

National Combustion Strategy of Korea

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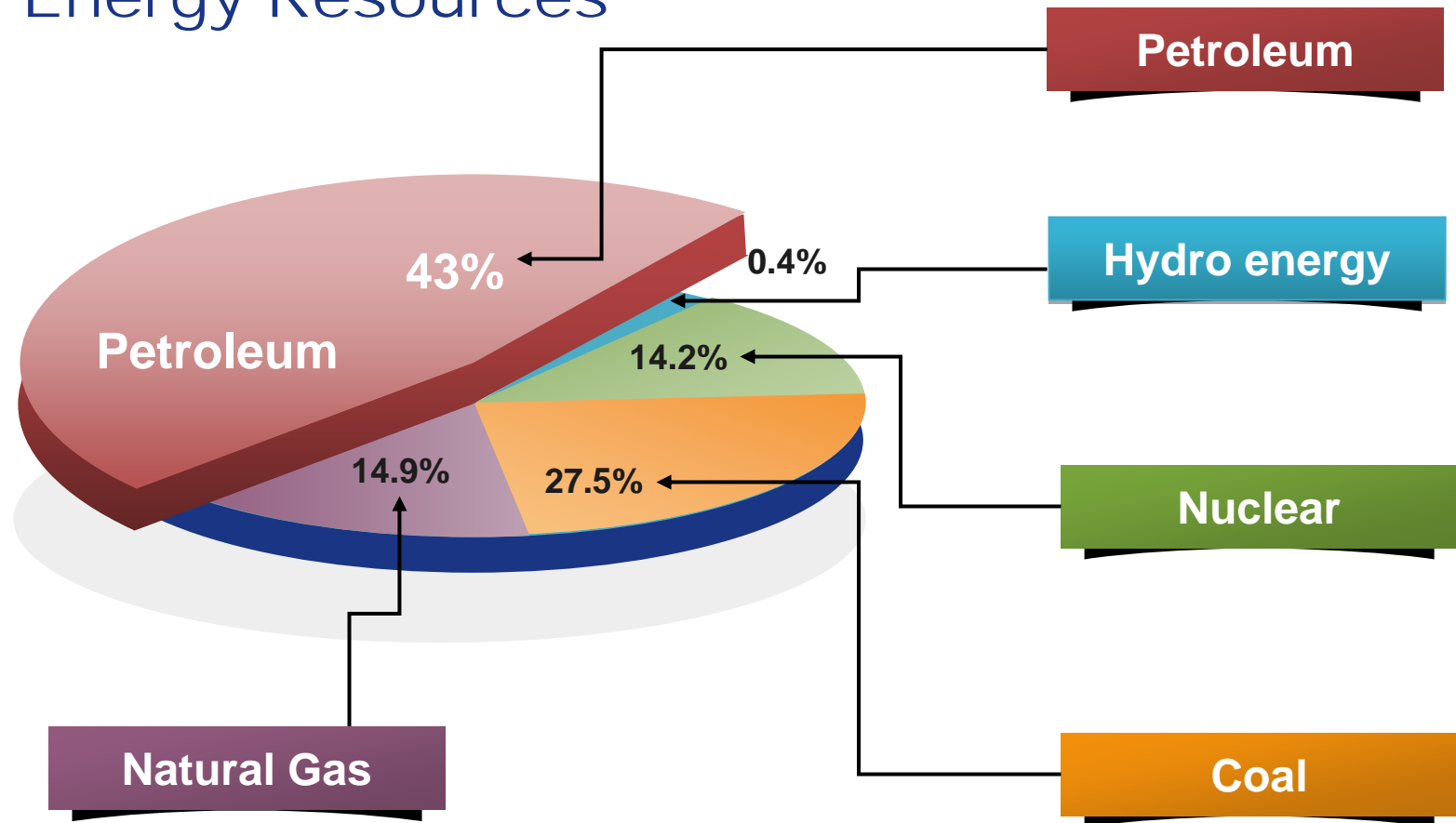
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Status of Energy Resources of Korea

Status of Energy Resources of Korea

The Energy Resources



Green Growth Policy

Green Growth Policy

-Low carbon and Green Growth

New Vision for Low Carbon & Green Growth

Green growth is a “new National Development paradigm” that creates new growth engines and job

[President Lee's Liberation day celebration speech, Aug. 15th, 2008]

Promotion of green energy industry as a core growth engine of green growth

[The 1st National Energy Master Plan, Aug 27th, 2008]

**Increase
Energy
Self-sufficiency**

- 18% by 2013
- 40% by 2030

**Raise the use of
New and Renewable
Energy**

- 11% by 2030
- 'Green Home' Project

**Invest in
Energy
Technology**

- Increase R&D investment
- Produce 'Green Cars'

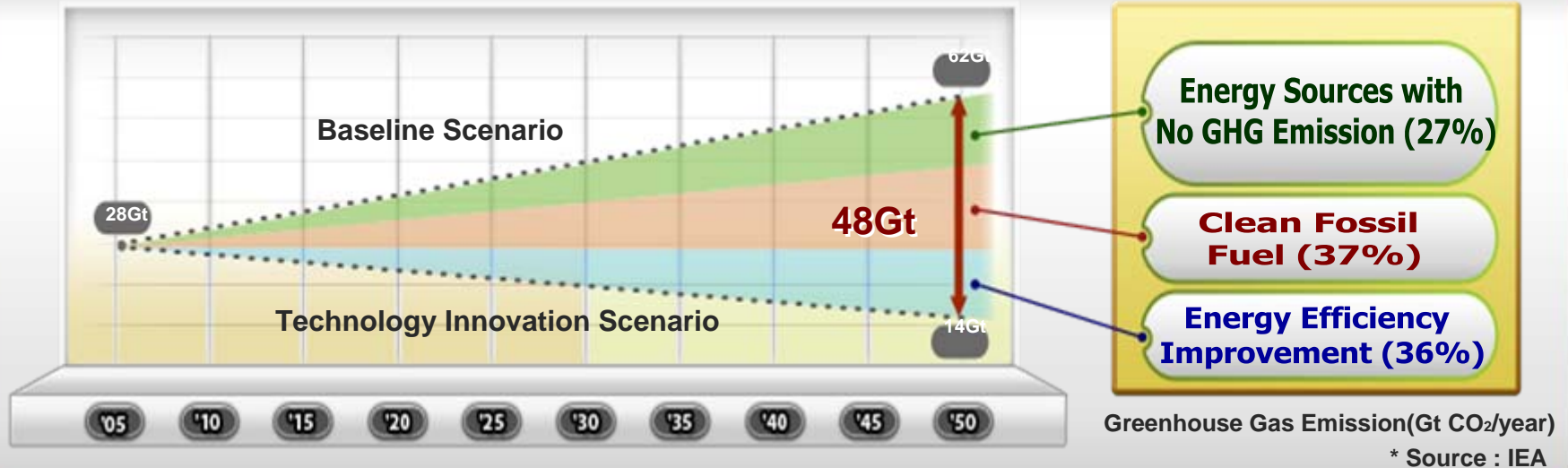


Low Carbon Society

Green Growth Policy

- Green Energy Industry Development Strategy

Green Technologies to Reduce Greenhouse Gases



Section

New and Renewable Energy

Clean Fossil Fuel

Energy Efficiency Improvement

Technologies

Photovoltaics, Wind Power, Hydrogen Fuel Cells, IGCC

CTL, GTL, CCS

LED, Power IT, Energy Storage, Combined Heat and Power, Heat Pump, Superconductivity

