

# "21st Century Power Generation Technologies and Challenges for a Sustainable Model of World Growth"

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Two dimensions will be considered in this contribution:

- The **Economic dimension** - primarily from an enterprise management perspective
- The **Environmental dimension** - specifically arising from the energy needs and consumptions

The “big” question is:

May a balanced relationship between these two dimensions be found, where all human beings can flourish and develop their potential, in a planet where the effects of human activities don't exceed certain limits, in order to preserve the system's diversity & complexity which allows the *“ecological life”*?

## The Economic dimension

(primarily from an enterprise management perspective)

## In the interest of whom?

Yesterday's answer:

Of the shareholders

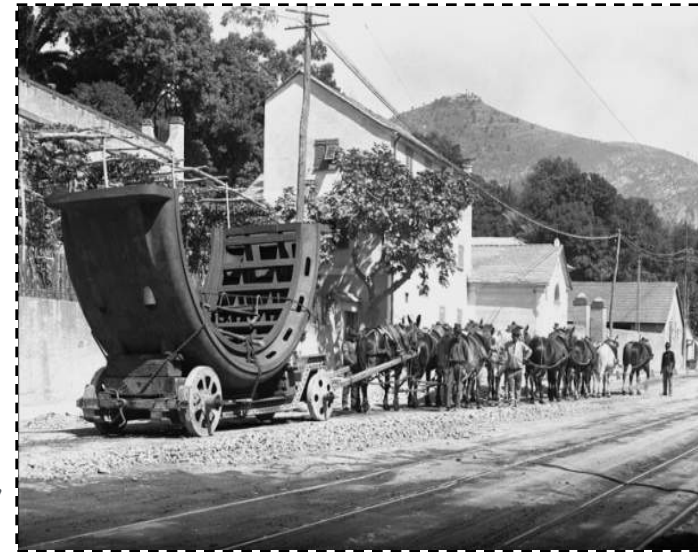
Today's answer:

Of the stakeholders

(i.e.: customers, local communities,  
suppliers, shareholders, employees,  
unions, ...)

# Ansaldo Energia - 154 Years of History

- 1853** Gio. Ansaldo & C. was born manufacturing the first locomotive
- 1923** First Power Station
- 1949** GE License for Steam Turbines and Generators
- 1980** Strong overseas commitment
- 1989** ABB Licensee for Steam Turbines and Generators
- 1991** Ansaldo Energia was born  
Siemens License for Gas Turbines  
Westinghouse License for Steam Turbines
- 1998** Business model refocused on energy sector
- 2004** Ansaldo Energia Service New Global Service Strategy
- 2005** Total technological independence
- 2006** ISP Strategy Launch: acquisition of two new companies



