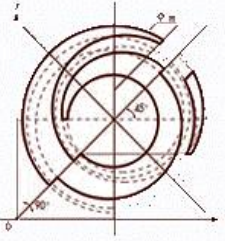


APGTF 10Sept. '02
DTI London

ALSTOM

Renewables & Distributed
Generation
Mike Cannon

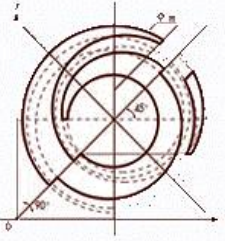
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Renewable Energy Technologies



- **Mini Hydro (<15MW)**
- **Wind**
- **Solar (PV and Thermal)**
- **Biomass (Solid, Liquid, Gaseous)**
- **Geothermal**
- **Combustible Renewables and Waste**
- **Biofuels (Landfill Gas,...)**
- **Others (Tide, Waves, Currents ...)**

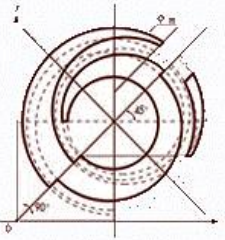


Environmental Issues

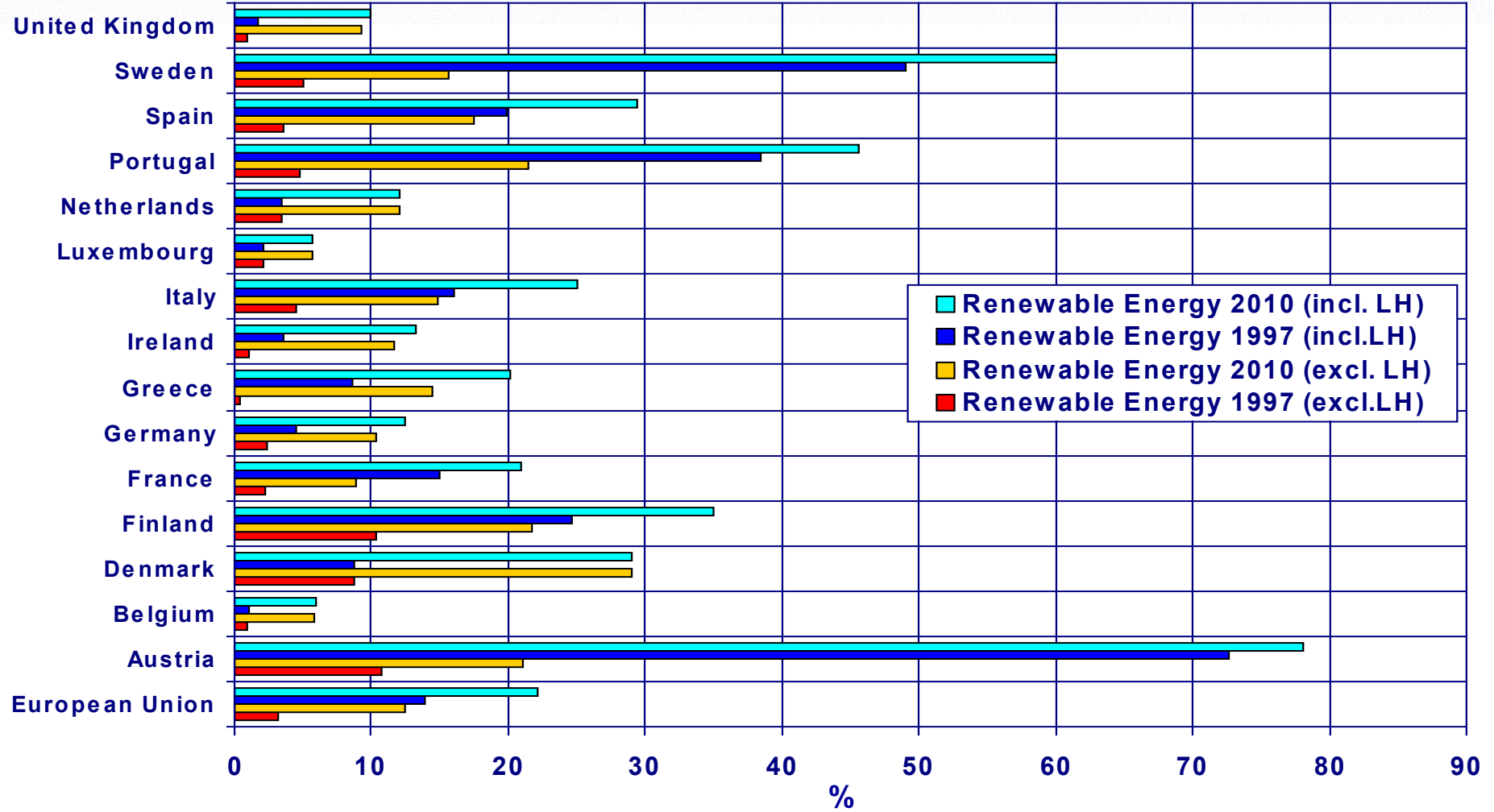
Key Developments / Facts



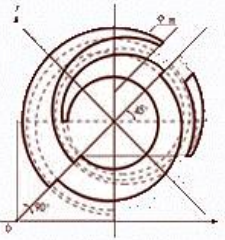
