Market Incentive - Programme of Activity (PoA) for Biogas

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GIZ Biogas Technology: Status and Trend in Asia *May 22-23, 2011 Bangkok, Thailand*

Outlines

1. History of Biogas in Swine Farms
2. Climate change and CDM
3. CDM Programme of Activities
4. Case study of PoA: Biogas from Swine Farms
5. Conclusions

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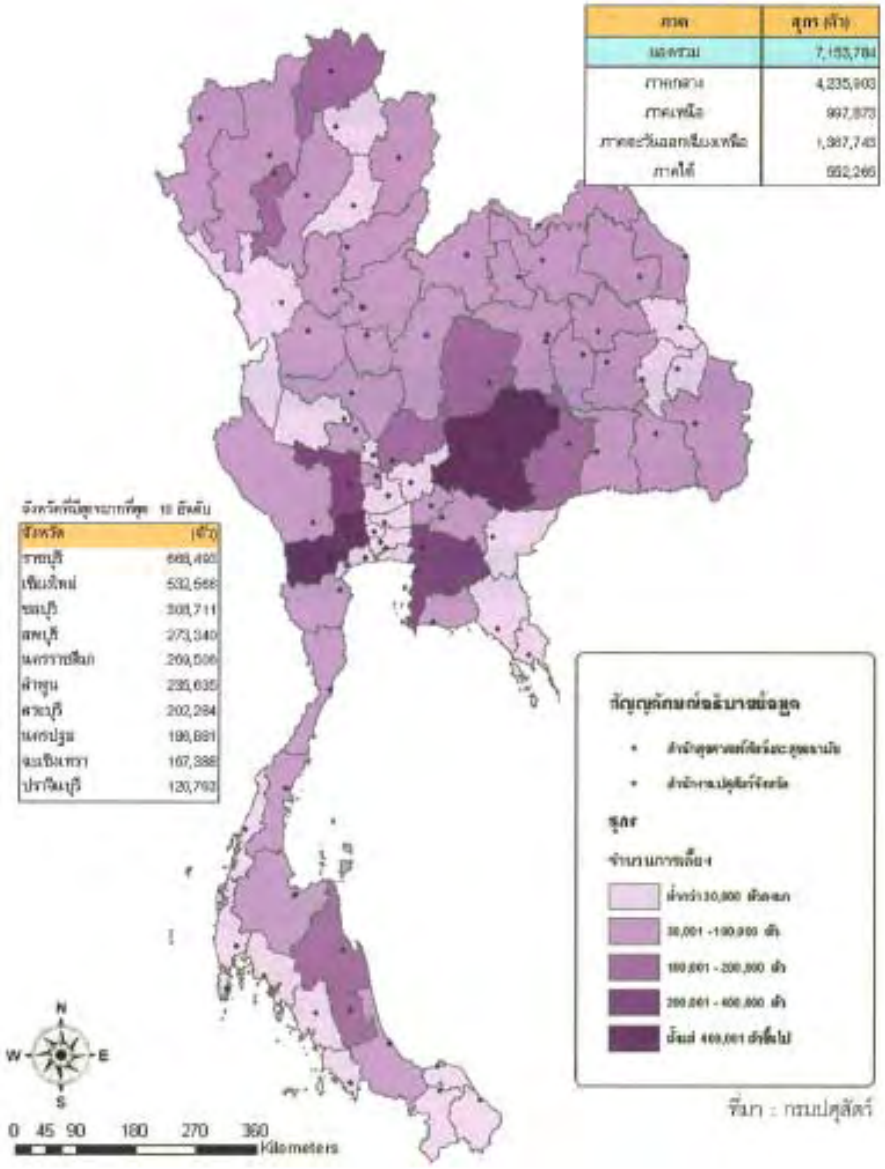
History of Biogas in Swine Farms

ประวัติอย่างย่อของก๊าซชีวภาพในฟาร์มปศุสัตว์ของไทย

Swine in Thailand



There are 7.1 million swines in Thailand

Farm size	head	Est. of farm	Total (Million)
Small	50-500	>200,000	3
Medium	500-5,000	1,309	1.36
Large	>5,000	186	2.78

Source: Department Livestock Development, 2006

Historical background: from project to institute

1988: Thai-German Biogas Program (TG-BP) by Chiang Mai University + Dept. of Agricultural Extension under support of GTZ (now, GIZ) initiated. Started from one research project

1991: Biogas Advisory Unit (BAU) established under CMU to promote and implement biogas technology in pig farm industry supported by Thai government (EPPO and ENCON Fund)

2003 : BAU transformed to Biogas Technology Center (BTC)

2008: Transformed to Energy Research and Development Institute-Nakornping (ERDI) directly under Chiang Mai University Council

http://www.erdi.or.th

Promotion of Biogas production: Swine manure

- **Small scale > Dpt. of Agricultural Extension (DOAE)**

- Implemented by DOAE since 1996-2004, now ERDI
- Installed 1,655 fixed dome biogas unit
- Total digester volume is 75,000 m^3
- Government subsidized 45%

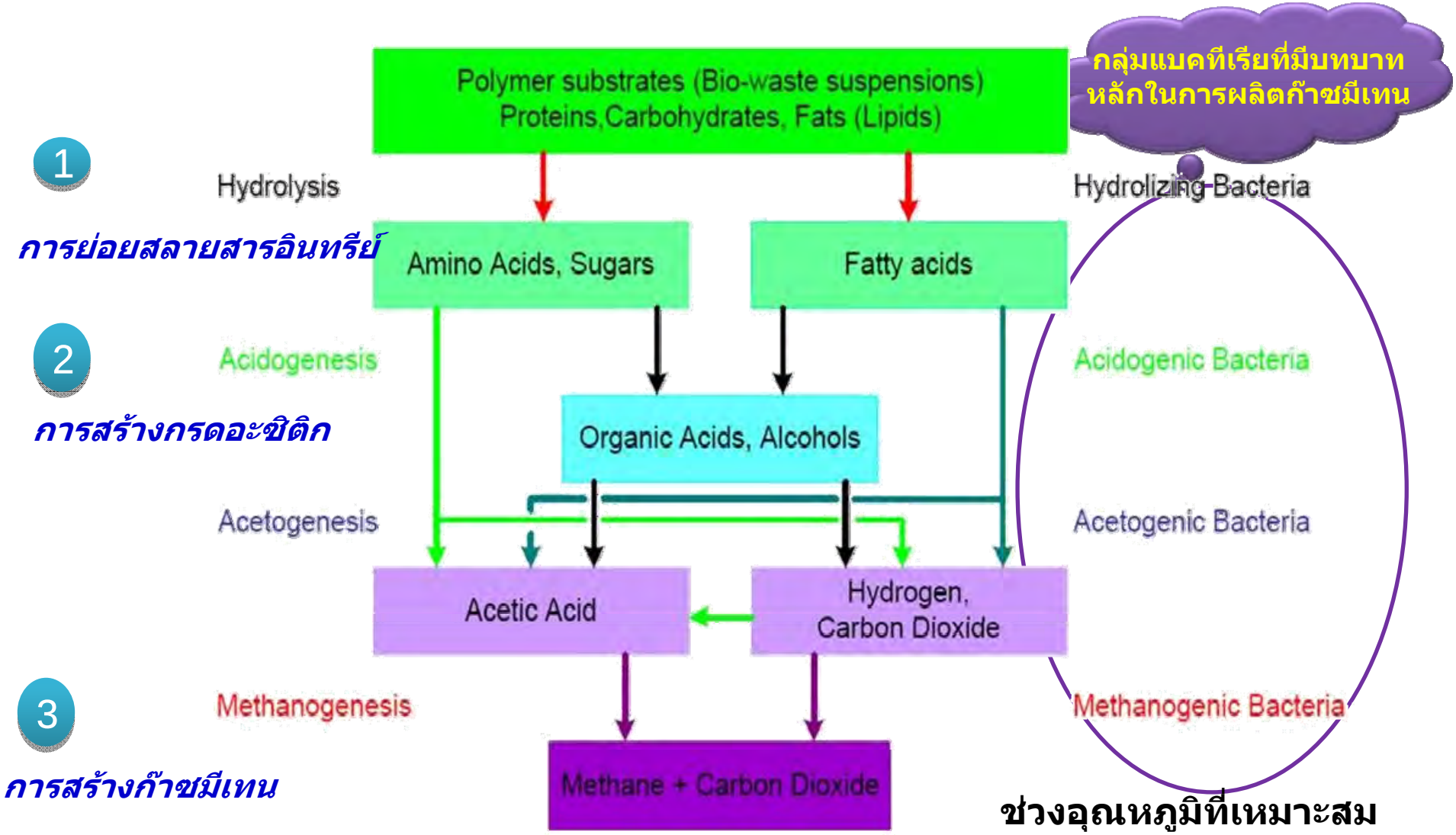
- **Small-Medium-Large farms > ERDI of Chiang Mai University**

