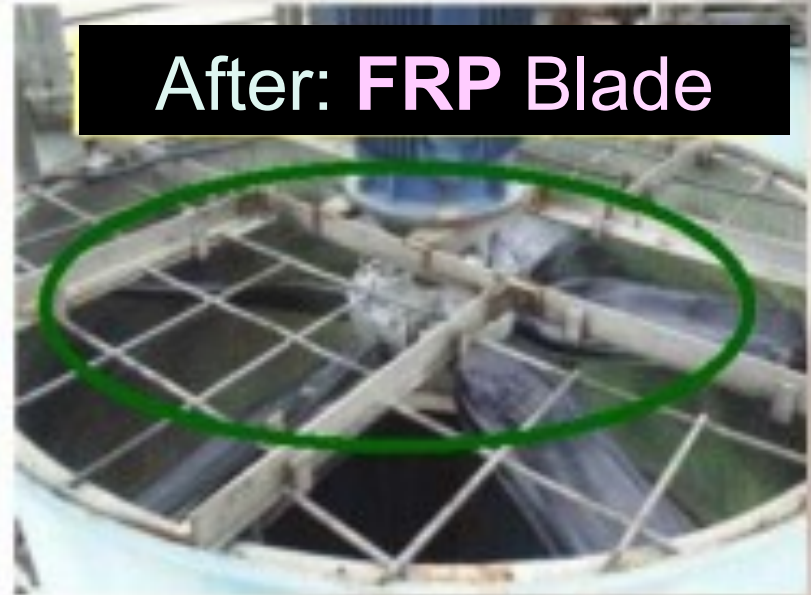
**Value  
Creation/Increasing**

# Change Stirring Blade of Cooling Tower from **AI** to **FRP**

Before: **AI** Blade



After: **FRP** Blade



Energy can be saved up to **212,636 kWh/year**

⇒ **532,000 THB/year**

# Pre-2020 action by countries

## Thailand

Thailand stated that it would endeavor **to reduce its GHG emissions in the range of 7 – 20%**, subject to the level of international financial, capacity-building, and technology support **below business as usual (BAU)** in the **energy and transportation** sectors **in 2020**.

**The following counter measures** were identified:

- Development of **renewable and alternative energy** sources;
- **Energy efficiency improvement** in industries, buildings, transportation and power generation;
- **Bio-fuels** in transportation; and
- Environmentally **sustainable transportation system**.



## Thailand communicated mitigation pledge to UNFCCC in COP20

No 1006.4/ 3061



Ministry of Natural Resources and  
Environment

29 December B.E. 2557 (2014)

Dear Executive Secretary,

Subject: Communication on Thailand's Nationally Appropriate Mitigation Actions (NAMAs)

In accordance with the provisions of Article 12 paragraph 1(b), Article 12 paragraph 4 and Article 10 paragraph 2(a), I have the honor to communicate to you the information on Thailand's Nationally Appropriate Mitigation Actions (NAMAs), for information to the UNFCCC Parties, as follows:

Thailand will endeavor, on a voluntary basis, to reduce its GHG emissions in the range of 7 to 20 percent below the Business as usual (BAU) in energy and transportation sectors in 2020, subject to the level of international supports provided in the forms of technology development and transfer, finance, and capacity building for NAMAs preparation and implementation.

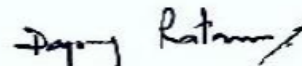
The above-mentioned NAMAs will include counter-measures, as following:

- Development of renewable and alternative energy sources;
- Energy efficiency improvement in industries, buildings, transportation and power generation;
- Bio-fuels in transportation; and
- Environmentally sustainable transport system.

Please note that the communicated information on NAMAs as announced will not have a legally binding character, and will be implemented in accordance with the principles and provisions of the UNFCCC, in particular Article 4 paragraph 7, and taking into account the national circumstances.

Yours sincerely,

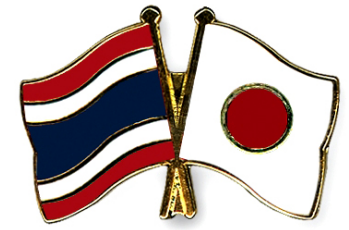
General



Dapong Ratanasuwan

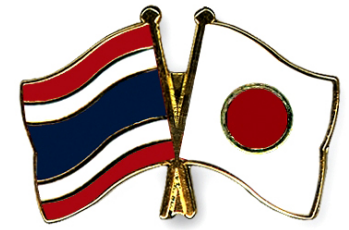
Minister of Natural Resources and Environment

มติ ครม. 20 มค. 2558 เห็นชอบการจัดทำความร่วมมือทวิภาคี  
Joint Crediting Mechanism (JCM) กับประเทศญี่ปุ่น



Cabinet Resolution on 20<sup>th</sup> January 2015  
Allow Thai Government to join JCM with Japan.

# มติ ครม. 20 มค. 2558 เห็นชอบการจัดทำความร่วมมือทวิภาคี Joint Crediting Mechanism (JCM) กับประเทศญี่ปุ่น



คณะรัฐมนตรี มีมติเห็นชอบในหลักการ การจัดทำข้อตกลงทวิภาคีความร่วมมือระหว่างประเทศญี่ปุ่นกับประเทศไทย ในการพัฒนากลไกเครดิตร่วม (JCM) และมอบหมายให้ TGO เป็นผู้ดำเนินการในรายละเอียดตามกฎหมายและระเบียบที่เกี่ยวข้องต่อไปตามที่กระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม (ทส.) เสนอ

**JCM** มีวัตถุประสงค์ เพื่อสนับสนุนการถ่ายทอดเทคโนโลยีคาร์บอนต่ำ เพื่อส่งเสริมการพัฒนาอย่างยั่งยืนของประเทศกำลังพัฒนาและประเทศพัฒนาน้อยที่สุด โดยมีการประเมินอย่างเหมาะสมเกี่ยวกับการให้การสนับสนุนต่อการลดการปล่อยหรือการดูดซับ GHGs โดยประเทศพัฒนาแล้ว ในเชิงปริมาณ ผ่านทางการดำเนินงานลด GHGs ในประเทศกำลังพัฒนา และใช้ปริมาณการลดการปล่อยหรือการดูดซับเหล่านั้น เพื่อบรรลุเป้าหมายการลดGHGs ของประเทศต่างๆที่เกี่ยวข้อง และสนับสนุนต่อวัตถุประสงค์สูงสุดของ UNFCCC

ภายใต้ความร่วมมือทวิภาคีนี้ ญี่ปุ่นจะให้การสนับสนุนความรู้ทางเทคนิค และ/หรือ งบประมาณบางส่วน (ไม่เกินร้อยละ 50 ของมูลค่าโครงการ) แก่โครงการที่ได้รับการพิจารณาคัดเลือก โดยมีเงื่อนไขว่า รัฐบาลของประเทศเจ้าบ้านจะต้องทำการส่งมอบคาร์บอนเครดิตที่เกิดจากการดำเนินโครงการลด GHGs ภายใต้กลไกนี้ในสัดส่วนที่ตกลงกัน ให้แก่รัฐบาลญี่ปุ่น เพื่อใช้ประกอบเป็นส่วนหนึ่งในการรายงานผลการดำเนินการเพื่อบรรลุเป้าหมายการลด GHGs ของญี่ปุ่นภายใต้อนุสัญญา UNFCCC