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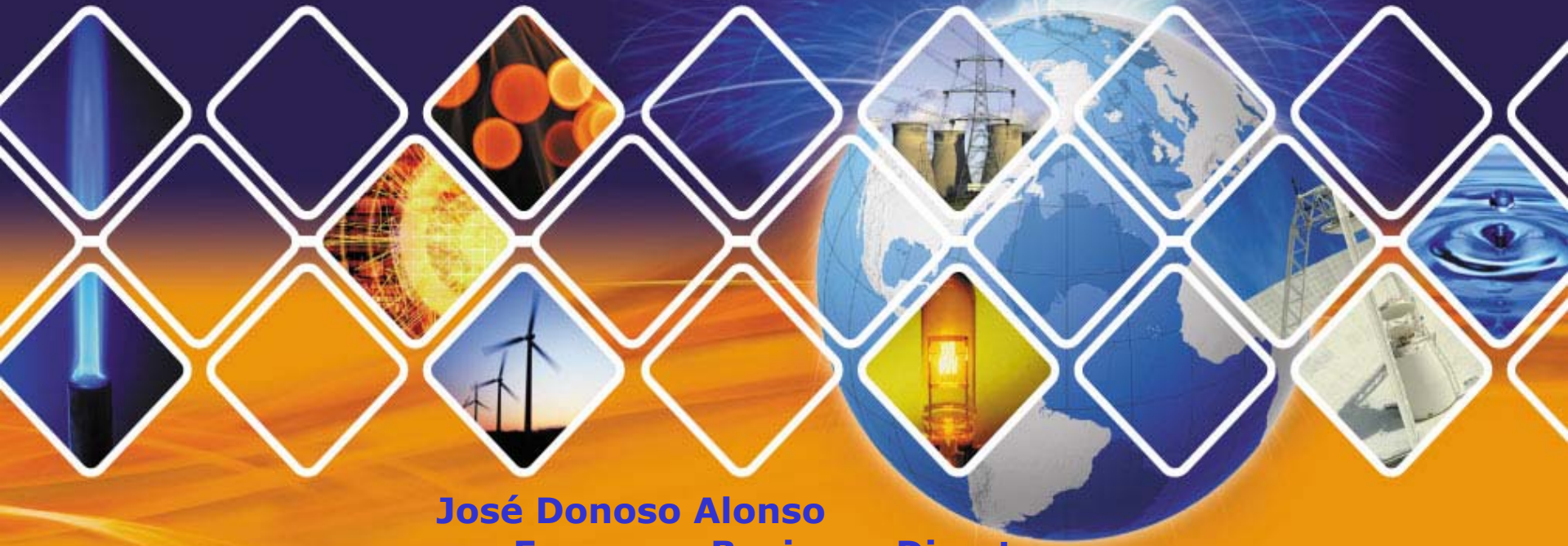
TRENDS IN RENEWABLE ENERGY: LOOKING FORWARD



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World Energy Council Task Force on Financing Renewables

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World Energy Council (WEC)

To promote the sustainable supply and use of energy for the greatest benefit of all

- **Established in 1923 as the World Power Conference**
- **Member Committees in 97 countries**
- **Multi-energy, non-governmental, non-commercial**
- **Triennial World Energy Congress**
- **Work Programme: Studies, Technical Committees, Regional Programmes, Global Energy Information System (GEIS)**