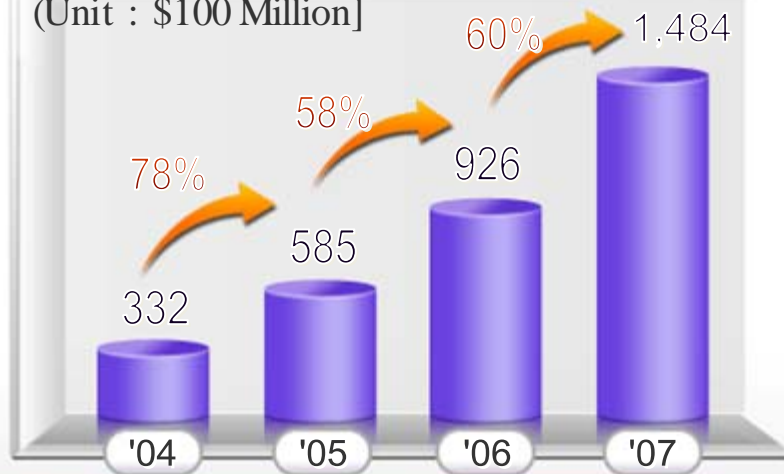
Green Growth Policy

- Core Driving Force of Green Growth

Emerging as a gigantic industry that creates a new market

Investment in green energy increased 60 ~ 80% every year

(Unit : \$100 Million)



GE Expanded R&D Investment : ('04) \$0.7 billion → ('10) 1.5 billion

BP \$8 billion investment over the period of 10 years from '02

A fast growing industry following the IT revolution

- CleanEdge, USA : Average growth rate of 15.1% for 10 years
- Cambridge Energy Research Associates: \$7 trillion investment in 2030

Economic , social spill-over effects

Green Energy Industry
(Technology + Infrastructure)

Green Transformation
of other industries

Social and
Cultural Change

The axis of national growth has shifted from IT to green energy

Green Growth Policy

- Our Status and Potential

Domestic Industries are in the initial phase, whereas global market is in the developing stage

- Industry Size : \$1.8 billion production (1.4% of global market share)
\$1.1 billion export, and 9,000 Employees
- Technology Level : 50~85% of the level of developed countries
- Propensity to import : Photovoltaics 75%, Wind Power 99.6%

Recognition

- Reluctant Investment due to low economic viability
- Recognized as a supporting industry

Policy

- R&D budget : 1/7 of Japan, USA
- Energy mix based on fossil energy (83% in '07)

Market

- Lack of connection between R&D and market
- Insufficient demand in the public sector

Substantial Potential for a Future Growth Engine Industry

- Increase of economic feasibility of green energy due to high oil price
- Global competitiveness of related industries, i.e. semi-conductor, IT
- 10th largest energy consumer with a large domestic market for greenhouse gas reduction

Green Growth Policy

- Vision and Strategy

Realization of Global Green Energy Industry Leader

Narrowing technology gap by choosing and focusing
Establishing a supporting system For the entire RD&D

Strategy 1

Selecting 9
Key Technologies

- Marketability, technical feasibility, and urgency
- Distinction between early revitalization and next generation Development

Strategy 2

Market-oriented
technology
development

- Technology development goals and roadmaps
- Diversifying technology acquisition measures
 - Linking R&D with Demonstration

Strategy 3

Creating
domestic/international
markets

- Demand creation in public sectors
- Support for seeking international markets



Strategy 4

Expanding
Infrastructure

- Establishing public - private partnership
- Securing stable financial sources
- Reformation of Regulations

Green Growth Policy

- 9 Key Technologies

	9 Technologies	Global Markets	Domestic Production	Technology Level
Rapid Growth of Global markets Development of Related Domestic Industries  Early development	Photovoltaics	\$ 20 b	\$140 m	83%
	Wind Power	\$ 37.5 b	\$ 400 m	79%
	LED	\$ 14 b	\$ 1.16 b	65%
	Power IT	\$ 13 b	\$70 m	85%
Large Potential of Global Markets Urgency of Securing Technological Competitiveness  Next generation development	Hydrogen Fuel Cells	\$ 3.2 b	-	66%
	IGCC	\$ 8.6 b	-	56%
	CTL / GTL	\$ 28.5 b	-	50%
	Energy Storage	\$ 0.5 b	-	60%
	CCS	-	-	65%

* As of the end of '07

* LED and power IT include peripheral units and small systems with low energy efficiency are excluded from energy storage

