A STEM Approach on Energy Education in Thailand

Niphon Chanlen

Xth APEC-Tsukuba conference Innovation of Mathematics Education through Lesson Study Challenges to Energy Efficiency on STEM and Cross-border Education
13 Feb 2016

Niphon Chanlen, Ph.D.

Educational Backgrounds

Ph.D. (Science Education)
University of Iowa

2006-Present

Academic staff of The Institute for The Promotion of Teaching Science and Technology

Summary of Responsibilities

Curriculum design
Professional development
Learning material design
Educational Research

IPST

The Institute for The Promotion of Teaching Science and Technology

An autonomous entity with budget support and policy direction from the Ministry of Education

IPST

Mission

- Development of basic-education curriculum, methodology and evaluation.
- Training of science teachers, students and talents.
- Provision of science educational materials.
- Promotion of quality assurance and standard assessment for in-school science education.
- Science education policy advisory.

Outline

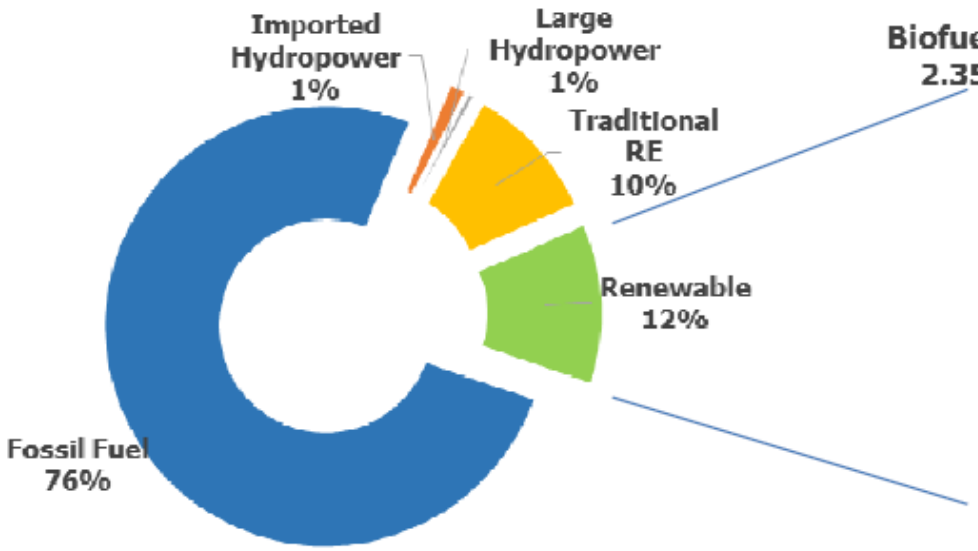
- Thailand's energy situation
  - Power Development Plan (2015-2036)
- Energy education in Thailand
  - Fuel energy for transportation
  - Renewable energy
- Energy STEM project

Thailand's Energy situation

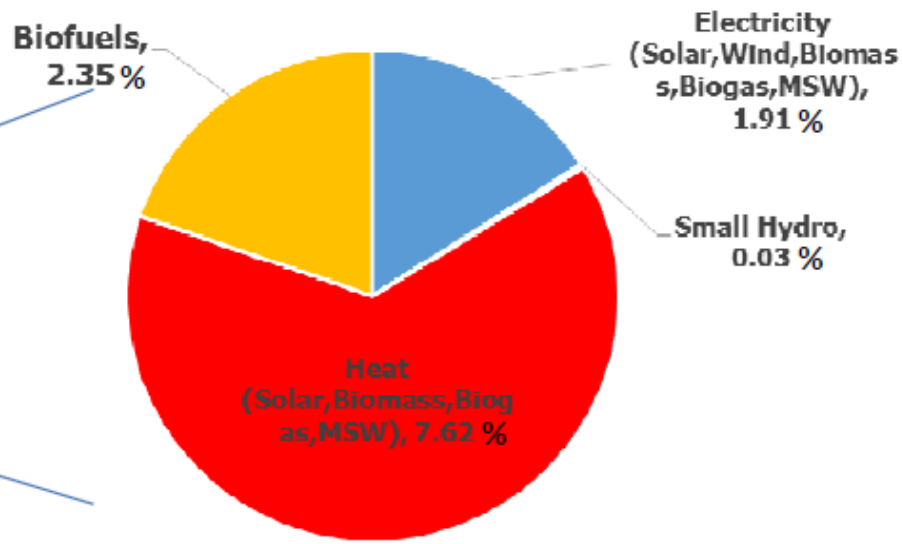
Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Thailand Final Energy Consumption 2014