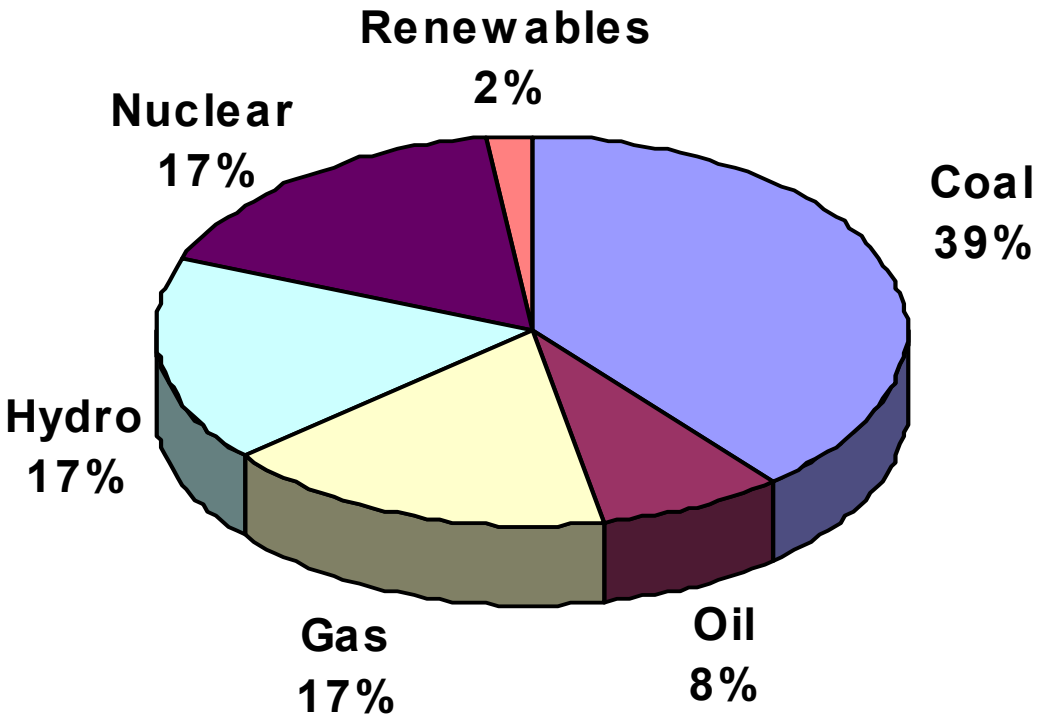
Global Energy Information System (GEIS)
www.worldenergy.org

- **The current path of world energy production & consumption, *even with presently expected policy measures*, is not sustainable**
  - **Environmental impact**
  - **Access to lasting, dependable & affordable energy sources**
  - **Disparity of levels of energy consumption**

The components of a sustainable energy system

- Lasting, dependable & affordable access to primary energy sources
- Adequate capacity of infrastructures & security of delivery
- Sustainable environmental impact
- Adequate economic development. Issues:
  - Impact of environmental regulation on competitiveness
  - Questionability of endless growth
- Reasonably fair universal access to modern forms of energy supply

World Electricity Production 2002



DATA ON INVESTMENT, PRODUCTION AND EXTERNAL COSTS OF ELECTRIC POWER PLANTS

Type of plant	Average Investment cost * (€ / kW)	Production cost * (including exploitation, investment amortization, fuel and R&D) (€ / MWh)	External costs ** ($€_{95}$ / MWh)	Rate external cost / production cost (%)
Nuclear	1730	29	0.05 – 4.8 (0% actualization)	0.2 – 17 %
Coal (CFB)	1273	33	19 – 99	58 – 300 %
Gas (CCGT)	488	35	7 - 31	20- 89%
Hydro		40	0.04 – 6.03	0.1 – 15 %
Micro Hydro	1250			
Wind (terrestrial)	1000	45	0.5 – 2.6	1.1 – 5.8 %
Solar PV (grid - connected)	8000	650	1.4 – 3.3 (only one study)	0.2 – 0.5 %
Biomass	1200	128	2.0 - 50	1.6 - 39 %
Geothermal	1830	55***	0.2 – 0.5***	4 – 14%

*** Source Eurostaf Les Echos march 2003** **** Source European Commission ExternE 1999** ***** Source IGA 2004**

Life Cycle Emissions

Life Cycle Emissions g/kWh	CO_2 G/kWh	SO_2 g/kWh	NOx g/kWh
Coal Best Practice (UK)	955.00	11.80	4.30
Coal FGD and low N0x (UK)	987.00	1.50	2.90
Gas CCGT (UK)	430.00	-	0.50
Hydro small scale	9.00	0.03	0.07
Hydro large scale	3.60-11.60	0.009-0.024	0.003-0.006
Wind	7.00-9.00	0.02-0.09	0.02-0.06
Solar PV	98.00-167.00	0.20-0.34	0.18-0.30
Energy crops current practice	17.00-27.00	0.07-0.16	1.10-2.50
Energy Crops future practice	15.00-18.00	0.06-0.08	0.35-0.51
Geothermal	79.00	0.02	0.28

- **Energy markets are the results of a political choice**

Why should we support the renewable energy markets?

no geo-political risk
no external energy dependence
no energy imports
no fuel costs
no fuel price risk
no exploration
no extraction
no refining
no pipelines
no resource constraints
no CO2 emissions

