

# Agricultural Engineering and Technology for Food Security and Sustainable Agriculture in Thailand

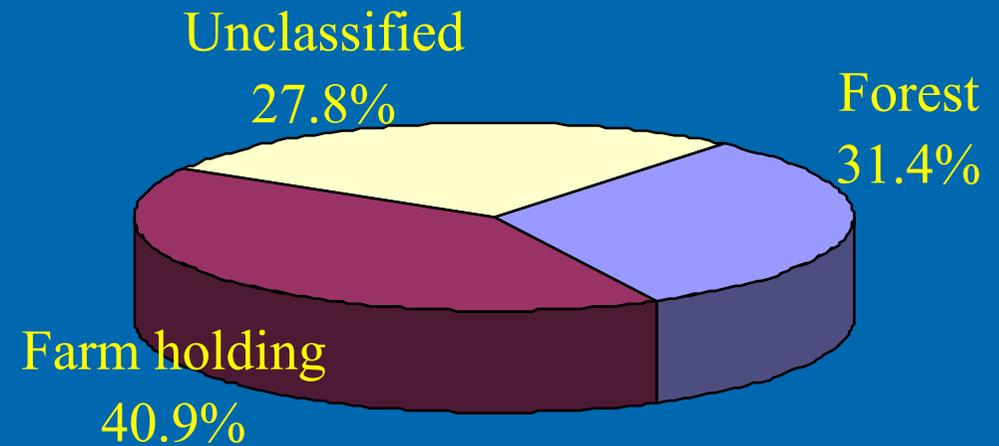
Viboon Thepent



# Presentation Outlines

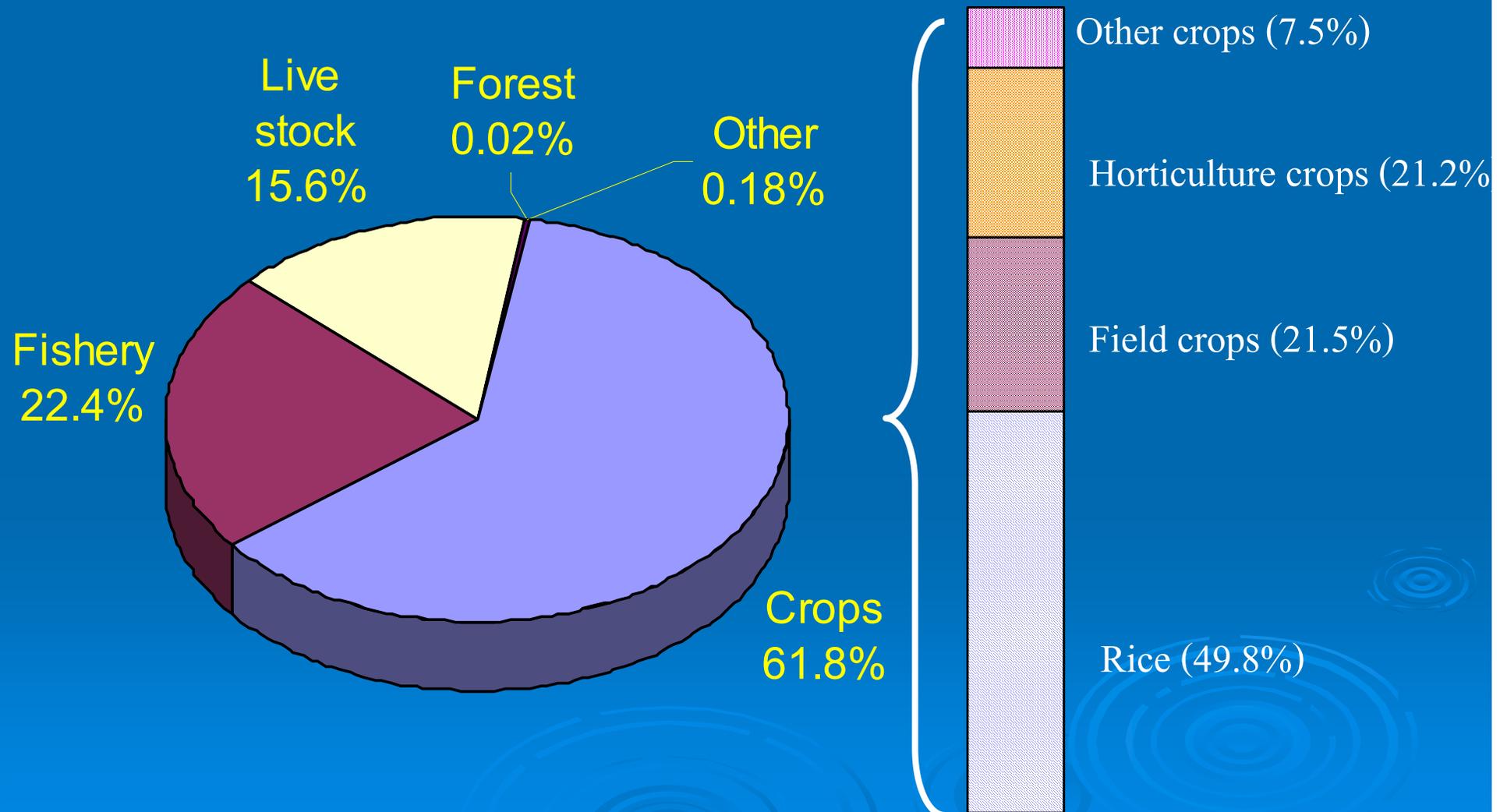
- **Introduction**
- **Agricultural and Food Development Goals**
- **Agricultural R&D for Food Security and Sustainability**
- **Conclusion**