**Sustainable Transportation!**

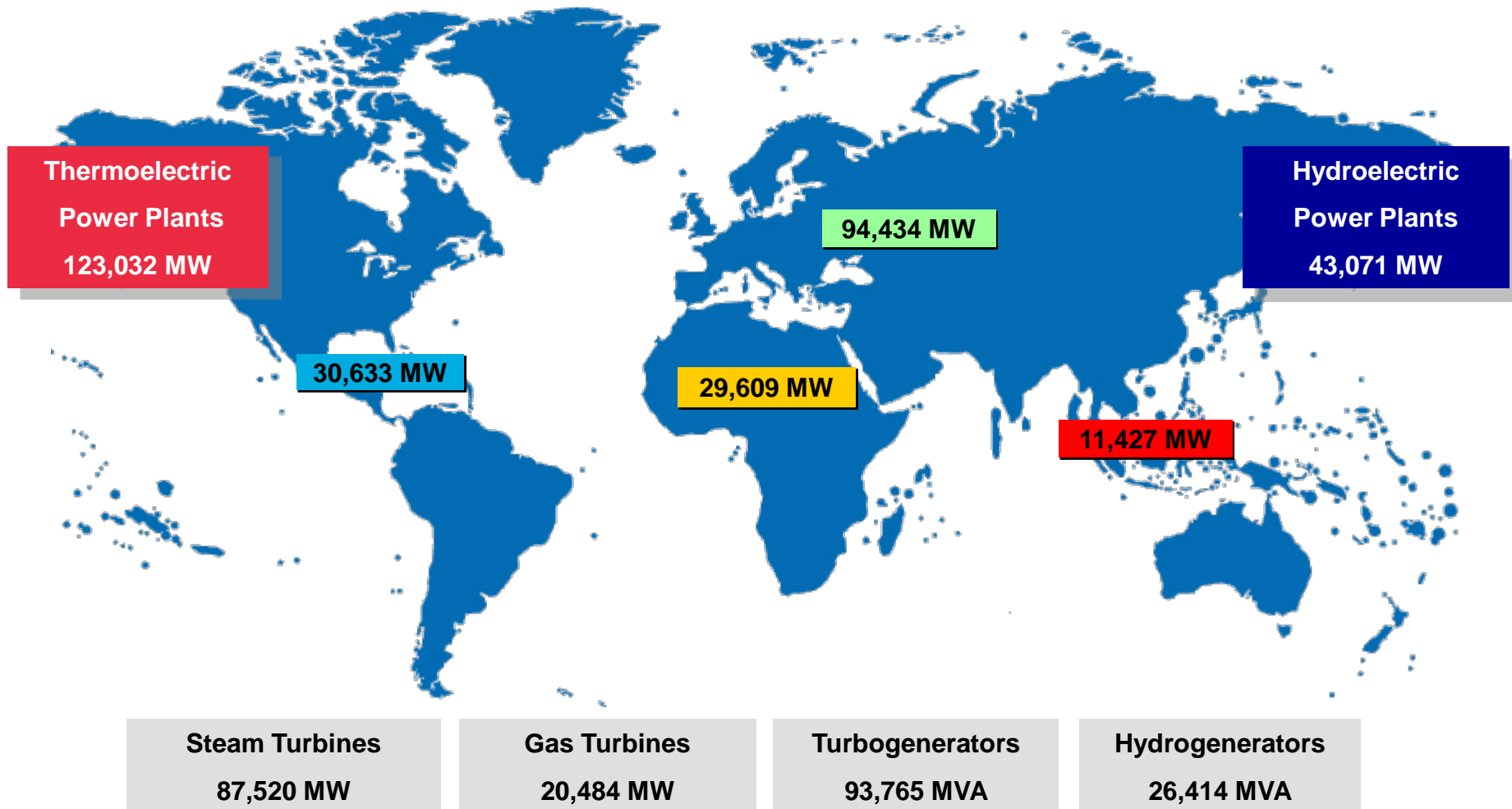
**Deep roots are a huge heritage!**

**Ansaldo Energia, a Finmeccanica Company, is a distinguished player in the energy industry, providing reliable and flexible solutions across a complete and innovative product portfolio:**

- 
- Equipment & Plant Design
  - Engineering
  - Manufacturing
  - Contracting
  - Service