Final Energy Consumption



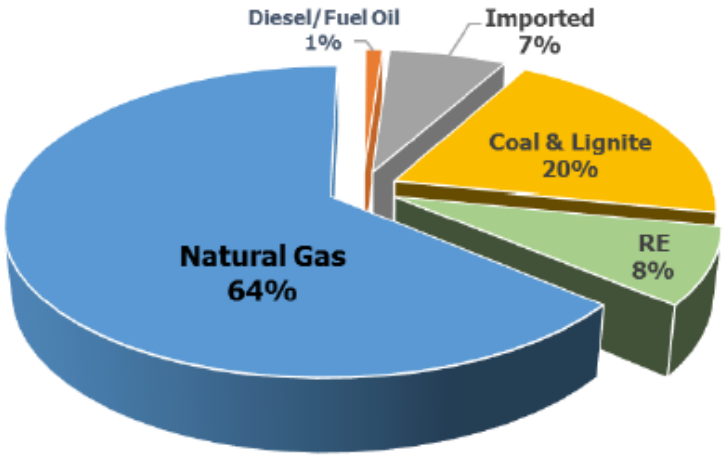
Renewable Energy Consumption



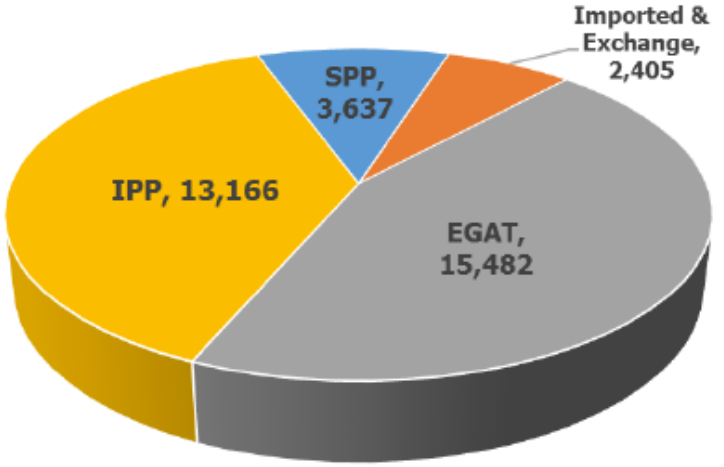
Source: http://www.egnret.ewg.apec.org/

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Power Generation by Fuel Type in 2014



Power Generation by Fuel Type



Unit : ktoe

Power Generation by Producer

Source: http://www.egnret.ewg.apec.org/

Thailand's Power Development plan 2015-2036 (PDP 2015)

1) **Security**
   - o less dependent on natural gas (target is no more than 40% in 2036 from 65% as of now)
   - o rely more on alternative/ renewable energy, clean coal, and electricity import from neighboring countries.

2) **Ecology**:
   - o releasing 37% less carbon monoxide within 2036
   - o implementation of energy conservation in 4 key target groups: industry, business buildings, houses, and public sector.

3) **Economy**:
   - o determining appropriate electricity rate that effectively reflects actual cost, production/transmission/sales systems

