

# Biogas & Climate protection potential (CDM)

CDM projects involving livestock &  
bio digestion in China: project  
development, institutional setup and  
financial aspects

# People's Republic of China

- Has the largest population of any country in the world. 2005, the total population of China is 1.3 billion or about one fifth of the world population.
- Population density 135 people per square kilometer.
- Annual population growth rate in 2006 at 0.59 percent.
- GDP per capita is ranking after No.100 among all countries in the whole world.
- 23 million people are living below the national poverty line.
- 57 percent of China's population is living in the undeveloped rural areas.

*UNDP, Human Development Report 2006*

# Lower-middle-income country

- ... categorized as a developing country with a per capita income of approximately between 1500 and 1.740 USD per year.
- ... classified under OECD/DAC as „lower-middle-income country“.
- The gap between rich and poor is widening: World Bank estimates, 320-350 Mio Chinese are still living on less than 2 USD/day.
- .... no overall, economic and accessible health care system. only 14% of employees hold unemployment insurance, 18% health insurance and 23% retirement schemes.
- Unemployment is on the rise: The official unemployment rate in urban areas is at 8.5%, in the country at 30%. This leads to migration, especially to the urban centers in the east.
- There is a strong need for qualified personnel.

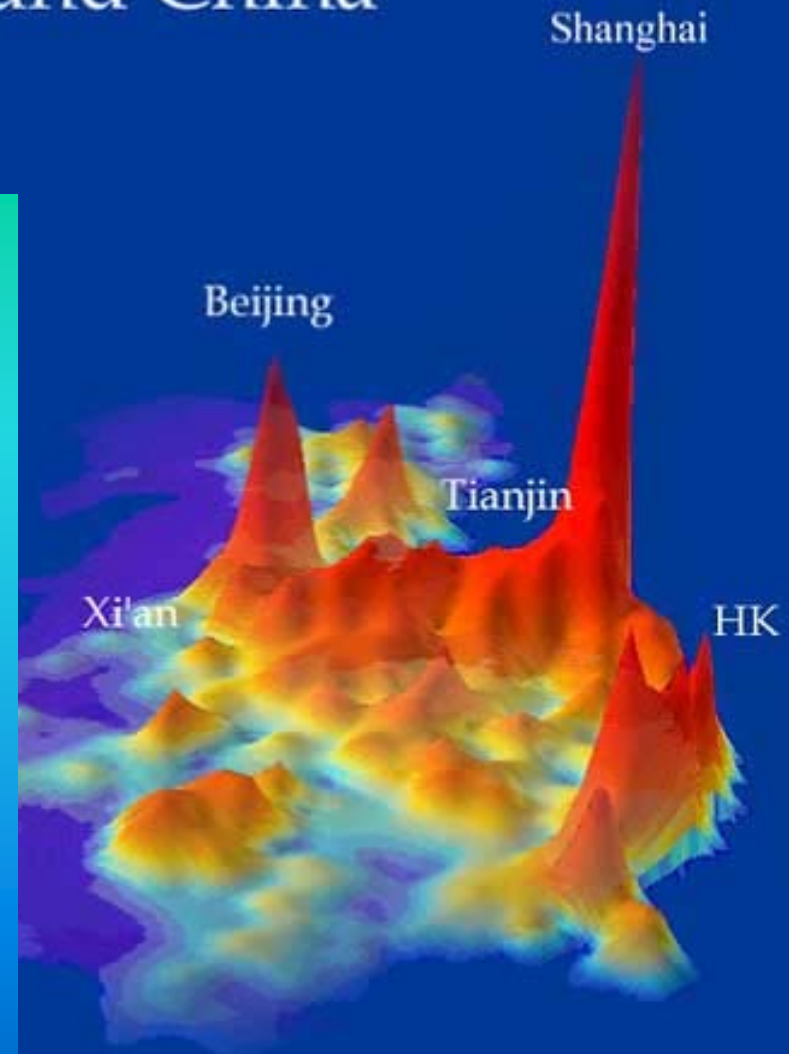
*USD 1500 according to 2006 BMZ Country Strategy Paper, USD 1740 according to figures available from the Chinese Embassy in Germany (2007) and People's Daily, 21. August 2006 & World Development Report 2007*



# Economic Map of Mainland China

[GDP per square kilometer]

- Malnutrition is now widespread in western and northern China. Since 1995, for the first time in its history, China imported more food than it grew domestically.
- It has been noted that if per capita beer consumption were to increase from just one to three bottles per year, China would have to import virtually the entire grain production of Norway.
- China's growing taste for meat (167% from 2000 to 2020) also has grave implications for world grain supplies and prices.



# Biogas

- Biogas is generated by controlled fermentation of natural organic material.
- China used biogas technology early in its history, at least since the end of the 19th century.
- The scale of biogas production could be significantly increased as soon as more advanced technologies open pathways for the efficient conversion of biogas to energy.
- There are many options for the use of biogas:
  - energy carrier for the generation of electricity and heat,
  - transformation of heat to cold,
  - biogas purification and compression,
  - utilization of biogas in direct combustion for cooking, refrigeration
  - gaseous biofuel for transport.

# Medium scale biogas plant



**New-typed big biogas engineering (with parallel separated fermentation reactors and gas storages) can reduce construction costs by a big margin.**



# Medium scale biogas plant





# Medium scale biogas plant



# Straw biogas in Shandong

**4 reactors with capacity of 50 m<sup>3</sup> each, are able to provide cooking energy for 100 families.**





# 大中型沼气工程

Large and Medium Size Biogas Plants

大中型沼气工程是指单体沼气发酵容积在300-500米<sup>3</sup>的中型或500米<sup>3</sup>以上的大型沼气发酵系统，包括料液前处理、沼气发酵、发酵排出液后处理以及沼气的输配、储用系统等，共同构成沼气工程的全部。