- Several power producers as well as Oil&Gas companies have packaged green power in their portfolio, looking to expand their activities
- Renewable power production will become more competitive due to:
 - Decrease in production costs (increased production level and technical progress)
 - Future economical impact of the marginal costs of carbon abatement
- Use of Renewable Energy Systems (RES) is expected to expand further, supported by implementation of legal restriction framework on emissions



Renewables in Europe RES Directive 9/2001



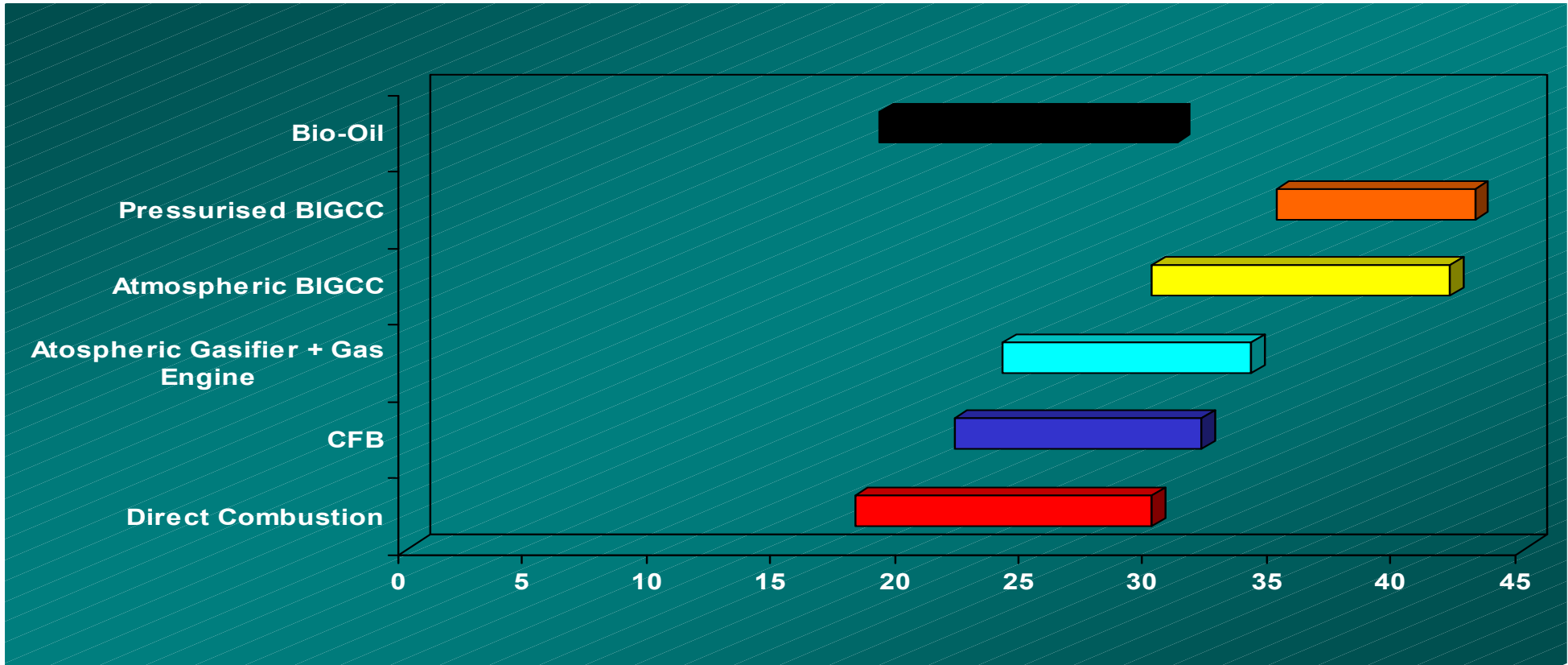
Notes: - Renewable Energy Systems (RES) Directive is based on the 1997 EU White Paper (COM(97)599; Nov. 1997)
 - LH = Large Hydro (>10 MW)