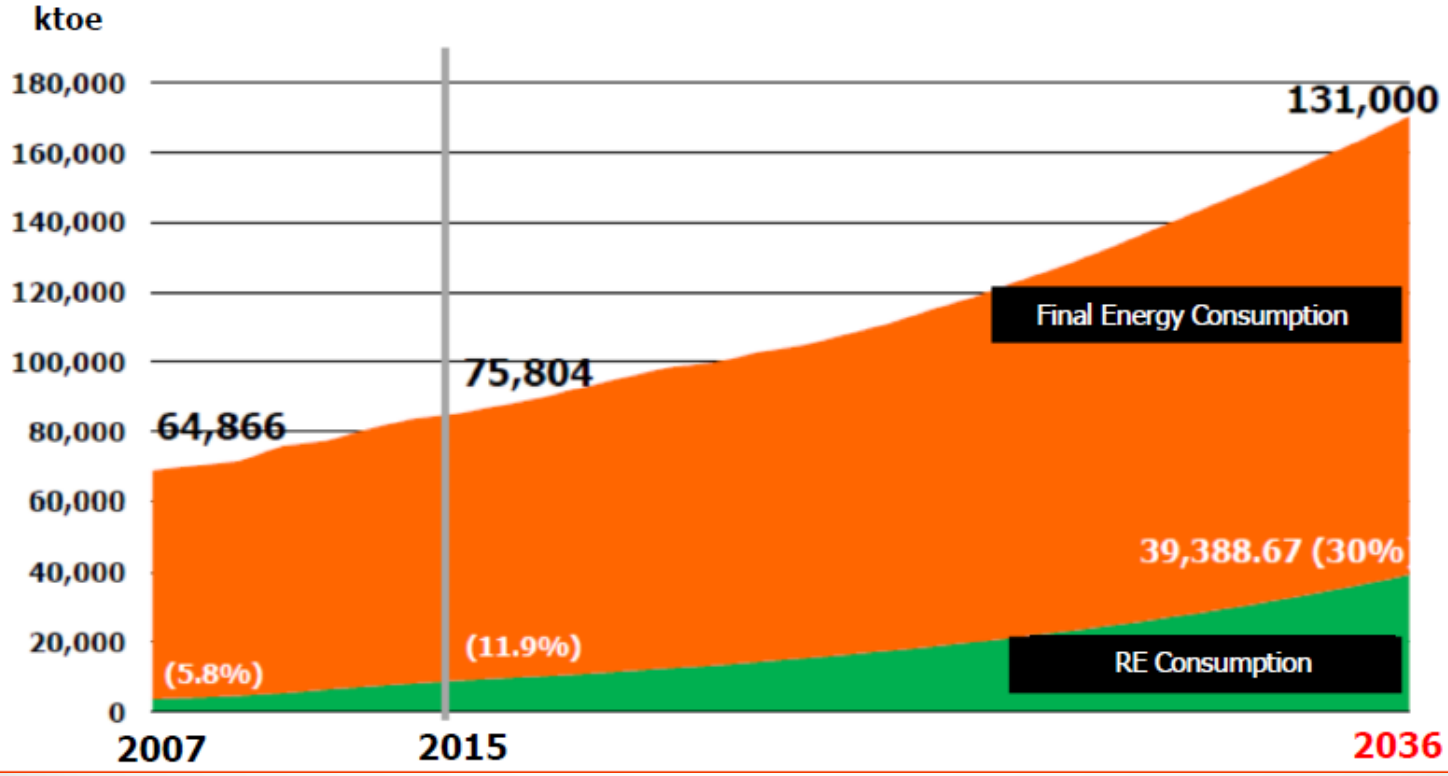
- Source: http://www.thaigov.go.th/index.php/en/issues/item/93134-93134.html

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

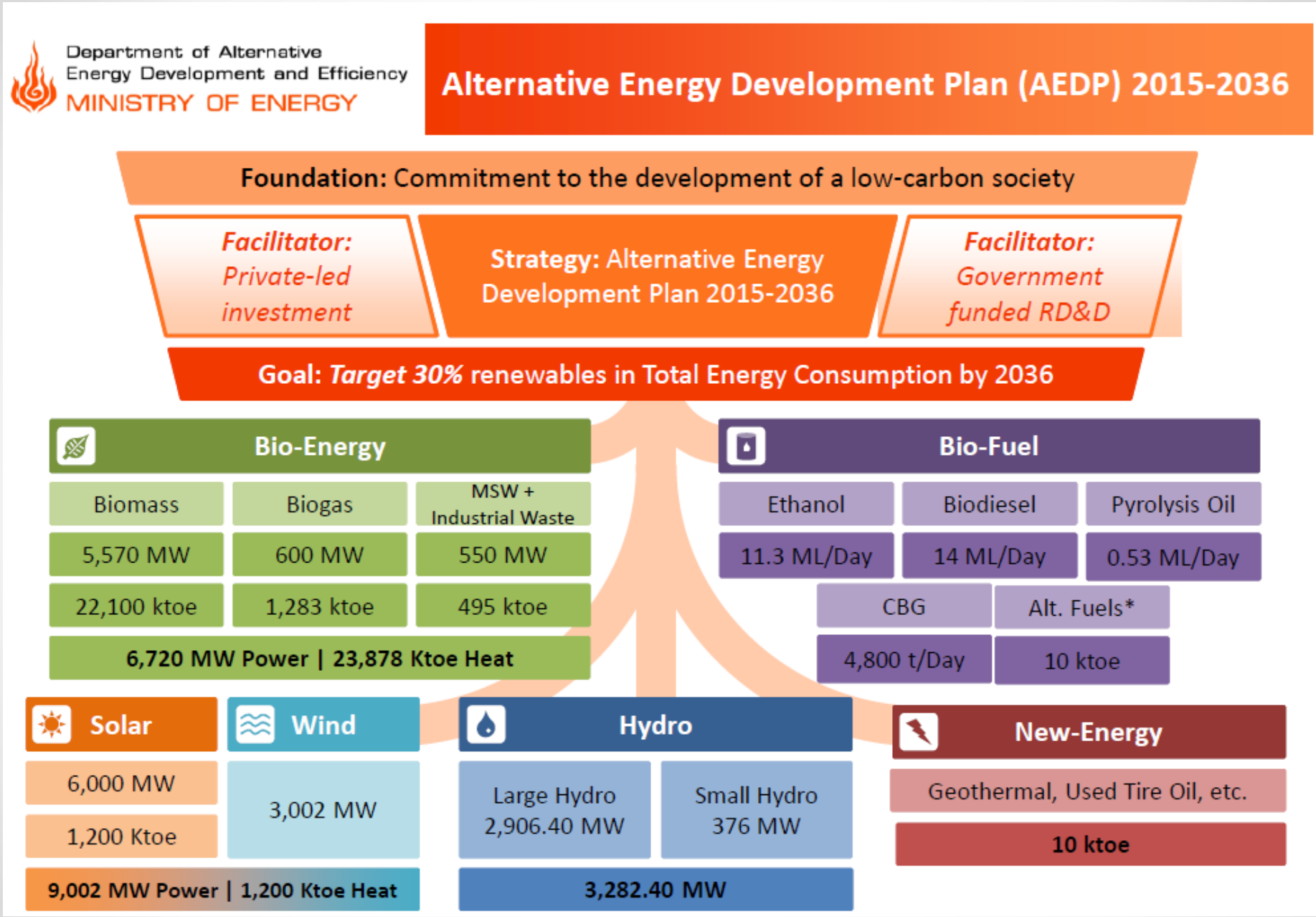
Alternative Energy Development Plan (AEDP) 2015-2036