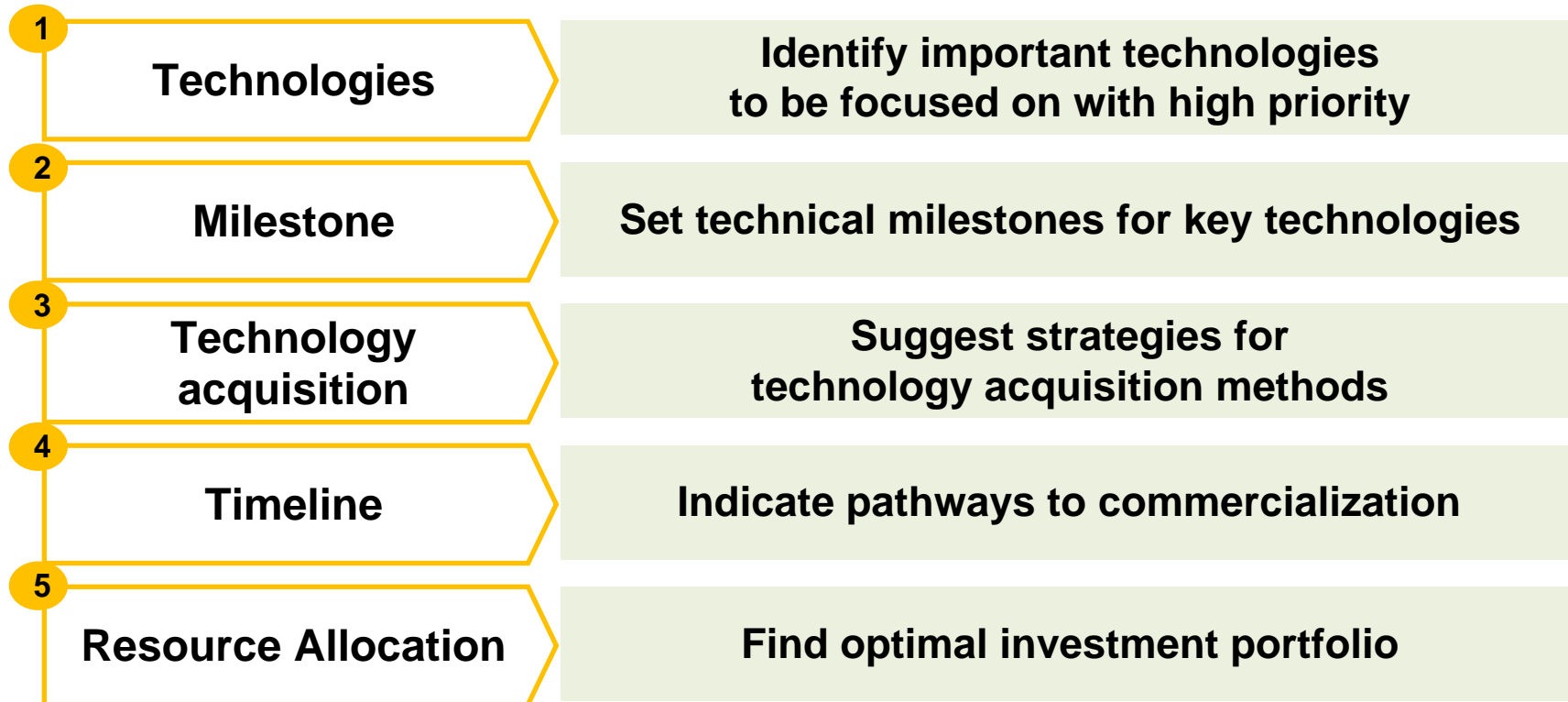
* Conducted research on the trends in developed countries, demand for industries, and expert evaluations (Dec '07. ~ Jul '08.)

Green Growth Policy

- Technology Roadmap Formulation

15 Technologies(including 9 key technologies):

Photovoltaics, Wind Power, Hydrogen Fuel Cell, Clean Fossil Fuel, CCS, IGCC, LED, Power IT, Energy Storage, Heat Pump, Combined Heat and Power, Nuclear Power, Efficient Building, Green Car, Superconductivity