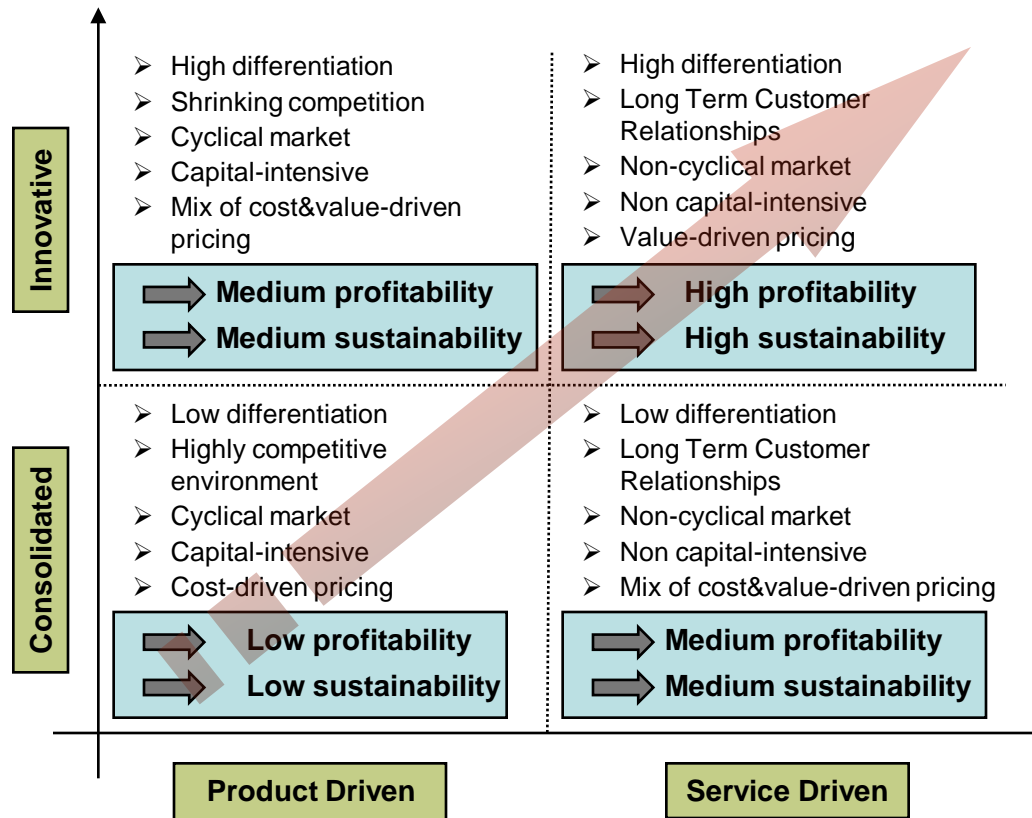
# AEN's Worldwide Foothold

**Installed power worldwide: 166,103 MW (As of Dec.06)**

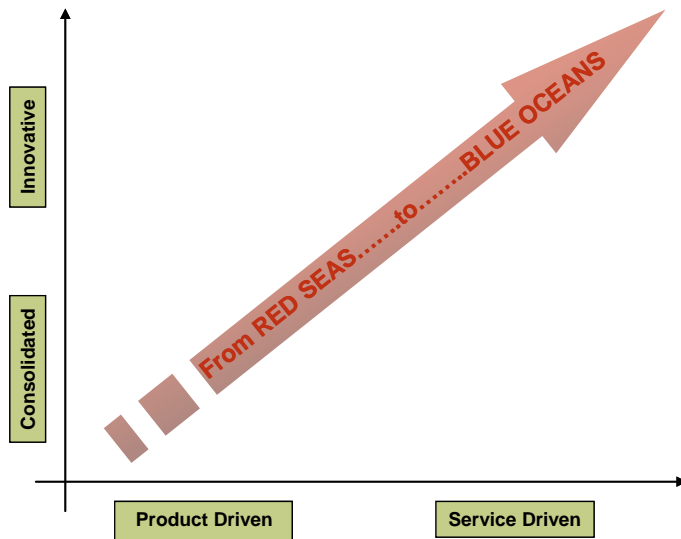




# Profitability vs. Sustainability



# From Red Seas to Blue Oceans



Service-driven enterprises, heavily investing in R&D and with strong product and process development capabilities, are more likely to maximize stakeholders value, i.e.:

- Higher financial returns
- Long term sustainable growth
- More adaptive to new laws & regulations
- More aware and respectful of local & diverse environments

## Key Processes in Ansaldo Energia today:

- Design for maintainability
- Total life cycle management
- Product life extension
- Supply Chain redesign
- Environmental, Health & Safety procedures

## Key Products & Services in Ansaldo Energia today:

- Low NOx gas turbine burners
- Low BTU gas combustors
- Blades and vanes refurbishment

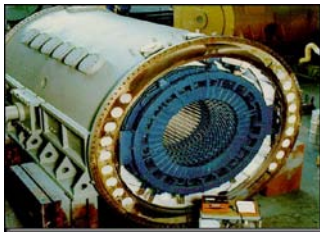
Achieving sustainability goals .....while pursuing  
profitability goals

# Technology: Building the future

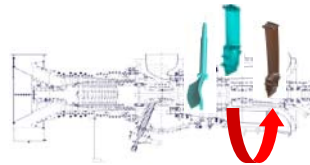
## • New Units



- Focus on Gas Turbines: performance improvements with retrofitable upgrades
  - Large Size V94.3A(5): 450MW 58% Eff. in Combined Cycle
  - Medium Size V94.2(7): 270MW @ 53.5% Eff. in Combined Cycle
  - CC operational flexibility
- Ultra supercritical development for Steam Turbines
- Extend air cooled generators up to 400MVA



## • Service OEM



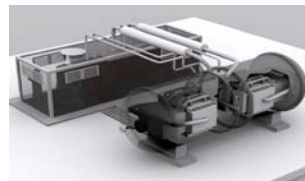
- V94.2 Life Extension
- V94.3A Extend Maintenance Intervals
- Field service improvements

