

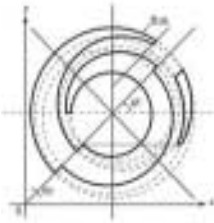


May 2001

CO₂ Separation

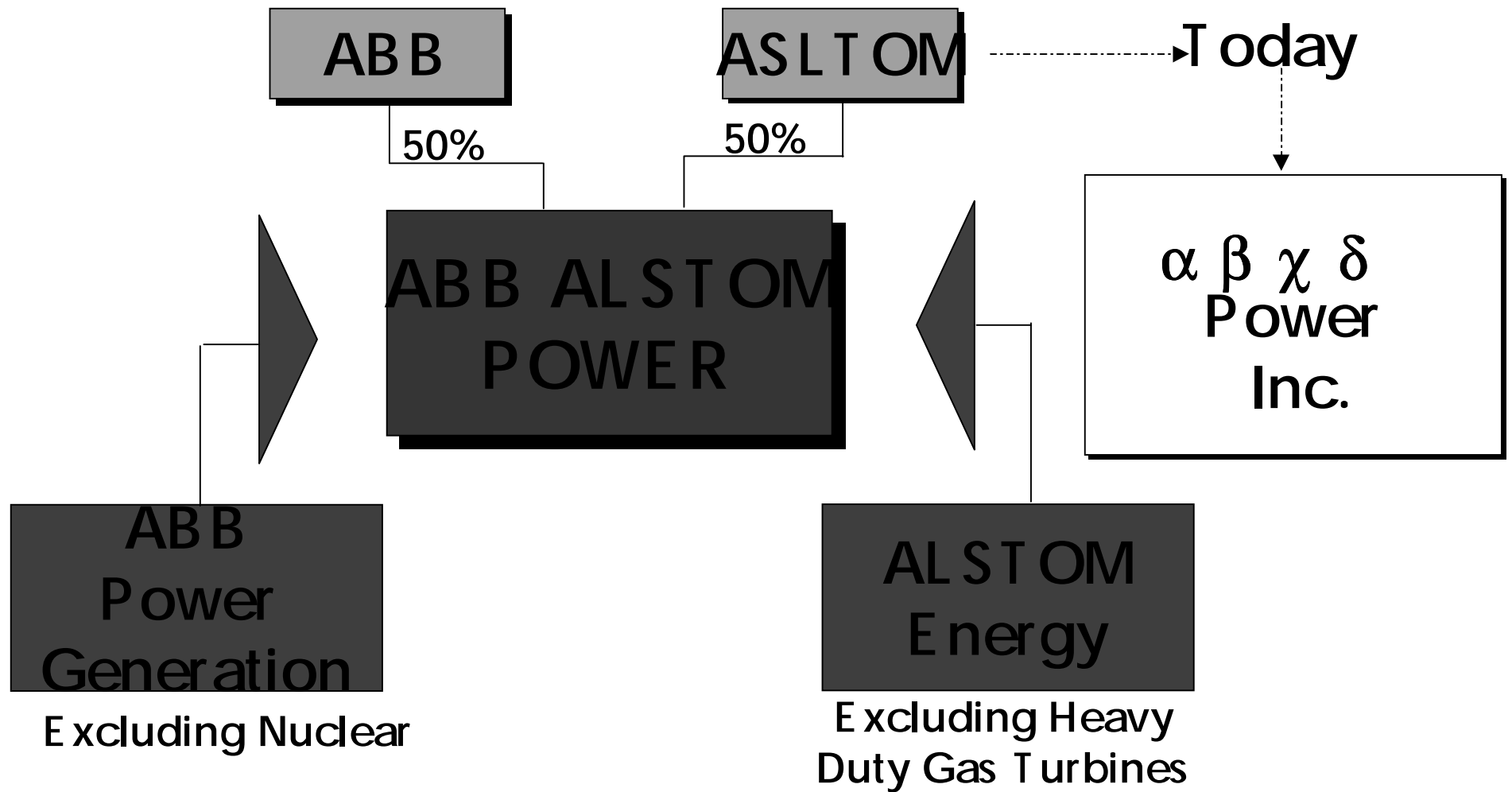
Michael S. McCartney

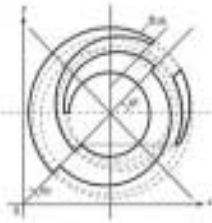
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The New Company