Large scale biogas plant: fermentation capacity of 500m<sup>3</sup>

Medium size biogas plant: fermentation capacity between 300 to 500m<sup>3</sup>

# Biogas Plant Gansu Holstein Cow Breeding Centre 甘肃Holstein奶牛养殖中心的沼气系统



2600 dairy cows

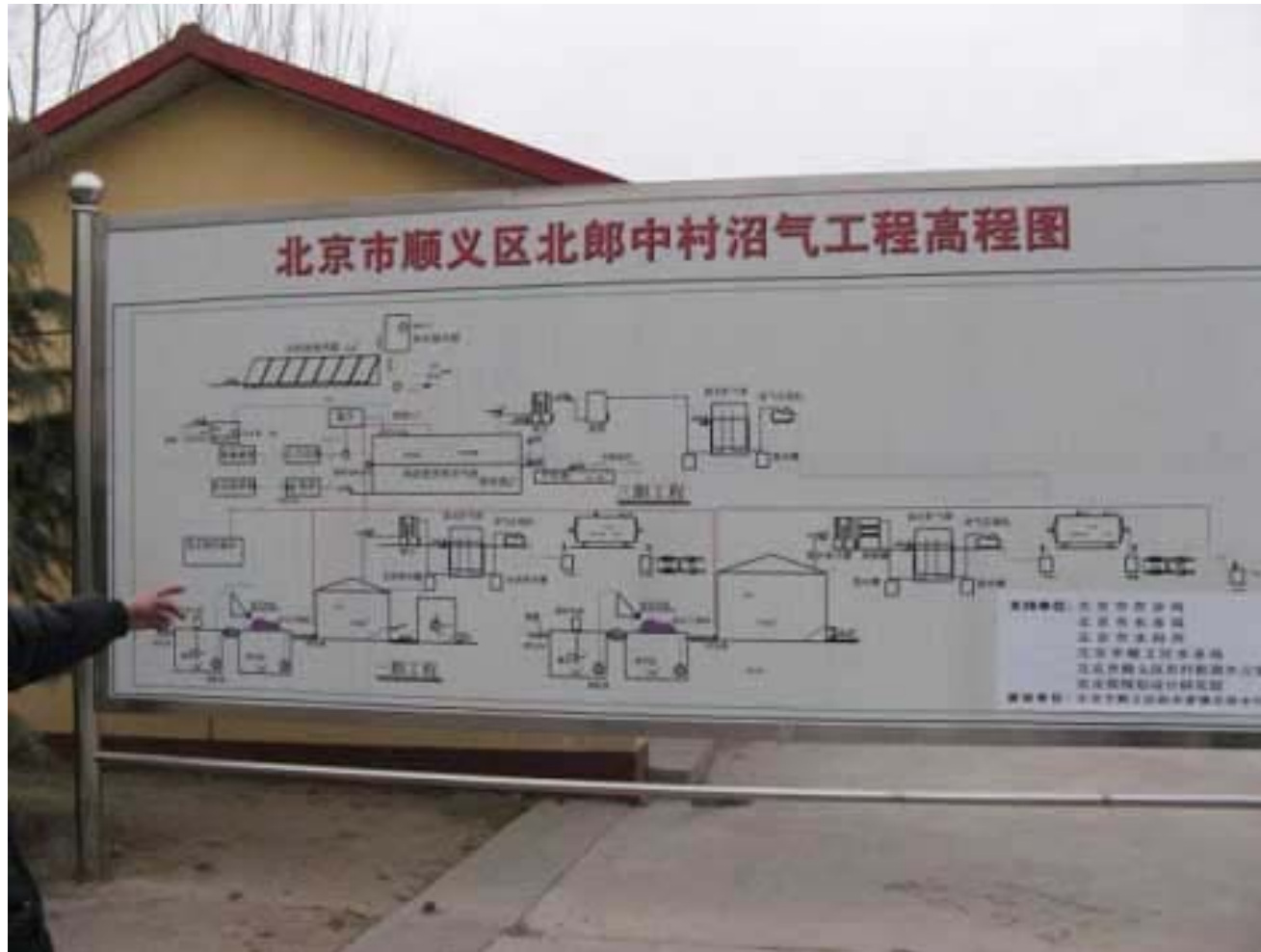
**2600**头奶牛

2 x 600 m<sup>3</sup> UASB

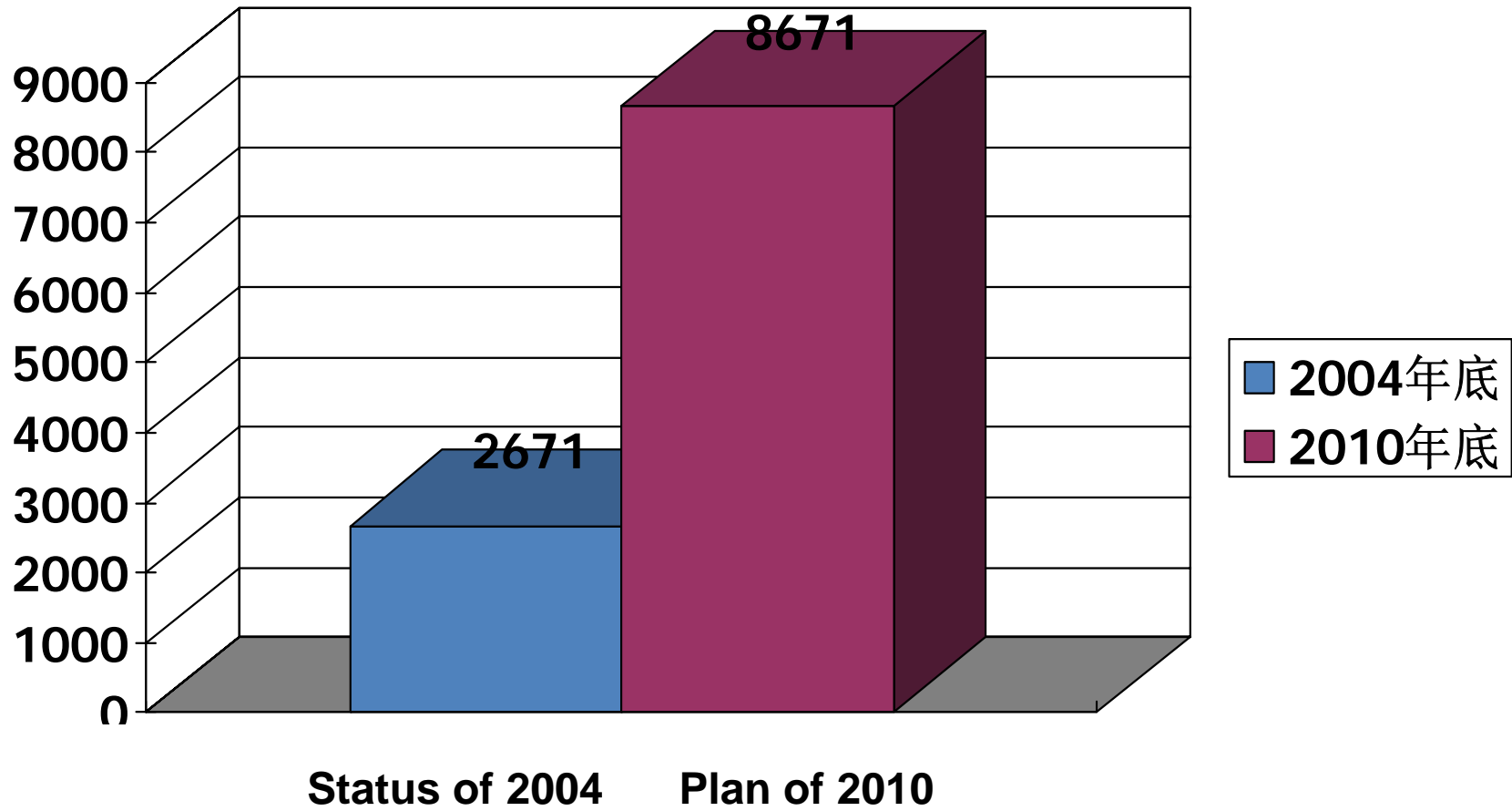
2 x 96 kW<sub>el-instal</sub>



# 北京Beilangzhong猪场沼气系统 Biogas system Beilangzhong Pig Farm Beijing



# Present state and plan on construction of medium-large biogas engineering



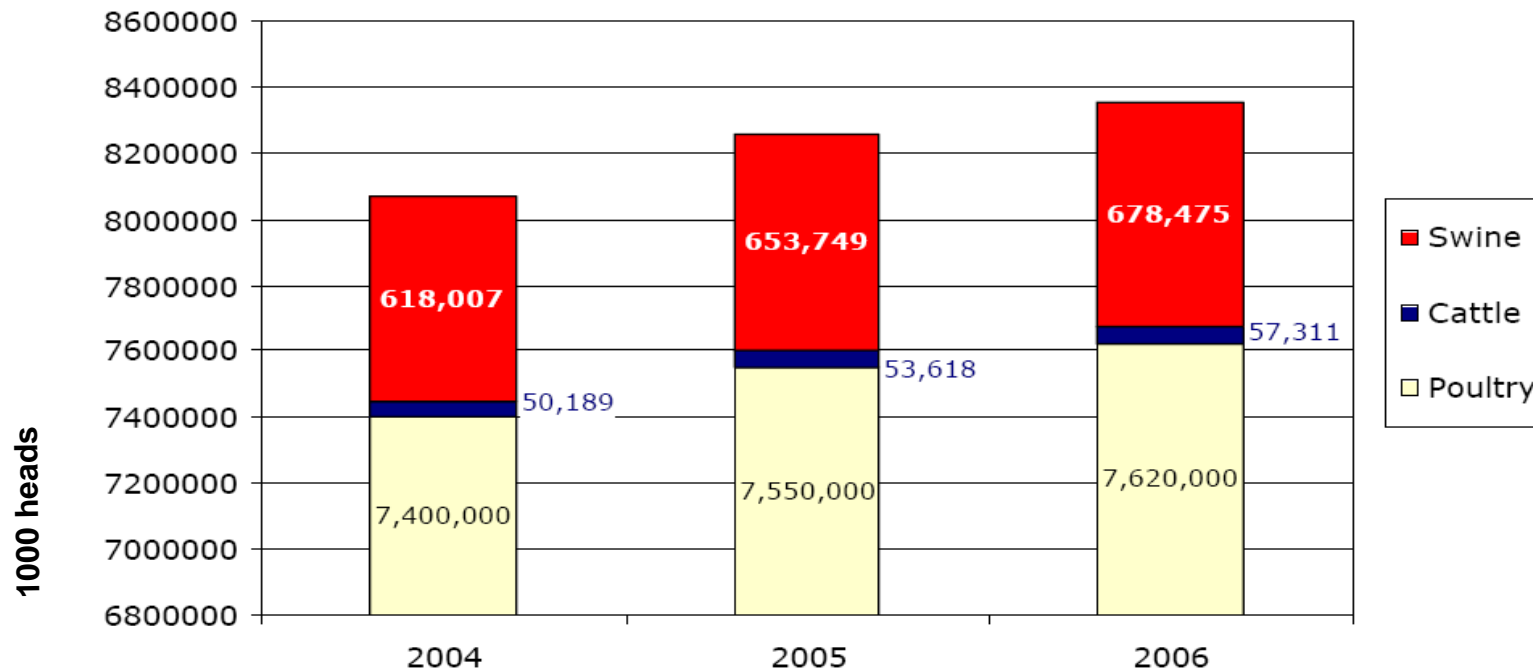
# Production of biogas in China (2006)\*

Technology / energy carrier	Installed units	BG Production Bn Nm <sup>3</sup> /a	Source
Medium and large scale biogas from livestock or food industry	4,000	3.4	MOA
Biogas from municipal wastewater and septic sludge (DEWATS)	137,013	0.05	MOA
Household biogas digesters (small scale)	18,000,000	6.9	NDRC, MOA
Landfill biogas recovery (15 of them are approved or “in the pipeline” for CDM; average installed capacity: 2 MW)	24	0.12	EU Asia Pro Eco Project
Biogas from BMW or MSW (RRU-BMW Project Shenyang ICEEE, 2006), only at laboratory scale	-	-	ICEEE
<b>Estimated Total Biogas Yield per year</b>		10.47	

\*Sewage sludge from centralized waste water treatment plants is not included in the table.



# Livestock in China (2006)



- Pork production - over half of the world's total - increased by 4.7 % to 52 MMT.
  - Pork products comprise the majority of the animal protein in the Chinese diet.
- Economic growth resulted in greater investment in the cattle and beef industry.
  - Although beef prices remain relatively high, rising consumer incomes lead to 6% increase in beef consumption.

## Large sized biogas engineering projects

	Number of Projects	Total Volume (m <sup>3</sup> )	Manure/Waste Treated (Mio t)	Biogas Yield (Mio m <sup>3</sup> )
2001	1359	639,200	34.04	168.69
2003	2355	882,900	58.01	183.92
2004	2671	1,094,300	71.90	176.19
2005	3764	1,724,100	122.82	341.14
<b>2006</b>	<b>4000</b>	<b>1,900,000</b>	<b>130.00</b>	<b>362.50</b>

End 2005	Agricultural Biogas Plants	Industrial Biogas Plants	Total
Operating Quantity (unit)	3,556	208	3,764
Digester Volume (m <sup>3</sup> )	1,005,600	718,500	1,724,100
Manure/Waste Treatment Amount (t)	87,109,400	35,710,000	122,820,000
Biogas Output (m <sup>3</sup> )	229,851,100	111,291,300	341,142,400
Biogas Supply to Households (number of household)	131,981,500	6,384,700	138,366,200
Biogas Power Generation (kWh)	8,726,228	31,721,317	40,447,545
Installed Capacity (MW)	6.699	12.5	19.199
Commercial Fertilizer (t)	3,031,000	1,499,100	4,530,100
Commercial Feed (t)	37,800	722,600	760,400