# Thailand is an agricultural country



- 46.6% of population engage in agricultural sector.
- The world largest rice exporter
- 10.1% of GNP

# Contribution for agricultural sector



## 2. Agricultural and Food Development Goals

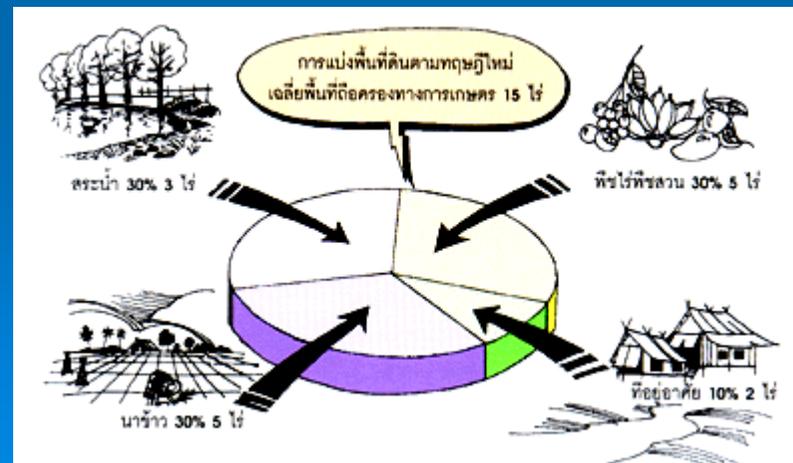
The Tenth National Economic and Social Development Plan (2007 – 2011)

The Plan will focus on 'human' as center of development efforts.

Three main elements are accentuated:  
sufficiency economic,  
sustainable development,  
long-term planning vision spanning the next 20 years to provide 'change management'.

## The Government policies and strategies relate to agriculture as following:

- Promote agricultural development based on the “New Theory” as an important alternative for small farmers; at the same time, expand opportunities for product development and improve product quality through the use of technology, management and access to markets;



-Local Community Products will be supported so that they are recognized by consumers as quality products in line with their market potential, whether at the regional, national or export levels;

this can be accomplished through the establishment of an integrated project management system that will improve technology and management as well as provide market support;

- Small and Medium Enterprises (SMEs): make use of the public-private sector alliance to increase the effectiveness of, and thereby strengthen, all SMEs through science and technology and management; in addition, special importance will be give to those SMEs that make use of intellectual property;

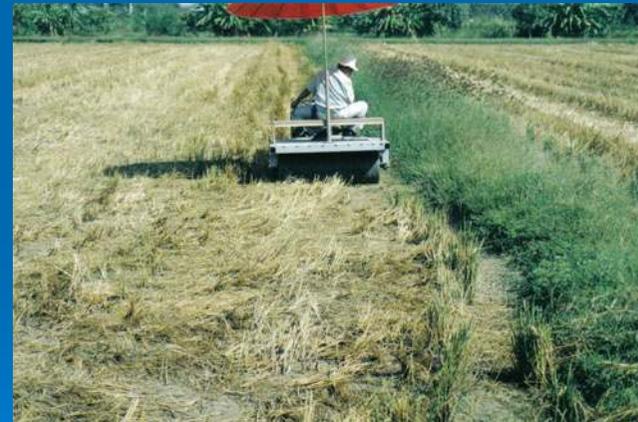
-Promote energy efficiency, energy saving, the development and use of alternative energy, the survey and development of domestic and international sources of energy-including the joint development areas with neighboring countries-the use clean energy, and appropriate price structure for energy and restructuring of the management of energy affairs by ensuring that there is a clear division between energy policy-making and regulation, and promoting long-term competition in the energy business as well as research and development of alternative energy.