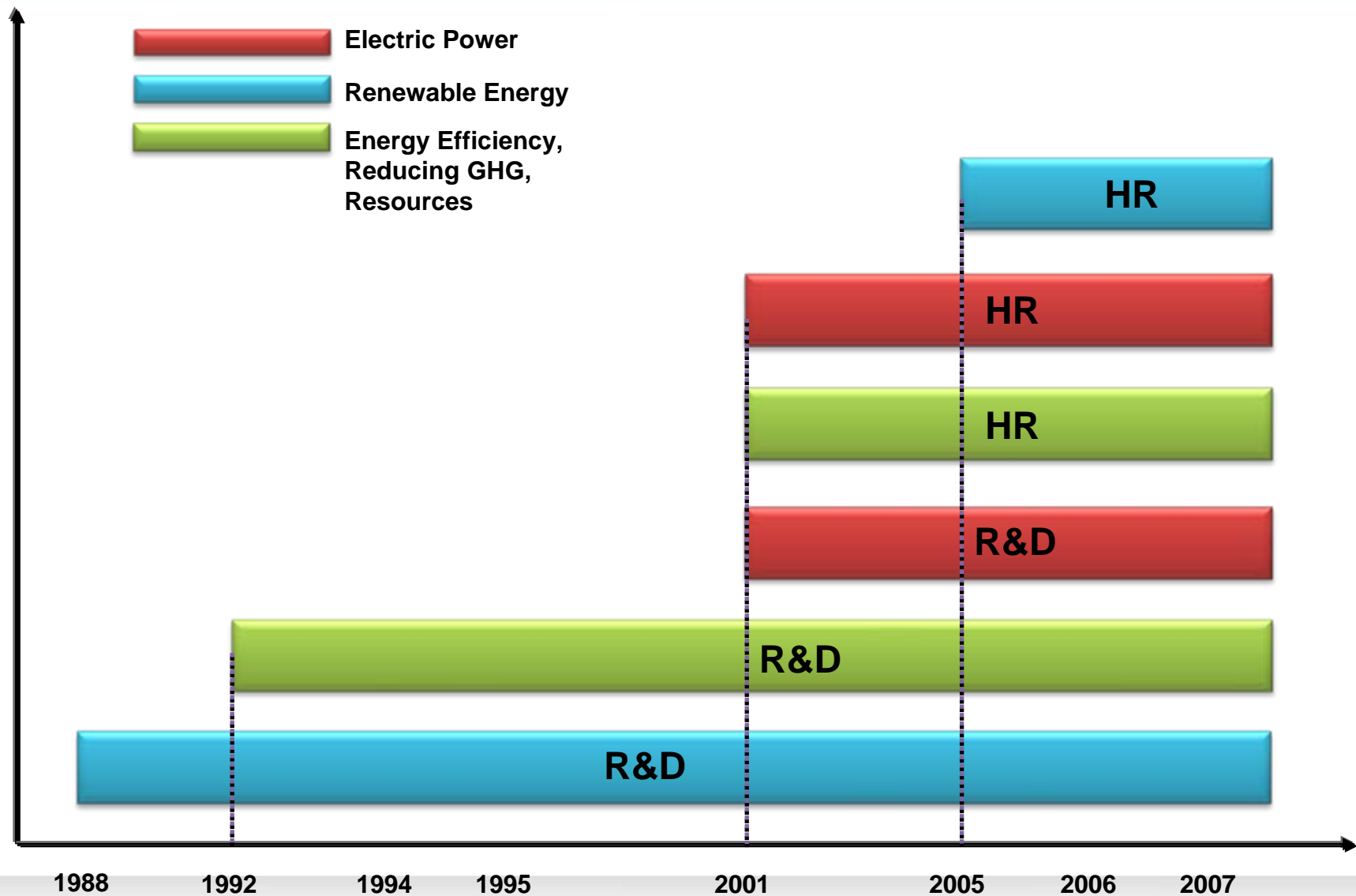




R&D Budget of Energy Sector in Korea

R&D Budget of Energy Sector in Korea

-History of Energy R&D



R&D Budget of Energy Sector in Korea

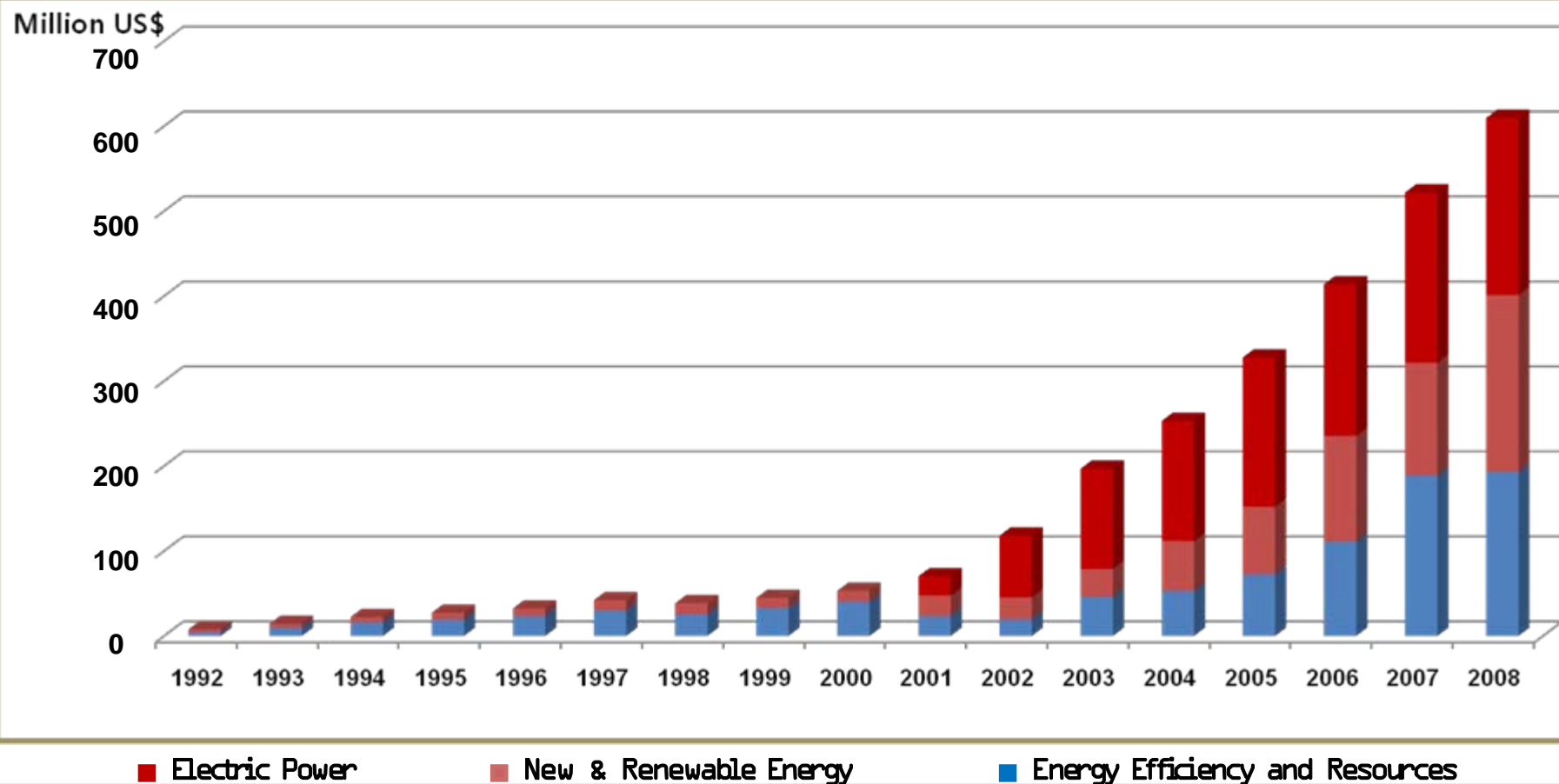
-History of Energy R&D

R&D budget has increased more than 10 times since 2000.