- The technology modified from an imported prototype in 1984
- Installed >1,300 farms in small-medium-large farms
- Channel Digester + UASB, remove 80-90% COD
- Government subsidized: Phase I (1995-1998) 47%, Phase II (1997-2003) 33%, Phase III (2002-2011) 18% and Phase IV (2009-present)

- **Financial support by: Energy Conservation Promotion Fund through Energy Policy and Planning Office (EPPO), Ministry of Energy**

Now: *We're doing biogas on Swine & chicken farms, Palm oil mill, Poultry Slaughterhouse and various agro-industry & CDM*

Biogas Technology



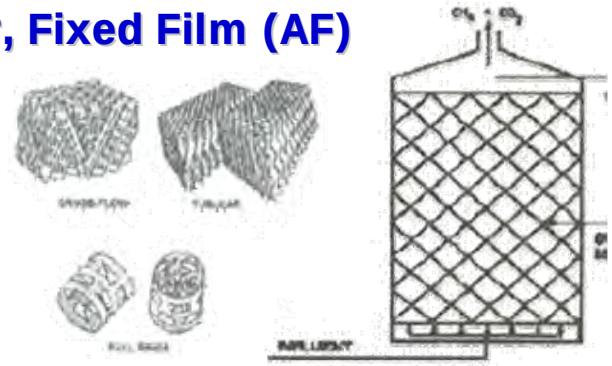
ช่วงอุณหภูมิที่เหมาะสม
30-35^{O}C และ 50-60^{O}C

Source: EPPO by Chananan Buakhiew

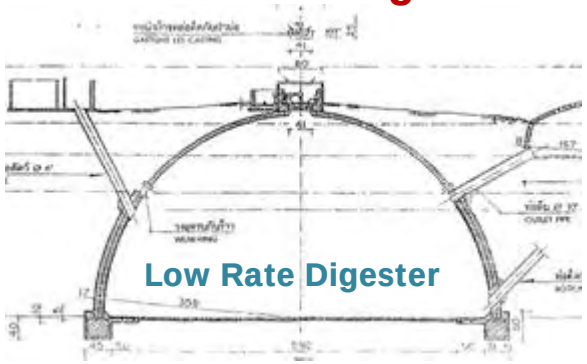
Biogas Technology

Anaerobic Filter, Fixed Film (AF)

Media

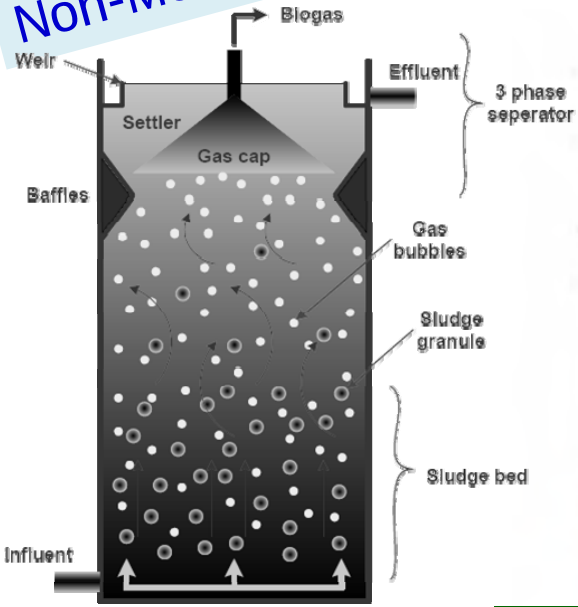


Fixed dome digester



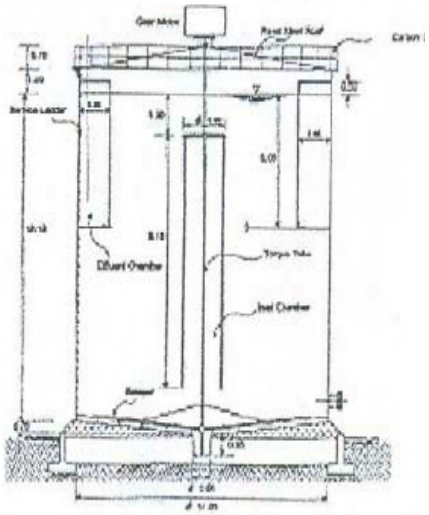
Upflow anaerobic sludge bed (UASB) reactor

Non-Media

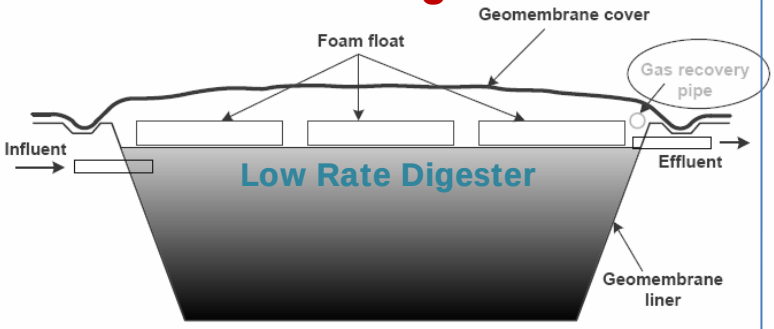


Continuously Stirred Tank (CSTR) Reactor

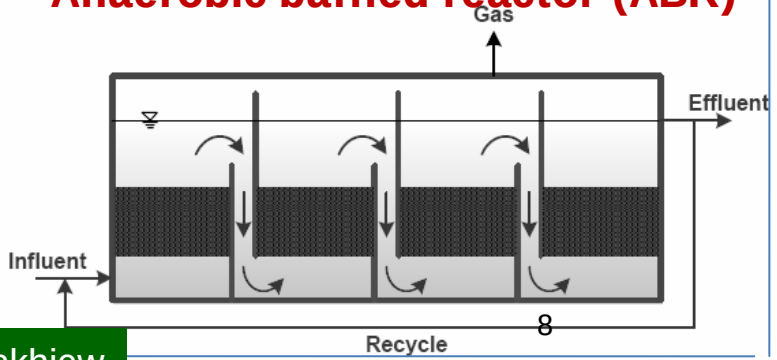
Low Rate Digester



Cover lagoon



Anaerobic baffled reactor (ABR)

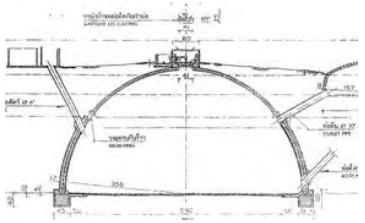


Source: EPPO by Chananan Buakhiew

Biogas Technology

Anaerobic Filter, Fixed Film (AF)