# Targets in biogas generation within the Chinese renewable energy framework

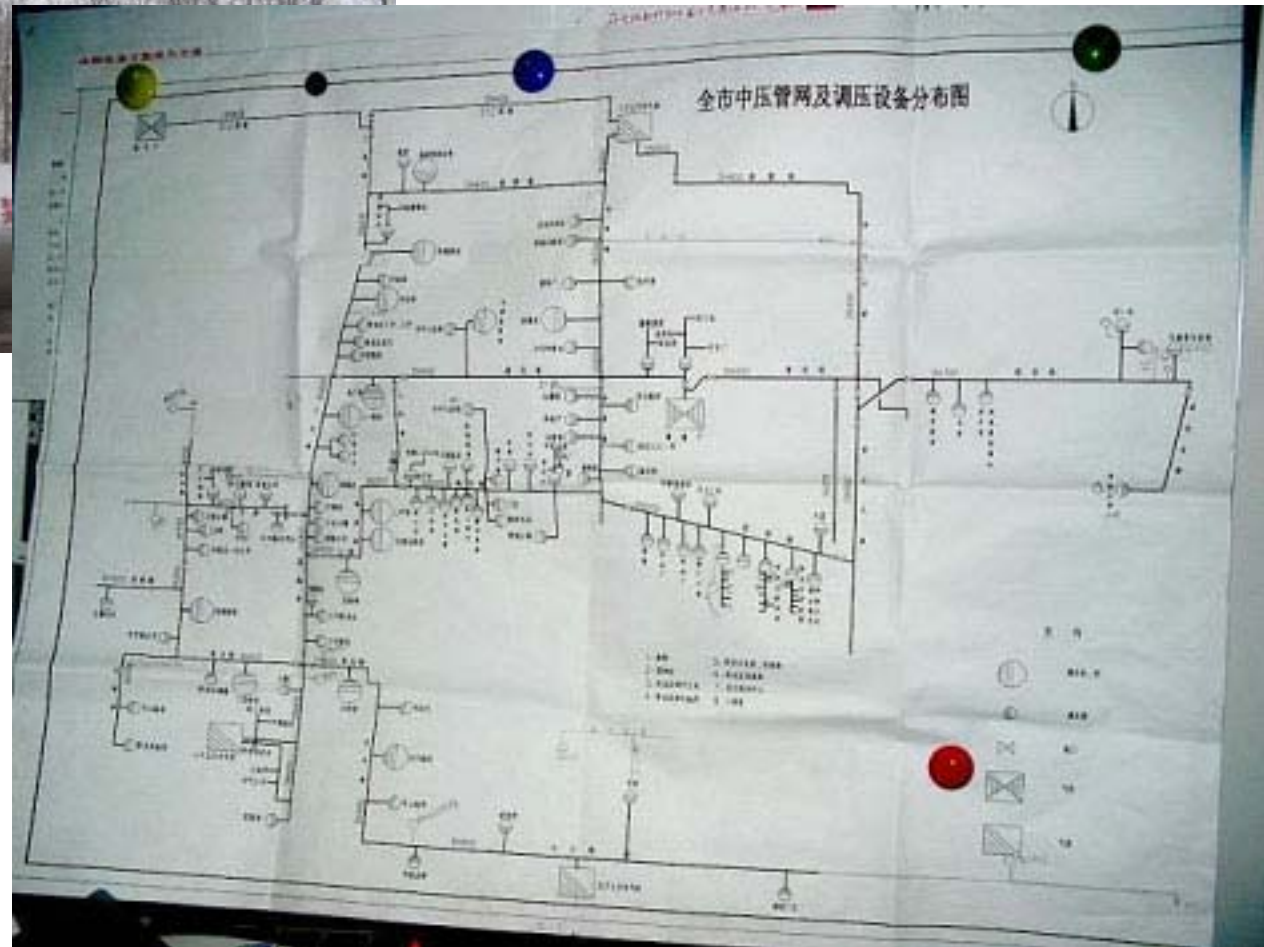
	2010	2020	Source
Total share of RE among total energy production	10%	16%	NDRC, CS
Share of biomass within total RE share	18.4%	18.5%	NDRC, CS
Biogas: total production		24 Bn m <sup>3</sup>	State Company      Grid
Landfill biogas	0.2 GW	1 GW (100 out of 580 potential sites)	NDRC
Medium & large scale biogas production from agriculture and industry	0.8 GW	3 GW	NDRC
	4000 - 4700 units		MOA: The Biogas Construction Plan
Biogas generated from municipal wastewater & septic sludge treatment <sup>1</sup>	100 Mio m <sup>3</sup>		MOA
Rural household biogas, small scale	11 Mio m <sup>3</sup>	18 Mio m <sup>3</sup>	NDRC
	23 Mio units	56 Mio units	MOA

# Biogas market development

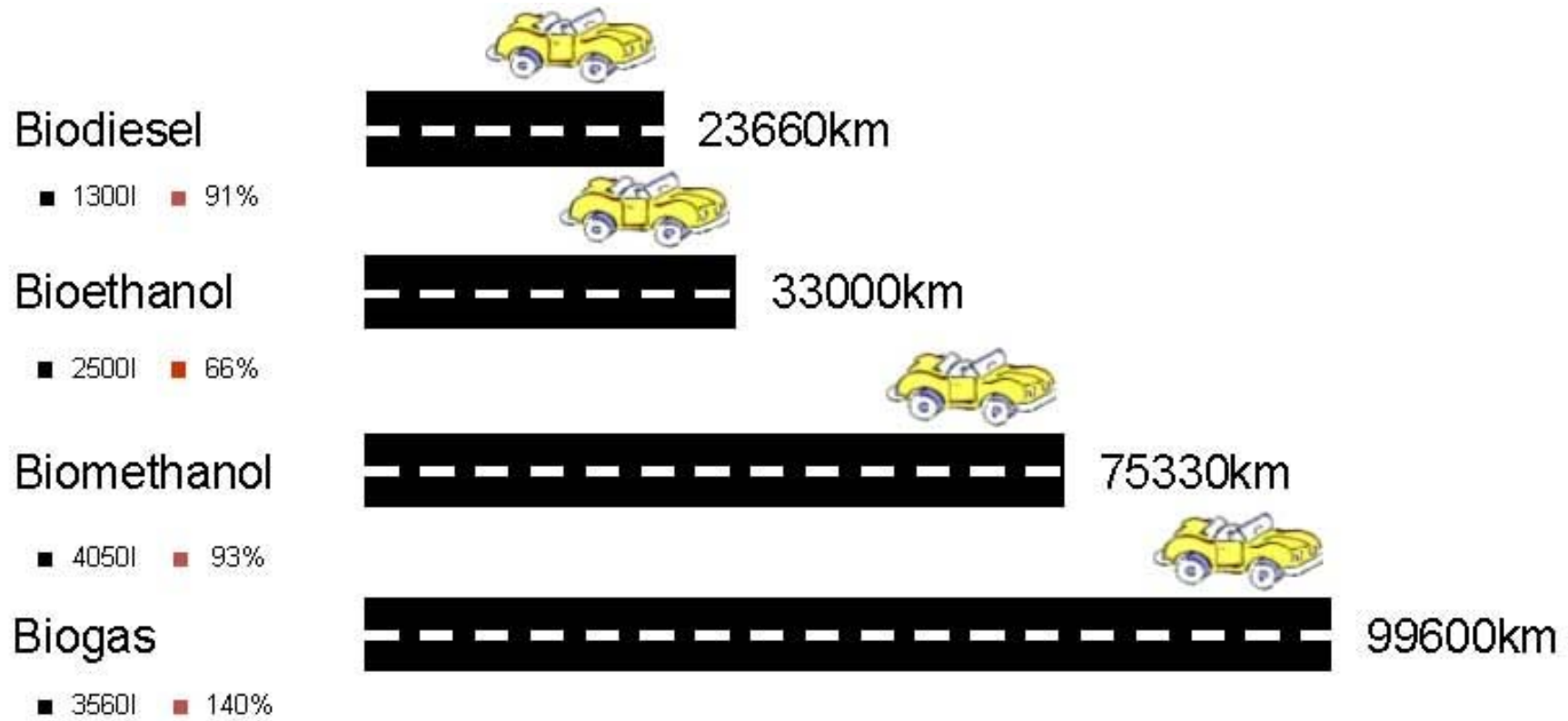
- Production of biogas increased significantly
  - For cooking
  - For combined heat and power generation
- Over 500 000 gas-fuelled vehicles (95% LNG, 5% on CNG) have been sold in recent years:
  - they mainly run on fossil gas.
- Biogas as a transport fuel is used in some pilot projects.
- Large scale biogas purification and high compressing plant installed in Anshan landfill (Liaoning)
  - never started permanent operation due to high processing and compressing costs of EUR 0.12/m<sup>3</sup>.
- Compressed natural gas (CNG and LNG) at fuel stations is available for EUR 0.17/m<sup>3</sup>.
  - Biogas prices are varying between EUR 0.05 – 0.17/m<sup>3</sup>, if biogas is delivered to a (bio)gas grid.

# Biogas Network for Small City

## 小城市沼气管网

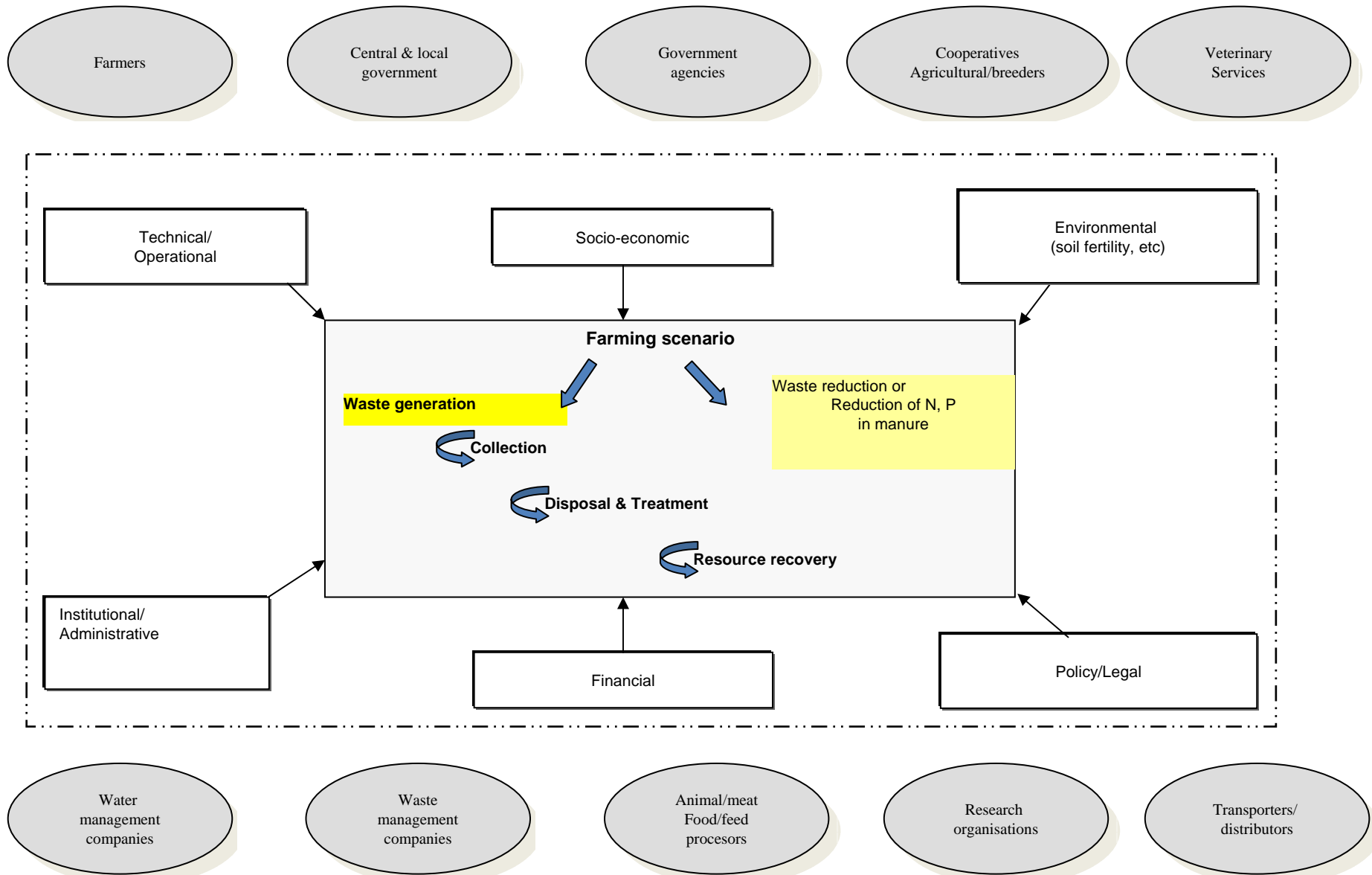


# Ecological footprints based on 5.0 l/100 km



- Annual production per ha
- Energy potential compared to fossil Diesel
- Energy potential compared to fossil Gasoline