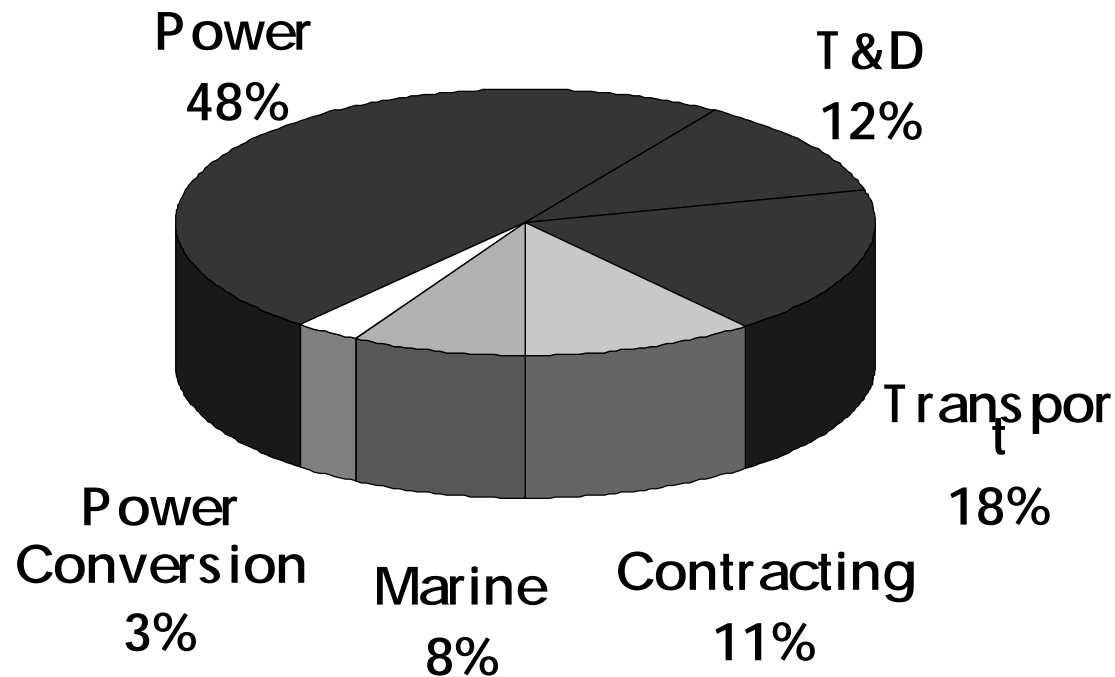
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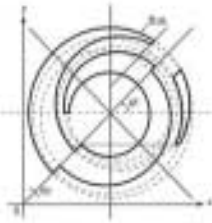
What is ALSTOM?