Fixed dome digester



Upflow anaerobic sludge bed (UASB) reactor

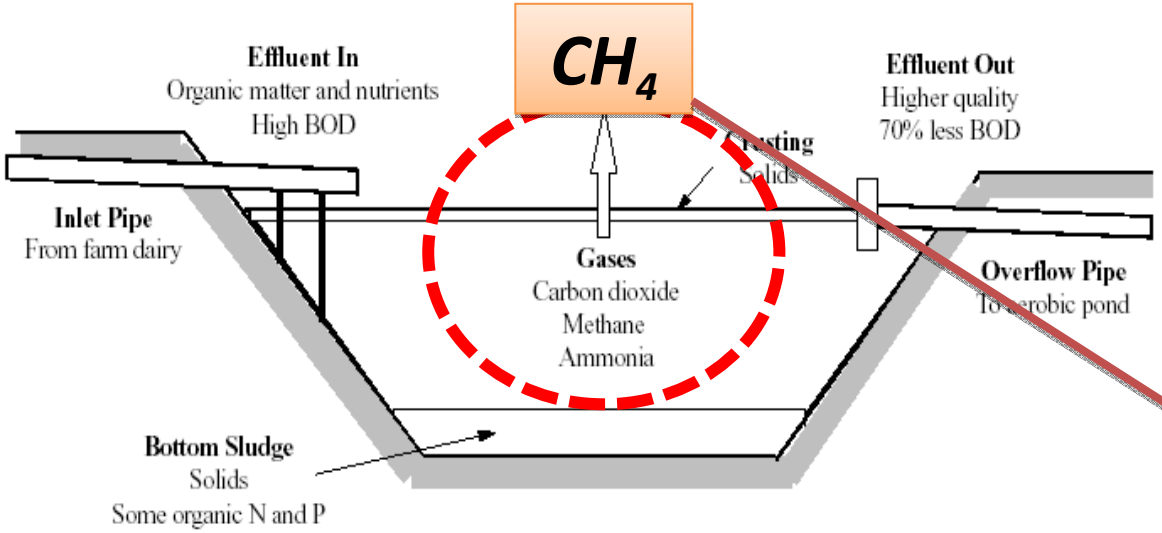
Floating Drum

Cover lagoon

Continuously Stirred Tank (CSTR) Reactor

Source: EPPO by Chananan Buakhiew

Biogas and Methane recovery

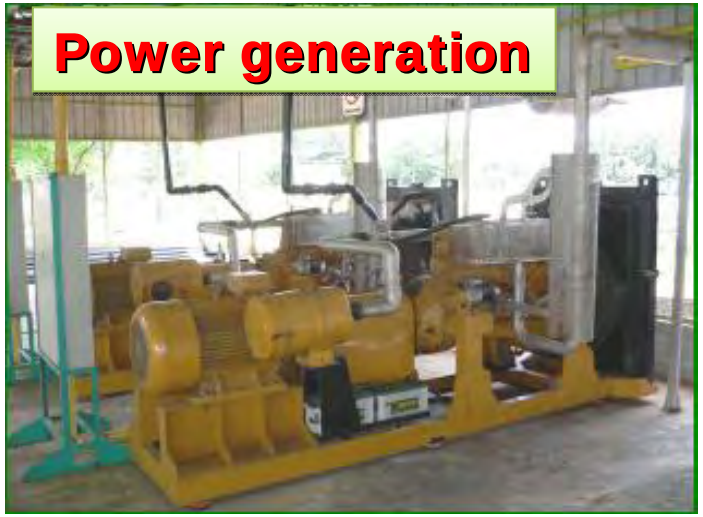


ระบบบ่อหมักแบบเปิด (Aerobic Pond)

- Biogas system recovers methane which generated from the wastewater treatment's methanogenosis process,
- Biogas, which has 60-65% methane (CH_4) proportion, can be used as fuel or power generation through gas engine,
- From Kyoto Protocol, CH_4 has **21 times** of global warming potential compared with CO_2 and we can be sold the CH_4 mitigation as Carbon credit (CERs).

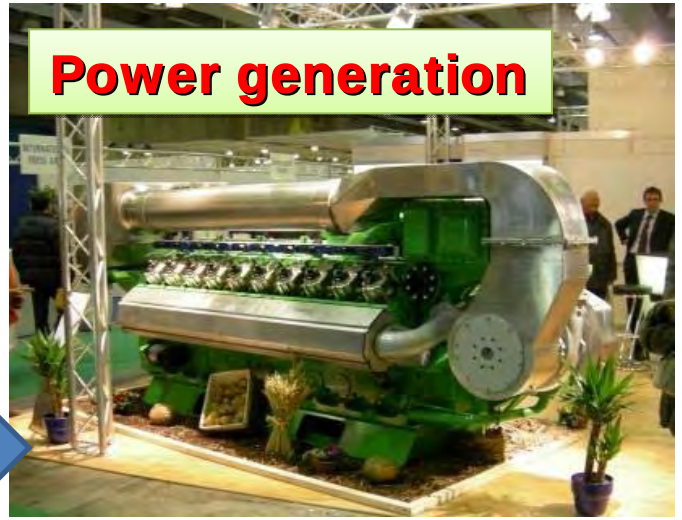
Biogas utilization

Fuel oil substitution
(e.g.cassava starch, slaughterhouse factory)



Modified gas engine

Power generation (e.g. palm oil mill ethanol, cassava starch, food , swine farms, etc.



Biogas engine

Facts: Biogas from swine farm

- 1 LU = 500 kg = Average 8.3 pigs
  - 37-40 liters/day
    - ❖10-12 kg of solid waste
    - ❖25-27 liters of urine
    - ❖185-190 liters/day of water/farming activity
  - 0.9 cu.m./day (@ 0.55 biodegradable rate)
- 65% Methane in biogas with 0.00067 ton per cu.m density
- 1 cu.m. of Biogas equals to
  - 0.46 kg LPG
  - 0.67 liters of gasoline
  - 1.2-1.4 kWh (modified gas engine)

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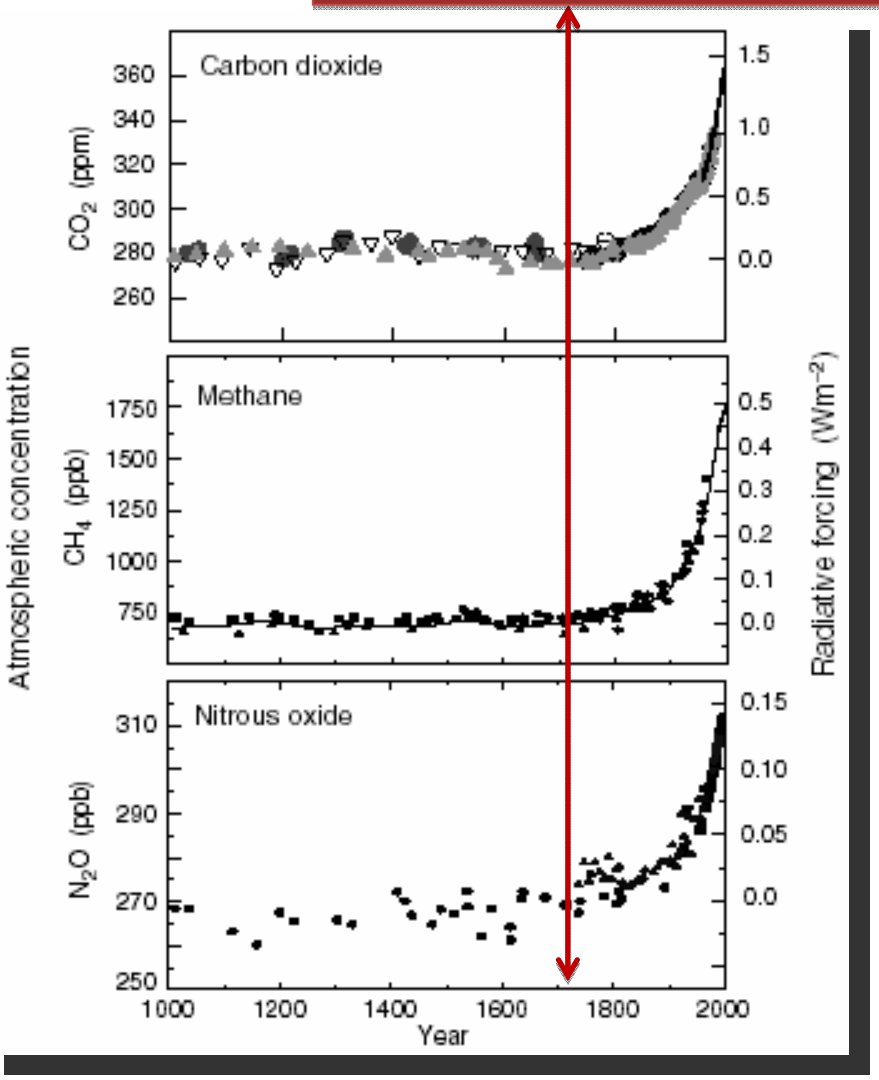
Climate change and CDM