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

Target	ktoe
RE Consumption (ktoe)	39,388.67
Final Energy Consumption (ktoe)	131,000
RE share (%)	30%



Source: http://www.egnret.ewg.apec.org/



Source: http://www.egnret.ewg.apec.org/

Energy Crisis: Protesting

- Previous experiences: Health and environmental impacts
  - Case of Mae moh power plant

- Uninformed citizen
- Miscommunication

Education as a solution

Energy Education in Thailand

Thailand educational context

- 400,000 teachers
- Large class size
- Small –medium size schools have no enough science teachers for all disciplines
- 10% of science teachers were tested and ranked in low proficiency base on their test score.
- 80% were ranked in medium proficiency.
- Difficult to access to books and expensive materials.

How textbooks and materials can help teachers?

Developing textbook for Thai teachers

- Textbook has to be completed package
  - Textbook
  - Teacher guidebook
  - Suggested lesson plan
  - Assessment
  - Material kits
- Additional materials
  - Additional activities (STEM activity)
  - AR (Augmented Reality)
  - Learning Objects
  - Ebook

Overview of Energy Education

- 2008: The Basic Education Core Curriculum
- 2010: Coordination with ministry of energy
- 2011: Launched Fuel energy for transportation textbook
- 2013: Hawaii-Thailand-Lao STEM Education
- 2013: Launched Renewable energy textbook
- 2013: National and reginal STEM center
- 2014: Energy STEM project

Partners

กระทรวงพลังงาน
MINISTRY OF ENERGY

Island Energy Inquiry™

สสวท

STEM EDUCATION THAILAND สะเต็มศึกษา ประเทศไทย

Empower world class
teaching & learning experiences

DEPARTMENT OF THE NAVY
USN
ONR
Science & Technology

Overview of Energy Education

- **2008: The Basic Education Core Curriculum**
- **2010: Coordination with the ministry of energy**
- **2011: Launched Fuel energy for transportation textbook**
- 2013: Hawaii-Thailand-Lao STEM Education
- **2013: Launched Renewable energy textbook**
- 2013: National and reginal STEM centers
- 2014: Energy STEM project

Why energy literacy?

Sufficient information to make a decision related to Energy

Leading to sustainable use of resources

Development of economic and society

Reducing environmental impacts

Secure the nation energy supply

กระทรวงพลังงาน
MINISTRY OF ENERGY

Early take on Energy education and STEM

Fuel energy for transportation

Renewable energy

Put them into real classroom

- Teacher does not like extra works.
- Need to be aligned with curriculum.

Science Curriculum

Basic Science Core

- M.1-M.3 (G 7-9)
- 120 Hrs/ year
- Basic science concepts
  - Force and motion
  - Energy
  - Electricity
  - etc
- Under revising process

Additional Science

- M.1-M.3 (G 7-9)
- 80 Hrs/ year
- Theme-based textbook
- Integrated science
  - **Fuel energy for transportation**
  - **Renewable energy**
  - Science and beauty
  - Scientific toy
  - Science project