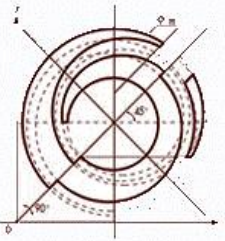


Biomass-to-Electricity Conversion Efficiency

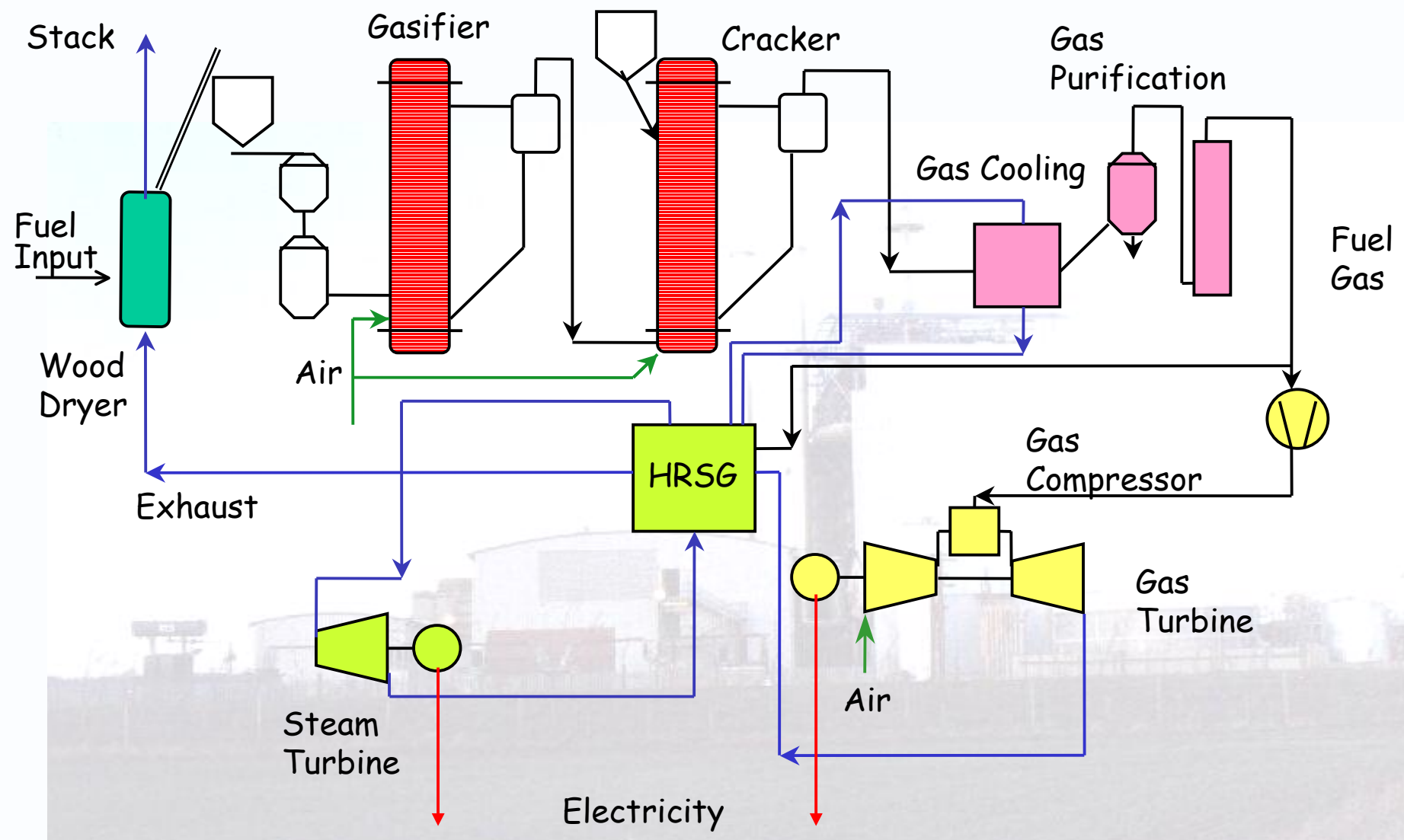


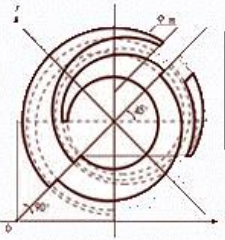
Sub 40MW schemes





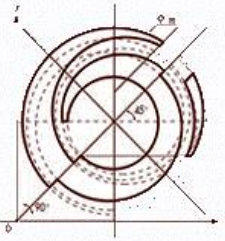
ARBRE B-IGCC Process





Harvesting SRF 2002



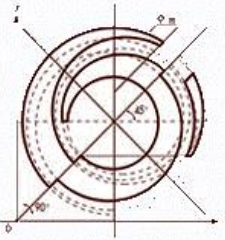


Primary Support Mechanisms for RES in the EU



- **Guaranteed prices**
 - stand alone tariff or premium on top of market price
 - premium is defined by regulator
 - promotes new renewable capacity addition
 - little incentive to lower costs
 - little adaptations to technological advances
- **Competitive bidding**
 - regulator chooses projects on basis of relative competitiveness
 - ⇒ less capacity installed, administrative hurdles
 - strong incentives to lower costs
 - firmer control of government spending
 - intensive use of good sites
- **Green Certificates**
 - power sold at prevailing market price and sale of certificates to customers that must demonstrate that a certain percentage of their power is derived from RES
 - incentives to reduce costs
 - prices of green certificates subject to uncertainty