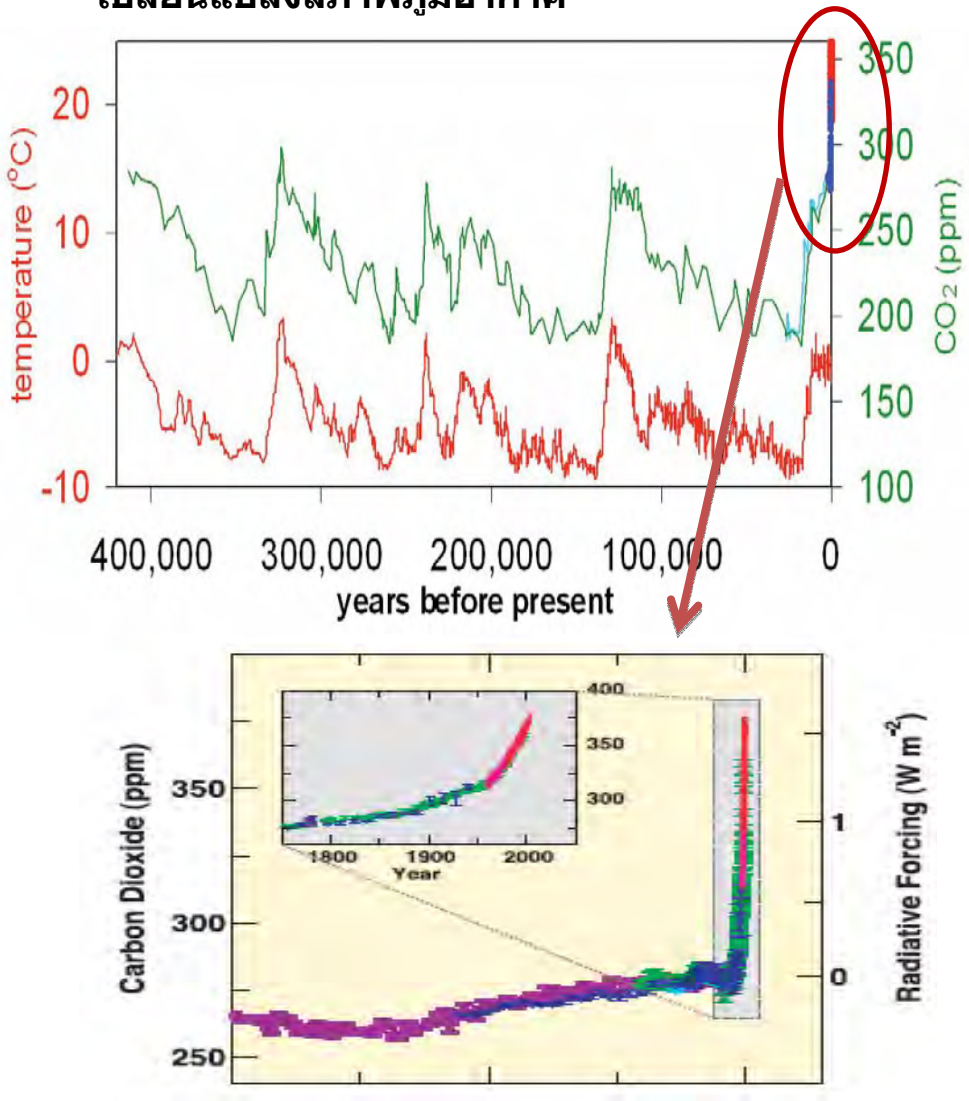
การเปลี่ยนแปลงสภาพภูมิอากาศ และกลไกการพัฒนาที่สะอาด

Concentration of GHGs over 1,000 years

Industrial revolution

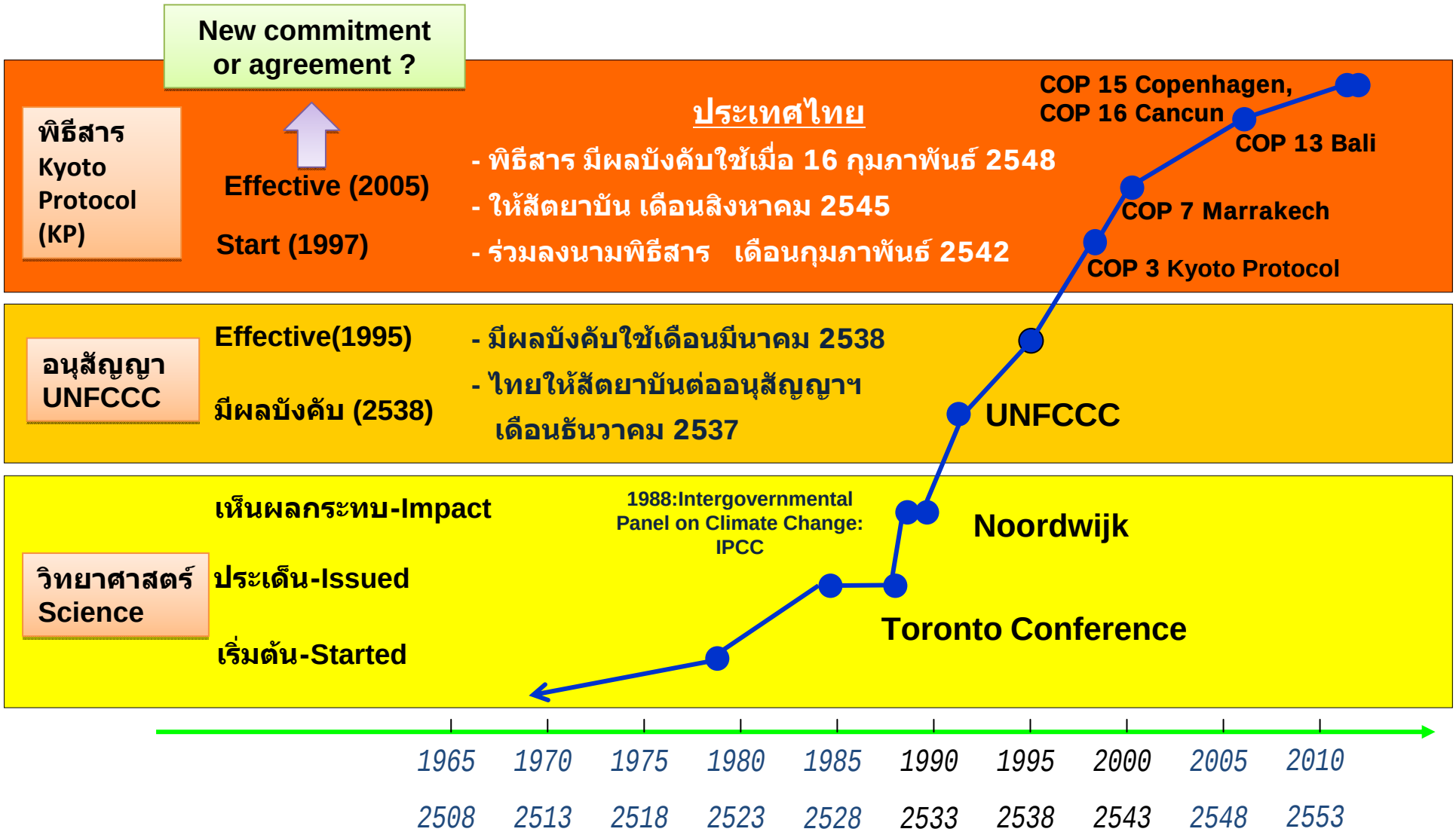


- **Intergovernmental Panel on Climate Change: IPCC Study**
- **การศึกษาของ “องค์กรระหว่างรัฐบาลว่าด้วยการเปลี่ยนแปลงสภาพภูมิอากาศ”**