## Stakeholders in the Management of Agricultural Waste





Organizational chart of MOA Renewable energy management system

农业部的可再生能源管理体系



# Livestock Regulation Development

## 日益健全的畜牧业规章制度

- 1996, Ministry of Agriculture (MOA): regulation requiring all new large-scale livestock farms to establish manure storage facilities.  
**1996年农业部立法要求所有大型新建畜牧场安装粪便贮存设备。**
- 1999, State Environmental Protection Administration (SEPA): established new division focusing on environmental pollution from agriculture.  
**1999年国家环境保护总局 (SEPA) 新设部门主抓农业环境污染问题。**
- 2001, China Government: Discharge Standard for Pollutants from Livestock and Poultry Breeding (GB18596-2001),  
**2001年中国政府出台了《畜禽养殖业污染物排放标准》 (GB18596-2001)。**
- 2003, SEPA: Pollution Material Emission Standard for Animal and Poultry Industry  
**2003年国家环境保护总局 (SEPA) 颁布了动物养殖业污染物排放标准。**
- 2003, SEPA: Technical Standard for the Prevention of Pollution from Livestock and Poultry Breeding  
**2003年国家环保总局 (SEPA) 制定了畜牧养殖业污染防治技术标准。**

可再生能源法  
Renewable Energy Law

第十届全国人民代表大会常务委员会第十四次会议于2005年2月28日通过，自2006年1月1日起施行。

Approved by the 14th Meeting of Standing Committee of People's Congress on Feb. 28 and has been put into action since Jan. 1, 2006.

增加能源供应； Increase energy supply

改善能源结构； Improve energy supply structure

保障能源安全； Enhance energy security

保护环境。 Protect environment

**Biogas relevant articles 13-16 of the  
Chinese Renewable Energy Law (2006)**  
中国《可再生能源法》（2006）沼气相关的13-16条款

- regulates and enables the feed-in-grid of renewable energy into the existing electrical power, gas and heat grids,  
规范并建立可再生能源与现行电网、气网及热网的并网系统。
- enterprises operating electrical grids, gas pipeline networks and heat pipeline networks shall accept them into the networks  
经营电网、天然气管网及热管网的企业应接受并执行相关条款。

其他法律  
Relevant Laws and Regulations

固体废物污染环境防治法 Law on the Prevention and Control of Environmental Pollution by Solid Waste

环境保护法 Environmental Protection Law

水污染防治法 Prevention and Control of Water Pollution

农业法 Agriculture Law

节约能源法 Energy Conservation Law

农业技术推广法 Popularization of Agricultural Technology

湖南省、四川省、浙江省、安徽省、广西壮族自治区、甘肃省和黑龙江省等地方政府分别出台农村能源和可再生能源的政策和法规，促进和规范大中型沼气工程的建设。

Hunan, Sichuan, Zhejiang, Anhui, Guangxi, Gansu, and Heilongjiang provinces launched regulations and policies for rural and renewable energy promotion, emphasizing on large and medium biogas plants application.

约束性指标：单位国内生产总值能源消耗降低20%（发改委），主要污染物排放总量减少10%（环保总局）  
森林覆盖率达到20%（林业局）

重点工程：新农村建设（农村沼气工程、农村饮水安全、送电到村和绿色能源县工程、农村医疗卫生服务体系、农村劳动力转移就业服务体系等），节能重点工程（区域热电联产、节约和替代石油、绿色照明工程等），循环经济示范试点工程（循环经济、再生资源回收利用等）等。

相关法律任务：循环经济法、能源法等。

沼气工程是新农村建设的主要手段之一

Biogas Promotion is One of Key Activities in New Socialist Countryside Development

国家发展改革委员会、农业部、财政部、科技部、林业总局、环保总局、建设部等，甚至水利部等，都有支持沼气工程发展的政策和/或经费，作为服务于新农村建设的主要手段之一。

National Development and Reform Commission, Ministry of Agriculture, Ministry of Finance, Ministry of Science and Technology, Ministry of Construction, State Environmental Protection Administration, State Forestry Administration and even Ministry of Water Resources,

# New socialist countryside (1/2)

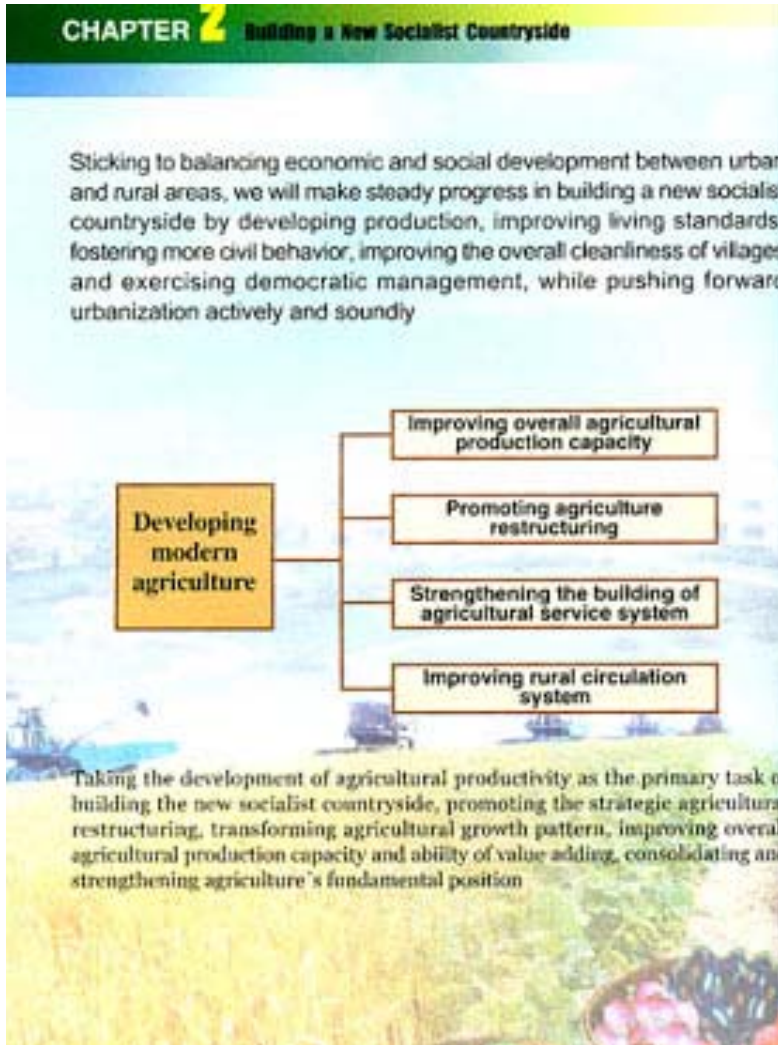
**CHAPTER 2 Building a New Socialist Countryside**

Sticking to balancing economic and social development between urban and rural areas, we will make steady progress in building a new socialist countryside by developing production, improving living standards, fostering more civil behavior, improving the overall cleanliness of villages and exercising democratic management, while pushing forward urbanization actively and soundly

**Developing modern agriculture**

- Improving overall agricultural production capacity
- Promoting agriculture restructuring
- Strengthening the building of agricultural service system
- Improving rural circulation system

Taking the development of agricultural productivity as the primary task of building the new socialist countryside, promoting the strategic agricultural restructuring, transforming agricultural growth pattern, improving overall agricultural production capacity and ability of value adding, consolidating and strengthening agriculture's fundamental position



**Increasing farmers' income**

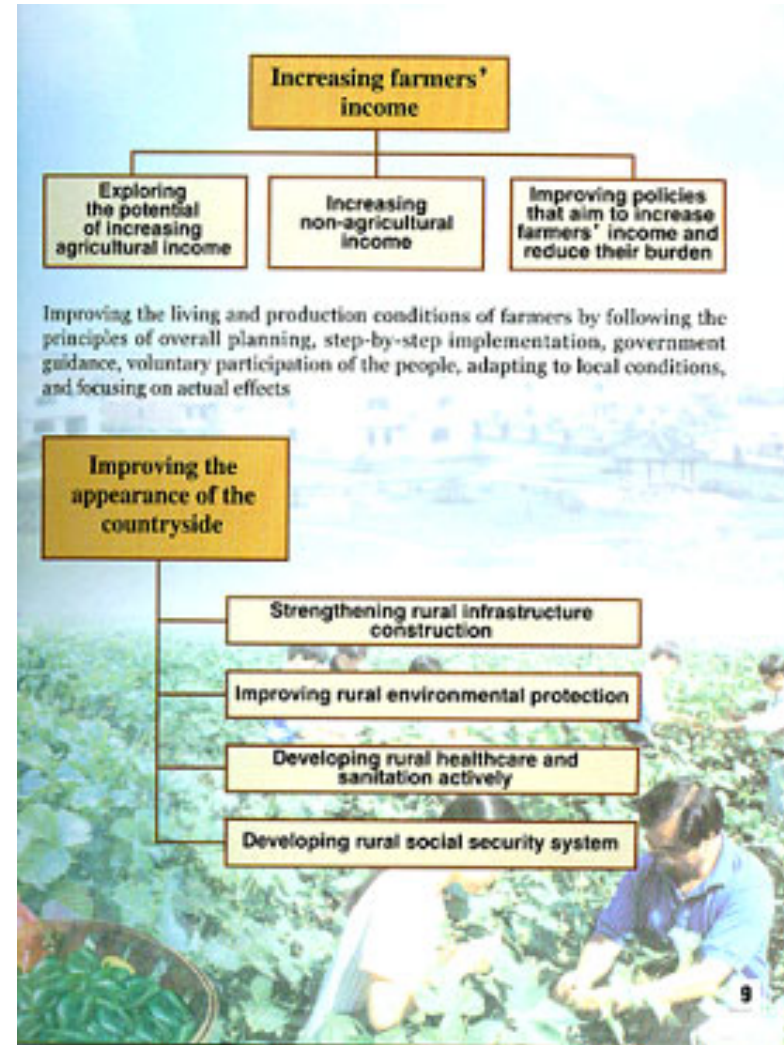
- Exploring the potential of increasing agricultural income
- Increasing non-agricultural income
- Improving policies that aim to increase farmers' income and reduce their burden

Improving the living and production conditions of farmers by following the principles of overall planning, step-by-step implementation, government guidance, voluntary participation of the people, adapting to local conditions, and focusing on actual effects

**Improving the appearance of the countryside**

- Strengthening rural infrastructure construction
- Improving rural environmental protection
- Developing rural healthcare and sanitation actively
- Developing rural social security system

9





# New socialist countryside (2/2)

**CHAPTER 2** Building a New Socialist Countryside

Developing rural education, vocational training and cultural undertakings, nurturing new farmers with better education, knowledge of technologies and skills of running business.