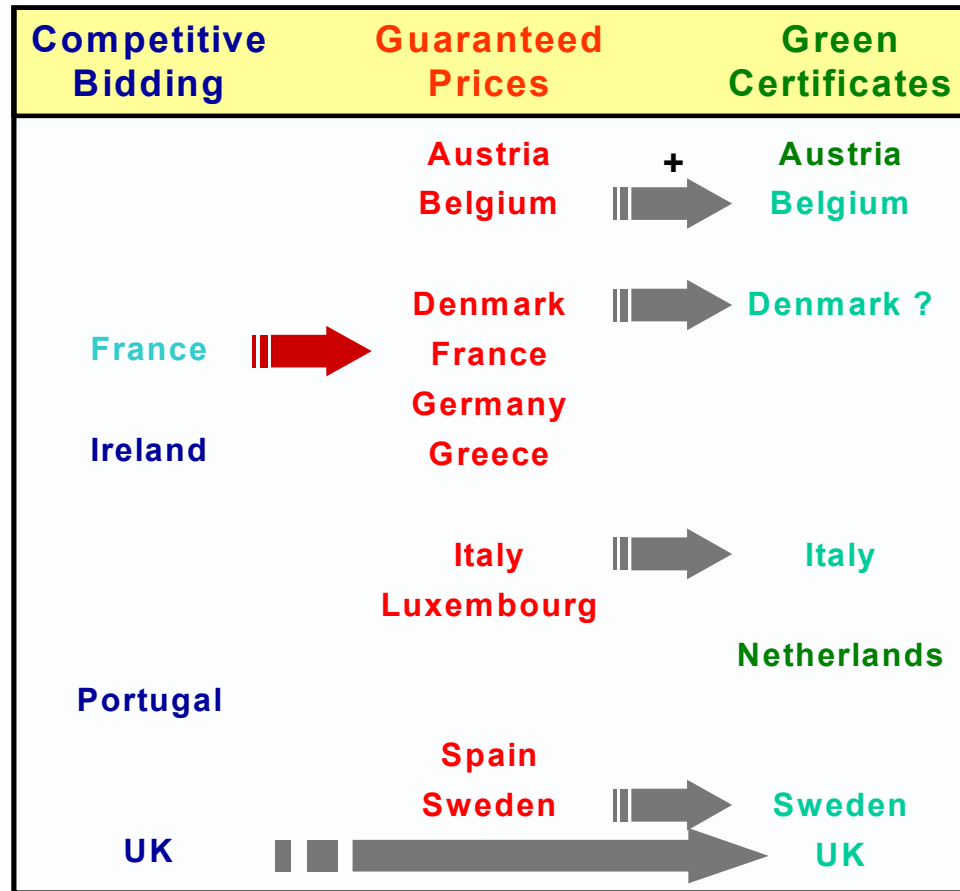
Note: - RES = Renewable Energy Systems



EU Support Mechanisms for RES

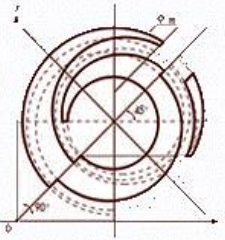


One Power Market , 15 Different Approaches



Note: Finland has no renewable price support system

Source: CERA



Future Electric Systems: Decentralized & Distributed Power Supporting the Grid



Centralized Production

Decentralized Production

Distributed Generation Incl. On-site/ Home/ Portable

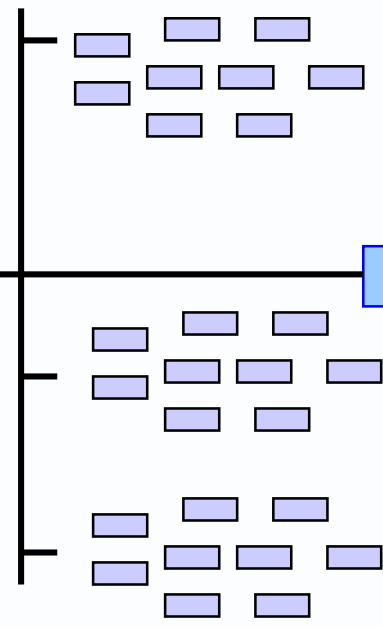
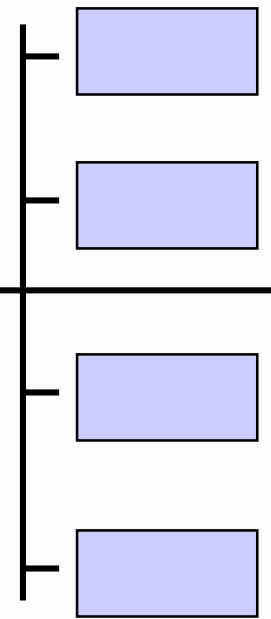
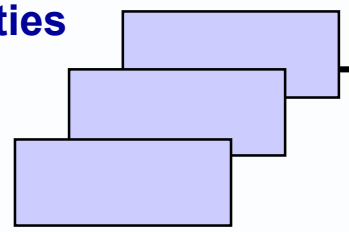
1000 MW

10-100 MW

0.1 - 15 MW

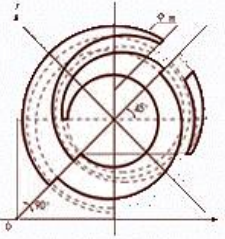
1-100 kW

New utilities



Distribution





Distributed Generation Technologies and Applications



DG Technologies

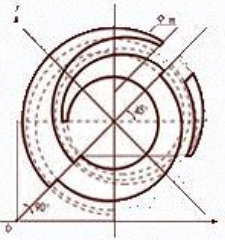
- Incumbent:
 - Reciprocating engines (diesel, gas)
- New Technologies:
 - Stirling engines (conv., new concepts)
 - Combustion turbines (industrial, mini, micro)
 - Fuel Cells (PAFC, SOFC, MCFC, PEM)
 - Photo Voltaic

Applications

- Stand by
- Peak shaving
- Grid support
- Stand alone (grid isolated)
- CHP + cooling
- Energy Rental (temporary mobile power)

New renewables:

- Wind (site dependent)
- Geothermal (site dependent)
- Biomass (fuel issue only)



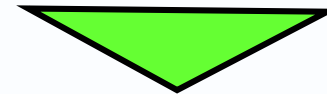
Distributed Generation: Market Drivers and Implications



- **Increased liberalization (at wholesale and retail level)**
 - intense price volatility
 - more customer choices