## • Service OSPTM



- GE...extend portfolio and solutions
- Other technologies on GTs

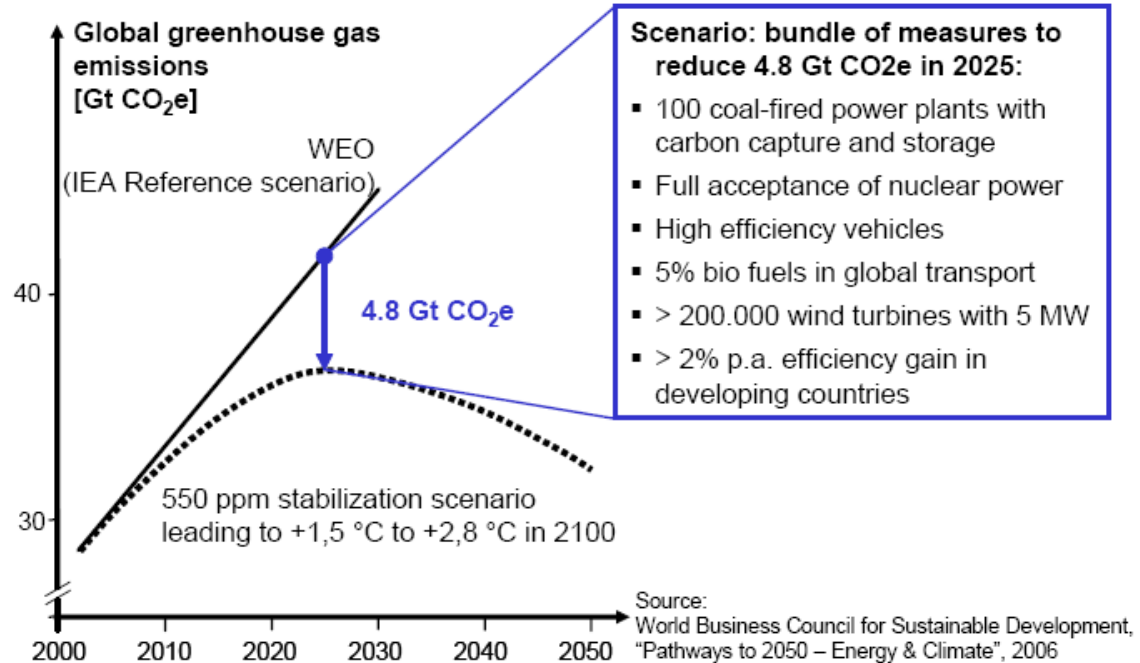
## • Renewables



- Fuel Cells: 1MW by 2012

**The Environmental dimension**  
(specifically arising from the energy  
needs and consumptions)

# CO2 "inertial" scenario is catastrophic

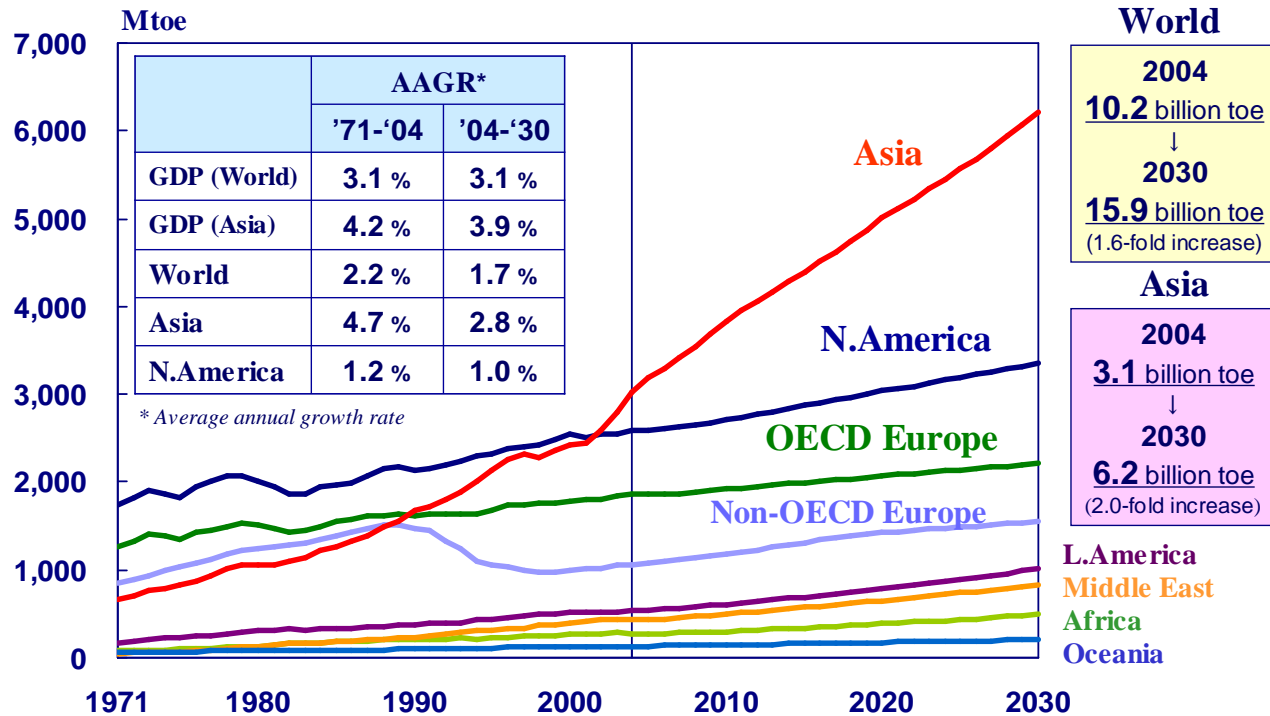


Cross sector mitigation scenario for 2025