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graph LR; A[Accelerating the development of rural compulsory education] --- B[Nurturing the new farmer]; C[Strengthening labor skill training] --- B; D[Developing rural cultural undertakings] --- B; E[Increasing investment in agriculture and rural area] --- F[Deepening rural reform];
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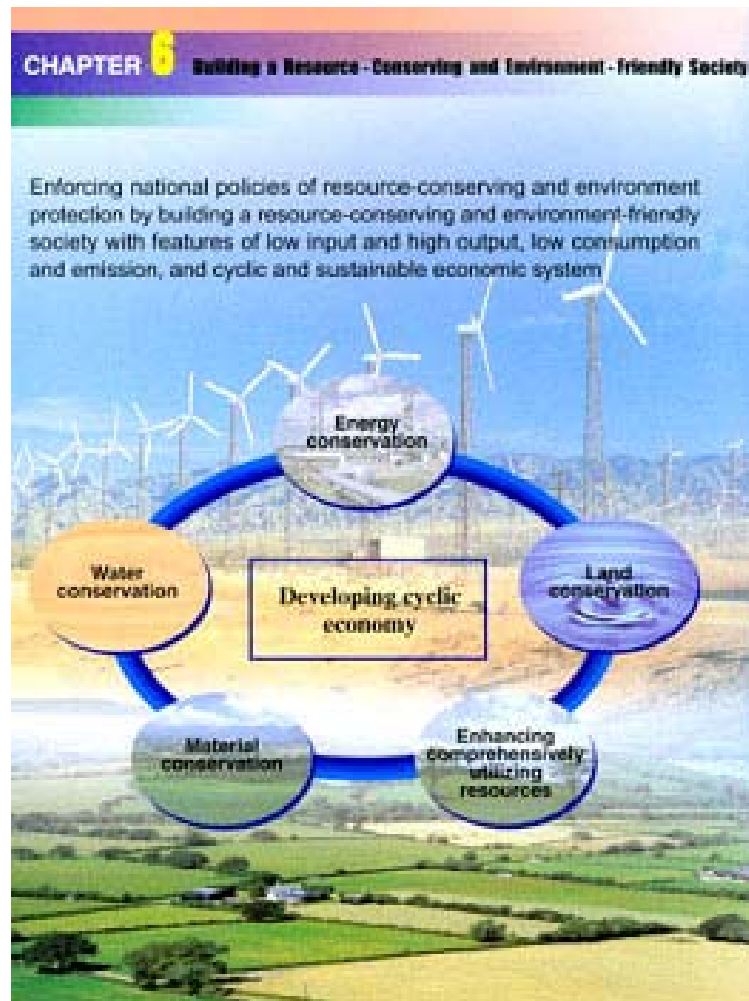
The diagram illustrates strategies for building a new socialist countryside. It features a central box labeled "Nurturing the new farmer" which is connected to three boxes: "Accelerating the development of rural compulsory education", "Strengthening labor skill training", and "Developing rural cultural undertakings". Below these are two more boxes: "Increasing investment in agriculture and rural area" and "Deepening rural reform". The background shows a blurred image of people in a rural setting.

**Priority Programs for Building the New Countryside**

- Large-Scale Production Bases of Grain, Cotton and Edible Oil and the High-Quality Grain Industry Program
- The Land Enrichment Program
- The Vegetation Protection Program
- Follow-Up and Supplementary Construction and Water-Saving, Upgrading in Large Irrigation Areas and the Upgrading of Large-Scale Drainage Pump Stations in Four Central Provinces
- The Superior Seed and Breed Program
- The Animal Epidemic Prevention System
- The Inspection and Examination System for Quality and Safety of Agricultural Products
- Rural Drinking Water Safety
- Rural Roads
- Rural Biogas
- The Village Electrification Program and the Green Energy County Program
- The Rural Health Service System
- The Rural Family Planning Service System
- Rural Labor Transfer and Employment

The slide lists 14 priority programs for building the new countryside. A blue oval highlights the items "Rural Drinking Water Safety", "Rural Roads", and "Rural Biogas". The background features a collage of images: a large greenhouse, a field of red flowers, a group of people, and a rural landscape with cows.

# Resource conserving and environmental friendly society (1/3)



Persisting in laying equal emphasis on exploitation and conservation, and giving priority to conservation in the short term, following the principle of "reducing, reusing and recycling", and gradually establishing in the whole society a resources recycling system that covers resources exploitation, consumption in production, emission of wastes and consumption

**Priority Programs of Energy Conservation**

- Upgrading of Low-Efficiency Coal-Fired Industrial Boiler
- District Heat and Power Cogeneration
- Recovery of Residual Heat and Resources
- Oil Saving and Substitution
- Energy Conservation of Motor System
- Optimization of Energy System
- Energy Conservation in Buildings
- Green Lighting
- Energy Conservation in Government Agencies
- Building the Energy Conservation Monitoring and Technological Support System

**Demonstration and Pilot Projects of Cyclic Economy**

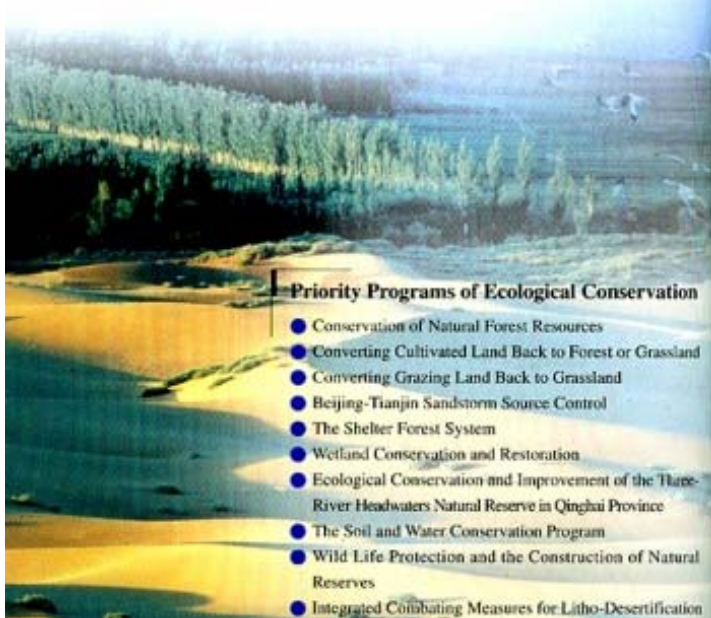
- Major Sectors
- Industrial Parks
- Resource Recycling and Reuse / Metal Recycling and Reuse
- Recycling of Used Home Appliances
- Re-manufacturing

# Resource conserving and environmental friendly society (2/3)

**CHAPTER 6** Building a Resource-Conserving and Environment-Friendly Society

## Ecological conservation and restoration

The priority of ecological conservation and improvement is to shift from post-treatment to prevention, move from artificial improvement to natural restoration, and reverse the trend of ecological deterioration at the source



### Priority Programs of Ecological Conservation

- Conservation of Natural Forest Resources
- Converting Cultivated Land Back to Forest or Grassland
- Converting Grazing Land Back to Grassland
- Beijing-Tianjin Sandstorm Source Control
- The Shelter Forest System
- Wetland Conservation and Restoration
- Ecological Conservation and Improvement of the Three-River Headwaters Natural Reserve in Qinghai Province
- The Soil and Water Conservation Program
- Wild Life Protection and the Construction of Natural Reserves
- Integrated Combating Measures for Lihuo-Desertification

## Intensifying environmental protection efforts

Sticking to the principle of putting prevention first and taking integrated controlling measures, intensifying pollution prevention and control at the source, determined to change the situation of post-pollution control and pollution-accompanying control. Improving environmental quality of areas along main rivers, priority regions and priority cities

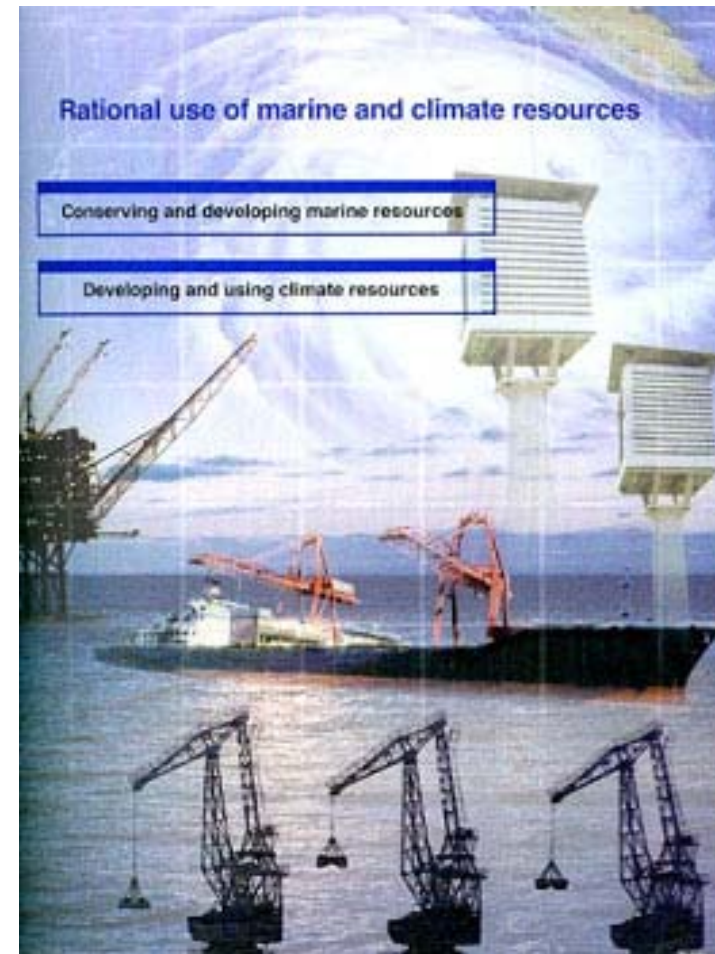


- Reinforcing water pollution prevention and control
- Strengthening air pollution prevention and control
- Enhancing solid waste pollution prevention and control
- Carrying out enforceable environmental protection activities