 - new offerings by unregulated retailers
- **Transmission bottleneck and “gridlock” (USA)**
- **Growing technology improvements in small size PG**
(in different phase of commercialization)
- **Evolving environmental requirements and regulatory incentives**



Local electricity
retail



DG
as arbitrage



Local fuel
(gas)



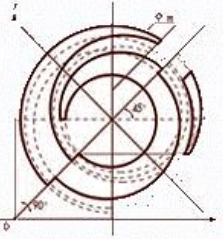
New:

Multi offerings,
Enterprise energy
management, ...



Existing:

Power distribution & fuel
distribution
companies,
both become also
active DG providers



Renewable Energy and DG - Summary



- RES percentage increasing
 - generally generation units <40MW
 - compatible with DG expansion
 - needs to demonstrate cost reductions
 - wind, solar, ocean, biomass and EfW are all important
 - needs significant support in the short/medium term
- Drivers supporting DG growth are identified but crystal ball still cloudy
 - Deregulated market not stimulating investment
 - Micro generation technologies still emerging
 - Distribution management rules & technology not developed
 - Fuel supply and carbon management issues unclear

The Alstom logo is centered on a white semi-circular background. The letters 'ALSTOM' are in a bold, sans-serif font. The 'O' is a red circle with a white center, and the 'M' is in blue. A thick red curved bar arches over the top of the white semi-circle. The background of the entire image consists of vertical blue stripes of varying shades and some faint white curved lines.

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