Fuel Energy for Transportation

Textbook

Teacher guide

Fuel Energy for Transportation

CH 1: Petroleum exploration and production

CH 2: Petroleum products

Fuel Energy for Transportation

CH 3: Current situation of fuel energy in transportation

CH 4: Renewable energy in transportation

Renewable Energy

Textbook

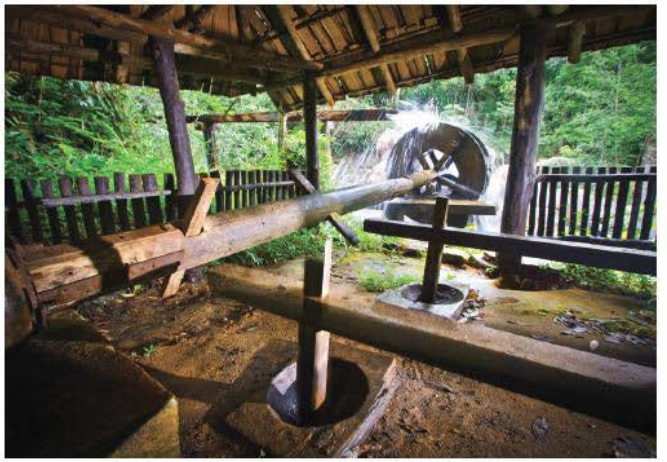
Teacher guide

The focuses of each chapter

- Energy in everyday life
- Generating electricity
- Advantage and disadvantage

Renewable Energy

CH 1: Hydro Power



Renewable Energy

CH 2: Wind Power

ใช้หมุนกังหันลมเพื่อฉุดระหัดในการวิดน้ำเข้านาเกลือ

Renewable Energy

บทที่ 3
พลังงานแสงอาทิตย์

CH 3: Solar Power

การตากแห้งอาหาร

การผลิตเกลือสมุทร

Renewable Energy

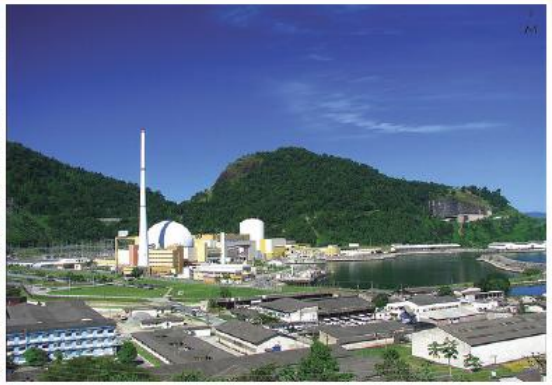
บทที่ 4
พลังงานชีวมวล

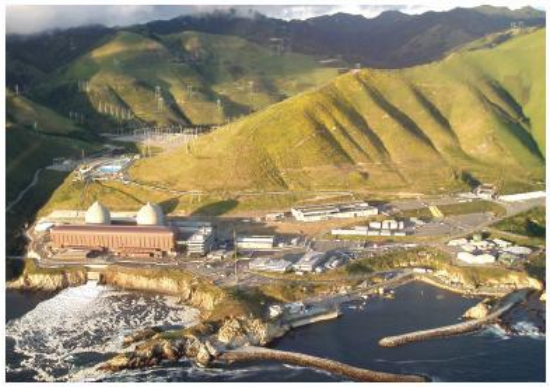
CH 4: Bio-Mass/ Bio Fuel

Renewable Energy

บทที่ 5
พลังงานนิวเคลียร์

CH 5: Nuclear Power





Promoting the Fuel energy for transportation and renewable energy textbook

2014-2016

- Professional development: 16 PDs throughout Thailand
- At least 1600 teachers were trained.
- Supporting textbook and teacher guidebook
- Supporting materials
- Energy projects award in schools
- Scholarship students

2016-2017

- Program evaluation

- Integrated Science concepts
- Early attempt on STEM
- Activities are mostly cook-book style
- No strong evidence of engineering design process

Overview of Energy Education

- 2008: The Basic Education Core Curriculum
- 2010: Coordination with ministry of energy
- 2011: Launched Fuel energy for transportation textbook
- **2013: Hawaii-Thailand-Lao STEM Education**
- 2013: Launched Renewable energy textbook
- 2013: National and reginal STEM center
- **2014: Energy STEM project**

Hawaii-Thailand-Lao PDR STEM Education Project

Hawaii-Thailand-Lao PDR STEM Education Project

- Cooperation with the Office of Naval Research (ONR) and Maui Economic Development Board (MEDB)
- Hawaii-Thailand-Lao PDR STEM Education Workshop: Energy Conservation
- Participants
  - 12 Teachers
  - 5 Schools (4 in Thailand and 1 in Lao PDR)
- Workshop and conference in Hawaii