(’00) 53 million ₩



(’08) 609 million ₩



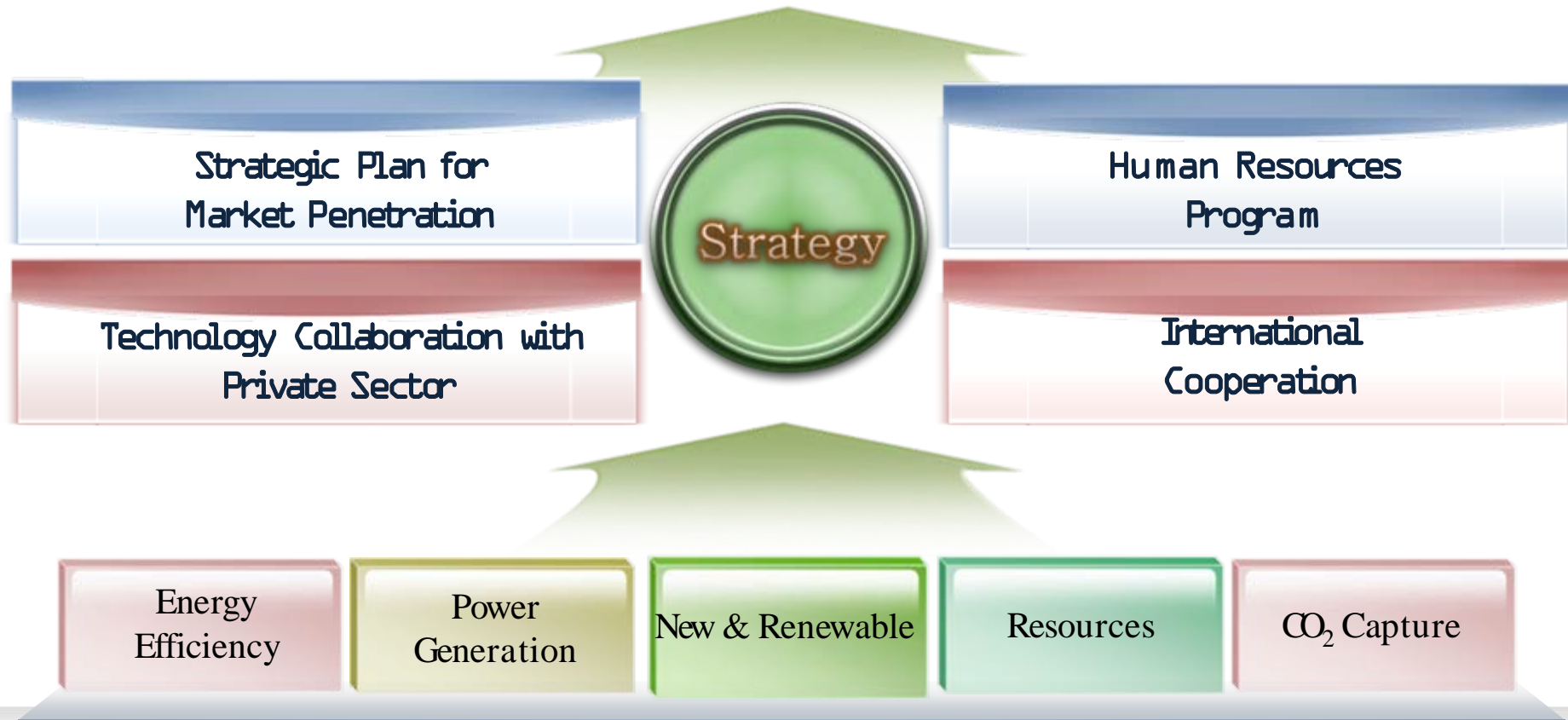
Themes of Energy R&D

The Themes of Energy R&D

- National Energy R&D Plan ('06~ '15)

Innovation system for sustainable development

- oil self-sufficiency : 18%('13)
- Reduction of Energy Consumption : 5%('15)
- CO2 Reduction : 17.5 MtCO2('15)
- Renewable energy : 5%('11)



The Themes of Energy R&D

- Energy Technology R&D (1)

Energy Efficiency & Resources

1

Energy Efficiency

- Innovative materials : nano technology
- Energy Storage
- Building Efficiency

2

Carbon Capture & Storage

- Pre-Combustion Technology
- Post-Combustion Technology
- Oxyfuel Combustion Technology

3

Resources Technology

- Minerals and Materials Processing
- Petroleum Resources
- Geology & Geo information

4

Clean Energy Sources

- GTL, CTL
- BTL
- Gas hydrate

The Themes of Energy R&D

- Technology R&D (2)

Electric Power Technology

1

Clean Coal Technology

- Advanced Power Generation
- Power Equipment Efficiency
- USC, IGCC

2

Transmission and Distribution

- Superconductivity
- Advanced transmission and distribution
- Efficient power devices

3

Power System

- Smart Grid
- Power Demand Control System
- Policy

4

Nuclear Power

- Advanced Nuclear Power
- High-level waste disposal
- Component Development

The Themes of Energy R&D

- Technology R&D (3)

New & Renewable Energy Technology

1 Hydrogen & Fuel Cells

- Hydrogen Production
- Hydrogen Delivery
- Hydrogen Storage
- Fuel Cells

2 Photovoltaics

- Electronic Materials and Devices
- High-Performance Photovoltaics
- Silicon Materials and devices
- Thin-film