### **3. Agricultural R&D for Food Security and Sustainability**

The research and development of agricultural technology in Thailand for food security and agricultural sustainable are:

## 3.1 Rice Cultivation by Stubble-Lodge Ratooning Rice

This method utilizes the rice stubbles from the previous harvest, allowing the apical buds on the stubbles to develop into full-grown plants which would later flower and produce seeds for another harvest. There are many positive effects of this method. There is neither the need to burn the paddy fields, re-till the soil, nor buy new seeds. It also reduces the amount of water needed and other production factors.



## 3.2 Rice Combine Harvester

The role of rice combine harvester in Thailand was considered to be on economic, social and agricultural production systems.

For economic aspect, the labor shortage in harvesting, the need in quality improvement of rice and cost reduction that lead to the utilization of rice combine harvester.

For social aspect, due to labour migration most available labour were the old people and children.

For agricultural production system, the rice combining harvester was necessary in timely harvesting for upland crop planting as a second crop after rice. In term of post-harvest loss, the use of combine harvester loss can be reducing when compared with traditional method.



### 3.3 Grain Dryer

Drying of wet paddy is done by the miller or by the collector using only dryer or both mechanical dryer and sun drying floor.

Types of paddy dryer used in Thailand are cross flow, mixed flow, fluidized bed and rotary dryer.

Head rice yield obtained from those dryers are higher compared to the sun drying floor method. Source of fuel used for generating hot air for drying is rice hull, and is mostly direct fire from the furnace.

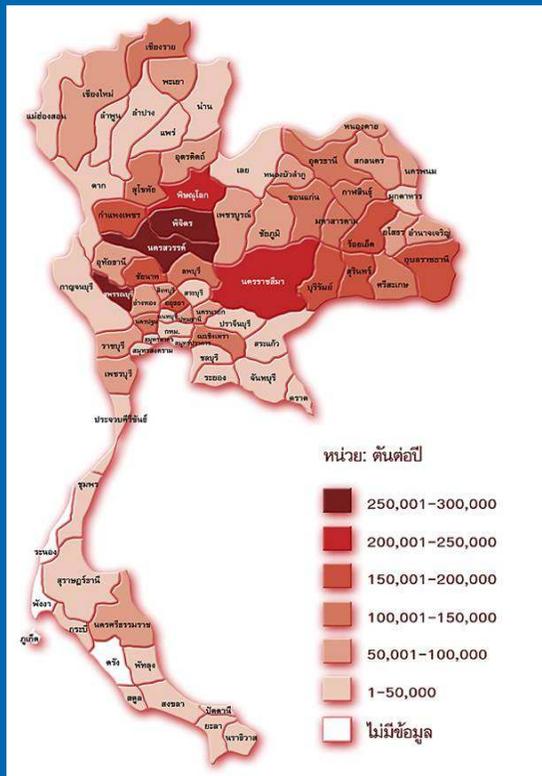


## 3.4 Biomass energy

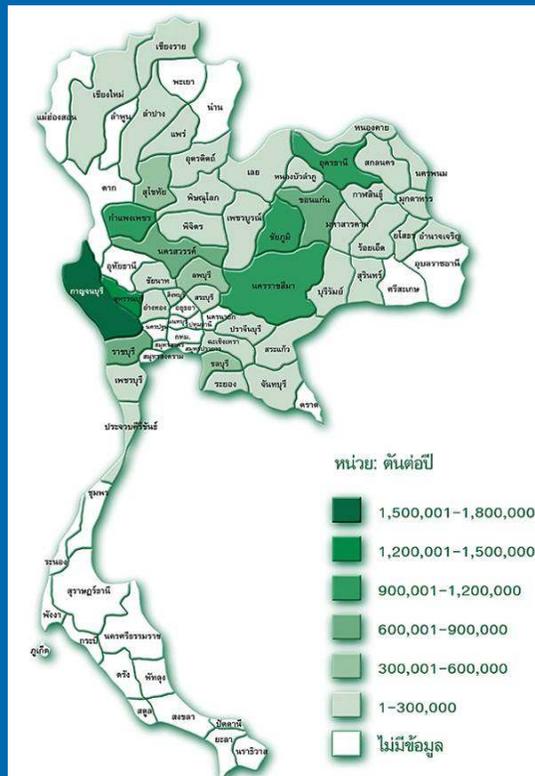
According to a recent study on Assessment of Sustainable National Biomass Resource Potential for Thailand, many potential biomass sources were identified, including agricultural and wood residues, wood fuels, new plantations, waste water from livestock farms and industries, and municipal solid wastes.