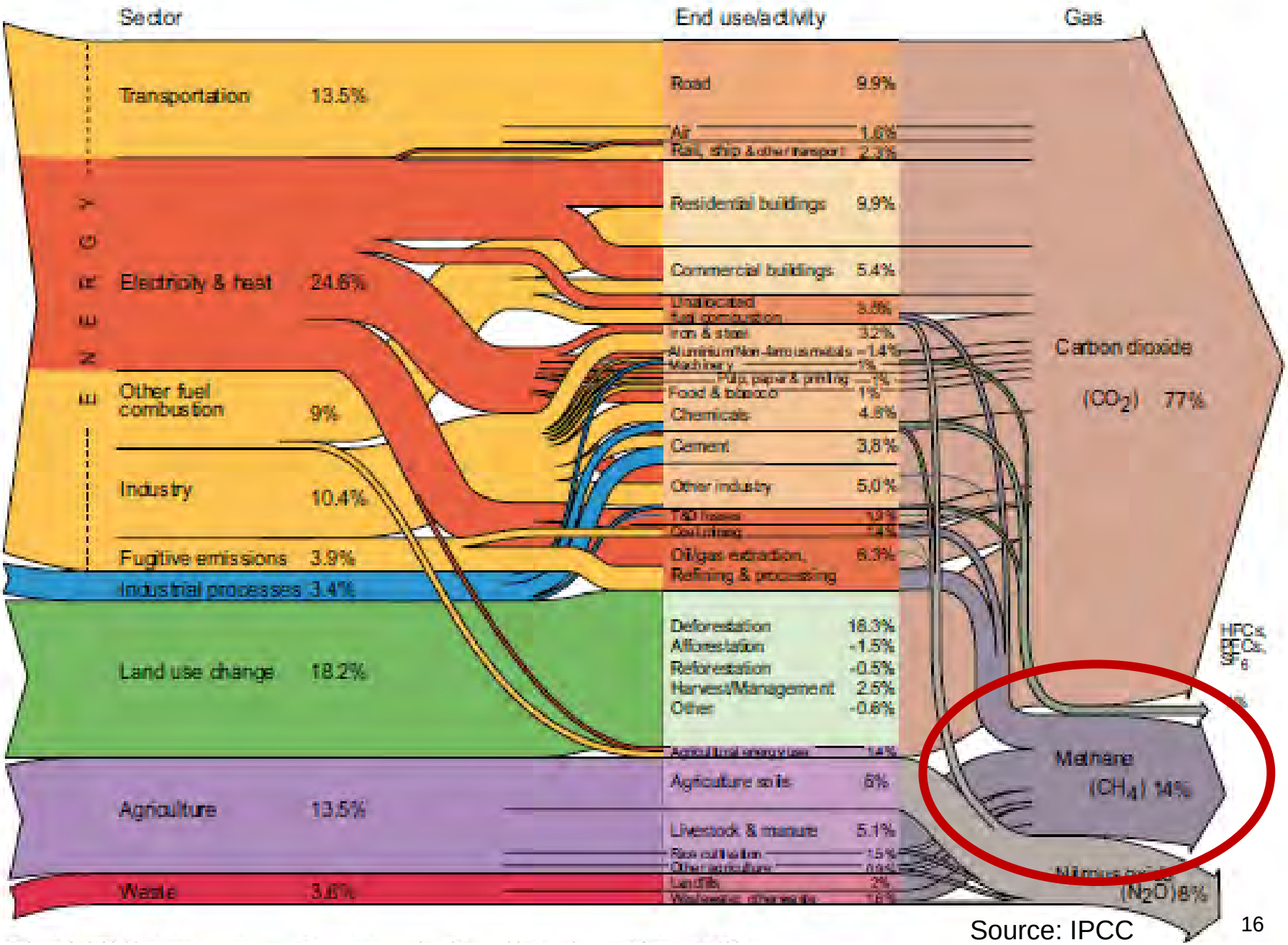
Source: IPCC Third Assessment Report 2001

Global steps on climate change



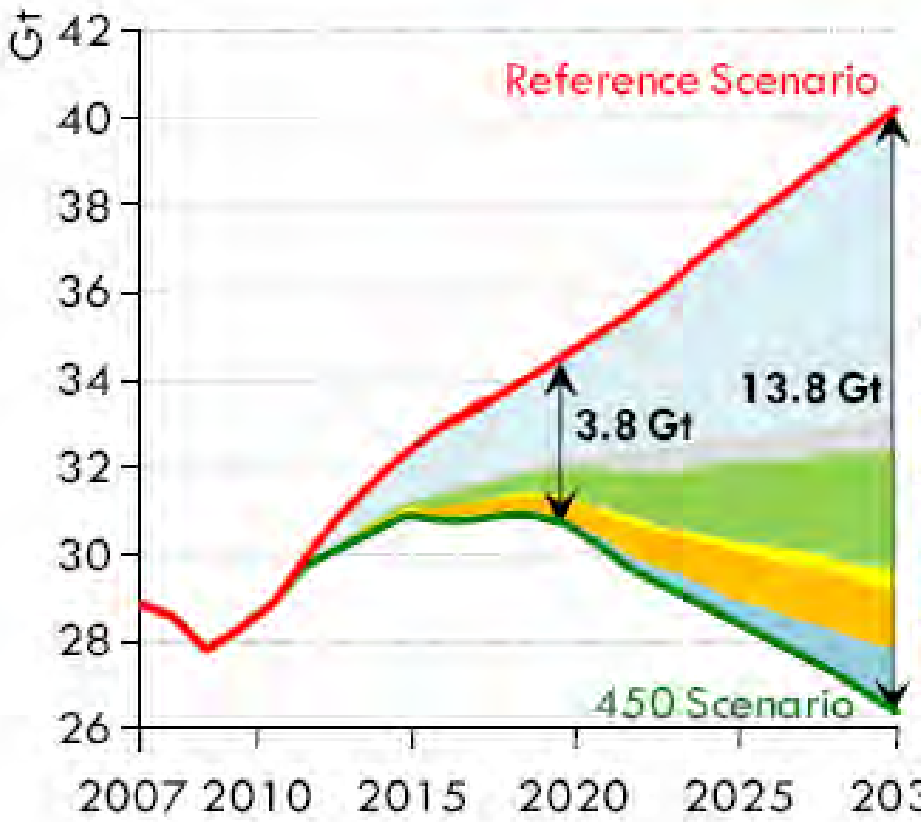
CDM is one of three main flexible mechanisms under KP

World greenhouse gas emissions by sector



Source: IPCC

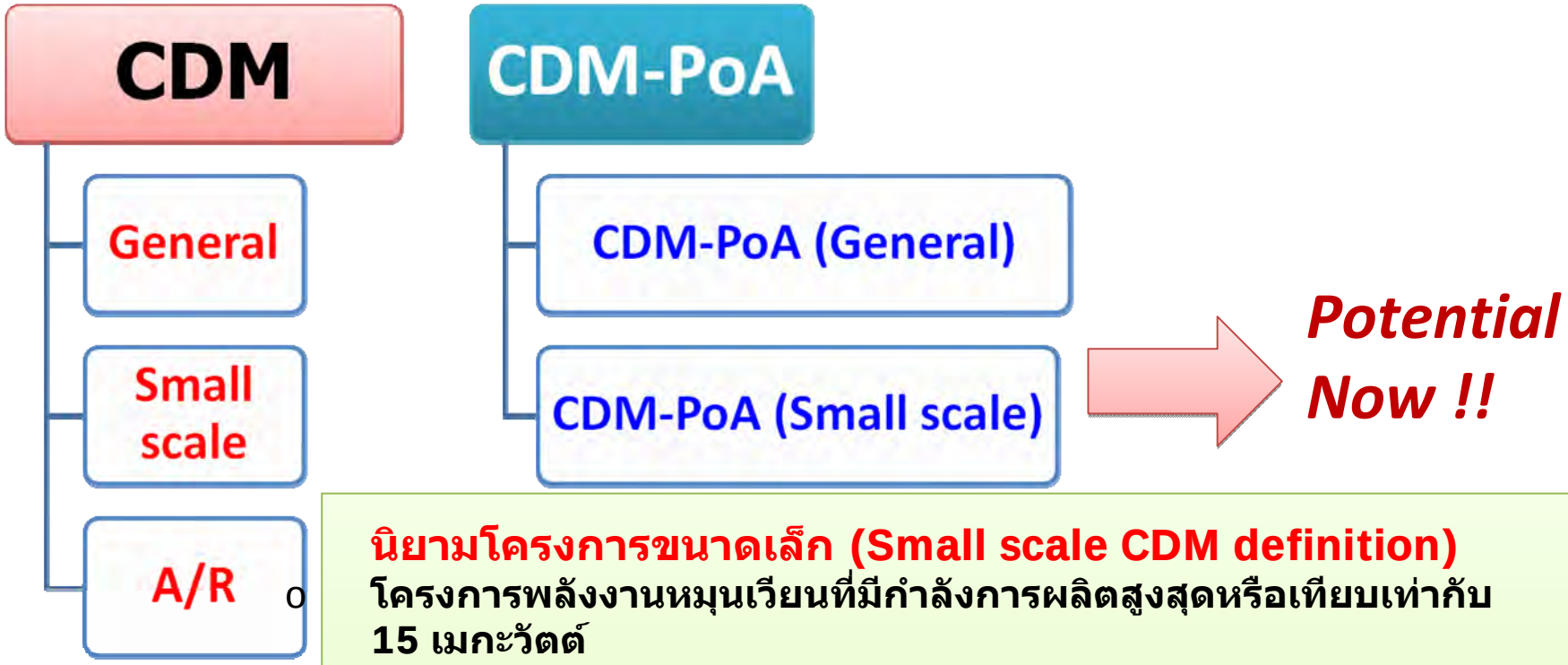
The 450 Scenario: Abatement by technology