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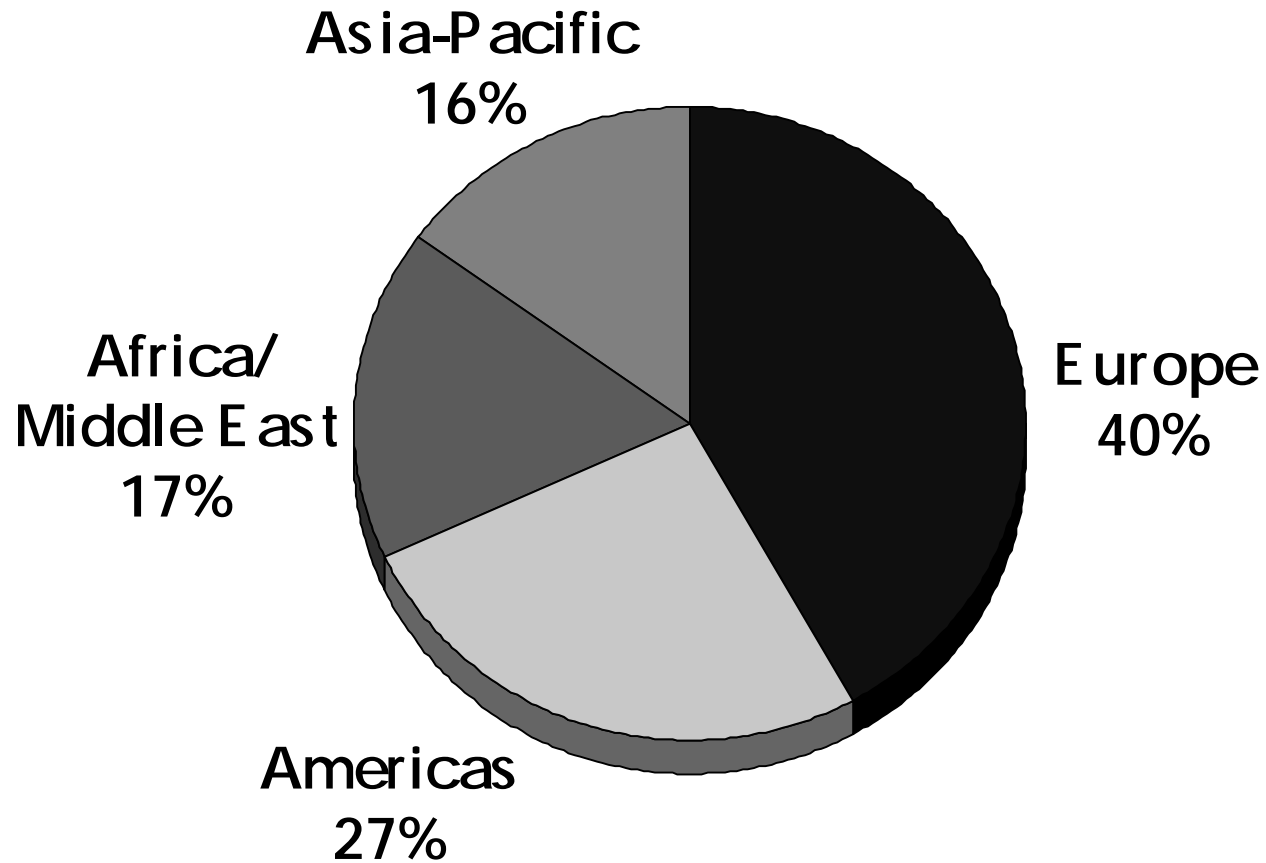
1999/00 ProForma Sales, Estimate

- Over \$22 billion sales
- ~ 80% of sales directly energy or transport related
- Strong global presence
 - USA/Americas
 - Eastern Europe
 - S.E. Asia
- 150,000 employees

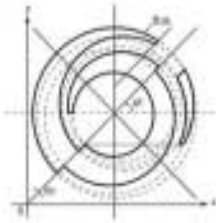


Combined Orders by Region

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A Global Reach

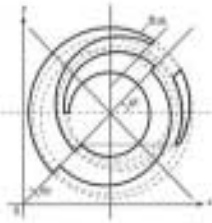


The Starting Point

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$$\underline{\$CO_2 = \$ separation + \$ compression + \$ sink}$$