3 Wind Power

- Large Wind Technology
- Offshore Wind Technology
- Advanced Blade Technology

4 Thermal Energy Sources

- Biomass
- Geothermal
- Solar Heating

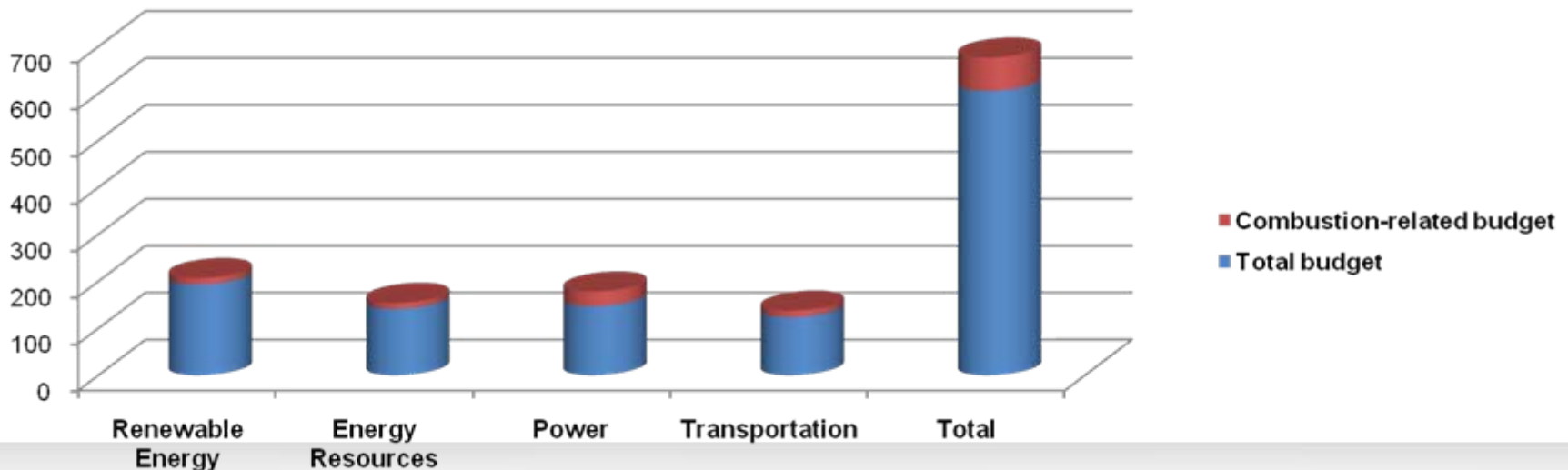


Subjects and Budget of Combustion-related R&D

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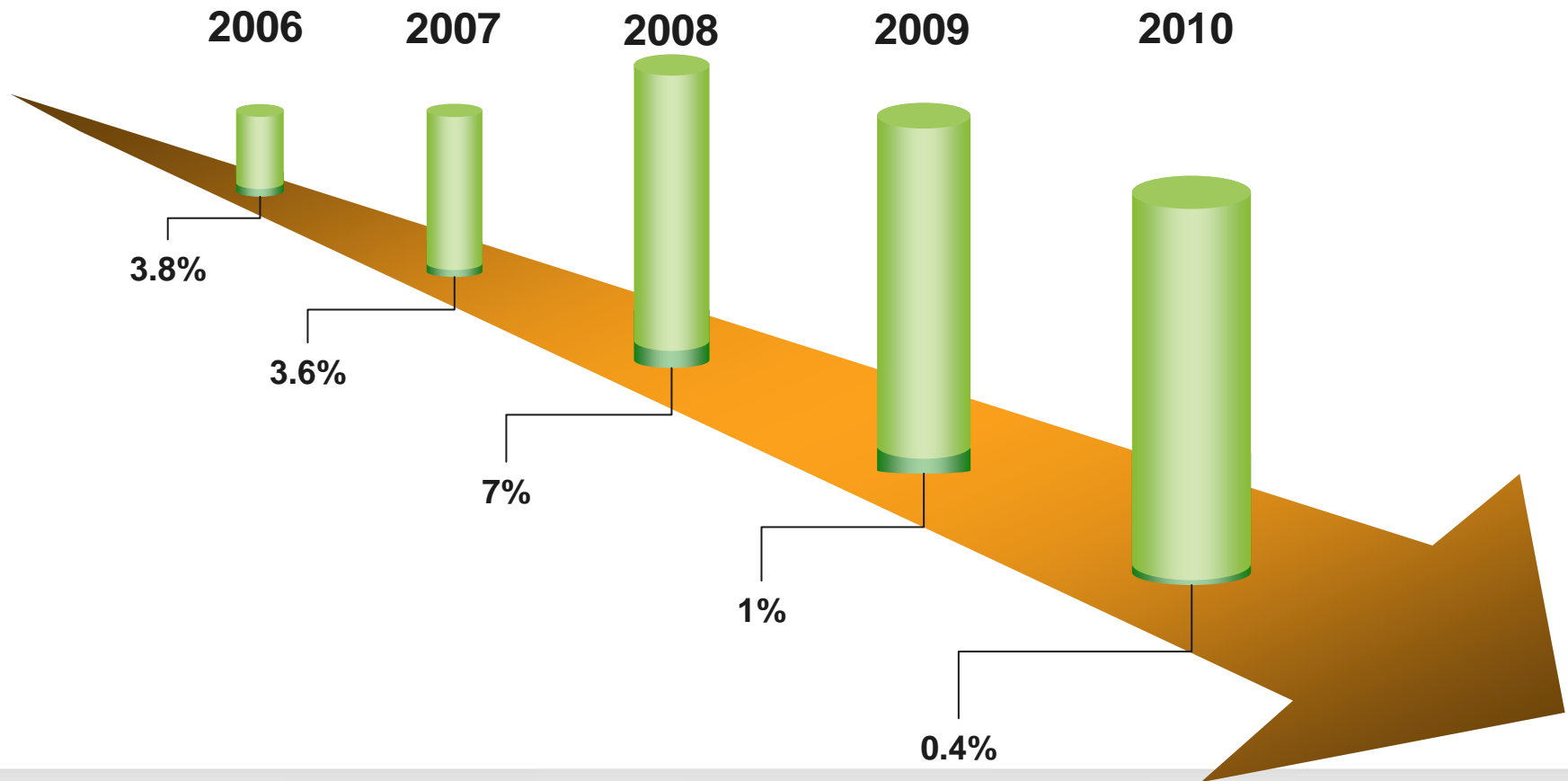
2008 Total US\$ = 600 million
Combustion-related Project 11.7%

	Total budget	Combustion-related budget
Renewable Energy	193,235,000	13,526,000
Energy Resources	141,456,000	12,639,000
Power	147,181,000	31,014,000
Transportation	123,705,000	13,662,000
Total	605,577,000	70,841,000



Subjects & Budget of Combustion-related R&D - Renewable Energy

Year	2006	2007	2008	2009	2010
Combustion	4,427,000	4,291,000	13,526,000	1,532,000	652,000
Total	114,369,700	118,474,000	193,295,000	194,935,000	166,590,000