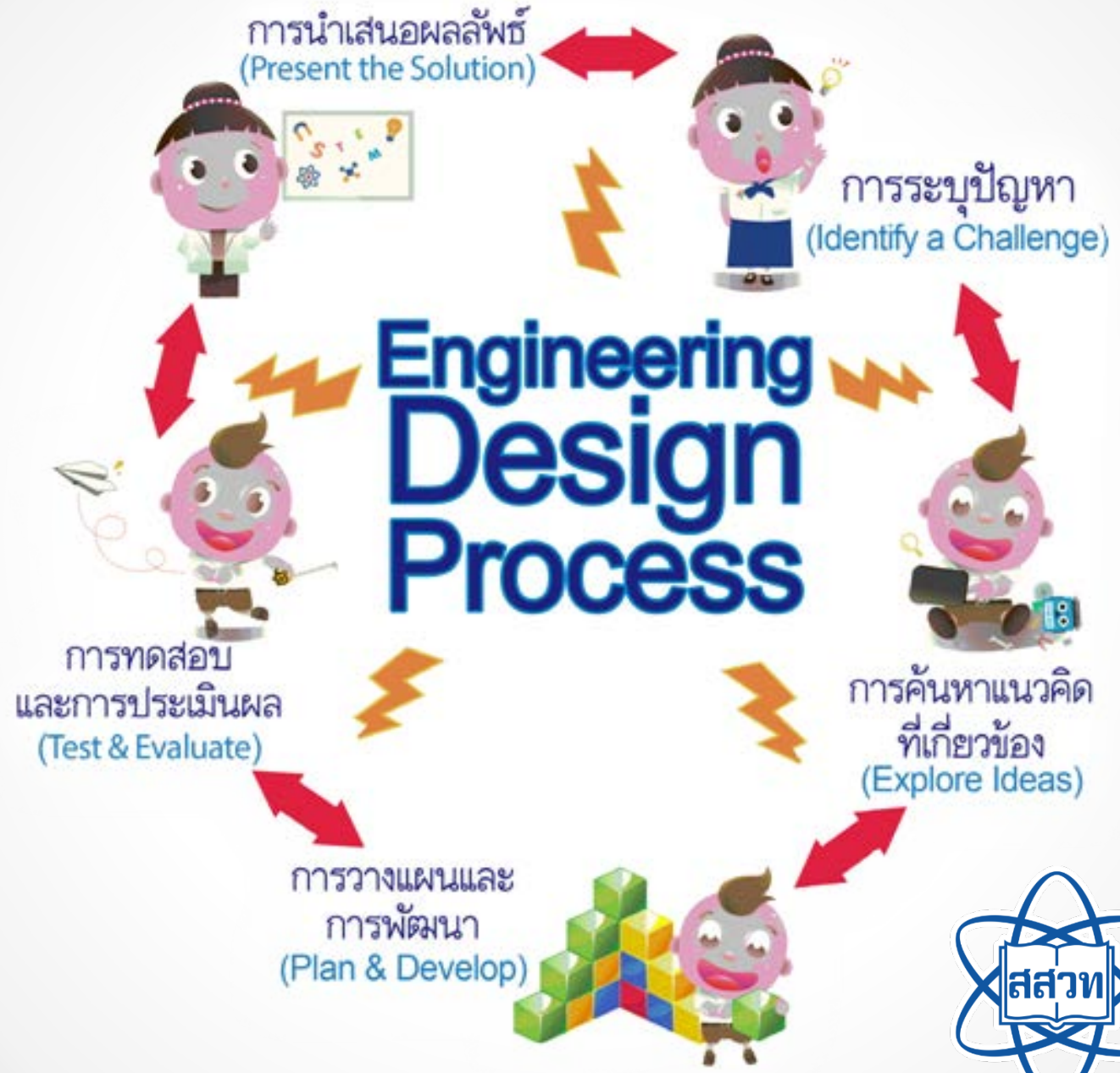
Energy STEM Project

- Design and redesign existing activities using STEM approach
- Addition to basic science curriculum and renewable energy textbook

Energy STEM Project

Features

- Engaging in inquiry process
- Connecting integrated STEM concepts to real world situations
- Enhancing problem solving and 21st century skills
- Highlighting engineering design process
- Designed for primary and secondary school levels