# Biomass Potential

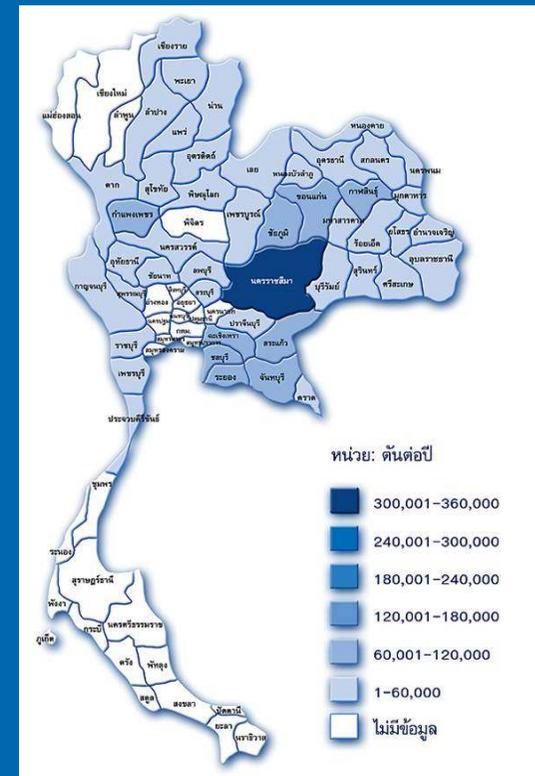
## Major agricultural residues in 2002/2003



**Rice husk 5.5 M tons/yr**  
**Power potential 560 MW**



**Bagasse 20 M tons/yr**  
**Power potential 1400 MW**



**Rhizomes 1.6 M tons/yr**  
**Power potential 110 MW**

# Rhizomes





Branch of palm oil

Corn cob



# Biomass are utilized as fuel for industrial' heat

## เตาแกเลบทอร์นาโด TORNADO HUSK FURNACE



ดอกบัวขาว  
WHITE LOTUS

ประหยัดพลังงานมากกว่า  
หาร 2 แต่ได้ความร้อนมาก

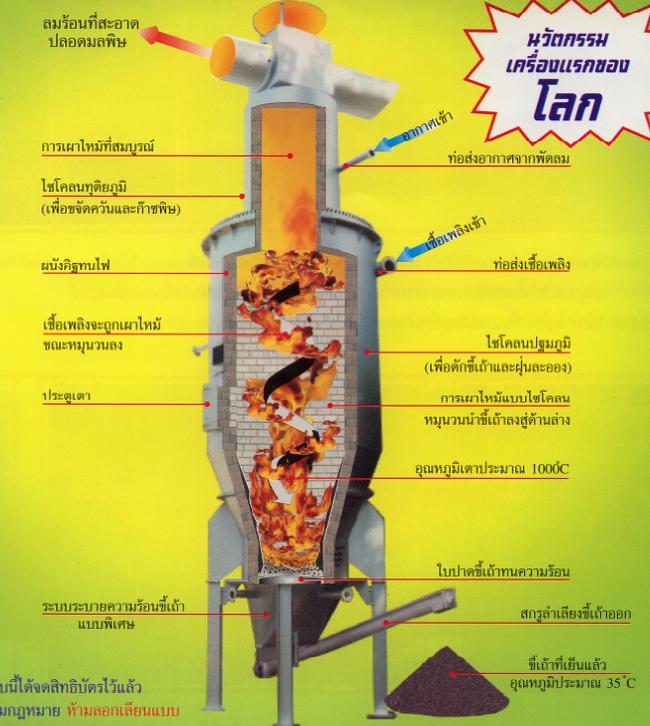
เตาแกเลบทอร์นาโด เป็นเครื่องกำเนิดความร้อนแบบประสม ใช้กลบซึ่งเป็นวัสดุเหลือใช้ทางการเกษตรเป็นเชื้อเพลิงทำให้อัตราต้นทุนด้านพลังงานต่ำ เมื่อเปรียบเทียบกับการใช้เชื้อเพลิงชนิดอื่น เตาแกเลบทอร์นาโดใช้การป้อนกลบด้วยการเป่ากลบเข้าห้องเผาไหม้ด้วยลมทางด้านบนของเตาการควบคุมการเผาไหม้ การป้อนกลบ และการเอาเถ้ากลบออก ทำได้สะดวก ง่ายด้วยวัสดุที่ใช้เป็นวัสดุทนไฟอย่างดีชนิดเดียวกับที่ใช้ในเตาหลอมเหล็ก ผู้ใช้จึงเชื่อมั่นได้ถึงความแข็งแรงทนทานอายุงานใช้ได้นานหลายปี นอกจากนี้โครงสร้างยังเป็นแบบถอดประกอบได้เพื่อความสะดวกในการติดตั้งเป็นต้นๆ นำมาประกอบเข้ากันด้วยสกรูและสลักเกลียวคือด้วยเซรามิกไฟเบอร์