### Priority Programs of Environmental Pollution Control

- Water Pollution Control in Major River Basins
- Smoke Desulfurization in Coal-Fired Power Plants
- Disposal of Medical Waste and Hazardous Waste
- The Nuclear and Radiation Safety Program
- Chromium Slag Pollution Control

# Resource conserving and environmental friendly society (3/3)



## Policy and project arrangements (A-F)

A Regulation on pollution control of livestock and poultry breeding issued by SEPA (took effect on 08/05/2001)

- Principles
- Supervision department
- EIA, discharging permits, pollution levy
- Prohibited areas
- Penalties
- Managing baseline: pig 500; beef 100; chicken 30,000

B Technical standard of preventing pollution for livestock and poultry breeding issued by SEPA (took effect on 01/04/2002)

- Technical principles
- Site selection
- Layout and waste clearing technology
- Storage of livestock and poultry excrement and urine
- Wastewater disposal
- Disposal and utilization of solid waste
- Feeds and breeding
- Disposal of corpse
- Monitoring of discharging pollutants

**C** Discharge standard of pollutants for livestock and poultry breeding (took effect on 01/01/2003, SEPA/AQSIQ)

Table 1 Controlling scale of industrial livestock and poultry production (husbandry)

Scale	pig ( $\geq 25\text{Kg}$ )	chicken		ox	
		hen	chicken	cow	beef
I	$\geq 3,000$	$\geq 100,000$	$\geq 200,000$	$\geq 200$	$\geq 400$
II	$500 \leq Q < 3,000$	$15,000 \leq Q < 100,000$	$30,000 \leq Q < 200,000$	$100 \leq Q < 200$	$200 \leq Q < 400$

Table 2 Controlling scale of industrial livestock and poultry breeding zone (husbandry)

Scale	pig ( $\geq 25\text{Kg}$ )	chicken		ox	
		hen	chicken	cow	beef
I	$\geq 6,000$	$\geq 200,000$	$\geq 400,000$	$\geq 400$	$\geq 800$
II	$3,000 \leq Q < 6,000$	$100,000 \leq Q < 200,000$	$200,000 \leq Q < 400,000$	$200 \leq Q < 400$	$400 \leq Q < 800$

- ◆ For breeding zone: 30 hen = 1 pig; 60 chicken = 1 pig;  
1 cow = 10 pigs; 1 beef = 5 pigs;  
3 sheep = 1 pig.
- ◆ For all industrial production and breeding zone within scale I, and all industrial production and breeding zones within scale II and national key cities, **river basins** and seriously polluted areas, the standard took effect on 01/01/2003.
- ◆ For other industrial production and breeding zones within scale II, implementing starting time will be decided by county-level EPBs, but no later than 01/07/2004.



Table 3 The highest water discharge permit for water washing technology

type	pig [m <sup>3</sup> /(100 pigs ·day)]		chicken [m <sup>3</sup> /(1000 chicken ·day)]		oxen [m <sup>3</sup> /(100 oxen ·day)]	
	winter	summer	winter	summer	winter	summer
standard	2.5	3.5	0.8	1.2	20	30

Table 4 The highest water discharge permit for dry clearing technology

type	pig [m <sup>3</sup> /(100 pigs ·day)]		chicken [m <sup>3</sup> /(1000 chicken ·day)]		oxen [m <sup>3</sup> /(100 oxen ·day)]	
	winter	summer	winter	summer	winter	summer
standard	1.2	1.8	0.5	0.7	17	20

Table 5 The highest water pollutants discharge permit

<b>item</b>	<b>BOD<sub>5</sub> (mg/L)</b>	<b>COD (mg/L)</b>	<b>SS (mg/L)</b>	<b>NH<sub>3</sub>-N (mg/L)</b>	<b>Total-P (mg/L)</b>	<b>excrement eschericheae (number/100ml)</b>	<b>roundworm spawn (number/L)</b>
<b>standard</b>	<b>150</b>	<b>400</b>	<b>200</b>	<b>80</b>	<b>8.0</b>	<b>1000</b>	<b>2.0</b>

Table 6 The highest water pollutants discharge permit

<b>Item</b>	<b>standard</b>
<b>roundworm spawn</b>	<b>Death ratio <math>\geq</math> 95%</b>
<b>Fecal Escherichia coli</b>	<b><math>\leq 10^5</math>/ kg</b>

Table 7 **The discharge permit of smell**

<b>Item</b>	<b>standard</b>
<b>smell</b>	<b>70</b>

## D Regulation on Pollution Levy

(SDPC/MOF/SEPA/MOFCOM, took effect on 01/07/2003)

### For livestock and poultry production

➤ starting point

- beef: 50; pig: 500; chicken and duck: 5000.

➤ pollution equivalent =  $\frac{\text{characteristic value of pollutants}}{\text{pollution equivalent value}}$

➤ Pollution Equivalent Value for Livestock & Poultry Production

type	Pollution Equivalent Value
Beef	0.1
Pig	1
Chicken and duck	30

➤ pollution levy =  
RMB 0.7 \* total pollution equivalent of the first 3 pollutants

# China Biogas Policy

## 中国沼气政策

- Government's program on renewable energy promotes the formulation of biogas from livestock waste.

政府可再生能源项目促进畜牧废物的沼气生产。

- The expected impact of that policy is reduced pollution from animal wastes through the sustainable use of biogas energy and fertilizer by-products.

该政策目标是通过沼气和副产品肥料的可持续利用，减少动物粪便污染。

**But ...**

**但是.....**

- Lack of enforcement of environmental laws at the local level because of economic pressure from the livestock operations has led many provinces to assume that direct **discharge to anaerobic lagoons** is the only solution. There is no legal requirement for the anaerobic lagoons to be covered to prevent methane emission.

由于畜牧场运营费用问题，环保法律在当地并未得到强制执行，许多省市表示将粪便直接排放到厌氧池可能是唯一解决方案。并无相关法律要求盖上厌氧池防止甲烷排放。

- Appropriate mechanism or agro-ecological system to dispose of all the liquid and solid effluents from biogas digester onto farmers' fields is rarely implemented. Risk of secondary pollution from **biogas** establishment occurs.

极少农场建立了适当装置或农业生态系统处理沼气池固液废物，因而存在二次污染风险。



Which kind of see it is?









**Usually, cassava wastewater has to be stored in a lagoon for as long as 10 months, or even longer, so that going through the natural oxidation.**



# Key to sustainable biogas market development

## 沼气市场可持续发展

- Investors in biogas digesters must see reasonable returns on investment and perceive that business risks are manageable.

沼气池投资商应合理估测投资回报并了解商业风险的可控制性。

- Government programs, policies and incentives play a critical role in encouraging the other market players to fulfill their roles.

政府项目、政策和奖励可鼓励其他市场参与者充分发挥作用。

- Due to the nature of biogas developments, many ministries are involved in policy making and development.

由于其特殊性，沼气发展及相关政策的制定涉及多个部门。

## But ...

但是.....

- National and provincial financial sources, and rural energy support services are heavily preoccupied by household biogas digesters. 大部分国家、省级有关资金及农村能源资助都用于开发于户用沼气池项目。
- Insufficient attention is paid to medium- and large-sized biogas systems although the latter is widely recognized as the future direction of rural energy development. 尽管大型沼气系统被广泛认为是未来农村能源发展方向，然而目前对大中型沼气系统关注并不够。
- Lack of cooperation between responsible agencies **and** lack of coordinated institutional arrangements result in different agencies promoting different technologies through different financial sources. 相关机构间缺少必要的合作沟通，在制度安排上有缺乏协调，致使不同的机构利用不同的资金来源推广不同的技术。

# **Selling Certified Emission Reduction of greenhouse gases** 温室气体核证减排销售

- **Possibility for additional farm revenues has made biogas expansion attractive to the provincial authorities, to biogas companies as well as to farmers.** 农业收入额外增加使得沼气项目的推广引起了省领导、沼气公司及农民朋友的广泛关注。
- **A common practice of middle scale pig farms is to use open anaerobic lagoon for disposal of pig wastes, which releases a large amount of greenhouse gases and severely pollutes the environment.** 中型养猪厂的普遍做法是将猪粪堆积在敞开的厌氧池中，这样产生大量的温室气体，严重污染环境
- **The integration of CDM brings opportunities to provide a future revenue stream for farms and help address financing and investment barriers to implement beneficial renewable energy and environmental projects.** 清洁发展机制（**CDM**）有利于增加农业收入，解决可再生能源开发项目及环保项目开展过程中的融资和投资困难。