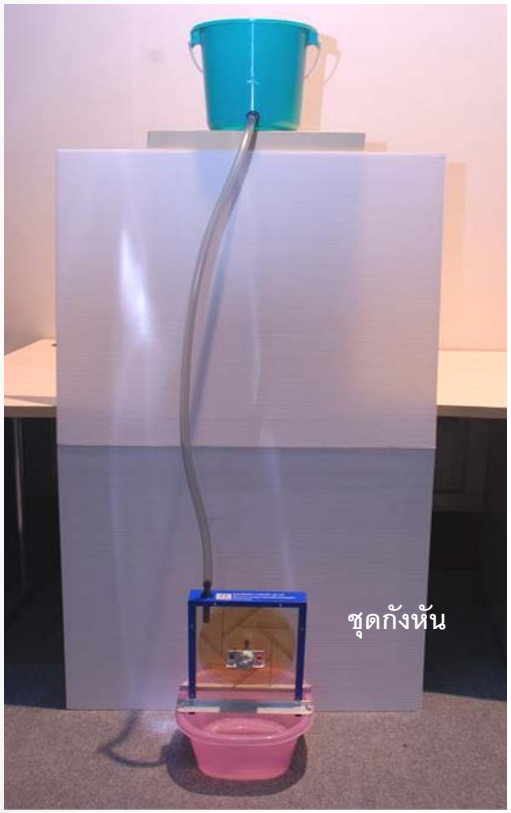


สสวท

STEM EDUCATION THAILAND สะเต็มศึกษา ประเทศไทย

Empower world class
teaching & learning experiences

Energy STEM Project



Science Lab

Engineering Design

Energy STEM Project

Products

- Activity book
- Teacher guidebook
- Suggested assessment
- Activity kits

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

Alternative Energy Development Plan (AEDP) 2015-2036

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

Wind

3,002 MW

9,002 MW Power | 1,200 Ktoe Heat

Hydro

Large Hydro 2,906.40 MW	Small Hydro 376 MW

3,282.40 MW

New-Energy

Geothermal, Used Tire Oil, etc.

10 ktoe

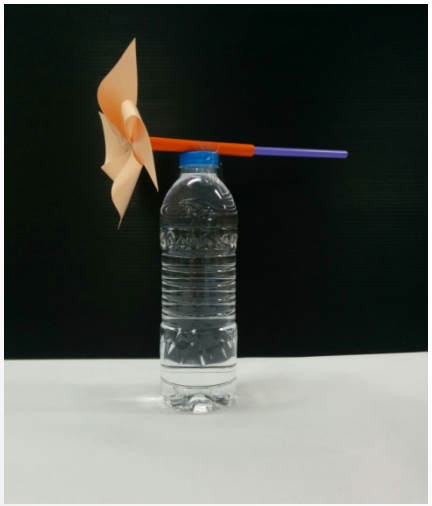
Source: http://www.egnret.ewg.apec.org/

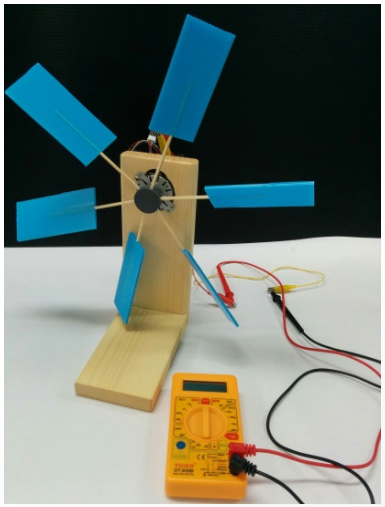
Energy STEM Activity

P.1-P.3	• Recognizing sources of energy
P.4 -P.6	• Harvesting energy by simple tools
M.1-M3	• Generating electricity

Energy STEM Activity

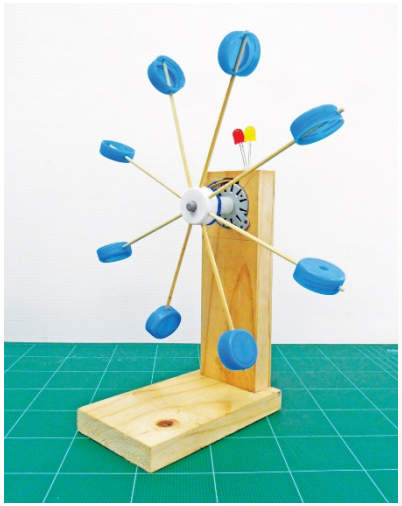
Wind energy	
P1-P3	Land windsurf
P4-P6	Hercules pinwheel
M1-M3	Wind turbine





Energy STEM Activity

Hydro energy	
P1-P3	Protecting wall
P4-P6	Water turbine
M1-M3	Hydro power



Energy STEM Activity

Solar energy	
P1-P3	Sunlight heat
P4-P6	Solar oven
M1-M3	Solar cell

Energy STEM Activity

Bio-Energy	
P1-P3	Toys from garbage
P4-P6	School Waste management
M1-M3	Biomass power