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Renewable Energy Market

It is today a reality in Europe, but…

- **Not in all countries**
- **Limited to Wind Energy**
- **Outside Europe the only interesting markets are USA, Canada, Australia, India and China**
- **Very depending on administrative decision**
- **In developing countries the only real market is in rural electrification. Even though Kyoto Protocol may change this situation**

R. E. Market

- **Region**
  - **OCDE countries**
  - **Asia and South America**
  - **Developing countries**

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R. E. Market in Asia and South America

- Lack of appropriate regulatory frame
- Market too tighten to bilateral agreement
- Important growth of energy demand, specially electricity
- Market niche in rural electrification
- High rates of population growth, economic growth and energy consumption
- Highly sensitive to international energy prices variations

R. E. Market in Developing Countries

- Lack of public support programs
- Weak or not existence of public support structures
- Good natural resources
- Market niche in rural electrification
- Clean development mechanism from Kyoto protocol: limited reach
- Dependence on the international or bilateral development aid programs

R. E. Market in Developing Countries

- Immediate need of additional energy, specially electricity
- High rates of demographic and energy consumption
- High political and exchange rate risk
- Very sensitive to international energy prices
- Lack of financial capacity

R. E. Market

- OCDE Countries
- Depending on public support programs
  → political will
- Environment is the main driver of development
- EU Leadership
- Big differences amongst countries
- Very diverse support schemes framework
- Financial capacity
- Little sensitivity to variation on international price levels

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Requirements for R.E.S. Set Up

Regulation

Resources

Grid

+

Country Risk

+

Public Awareness

Required actions for the worldwide development of R.E.

- Establish firm objectives for R.E.
- Remove existing barriers and subsidies that damage R.E.
- Put in practice mechanisms to assure and accelerate a new market

Actions to facilitate the development of R.E. in a big scale

- Energy prices do not reflect the social costs of generation.
  - External costs
  - Subsidies to "conventional generators"
- To achieve the benefits or R.E. generation, some kind of regulations on the market is needed
  - Subsidies
  - Price based mechanisms
  - Quantity based mechanisms
- To assure the right implementation of "Clean Development Mechanisms" and "Joint Implementation" of Kyoto Protocol.

Price mechanisms

- ✓ Transparent
- ✓ Homogeneous
- ✓ Global

→

- **Macroeconomic: industrialization and supply guarantee, multiplies added value**
- **Investment analysis from the point of view of business**

- ✓ Cost

→

- **Microeconomic**
- **Externalities**
- **Cost-benefit relationship (Macro level)**

- ✓ Substitution

→

- **Price support required to reflect the lack of externality costs in the final price**
- **Based on technical limits and not political objectives (and the incentives to achieve these)**

- ✓ Stability

→

- **Less financial risk**

Regulation it's not only establishing a support scheme

- Good and transparent administrative procedure
- Clear and transparent systems of connexion to the grid
- Declaration of public usefulness → **geographically** / **sectorial**
- To avoid dispersion of ruling
- To reduce discretional nature in the administrative decision processes

" The devil is in the detail"