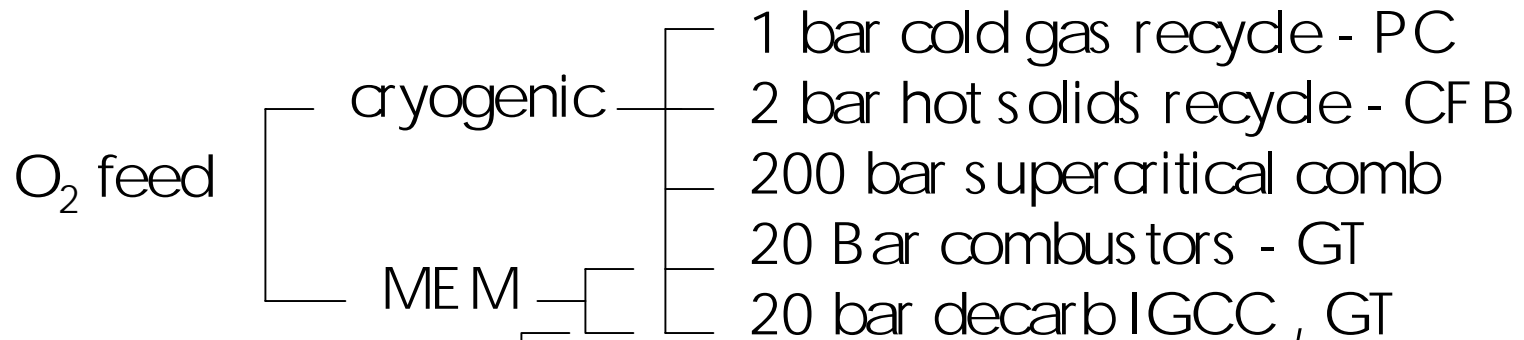
- Base cost of compression = \$450/kW export + 11% Qin
- Meas scrubbing = \$1130/kW export + 28% Qin
- Cryogenic O₂ with cold gas recycle = \$820 kW export + 26% Qin



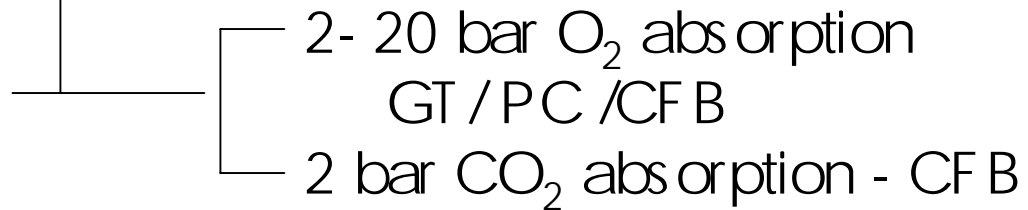
CO₂ Separation Options

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CO₂ scrubbing MEA — 1 bar PC, CF B, GT

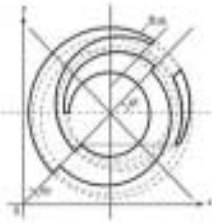


High temp chem absorption looping



High temp chem absorption looping

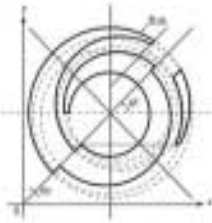
— 1 bar PC/CF B



Conclusion thus far (1)

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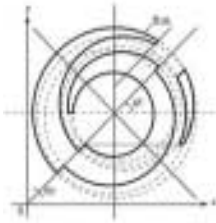
- Existing technology of MEA or O_2 w/ gas recycle to existing plants is not a solution.
- Higher potential exist for solid fuels high temp chemical looping for:
 - Decarb syn fuel
 - O_2 separation
 - Direct capture of CO_2
- Higher potential exist for methane with:
 - O_2 transport membrane



Conclusion thus far (2)

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- Ability to put multi pollutants “down hole” will have a major impact on cost.
- Ability to put all products of combustion “down hole” should be the long term goal.
 - One control for all pollutants known and not known



R & D Priorities

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- Down hole specs for all products of solid fuel combustion.
- Process design on high temp chem looping
- Process work on combustion at supercritical conditions.
- Cost and scale up potential of Membrane tech
- Target time frame toward demonstration

The ALSTOM logo is rendered in a bold, black, sans-serif font. The letter 'O' is stylized with a circular graphic element that resembles a signal or a stylized 'C' with a vertical line through it, positioned to the right of the letter's center.

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www.alstom.com