Energy STEM Activity

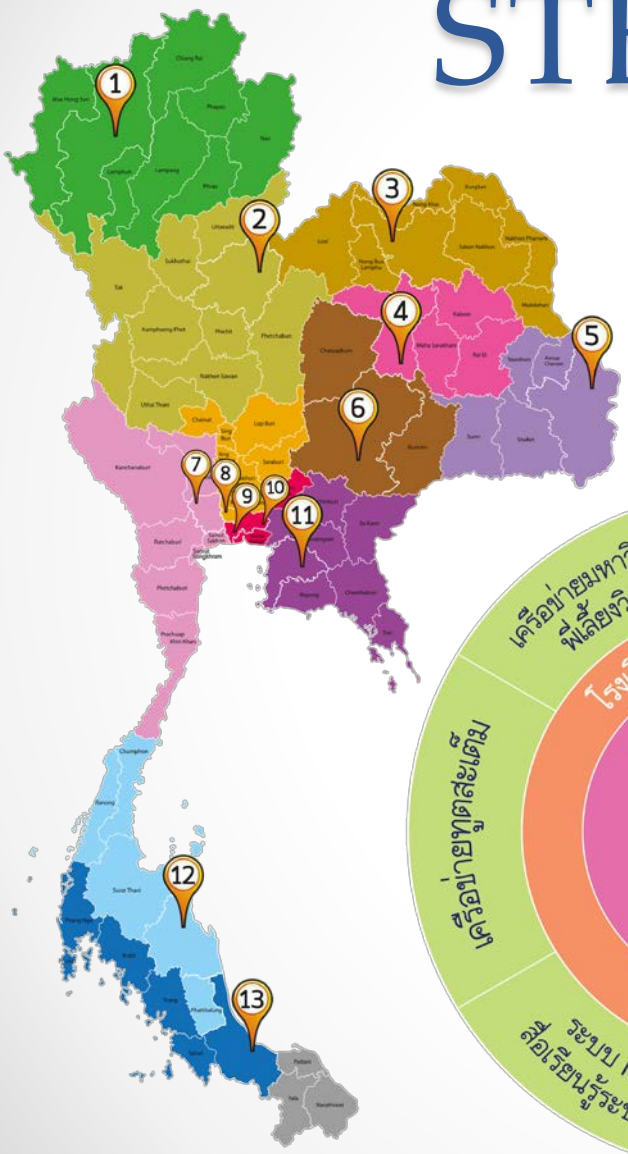
Power plant	
M1-M3	Choose and plan a power plant that suitable for your community

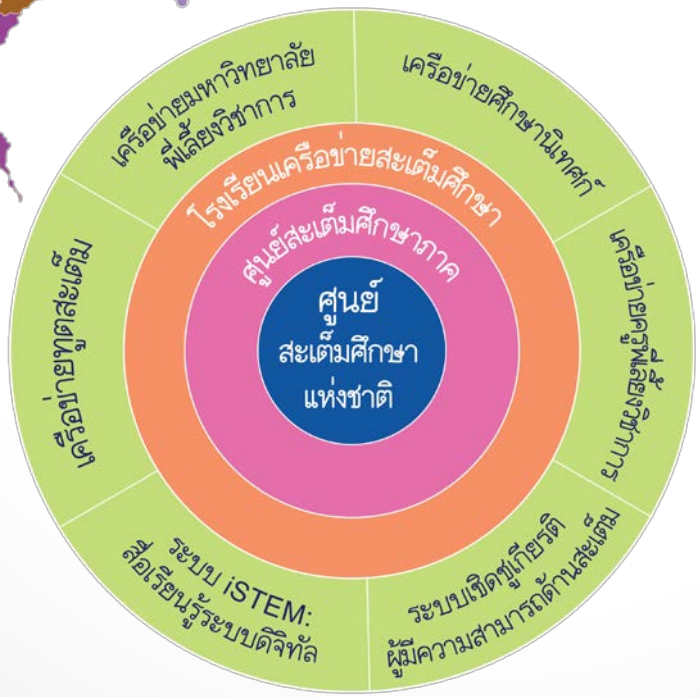
Energy STEM Activity

what's next

- Activity Trial (April 2016)
- Evaluation (May-August 2016)
- Revise
- Professional development (2017)
- Follow up & Evaluation (2017-2018)
- Research (2017-2018)

STEM Center





1. Chiang Mai
2. Phitsanulok
3. Ubon Thani
4. Khon Kaen
5. Ubon Ratchathani
6. Nakhon Ratchasima
7. Nakhon Prathom
8. Nonthaburi
9. Bangkok 1
10. Bangkok 2
11. Chonburi
12. Nakhon Si Thammarat
13. Songkhla

Niphon Chanlen, Ph.D.

The Institute for The Promotion of Teaching Science and Technology (IPST), Thailand

www.ipst.ac.th

+6623924021 #1212
nicha@ipst.ac.th