Share of abatement %	2020	2030
Efficiency	65	57
End-use	59	52
Power plants	6	5
Renewables	18	20
Biofuels	1	3
Nuclear	13	10
CCS	3	10

- *In the 450 Scenario, emissions peak before 2020 at 30.9 Gt of CO_2-e, falling to 26.4 Gt by 2030 – almost 14 Gt lower than in the Reference Scenario.*
- *Energy efficiency and renewable energy are crucial*

CDM project type



นิยามโครงการขนาดเล็ก (Small scale CDM definition)

- โครงการพลังงานหมุนเวียนที่มีกำลังการผลิตสูงสุดหรือเทียบเท่ากับ 15 เมกะวัตต์
  [Not more than 15 MW renewable energy project]
- โครงการปรับปรุงประสิทธิภาพการใช้พลังงาน ซึ่งช่วยลดใช้พลังงานทั้งด้านอุปสงค์และอุปทาน โดยลดการใช้พลังงานได้เทียบเท่ากับ 60 กิกะวัตต์-ชั่วโมงต่อปี
  [60 GWh per year energy efficiency project]
- โครงการอื่นๆ ที่ช่วยลดการปล่อยก๊าซเรือนกระจกจากแหล่งกำเนิดและก่อให้เกิดการปล่อยก๊าซเรือนกระจกน้อยกว่า 60 กิโลตันเทียบเท่าก๊าซคาร์บอนไดออกไซด์ต่อปี
  [< 60,000 t-CO2 per year GHG mitigation project]

CDM Status: Thailand

As of 18 April 2011 http://www.tgo.or.th

CDM

- LoI to TGO — 245 projects
- TGO approve the LoA — 131 projects
  [equal to 8.16 Million t-CO_2-e/yr]
- Registered to CDM EB — 46 projects
  [equal to 2.46 Million t-CO_2-e/yr]
- Issued CERs — 3 projects
  - A.T.Biopower Rice Husk Power Project [100,678 t-CO2-e]
  - Korat Waste to Energy [714,546 t-CO2-e]
  - [illegible]nich Lamthop POME Biogas Project1 [4,346 t-CO2-e]

CDM-PoA

- LoI to TGO — 6 projects
- In process of LoA — 1 projects

Thailand Small-scale Livestock Waste Management Program by ERDI

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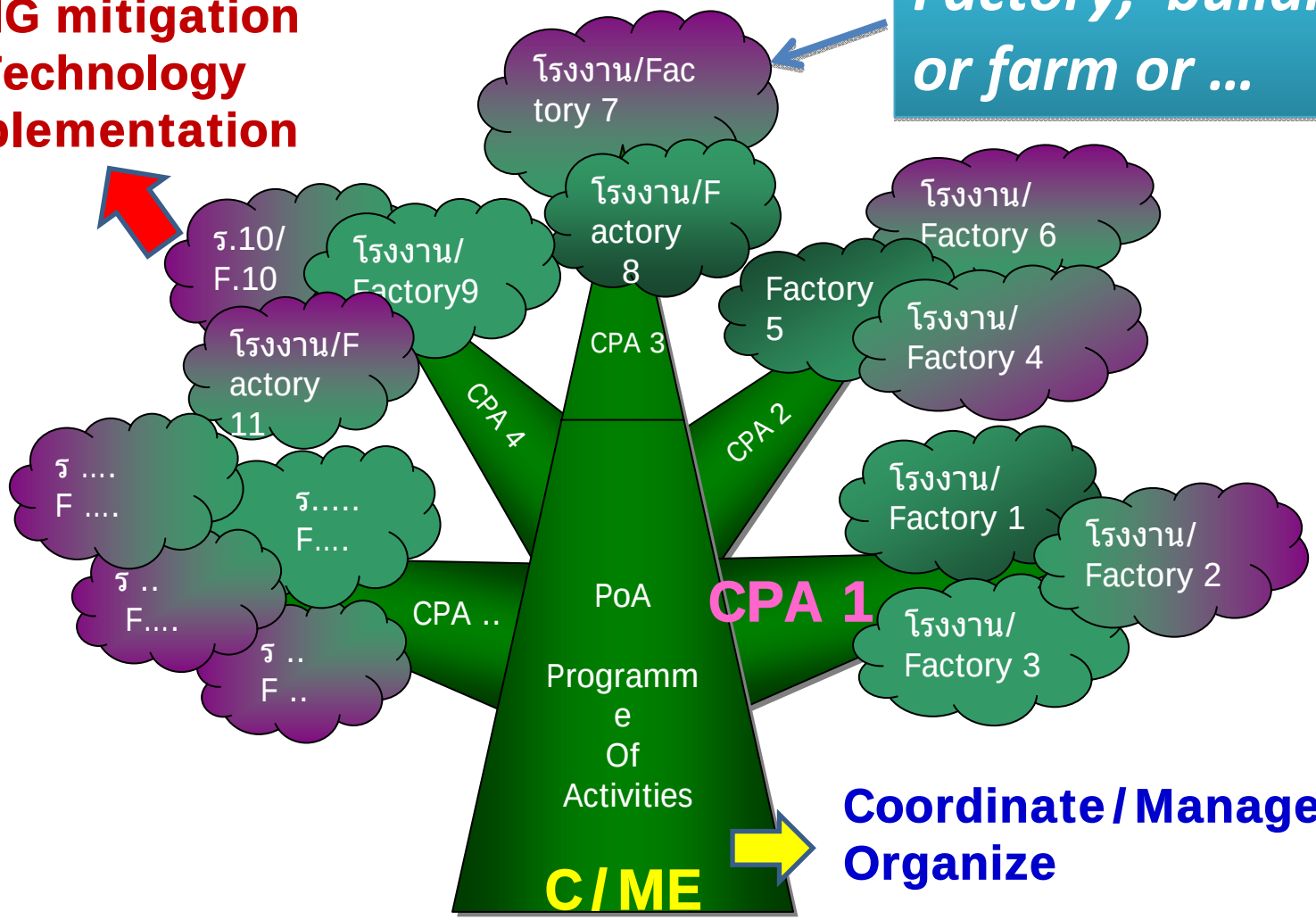
CDM Programme of Activities

กลไกการพัฒนาที่สะอาดแบบรวมโครงการตามแผนงาน

CDM-Programme of Activities (PoA)