Micro Level Kyoto Projects

# Baseline (Livestock Farming)

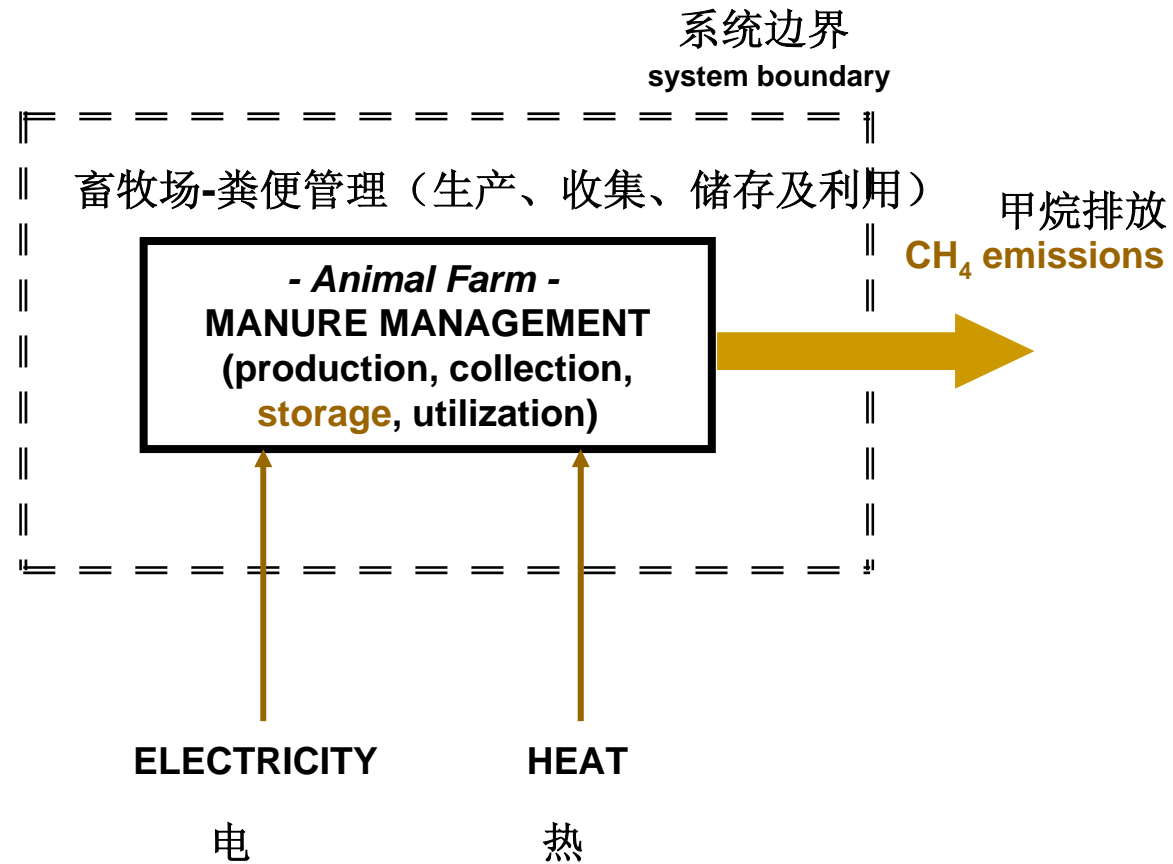
小型京都项目 基线（畜牧场）



# Micro Level Kyoto Projects

## Baseline (Livestock Farming)

小型京都项目 基线（畜牧场）



Micro Level Kyoto Projects

## Project Activity (Biogas Plant)

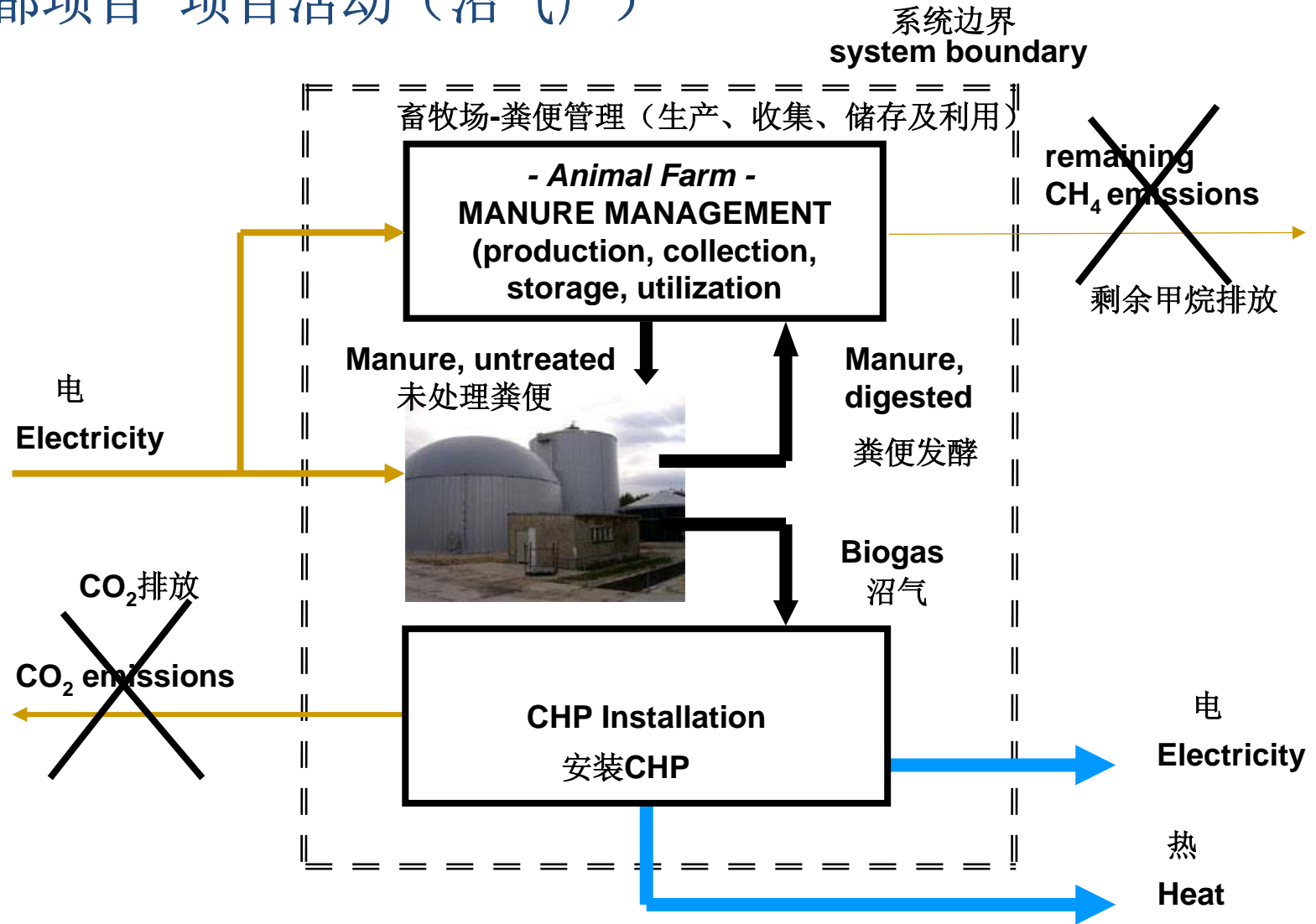
小型京都项目 项目活动（沼气厂）



# Micro Level Kyoto Projects

## Project Activity (Biogas Plant)

### 小型京都项目 项目活动 (沼气厂)



Micro Level Project

# CER Yield of exemplary Biogas Project

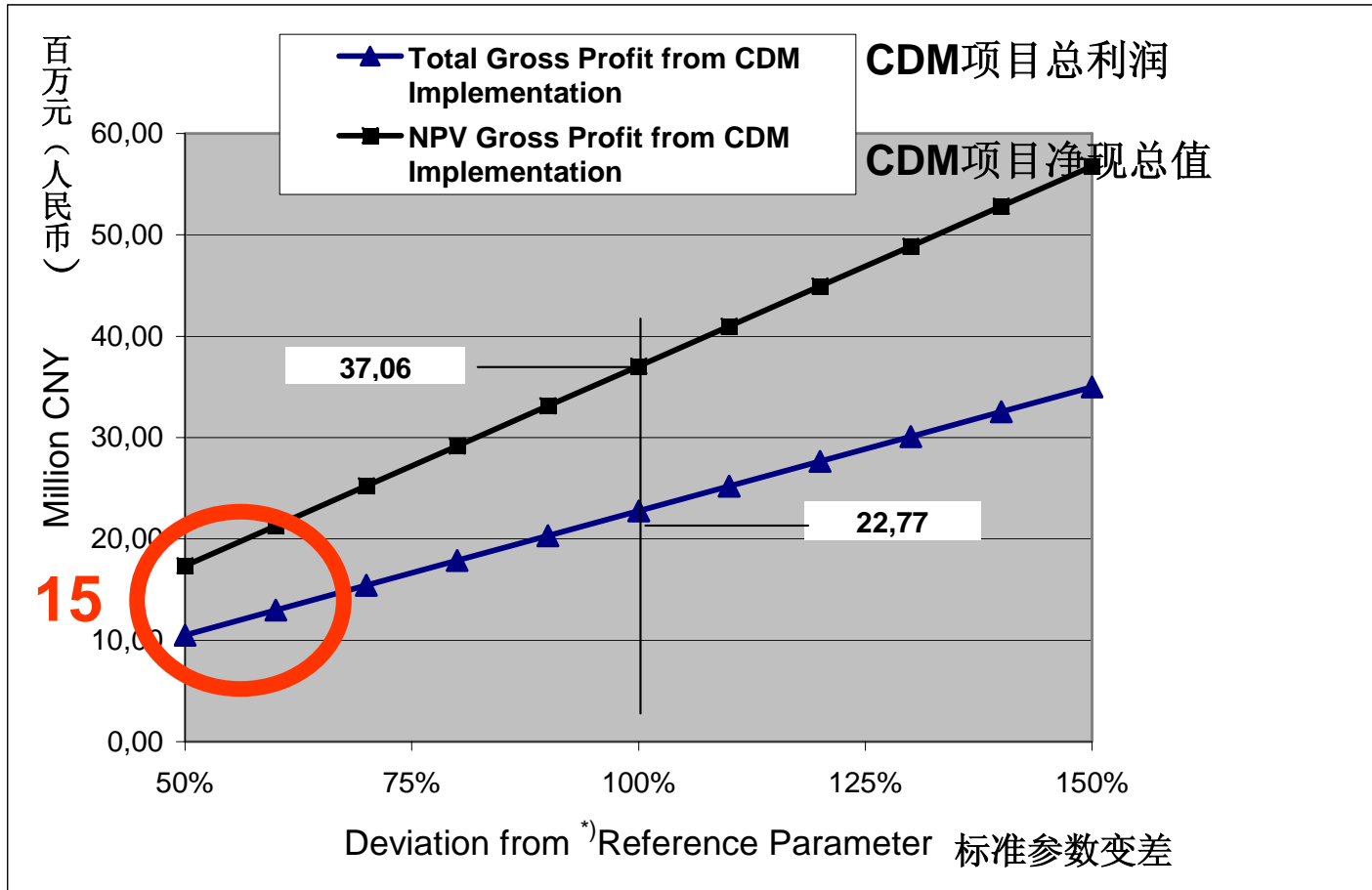
## 小型项目 沼气示范厂核证减排量

<b>Location</b> 地点	China, Piggery of 100000 tons od swine manure per year 中国 猪粪产量为10万吨/年的猪舍	
<b>Baseline Scenario</b> 基线场景	100000 tons of swine manure are stored in lagoons per year before final utilization; Fuel consumption for heating purposes of farm facilities 10万吨的猪粪在被利用前都储存在粪池里 农家供热燃料消耗	
<b>Project Scenario</b> 项目场景	Technical digestion of this 100000 tons of swine manure; Production von power and heat, and displacement of fuel 猪粪科技降解发电供热，替代燃料	
<b>Annual Amount of Emission Reduction</b> [t CO <sub>2</sub> e] 年减排量[t CO <sub>2</sub> e]	<ol style="list-style-type: none"> <li>1. CH<sub>4</sub> Reduction 甲烷减少量</li> <li>2. Heat (4000 MWh/a) 热</li> <li>3. Power (6000 MWh/a) 电</li> </ol> <p><b>Total总减少量</b></p>	<p>32000 t CO<sub>2</sub>e/a</p> <p>1050 t CO<sub>2</sub>e/a</p> <p>4200 t CO<sub>2</sub>e/a</p> <p><b>37250 t CO<sub>2</sub>e/a</b></p>
<b>CER Amount</b> 核证减排总量	37250 t CO <sub>2</sub> e/a x 10 years 年= <b>372 500 t CO<sub>2</sub>e</b>	