# Energy Consumption reflects GDP's

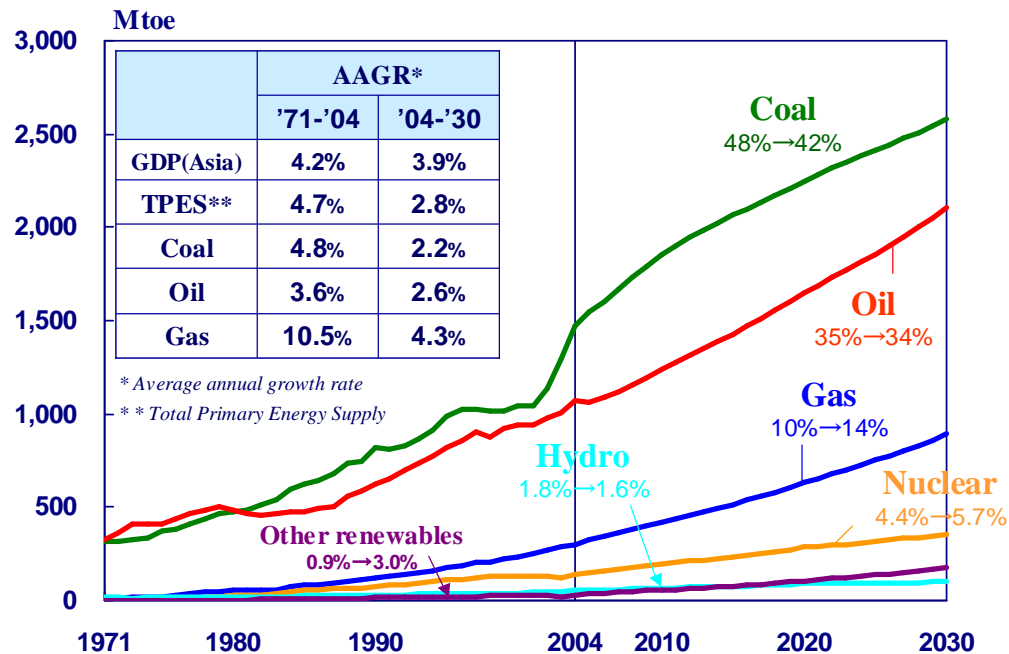


World primary energy consumption to 2030 by region

Source: EIA Energy Outlook 2006



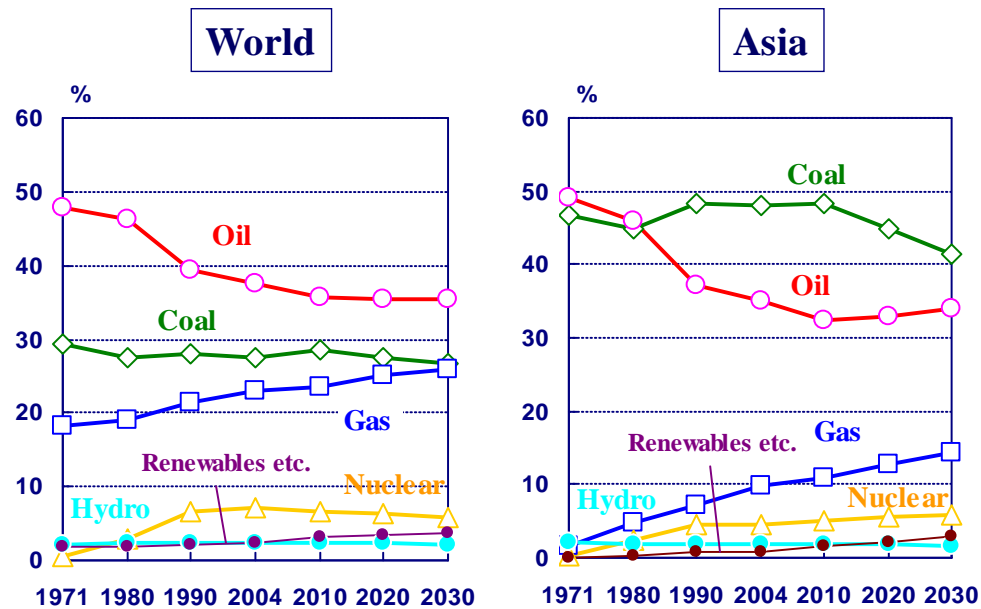
# Asia consumption by energy source



Asia primary energy consumption to 2030 by energy source

Source: EIA Energy Outlook 2006

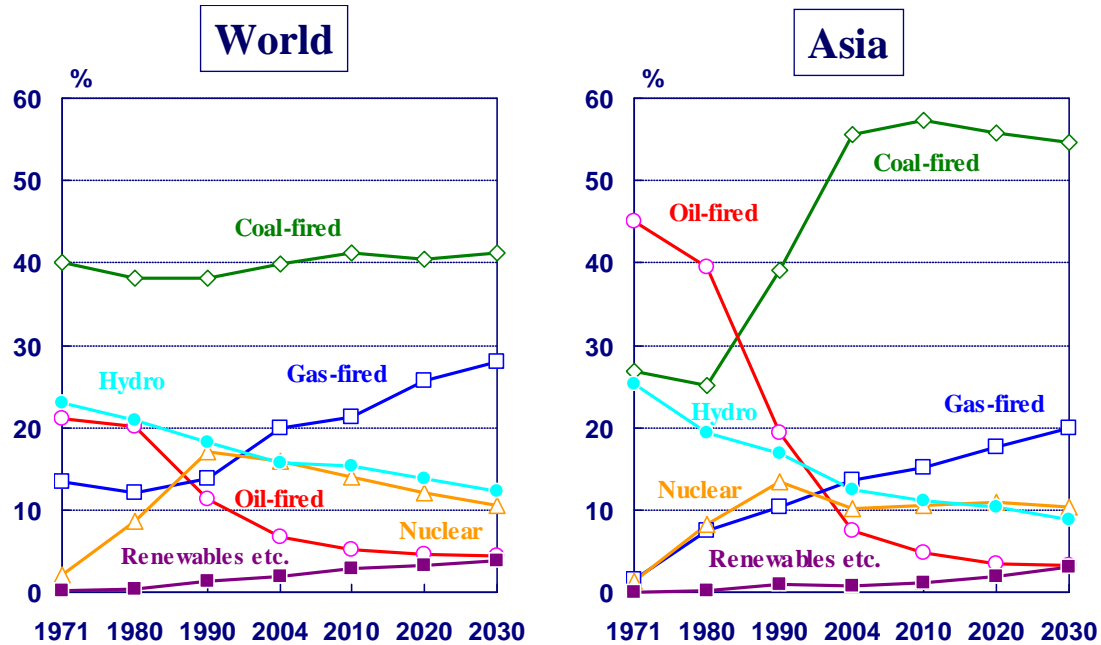
# Asia vs. World consumption, by energy source