GHG mitigation Technology implementation

Factory, building or farm or …

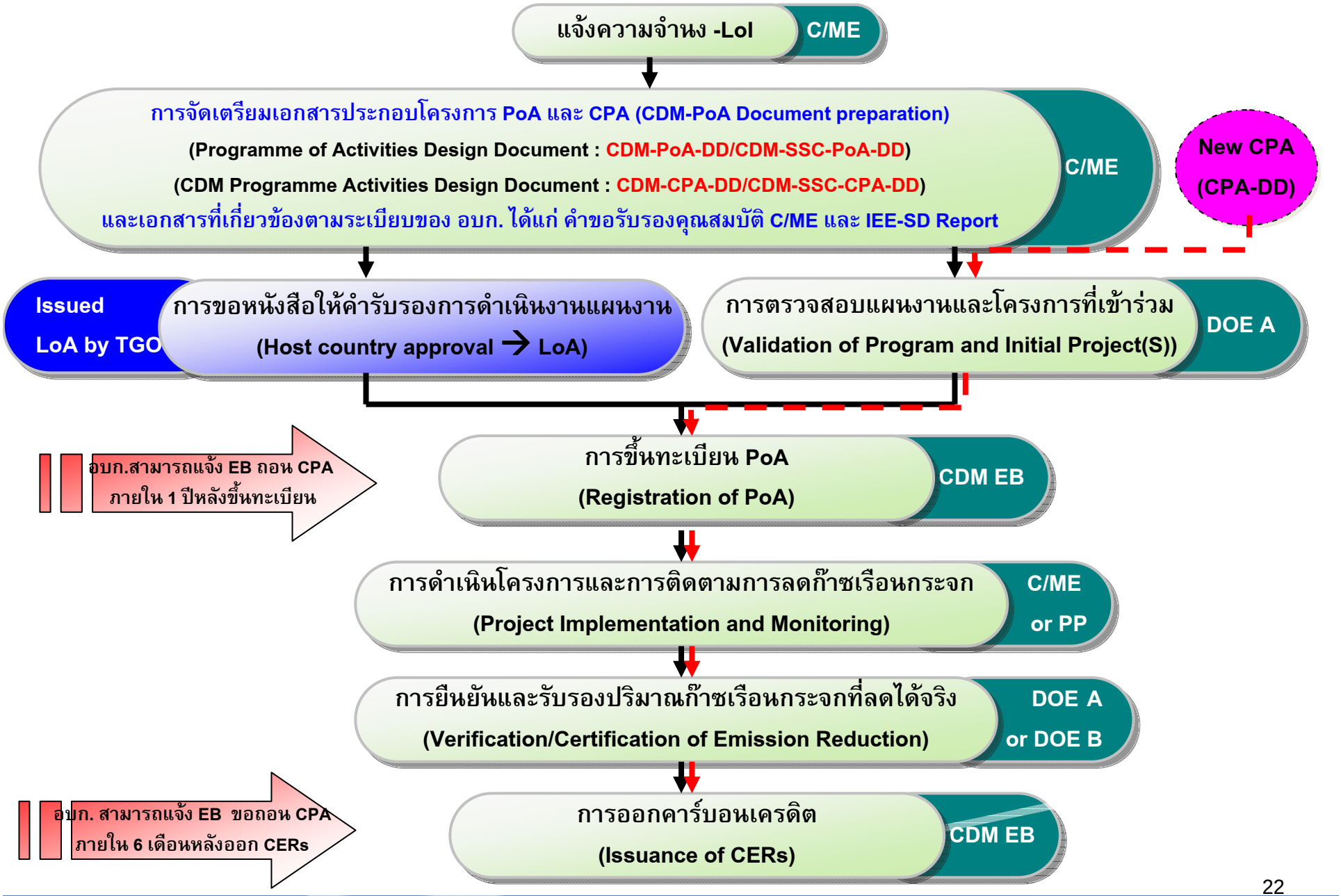


Coordinate / Manage / Organize

If less than 60,000 t-CO_2-eq/yr in each CPA → Can apply Small scale

CDM-PoA Structure

CDM-PoA Procedure



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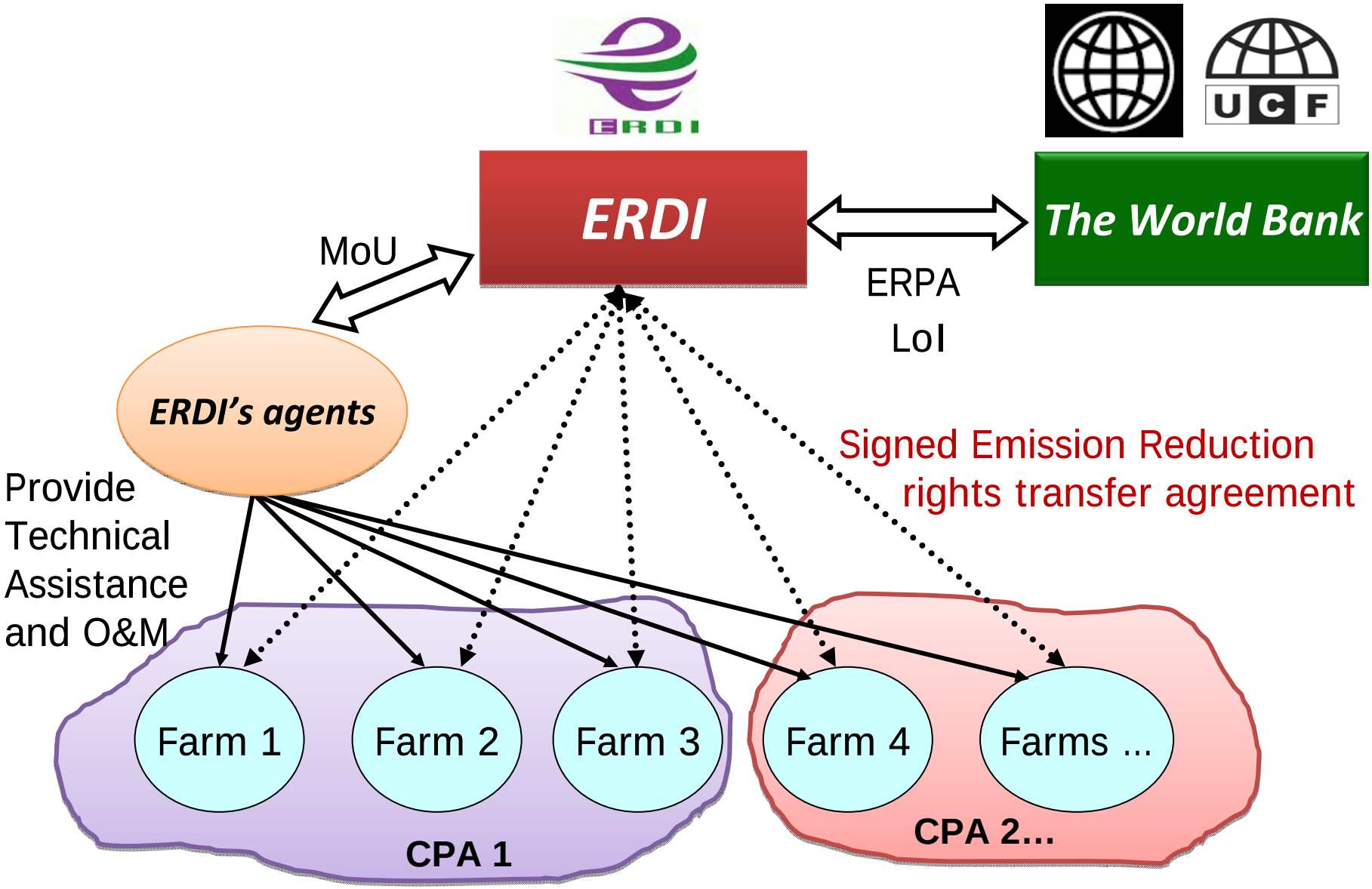
Case study of PoA: Biogas from Swine Farms

กรณีศึกษา: โครงการ PoA ในฟาร์มสุกรของประเทศไทย

Progress and procedure

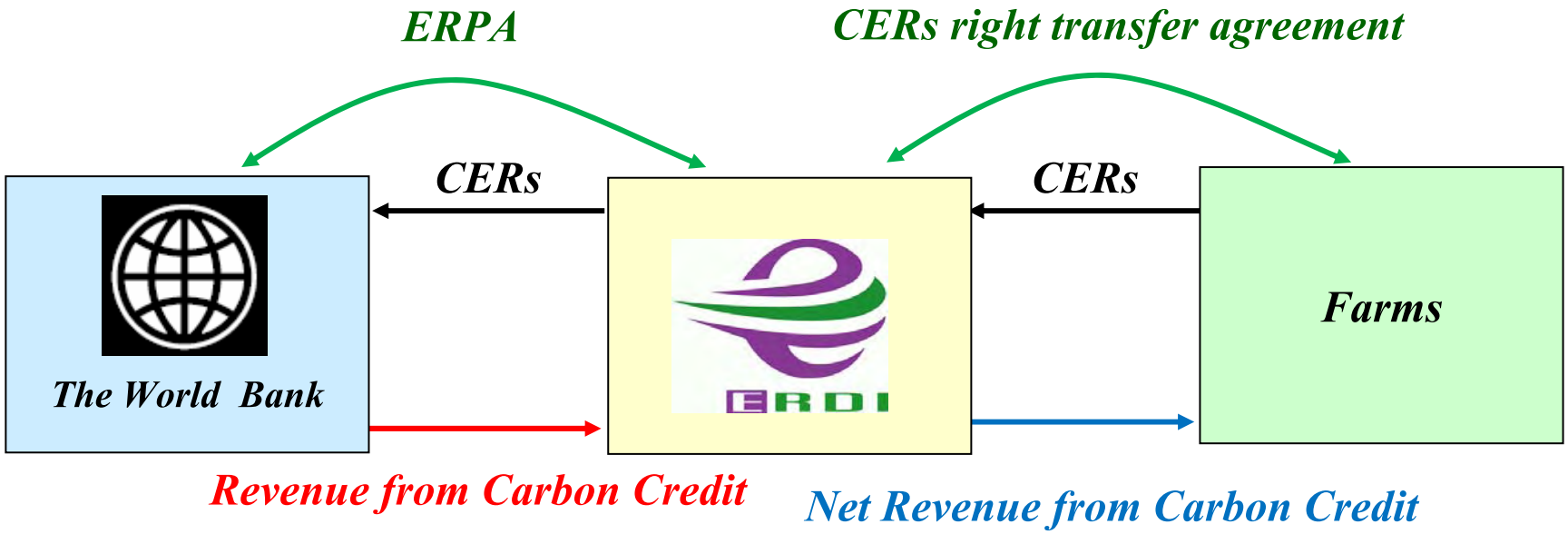
- Developed in 2008 by ERDI and World Bank
- Carbon credit with WB under signed Emission Reduction Purchase Agreement (ERPA) – 10 years
- Methodology for small scale project activity (AMS III.D “Methane recovery in animal manure management systems”)
- Approx. 0.3 Ton CO_2-Eq per year for 1 pig (60 kg – Live Stock Unit)
- Progressive contribution btw. farm and ERDI
  - 80% for Farms in the first year
  - 85% for Farms for other years (year 2 to year 10)