รุ่น  
KF-4000

## RES RISE ไรซ์

เตาเผาแกเลบกำเนิดความร้อนแบบไฮโคลนคู่  
ไร้ควัน ปลอดภัย และรักษาสีแฉดล้อม



รูปแบบนี้ได้จดสิทธิบัตรไว้แล้ว  
สงวนสิทธิ์ตามกฎหมาย ห้ามลอกเลียนแบบ

ผลิตในประเทศไทย



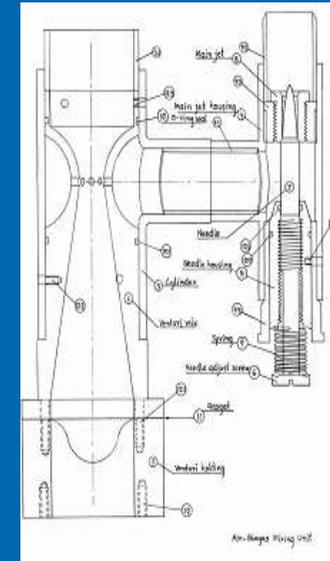
บริษัท ไรซ์ เอ็นจิเนียริ่ง ซัพพลาย จำกัด  
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Gasifier

**3.4.1 Biogas** - In addition to biomass residues, wastewater containing organic matters from livestock farms and industries has increasingly been used as a potential source of biomass energy. Biogas systems using anaerobic digestion techniques such as Up flow Anaerobic Sludge Blanket (UASB) and Fixed Film technology have substantially been established especially for pig farms and food processing industries. In general, the biogas systems can be locally produced and installed.



The biogas technology has been rapidly and widely accepted particularly in both large and small-sized livestock farms chiefly because the production of biogas in the livestock farms helps alleviate not only the pollution problems but also the energy cost by substituting the on-site use of fuel oil, LPG or electricity.

The production potential of biogas from industrial wastewater from palm oil industries, tapioca starch industries, food processing industries, and slaughter industries is also significant. It was estimated that in Thailand a total of 440 Mm<sup>3</sup> of biogas could potentially be produced from wastewater from such factories.

# Korat Waste to Energy - biogas

- Uses waste water from cassava to make methane
- Produces gas for all factory heat (30 MW thermal) + 3 MW of electricity
- Earns high market returns
- Developer estimates 300 MW from waste water + 800 MW from wet cake



**3.4.2 Ethanol** - The use of agricultural products, such as cassava and molasses, for ethanol production has been given particular attention since ethanol, which is 99.5% pure alcohol by volume, can replace the use of Methyl Tertiary Butyl Ether (MTBE), a fuel additive, which takes a long time to degrade. Each year Thailand spends more than 2 billion baht on MTBE import. Therefore, the use of domestically produced ethanol can contribute to foreign currency saving as well as mitigation of pollution problems resulting from fossil fuel combustion.

**3.4.3 Gasohol** - Gasohol is an alternative fuel for vehicles. It is a mixture of ethanol and regular gasoline at the ratio 1:9. The properties of derived gasohol are the same as Octane 95 gasoline. However, the use of gasohol will not only reduce oil consumption and air pollution from vehicle exhaust but also help farmers through the purchase of agricultural products, i.e. sugarcane and cassava.

# Gasohol Strategic Plan

Ethanol  
1.0 mill. lts /d

Ethanol  
3.0 mill. lts /d

2004

2005

2006

2007

2008

2009

2010

2011

**Phase I**  
MTBE replacement

**Phase II**  
Gasohol Mandate

Formulate policy on  
utilizing High  
Performance Vehicles  
for E10 and FFV

Formulated  
policy on fade out  
MTBE in ULG 95  
and promote  
Gasohol 91 in  
some areas

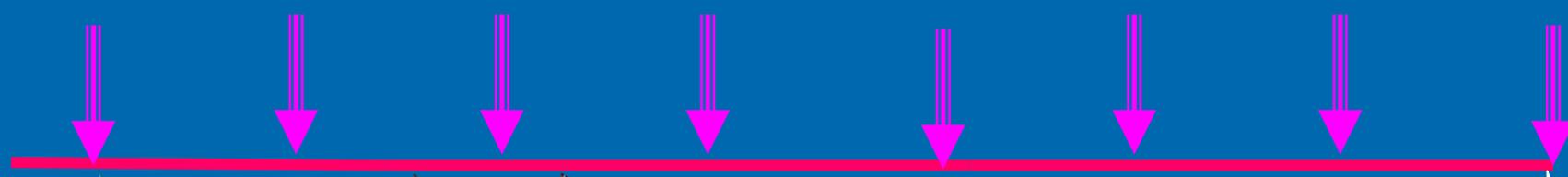
- Spec. of Gasohol 95 & 91
- Emission test on using Gasohol 95
- Defined gasohol use in Spec. of new vehicle procurement
- Requested governments' vehicles to refill gasohol