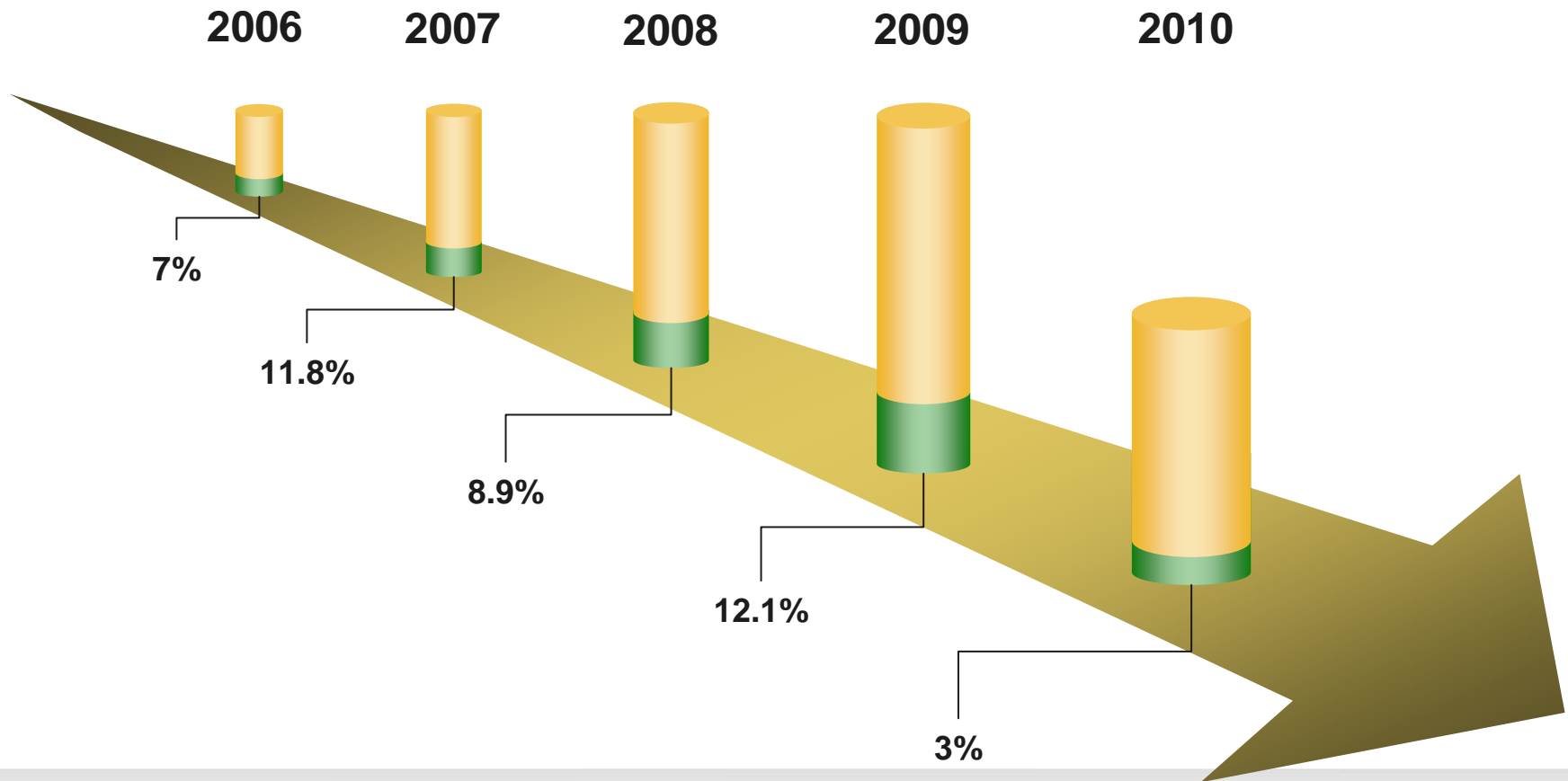


Subjects & Budget of Combustion-related R&D - Renewable Energy

Bio	<ul style="list-style-type: none">● LFG Generation● Distributed power generation by micro-gas-turbine using Bio-Energy in Animal farm
Hydrogen	<ul style="list-style-type: none">● Hydrogen station● Compressor for hydrogen station● Hydrogen production without CO₂● CO₂ reformation using renewable energy
Waste utilization	<ul style="list-style-type: none">● Waste steam power generation● High calorific value waste gasification and exhaust gas recirculation● Waste gas power generation with gas engine● RDF production

Subjects & Budget of Combustion-related R&D - Energy Resources

Year	2006	2007	2008	2009	2010
Combustion	6,738,000	15,154,000	12,639,000	19,874,947	1,630,000
Total	95,459,000	128,240,000	141,456,000	164,247,000	54,157,000



Subjects & Budget of Combustion-related R&D

- Energy Resources

Integrated Technology

- High temperature byproduct heat recollection
- Development of a high temperature and pressure resistive effector
- Development of hydrogen ion conductive ceramic membrane material
- Fermentation of high efficiency bio-butanol and refinement technology development
- Conditioning technology for gasification of biomass
- Clean biosyngas production for biomass gasification
- BTL synfuel production from biosyngas
- Construction of next generation safety system
- Development of gas safety system for U-Safety
- Development of integrated gas safety system

Waste Utilization

- Commercialization of small size high efficiency engine cogeneration system
- Improvement of 2L diesel truck fuel efficiency
- Development of high efficiency compact boiler with reduced NOx and CO

Subjects & Budget of Combustion-related R&D

- Energy Resources

Efficiency Enhancement

- Small-middle sized LPG commercial vehicle development
- Commercialization of high efficiency, low emission small engine cogeneration plant
- Development of ultra-high efficiency, ultra-low emission water-piped boiler
- Development of 1MW gas engine cogeneration system
- Research of next generation high performance low emission industrial boiler system
- Research of next generation industrial boiler core and system
- Commercialization of next generation low NOx burner for boiler
- Development of high efficiency low emission industrial water-piped boiler system
- Development of high output infrared drying device