Institutional Framework



Institutional Framework

- **The World Bank : CERs Buyer and co-developer**
  ผู้พัฒนาโครงการและผู้รับซื้อ คาร์บอนเครดิต
- **ERDI : C/ME หน่วยงานบริหารโครงการ**
- **Farms : Biogas investor and Owner of CERs**
  ผู้ลงทุน ผู้ขายและผู้เป็นเจ้าของ คาร์บอนเครดิต



Economic analysis

By Farm

- Biogas system Investment (Depend on size)
- CDM Monitoring system - ลงทุนค่าอุปกรณ์
  (~500,000 Baht; Flare, gas meter, online data system)
- O&M cost - ค่าดำเนินการและบำรุงรักษา
  (~30,000 Baht per year)

By CME (ERDI) and Buyer

- CDM related documents
- CDM LoA and registration fee
- Validation and verification fee

Investment and benefit (for 2,000 pighead)

Investment -ลงทุน

Biogas system- สร้างระบบก๊าซชีวภาพ	960,000 Baht
After treatment-สร้างระบบบำบัดขั้นหลัง	600,000 Baht
Gas engine-เครื่องยนต์ผลิตไฟฟ้า	400,000 Baht
GHG Monitoring system-ระบบตรวจวัดGHG	500,000 Baht
Total	2,460,000 Baht

Expected Income-รายรับ

Power generation	210,000 Baht/yr
Fertilizer	40,000 Baht/yr
Carbon credit	255,000 Baht/yr
Total	505,000 Baht/yr

Expected expenditure-รายจ่าย

Gas engine maintenance (0.3 B/kWh)	25,000 Baht/yr
Power supply to biogas	30,000 Baht/yr
Wastewater analysis	55,000 Baht/yr
Total	110,000 Baht/yr
Net income	395,000 Baht/yr

Pay back period

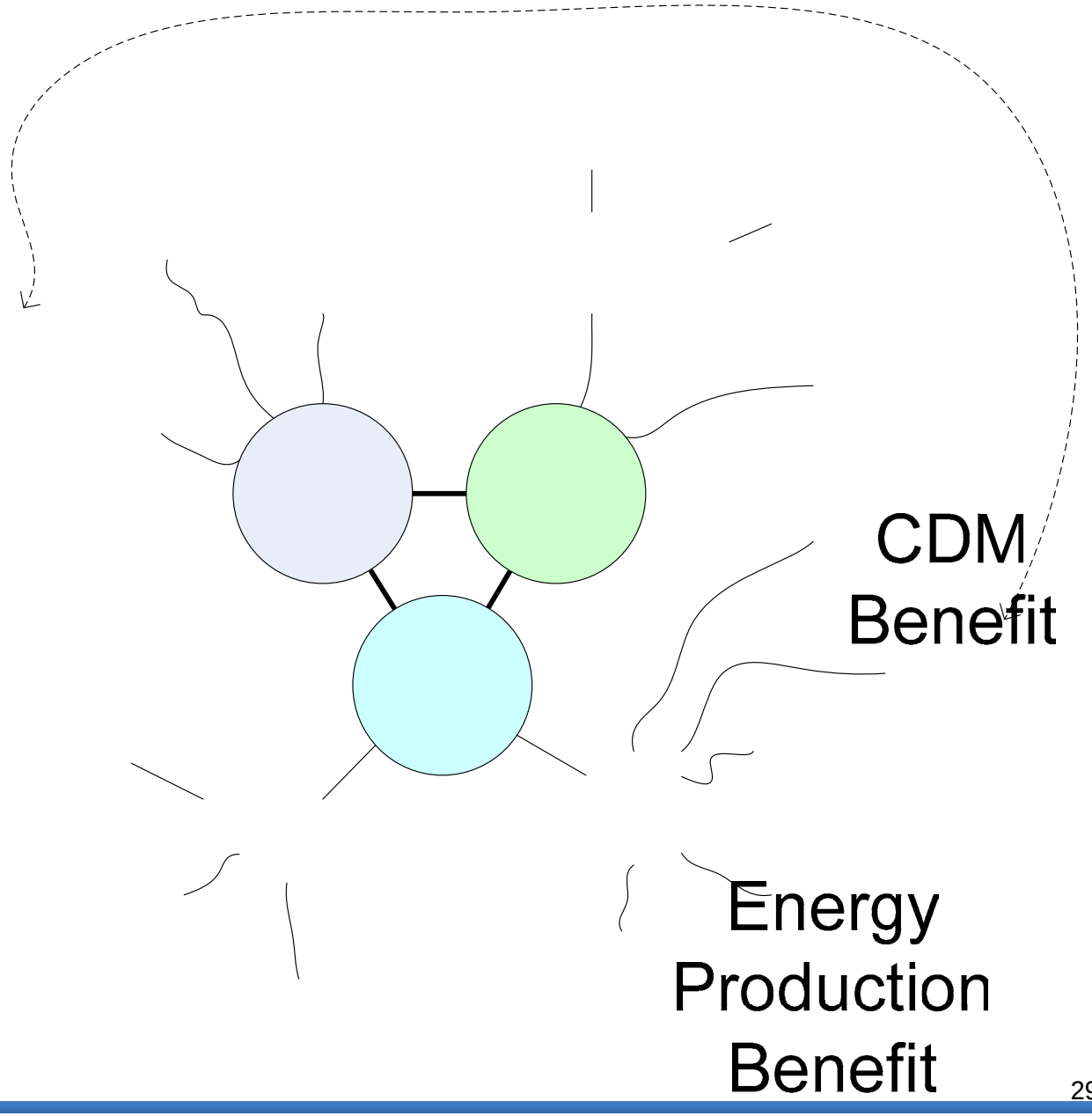
= 10.0 year (without PoA)

= 6.2 year (with PoA)

Economy of scale if more pig

Cost and Benefit of Biogas PoA

- Energy
- Environment
- Social
- Construction
- Fertilization
- etc.



Conclusions

- **Biogas system from swine farm wastewater treatment has long historical background, initiated and transferred technology by giz to Thailand,**
- **Government support, from ENCON Fund through EPPO, helps widespread expansion in biogas from Thai swine farms and agro-industry,**
- **Energy utilization from biogas, both power generation or thermal use, are considered as main income from biogas, while carbon credit through CDM considered as additional income or market incentive,**
- **Small biogas system from swine farm or industry, which may not suitable with CDM single project due to very high upfront CDM cost, may consider PoA as alternative CDM project,**
- **Challenges: Future carbon market**

Acknowledgement

- **GIZ and ex-CMU pioneers**

  Your long vision sustainable development in Thai biogas since 1988.

- **The World Bank** ***(Pongtip, Nat, Weiguo, Jiang, Waraporn)***

  For all support & introduced us to the world of carbon

- **TGO** ***(Director Sirithan, Dep. Director Prasertsuk & Dr.Chaiwat and their TGO team)***

  As first PoA, working together and guide us on CDM

- **EPPO and ENCON Fund**

  Big thanks for all financial support to the farms

- **ERDI Team** ***(Poon, Pruk, Chinnakorn, Alongkorn, Chaicharn, Jariyanan)***

Thank you - ขอบคุณครับ

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