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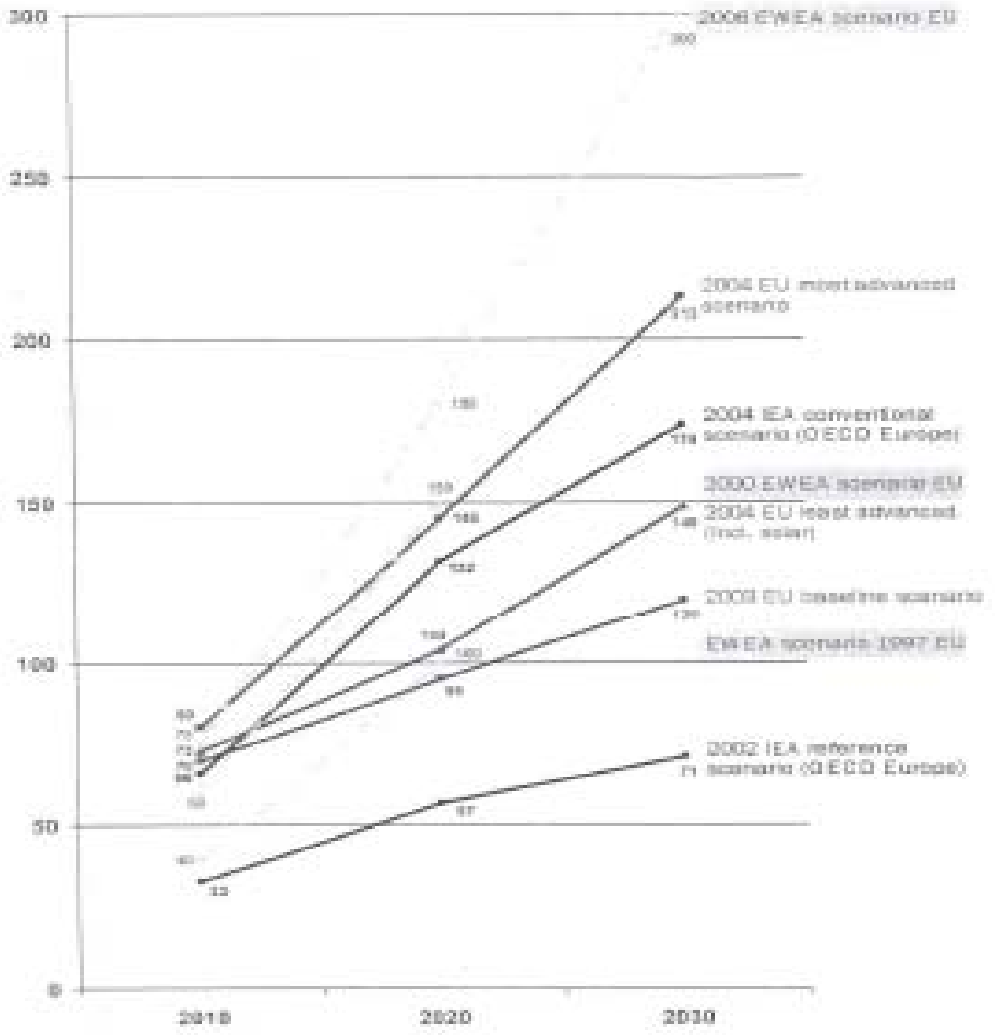
R. E. volume long term objectives for the differet Renewable technologies

Technology	Objective	Goal	Year	Source	Forecast date	Comments
Wind	**1.245.000 MW**	**Mundial**	**2020**	**Wind Force 12, EWEA**	**2005**	**In this scenario a 12% of production would be produced**
Solar PV Energy	**205 Gw p**	**Mundial**	**2020**	**European Photovoltaic Industry Association**	**2005**	**Annual world growth predicted to be 15%**
Biomass	**200 Mill. TEP/a**	**EU**	**2020**	**European Biomass Industry Association**	**2005**	**Including biomass for thermal and electrical use and biofuels**
Geothermal (thermal use)	**48000 MW**	**EU**	**2020**	**European Geothermal Energy Council**	**1999**	
Geothermal (electricity generation)	**8000 MW**	**EU**	**2020**	**European Geothermal Energy Council**	**1999**	**This goal has already been reached**
Thermal solar energy	**433.718 Gw h/a**	**EU**	**2015**	**European Solar Thermal Industry Federation**	**2003**	**Technical maximum**
	19.137 Gw h/a		**2015**			**Asumming actual growth rate**
Minihydro	**14.000 MW**	**EU**	**2010**	**Eurobserver**	**2004**	
Renewables as a whole	**20%**		**2020**	**Greenpeace**	**2005**	

Wind Energy: Global Considerations

- Evolved Market. The most successful case of integration of a RES technology in the global energy market.
- Increased participation of utilities and financial investors
- Small developers tending to disappear => market concentration
- High competitive market in countries with more favourable legislation
- Future depends:
  - Resolution of technical and financial uncertainties for off-shore wind farms
  - Repowering
  - Development in transitional economies

Estimates of wind GW installed per decade



BIOMASS: SPECIAL CASE

- *It is the R.E. source with biggest share of primary energy*
- *Regulatory milestones: readiness of raw material*
- *Supply obligation: residuals and waste have environmental normative that force them to have an energetic destination*
- *Seasonality and local source (transport)*
- *EU agricultural policies*
- *Rationalization of the developed MW cost*
- *Added value for the generated kWh*