Subjects & Budget of Combustion-related R&D

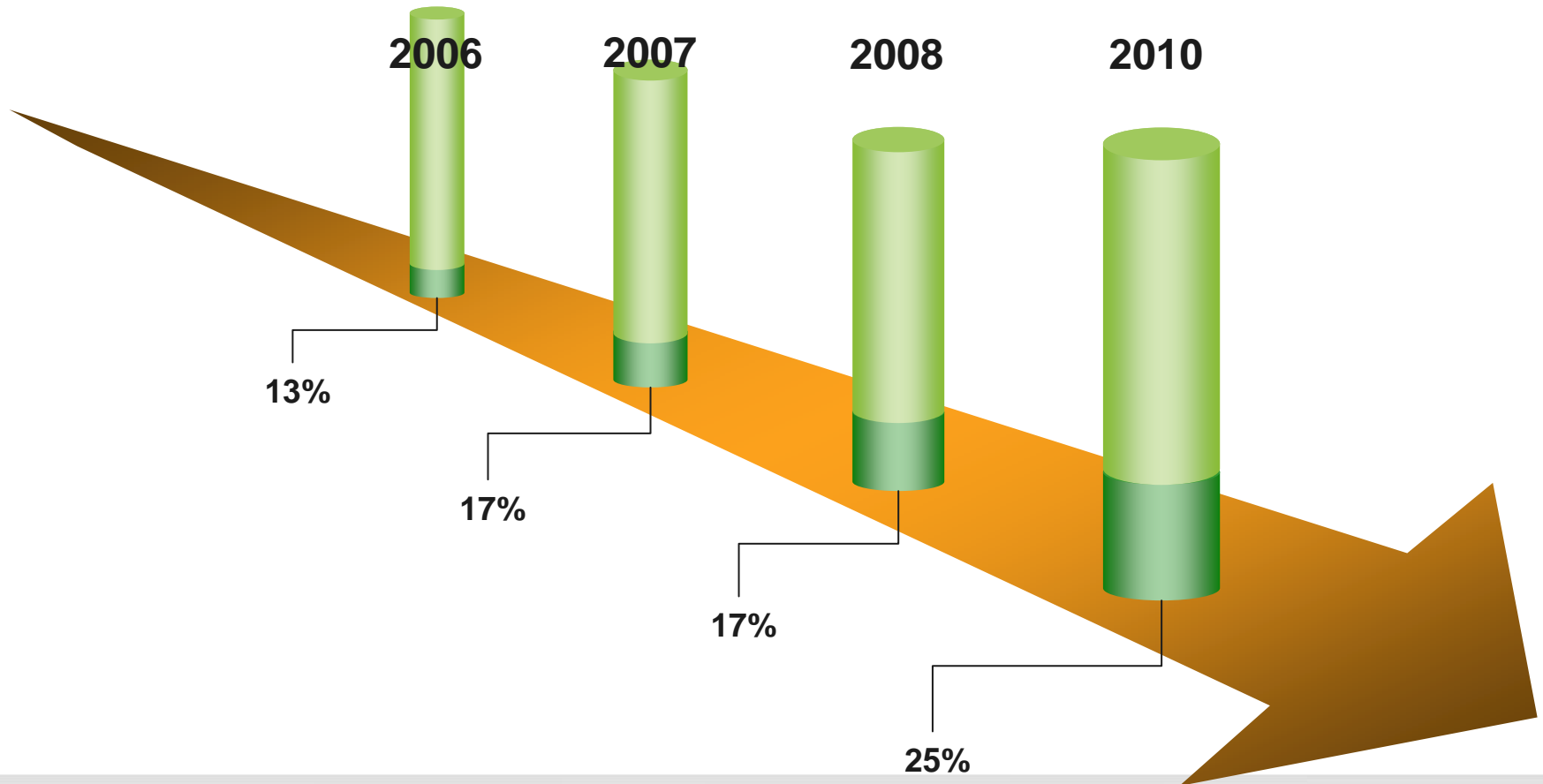
- Energy Resources

CO₂ Reduction

- Development of active denitrification catalyst
- Development of low NO_x burner using Metal Fiber Mat
- Development of real-time active control system for low emission
- Corrosion prevention of industrial combustion device for TIFI/SNCR/SCR Hybrid system and development of NO_x elimination
- Development of burner for 2-staged combustion with powdered coal
- Development of optimized technology for Oxy-PC generation system
- Development of environmental control technology for Oxy-PC system
- Development of Dust, SO_x, NO_x simultaneous treatment device in diesel boiler
- Development of core technology for next generation CO₂ recollection for coal power plant
- Development of simultaneous elimination technology of
- N₂O and NO_x from engine emission

Subjects & Budget of Combustion-related R&D - Power

Year	2006	2007	2008	2010
Combustion	36,546,398	51,772,426	31,014,888	53,847,123
Total	274,358,450	303,061,373	174,187,000	213,353,788



Subjects & Budget of Combustion-related R&D - Power

Advanced Technology of Power Generation

- Technology of performance improvement in gas turbine
- Optimized technology for turbine cycle
- Module development for performance improvement of obsolete equipment
- Process development for performance improvement of obsolete gas turbine
- Small gas turbine engine for 5MW high efficiency power generation
- Development of Feed water Heater Level Control Valve
- Development of 1350 large-sized gas turbine
- Highly-refined combustion technology
- Gas turbine module development for complex power plant
- Localization of E/F gas turbine burner assembly
- 5MW bio gas turbine cogeneration system development

Subjects & Budget of Combustion-related R&D

- Power

Efficiency Enhancement of Power Generation

- Combustion control development in NOx reduction for coal powered boiler
- Optimization technology of combustion for 2-staged gas turbine
- Combustion technology for medium quality oil
- Burner development for orimulsion low emission boiler
- Technology of applying DME to thermal power plant
- Combustion control development in NOx reduction for coal powered boiler
- Optimization technology of combustion for 2-staged gas turbine
- Combustion technology for medium quality oil
- Burner development for orimulsion low emission boiler
- Technology of applying DME to thermal power plant

Subjects & Budget of Combustion-related R&D

- Power

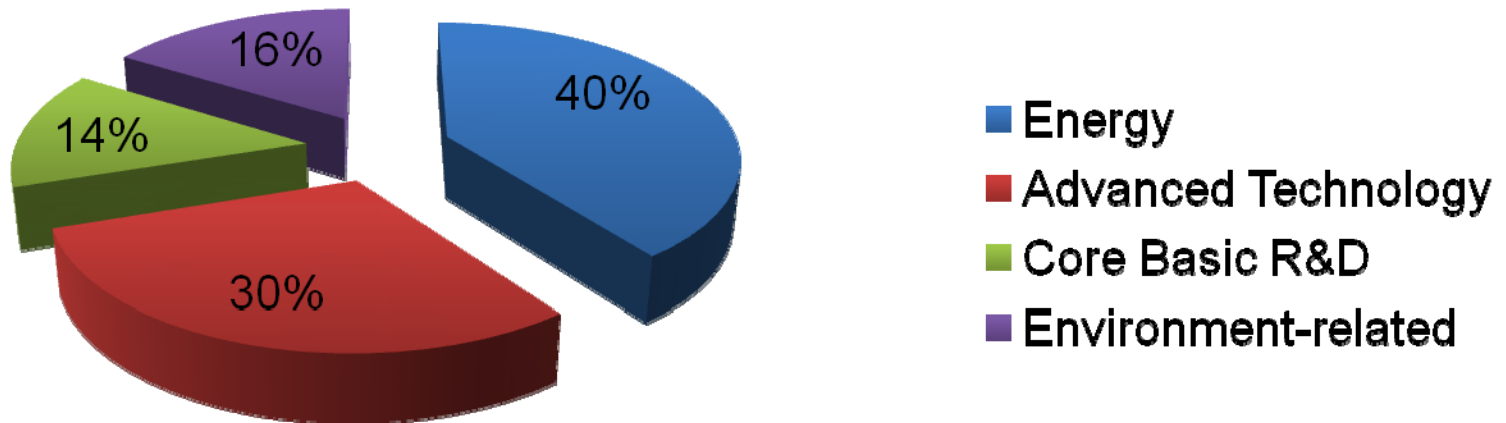
Environment -related

- Development of reduction technology of diesel engine emission using plasmatron
- Research of low emission combustion and production of deoxidating agent for denitrification
- CO₂ separation using medium circulated gas combustion system
- Operating and constructing technology for medium circulated gas burner

Subjects & Budget of Combustion-related R&D - Transportation

Transportation-related Budget	
Total budget	123,705,818
Combustion-related budget	13,662,069
Percentage	11%

Transportation



Subjects & Budget of Combustion-related R&D

- Transportation

Energy	<ul style="list-style-type: none">● Dual heater for common rail engine
Core Basic R&D	<ul style="list-style-type: none">● Virtual design technique of heat control system for next generation vehicle● System optimization of CVVT and auxiliaries to improve fuel economy● Development of air induction and exhaust system for future diesel vehicle● The volatile hazardous organic matter reduction catalyst● The volatile organic compound reduction technology for automobile
Environment -related	<ul style="list-style-type: none">● Liquid phase LPG direct injection engine developments● Simultaneous reduction of PM and NOx using Photoconductivity effect● Development of CAI engine● CCV integration system for common rail diesel engine

Prospects of Combustion R&D

Status

- Budget may keep its portion at 11%
- It may decrease unless the reasonable logics are provided

Problems

- Combustion is regarded as an old/conventional/dirty technology
- Combustion technology is laid to industry's responsibility

Vision

- Its importance should be clarified by combustion society through ;
 - Innovativeness of new-combustion technology
 - Contribution to energy conservation and emission reductions
 - Economic viability
- Public propaganda should be made with ;
 - More concrete vision and mission statement
 - Detailed items of R&D with quantitative specifications

Thank you for your attention.

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