Comparison in share of primary energy by energy source between world and Asia

Source: EIA Energy Outlook 2006

# Power Generation mix, by energy sources



Comparison in share of power generation mix between world and Asia

Source: EIA Energy Outlook 2006

Technological innovation, industry competitiveness and sustainable development should walk hand in hand in the next decades to come. As long as everyone realizes that *time* is the scarcest resource we have on the planet, rather than oil or natural gas.

When it comes to the environmental concerns, decoupling emissions from economic growth is a long term goal, which even the more optimistic scenarios cannot predict to happen before 2050.

By that time, the world demand for energy will be double than today, but even more importantly the mix of power generation technologies and their impact on the environment will have to be dramatically changed in order to preserve a living earth.

## The 3 A's:

➤ **Accessibility** 

▶ **Accessibility** means that a minimum level of commercial energy services (in the form of electricity, stationary uses, and transport) is available at prices that are both affordable (low enough to meet the needs of the poor) and sustainable (prices reflecting the full marginal costs of energy production, transmission, and distribution to support the financial ability of suppliers to maintain and develop these energy services). Getting access to the two billion people in the world without reliable commercial energy of any kind is the key.

➤ **Availability** 

▶ **Availability** relates to the long-term continuity of supply as well as to the short-term quality of service. Energy shortages can disrupt economic development, so a well-diversified portfolio of domestic or imported (or regionally) traded fuels and energy services is required. Keeping all energy options open is the key.

➤ **Acceptability** 

▶ **Acceptability** addresses public attitudes and the environment, covering many issues: deforestation, land degradation or soil acidification at the regional level; indoor or local pollution such as that from the burning of traditional biomass fuels, or because of poor quality coal briquettes or charcoal production; greenhouse gas emissions and climate change on a global scale; nuclear security, safety, waste management, and proliferation; and the possible negative impact of the large dams or large-scale modern biomass developments. Clean technologies and their transfer to developing countries is the key.

Improving **accessibility, availability** and **acceptability** of energy resources in a low-carbon world, dominated by cleaner and more efficient technologies, will only be achievable at least if:

- A global dialogue is pursued between energy consuming countries and energy producing countries.....and no dialogue can be constructive if security of supply is "the one" concern, while security of demand is left behind
- A serious energy technology and energy efficiency discussion is entertained, resulting in a clear and binding political, economical and legal framework, enabling all players along the whole energy chain to plan and act the best moves in the common interest of all stakeholders
- A closer integration of energy markets is achieved

# A wide spectrum of energy sources.....

Energy sources	Technology considered for the cost estimate	2005 Cost (€/MWh)	Projected Cost 2030 (€/MWh with €20-30/tCO <sub>2</sub> )	GHG emissions (Kg CO <sub>2</sub> eq/MWh)	EU-27 Import dependency		Efficiency	Fuel price sensitivity	Proven reserves / Annual production
		Source IEA			2005	2030			
Natural gas	Open cycle gas turbine	45 - 70	55 - 85	440	57%	84%	40%	Very high	64 years
	CCGT (Combined Cycle Gas Turbine)	35 - 45	40 - 55	400			50%	Very high	
Oil	Diesel engine	70 - 80	80 - 95	550	82%	93%	30%	Very high	42 years
Coal	PF (Pulverised Fuel with flue gas desulphurisation)	30 - 40	45 - 60	800	39%	59%	40-45%	medium	155 years
	CFBC (Circulating fluidized bed combustion)	35 - 45	50 - 65	800			40-45%	medium	
	IGCC (Integrated Gasification Combined Cycle)	40 - 50	55 - 70	750			48%	medium	
Nuclear	Light water reactor	40 - 45	40 - 45	15	Almost 100% for uranium ore		33%	Low	Reasonable reserves: 85 years
Biomass	Biomass generation plant	25 - 85	25 - 75	30			30 - 60%	medium	Reasonable reserves: 85 years
Wind	On shore	35 - 175	28 - 170	30	nil		95-98%	nil	
		35 - 110	28 - 80				95-98%		
	Off shore	50 - 170	50 - 150	10			95-98%		
		60 - 150	40 - 120	10			95-98%		
Hydro	Large	25 - 95	25 - 90	20			95-98%		
	Small (<10MW)	45 - 90	40 - 80	5			95-98%		
Solar	Photovoltaic	140 - 430	55 - 260	100			/		



- None of them can be excluded from the game....solution comes from a combination
- More funding has to be deployed for energy R&D
- In the short and medium term (2020 vision), funding has to be addressed to clean energy technologies....e.g. those who help reaching the Kyoto and the new EU targets (i.e.: the "20-20-20" target)
- In the medium to long term (2050 vision), a new generation of technologies (implying major breakthrough's) need to be commercially viable, in order to head to a complete decarbonization (e.g. hydrogen economy, fuel cells, zero-emission fossil fuel plants with 100% carbon sequestration, 4th generation nuclear from fission, nuclear fusion,...)