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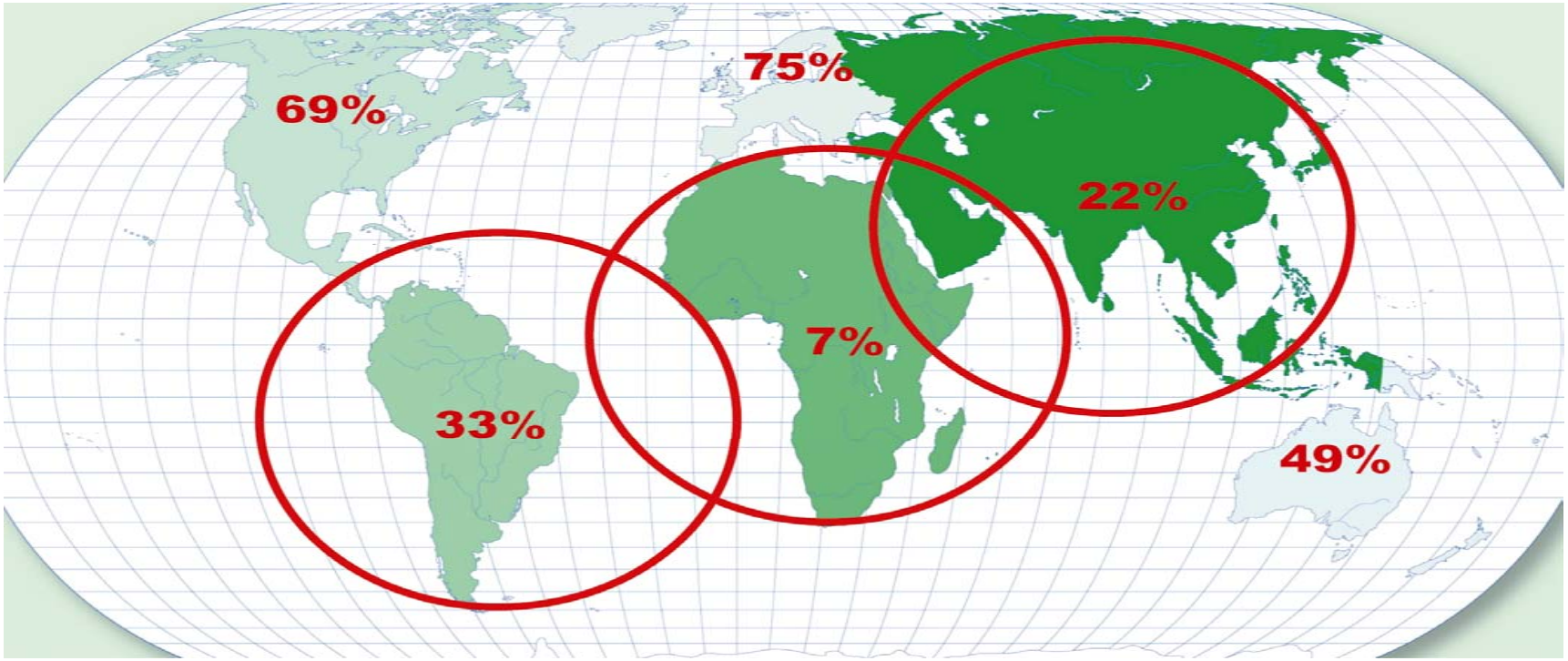
Hydropower: Usage/Potential



Conclusions

The International R. E. S. Market will present significant opportunities in the coming years, however…

Conclusions

- No single energy technology on its own will provide the solution. We will need a wide range of technology options.
- Today, Wind energy is the most competitive and reliable source of energy.
- Hydropower has an important potential in developing countries but has to deal with serious ecological constraints.

Conclusions

- PV have a niche of the market in rural areas.
- Biomass must solve many technological, economical, structural and resource availability problems in order to become an alternative with significant share in the energy balance.
- An interesting future alternative is the combination of wind energy and other renewable technologies. Hydrogen could play a role improving the quality and the profitability of the installations.

Conclusions

- There are many uncertainties due to the strong dependence of the market on government policy.
- The successful strategy must take into account the different risks associated with each national market.
- The strategies that work in one country may not necessarily work in another
- Right implementations of Kyoto Protocol, could mean an important opportunity. So far its impact is rather limited.

Renewables Focus

Visit the *Renewables Focus* section on the World Energy Council's Global Energy Information System (GEIS)

www.worldenergy.org

Thanks!