- Enforced government fleets use Gasohol
- Gas stations in govern. must sell Gasohol

**3.4.4 Biodiesel or Ester** - Biodiesel, or ester, another alternative fuel for vehicles, can be produced from oil plants such as coconut, soy bean, palm and sunflower via a chemical process (Transesterification or Alcoholysis), using alkaline as a catalyst to transform fatty acid into ester or biodiesel, which has similar properties to those of diesel oil.

# Biodiesel Strategic Plan

2004 2005 2006 2007 2008 2009 2010 2011



Research  
Demonstration

Incentive (Biodiesel Community base)

Biodiesel Mandate 10%  
Blend

Phase I: Specified areas

Phase II: Whole country

Prod. Cap.  
4.0 mill.lt/d

*Community based  
Biodiesel Pilot  
Project  
Development*

*Specification of  
B100 & B5, B10*

*Industrial based  
Biodiesel Development*

# Biodiesel : Business Model

Blending Facilities

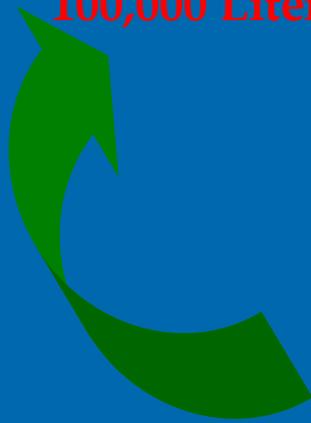


Farmers 60,000 Rai



Business  
Feasibility

100,000 Liters/day



Biodiesel Plant



Extraction Plant



Will produce in  
the 4<sup>th</sup> year and  
last 21 years



Glycerin

Oleochemical

Vitamin A,E

Value-added

Biodiesel Complex

**Biofuels** were developed as part of plans to limit and reduce greenhouse gas emissions, held responsible for global warming, but since they take up land that would otherwise be used for food production, they have been increasingly blamed for soaring food prices.

**3.5.1 Solar dryer** - The solar dryer in Thailand was employed many years ago but it has not been disseminated well due to lacking of technology transfer to farmers.

In addition, most research work has been focused on industrial scale with high capital cost, which obstructs most farmers who have low capital income.