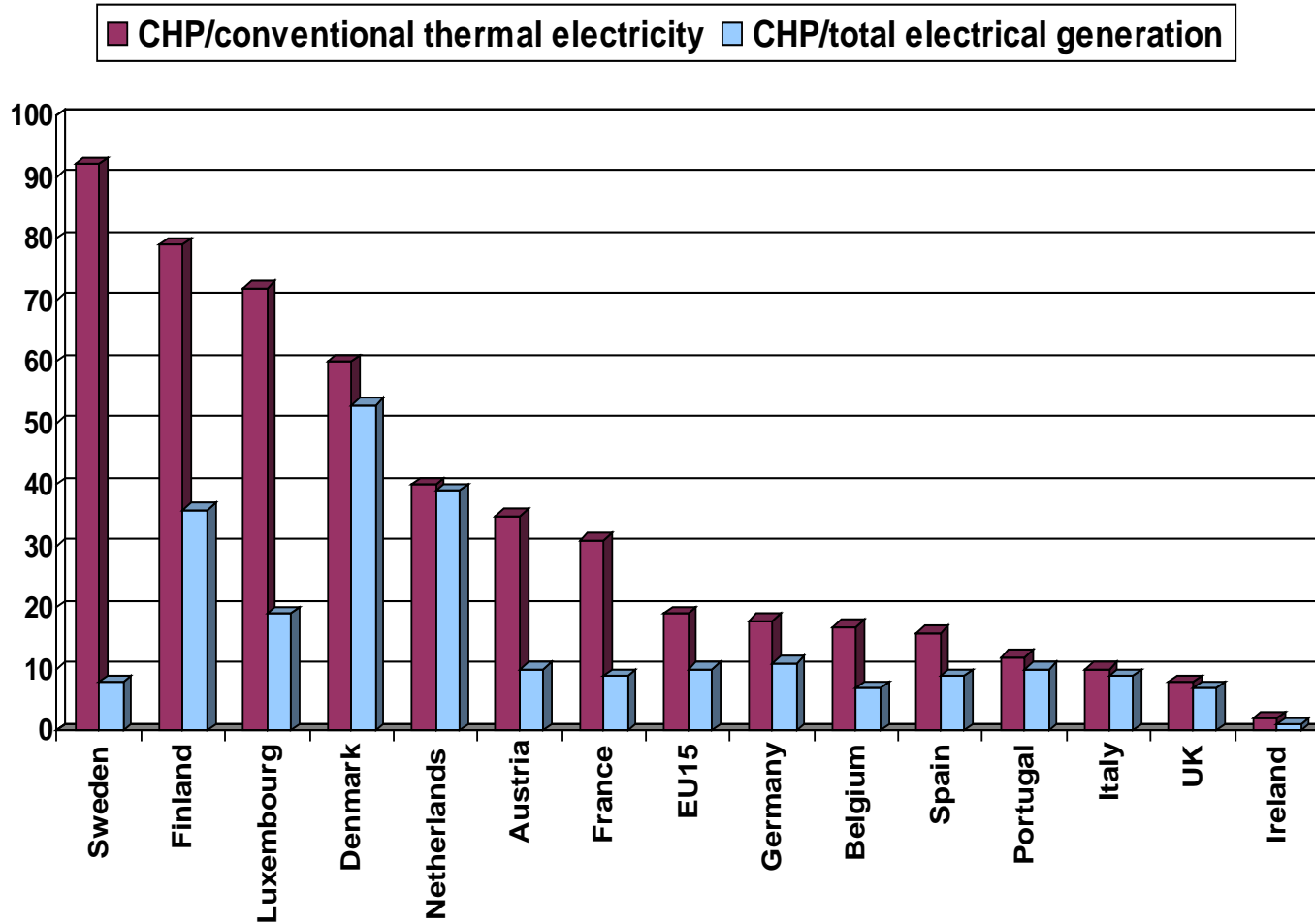
## Meanwhile a big push needs to boost...

- Renewable sources (e.g. wind, photovoltaic, biofuels from wastes)
- Cogeneration
- Distributed energy
- Energy Efficiency
- Clean fossil fuel technologies

While infrastructures need to support the cleaner and more efficient generation through:

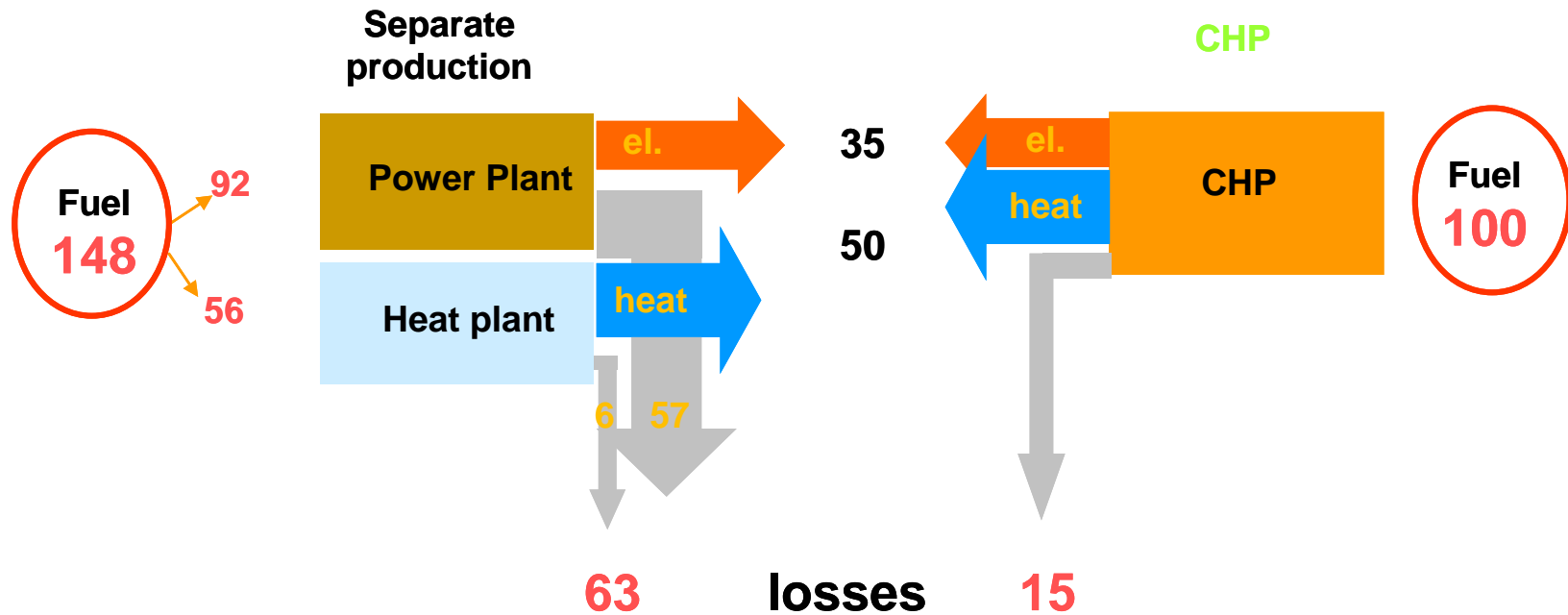
- Smart grids (without which renewables and distributed cannot be fully exploited)
- Fuels transportation infrastructures (e.g.: pipelines, LNG, etc..)
- Waste treatment and disposal facilities
- Energy Efficiency
- Energy Storage Technologies

# Cogeneration (I)



Source: Vattenfall, 2007

# Cogeneration (II)

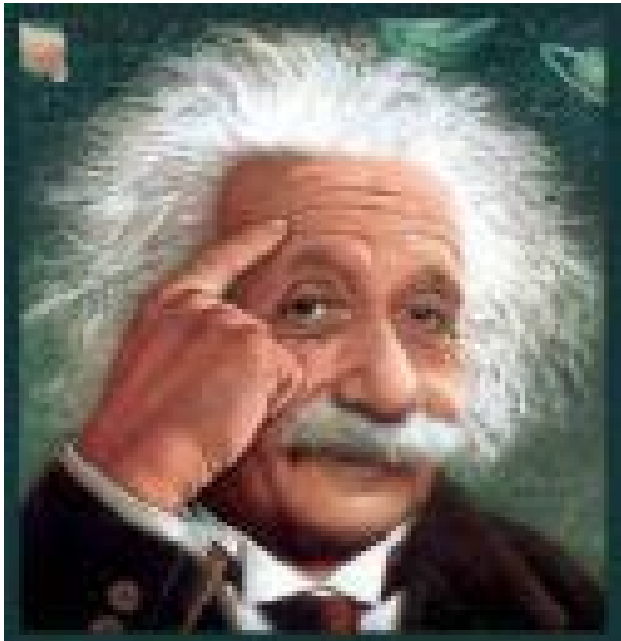


Source: Vattenfall, 2007

- We are facing an unprecedented challenge, on a global scale
- Oversimplifications & slogans do not lead anywhere
- Energy-producing and energy-consuming countries have to embark in a constant dialogue on energy options
- Technology & Innovation make the difference, especially in a clear political, economical and legal framework
- In such scenario, typical business' metrics & goals do not conflict with environmental goals and targets, actually they get along hand in hand

# We should always keep in mind Einstein's guidance....

**The significant  
problems we have  
cannot be solved at  
the same level of  
thinking with which  
we created them.**



# .....and act like Machiavelli's clever archers....



“.....act like the clever archers who, designing to hit the mark which yet appears too far distant, and knowing the limits to which the strength of their bow attains, take aim much higher than the mark, not to reach by their strength or arrow to so great a height, but to be able with the aid of so high an aim to hit the mark they wish to reach.”

*[N. Machiavelli, Il Principe, 6]*