# Micro Level Project Sensitivity Analysis on CER Price/Yield

## 小型项目 CER 价格/产量灵敏度分析



**CER产量: 37250 t CO<sub>2</sub>e/a** \*) CER Yield: 37'250 t CO<sub>2</sub>e/a  
**CER价格: 115元/吨CO<sub>2</sub>e** CER Price: 115 CNY per ton CO<sub>2</sub>e

Micro Level Project  
Financial Basics

# 小型项目 财务基础

- **Plant Magnitude (CHP Engine Power)** **1 MW-el**  
建厂规模 (CHP发动机)
  - **Investment Costs 投资额** **25 Million CNY 2500万 (人民币)**  
**Biogas Plant 沼气厂**
- 
- **总CER值 (远期)** **1500万 (人民币)**  
**Total CER Value (Forward)** **15 Million CNY**
  - **Cash-Flow Model 1 现金周转模式1** => 100% Upfront (预付100%)  
**Cash-Flow Model 2 现金周转模式2** => 50% Upfront (预付50%) + 50% Mezzanine (internat.) (50%国际资金)  
**Cash-Flow Model 3 现金周转模式3** => 100% Mezzanine (international) (100%国际资金)
  - **Remaining Capital Demand** **10 Million CNY**  
**剩余资金需求** **1000万 (人民币)**  
=> 100% Equity 100%净值  
=> 50% Equity + 50% Loan (local bank) 50%净值+50%贷款 (本地银行)  
=> 100% Loan (local bank) 100%贷款 (本地银行)



# Monitoring requirement

- Exact measurement of biogas out of each digester
- After desulphurization, dehydration and purification, the biogas should be measured including pressure, flow, temperature, CH<sub>4</sub> fraction
- Exact input of biogas to generator, mass & energy flow
- Install flow meter at the inlet of generator and flow respectively.
- Flare should operate in compliance with manufacture's specification
- Temperature, pressure or other parameters should be monitored
- Biogas flow and CH<sub>4</sub> fraction should be measured at 95% confidence level
- Ensure aerobic treatment of residues

# Parameters monitored

- Electricity generated, reported monthly , recorded daily
- Electricity imported, reported monthly , recorded daily
- Animal number, animal number of each species in all pig barns, stock number, production number, inlet number of piglets/calves. Monitored and reported monthly
- Animal weight, average weight of each species (age classes). Monitored and reported monthly
- Fraction of manure handled in project activity. Monitored and reported monthly (separated by volumes and DM, how collected/transported)
- Biogas flow as well as gas pressure and temperature (four flow meters needed, one at outlet of each digester, one at inlet of generator, another at inlet of flare). Measured continuously, recorded daily, reported weekly, confidence level: 95%
- Methane fraction (two measure devices needed, one at outlet of each digester), measured continuously, recorded daily, reported weekly, confidence level: 95%
- Flare efficiency. Monitored when flaring, parameters: temperature and others described in technical specification.
- Feeding formula of each animal species (age classes), monitored and reported monthly
- Proven document of generic source, reported annually
- Records of animal/meat/milk sales and records of feed purchase, reserve all records.

# Mandatory equipments (CDM – 1/3)



?

# Mandatory equipments (CDM - 2/3)



# Mandatory equipments (CDM - 3/3)



## CDM project examples in validation (1)

# 审定批准的CDM项目1

1. Methane capture and nitrous oxide destruction from swine manure treatment for Meng Miao, Luohe, Henan (April 2006):  
60000 pigs, CSTR 12000 m<sup>3</sup> size of treatment,  
405 kWel (displacement of grid supply),  
38069 tCO<sub>2</sub>/y  
河南漯河孟庙养猪场猪粪处理的沼气捕捉和减少氮氧化物（**2006年4月**），**60000**头猪，**12000m<sup>3</sup>**的连续搅动池，**405kWel**（取代供电电网），**38069吨CO<sub>2</sub>/年**
2. Methane capture and nitrous oxide destruction from swine manure treatment for Meng Miao, Luohe, Henan (December 2006):  
29177 pigs, CSTR 2500 m<sup>3</sup> size of treatment,  
235 kWel (displacement of grid supply),  
20342 t CO<sub>2</sub>/y  
河南漯河孟庙养猪场猪粪处理的沼气捕捉和减少氮氧化物（**2006年12月**），**29177**头猪，**2500m<sup>3</sup>**的连续搅动池，**235kWel**（取代供电电网），**20342吨CO<sub>2</sub>/年**

# De quing yuan biogas plant: 2 MW



## CDM project examples in validation (2)

### 审定批准的CDM项目2

3. Methane Recovery and Utilization CDM Project at Muyuan Swine Farm in Henan (December 2006):  
188500 pigs, UASB 2155 m<sup>3</sup>, IC 570 m<sup>3</sup>,  
1090 kWel (displacement of grid supply),  
110461 tCO<sub>2</sub>/y  
沼气回收  
利用**CDM**项目：河南牧原养猪厂（**2006年12月**）：**188500**头猪，**2155m<sup>3</sup>**的连续搅动池，**IC 570 m<sup>3</sup>**，**1090kWel**（取代供电电网），**110461**吨**CO<sub>2</sub>/年**
4. Animal Manure Management System GHG mitigation project Shandong MinHe Livestock Co. Ltd., Penglai, Shandong Province (March 2007):  
5000000 chicken, CSTR 30000 m<sup>3</sup>,  
2700 kWel (selling electricity to the grid),  
86829 tCO<sub>2</sub>/y  
山东蓬莱  
民和牧业股份有限公司动物粪便管理体系**GHG**减少项目（**2007年3月**）：**500**百万只鸡，**CSTR 3万m<sup>3</sup>**的连续搅动池，**2700kWel**（卖给电网），**86829**吨**CO<sub>2</sub>/年**。





**Hubei Eco-Farming Biogas Project Phase I (05/07)**  
**(in validation)**

湖北生态农业沼气项目第1阶段（已审定批准）

9,442 biogas digesters, 8 m <sup>3</sup> ;	<b>9,442个沼气发酵池,8m<sup>3</sup></b>
12,605 biogas digesters, 10 m <sup>3</sup> ;	<b>12,605个沼气发酵池,10m<sup>3</sup></b>
3,803 biogas digesters, 12 m <sup>3</sup> ;	<b>3,803个沼气发酵池,12m<sup>3</sup></b>
4,150 biogas digesters, 15 m <sup>3</sup> ,	<b>4,150个沼气发酵池,15m<sup>3</sup></b>
30000 households, 141,451 pigs.	<b>30000户家庭, 141,541头猪</b>

replacing fossil fuel thermal energy needs of households who are raising pigs.

替代养猪家庭对化石燃料热能需求

39,469 t CO<sub>2</sub> equivalent in 2008; 59,200 t CO<sub>2</sub>e per year from 2009 to 2017; and 19,733 t CO<sub>2</sub>e in 2018.

在**2008年39,469吨的CO<sub>2</sub>**；从**2009年到2017年每年59,200吨CO<sub>2</sub>排放**；**2018年19,733吨CO<sub>2</sub>排放**。

## Hubei Eco-Farming Biogas Project Phase I

### CER Revenue Distribution plan end

### 湖北生态农业沼气项目第1阶段CER收入分配计划

- 78 % of the carbon credit sales revenues to the individual farmer households for loan repayment, biogas digester maintenance, and livelihood needs.

**78%** 的碳信用收益用于农民还贷、沼气发酵池维护和农民生活所需。

- 2 % to Hubei Qingjiang Zhongye Company for technical service provided **2%**用于支付湖北清江种业公司技术服务费。
- 10 % to the village biogas service stations/centers for provision of technical services and farmer training;

**10%** 用于农村沼气服务站/中心对农民的技术服务和培训

- 10 % for project management and monitoring by Project Management Offices (PMO) established within Enshi Prefecture and project county energy bureaus.

**10%** 用于支付恩施市和县能源局项目管理办公室对本项目的管理和监督费用。

# Outlook 前景

- **In the absence of dramatic changes in the application of pollution control practice in livestock production the level of pollutant load discharges from livestock production will continue to rise to 2015.**  
如果畜牧养殖业污染控制得不到加强，那么畜牧业污染物排放量将在**2015年前持续增长**。
- **2020, the rate of livestock production in China is expected to have increased by 167% from 2000 levels.**  
到**2020年中国畜牧养殖业将在2000年的基础上增长167%**。
- **Reduction in pollution runoff of 40 percent will be needed by 2020 in order to simply stabilize pollution at current levels.**  
在**2020年之前将污染减少40%**才能够使污染稳定在目前水平。
- **This will represent a considerable challenge to livestock producer and a huge market for biogas systems.**  
对畜牧养殖户而言，这将是一个巨大挑战，而对沼气项目开发者来说这将意味着广阔的市场前景。

# **Business opportunities for larges scale Biogas Systems in China**

因此在这方面存在着商机:

- 1. Training on Technology, Equipment and Service Requirement**  
需要技术、设备及服务方面的培训
- 2. Development of high efficient fermentation technology for higher biogas yield**  
发展高效发酵技术用于沼气的高产出。
- 3. Demonstration of new building material and technology for digester construction and biogas storage**  
展示新的用于消化器建设的建筑材料和技术
- 4. Introduction of high pressure biogas storage**  
引入高压沼气储存技术

# Business opportunities (2)

因此在这方面存在着商机:

5. **Reliable (more than 7000 h/year) biogas heat and power co-generation & biogas fuel cell development cooperation**  
可靠的沼气热电联产系统和沼气电池技术
6. **Economic use of heat in tropical climate**  
在热带地区经济地使用热能
7. **Efficient post-treatment technology for water and solids after fermentation**  
用于水或固体发酵后的后处理技术
8. **Biogas purification with air intake (biological sulfur removal)**  
沼气净化技术（生物除硫）
9. **Biogas processing for feed in natural gas grid and as transport biofuel**  
用于天然气网络并且作为生物燃料输送的沼气处理技术

- Don't say that biogas plants are viable
- Prove and demonstrate that they are viable



**Heinz-Peter Mang**

Centre for Sustainable Environmental Sanitation (CSES)  
School of Civil & Environmental Engineering  
University of Science and Technology Beijing

**Thank You Very Much  
For Your Attention!**

감사합니다 !

谢谢!