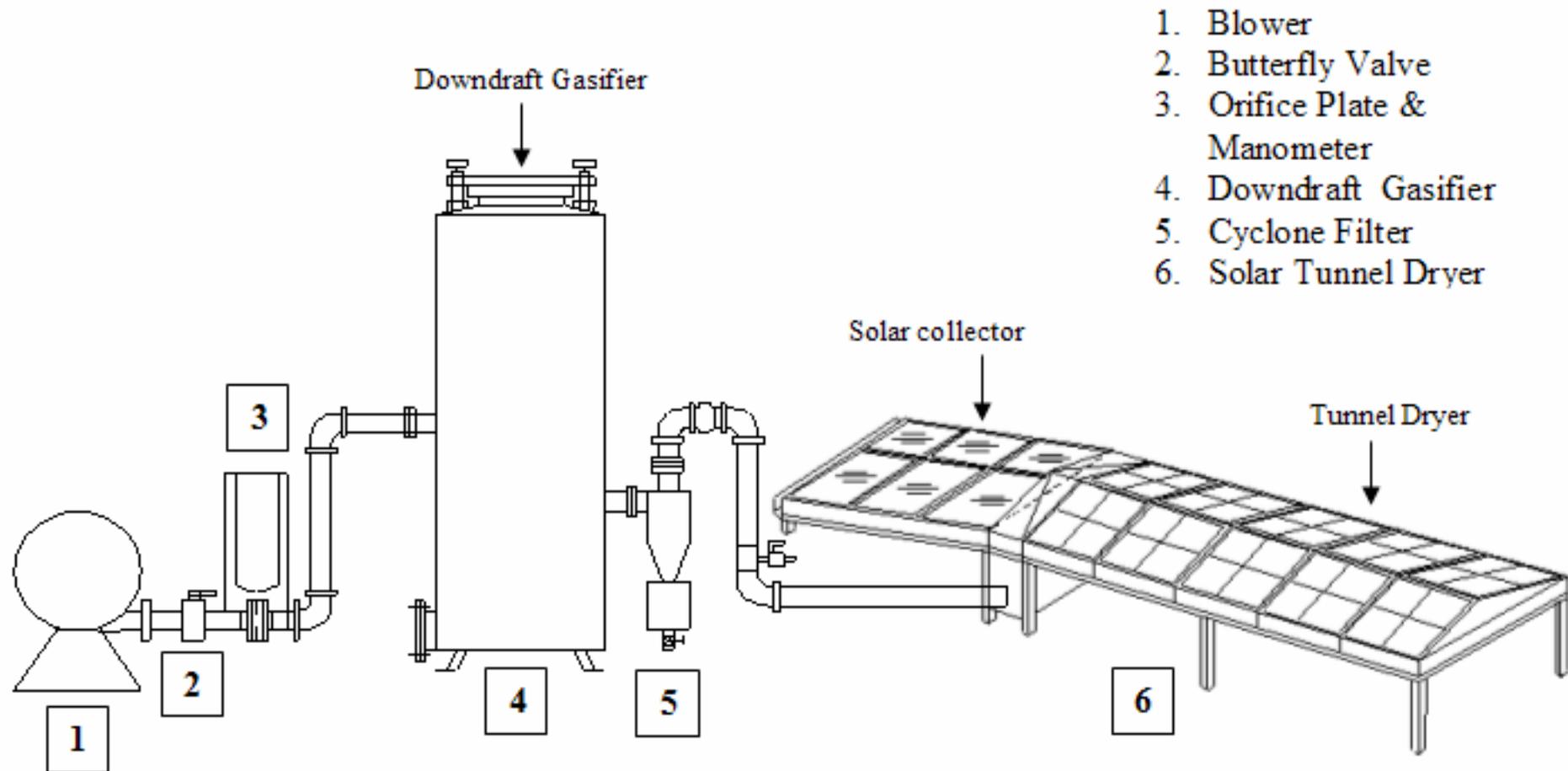
There are a number of solar dryer projects in Thailand at present. Some of these projects are as follow:

# Greenhouse dryer

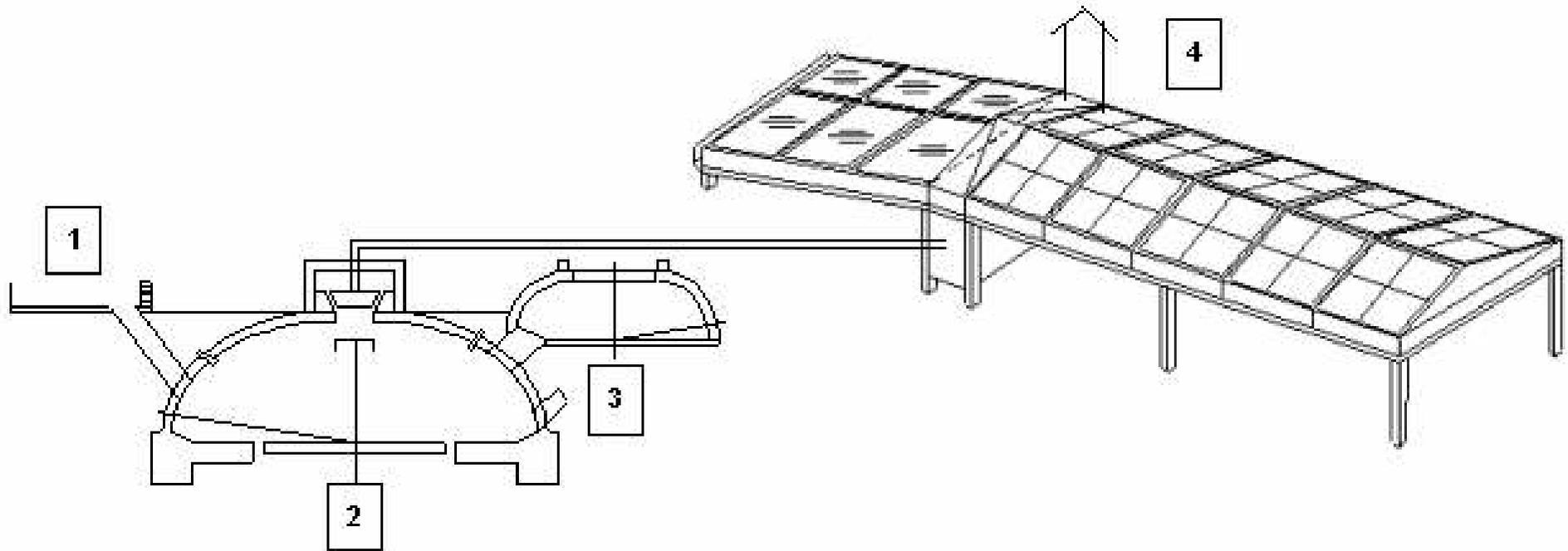




# Solar Tunnel Dryer for Agricultural Products Combined with Biomass Gasifier



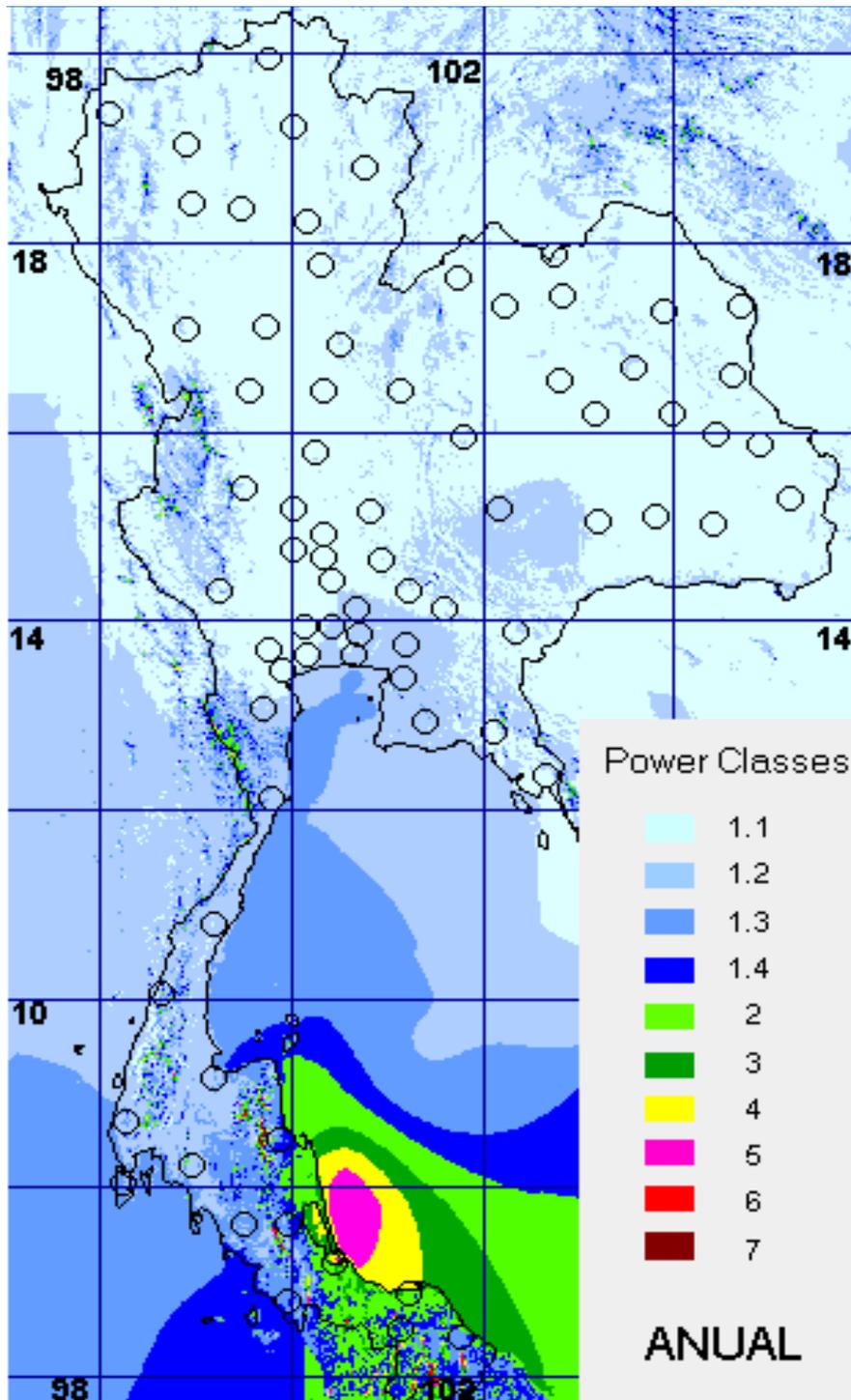
# Solar Dryer Combined with Biogas



# Wind Energy Potential Map

Average speed 4.4 - 6.4 m/sec

Power Potential 1,600 MW





# Conclusion

Actions taken to minimize the cause of climate change benefit the world. Reducing greenhouse gas emissions must prioritize mitigation measures in the energy sector, which includes less dependence on fossil fuels and moving increasingly towards renewable energy alternatives as well as more efficient energy.