Membrane Concepts

5-6 October 2009

Facilitator: Katie Jereza

Participants/ Attendees

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- Berend Smit
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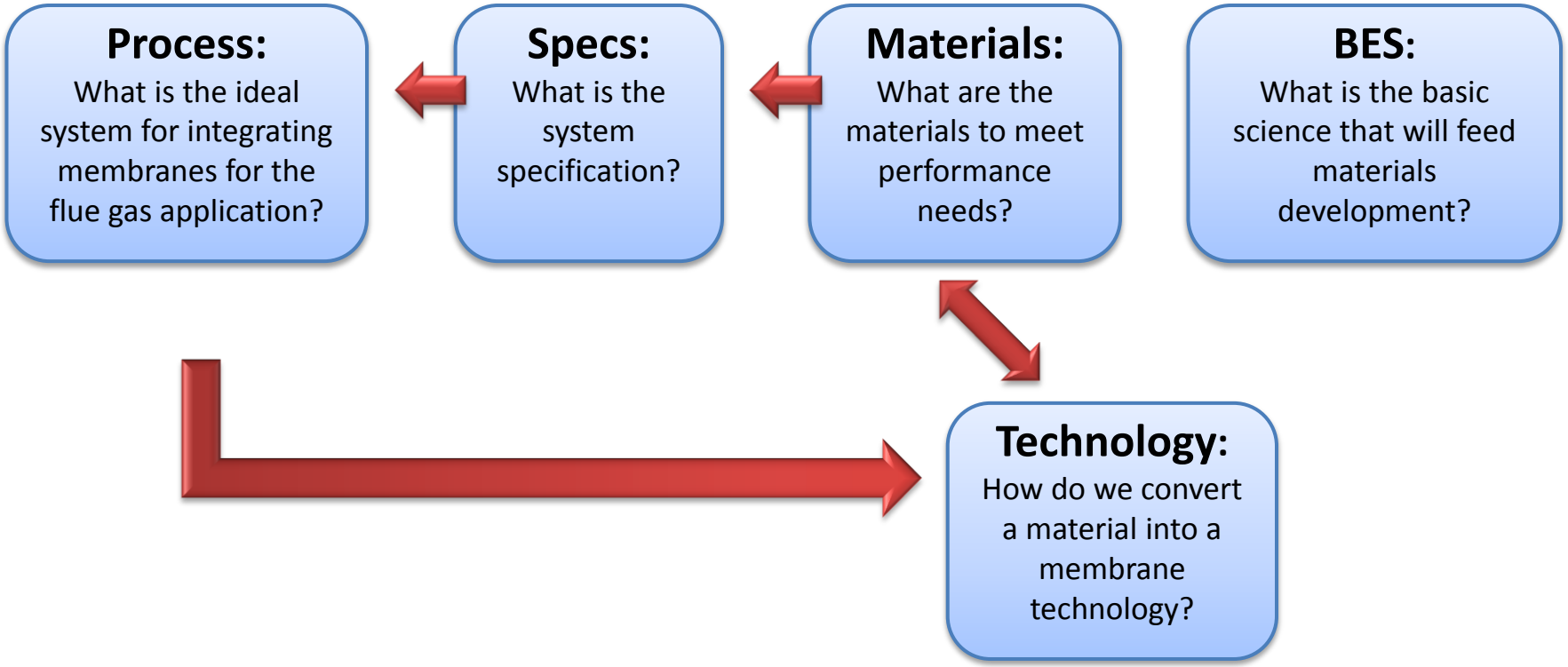
Key Questions

- What is the ideal system for integrating membranes for the flue gas application?
- What is the system specification?
- What are the materials to meet performance needs?
- How do we convert a material into a membrane technology?
- What is the basic science that will feed materials development?

- . . . What do we need to know to do each of our jobs?

Short Term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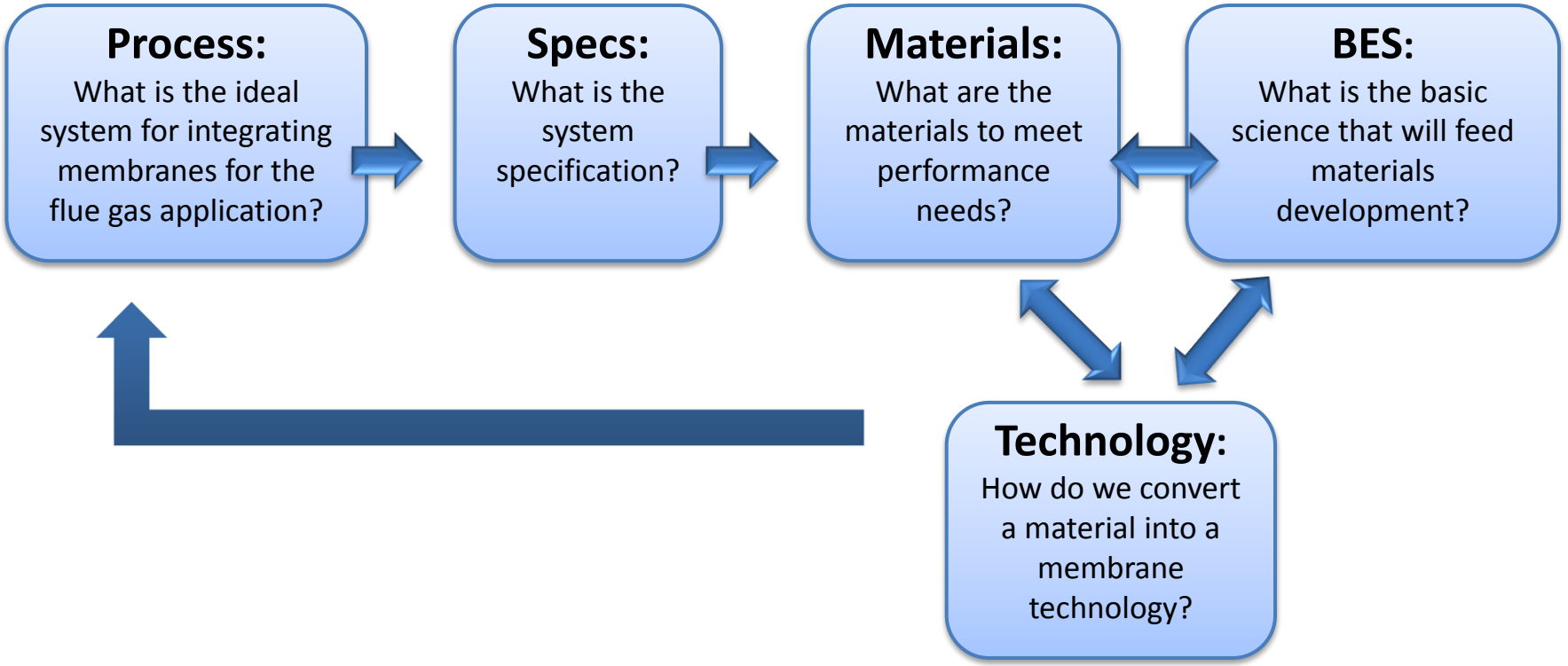
What is the ideal system for integrating membranes for the flue gas application?
Specs:
What is the system specification?
Materials:
What are the materials to meet performance needs?
BES:
What is the basic science that will feed materials development?
Technology:
How do we convert a material into a membrane technology?

Long Term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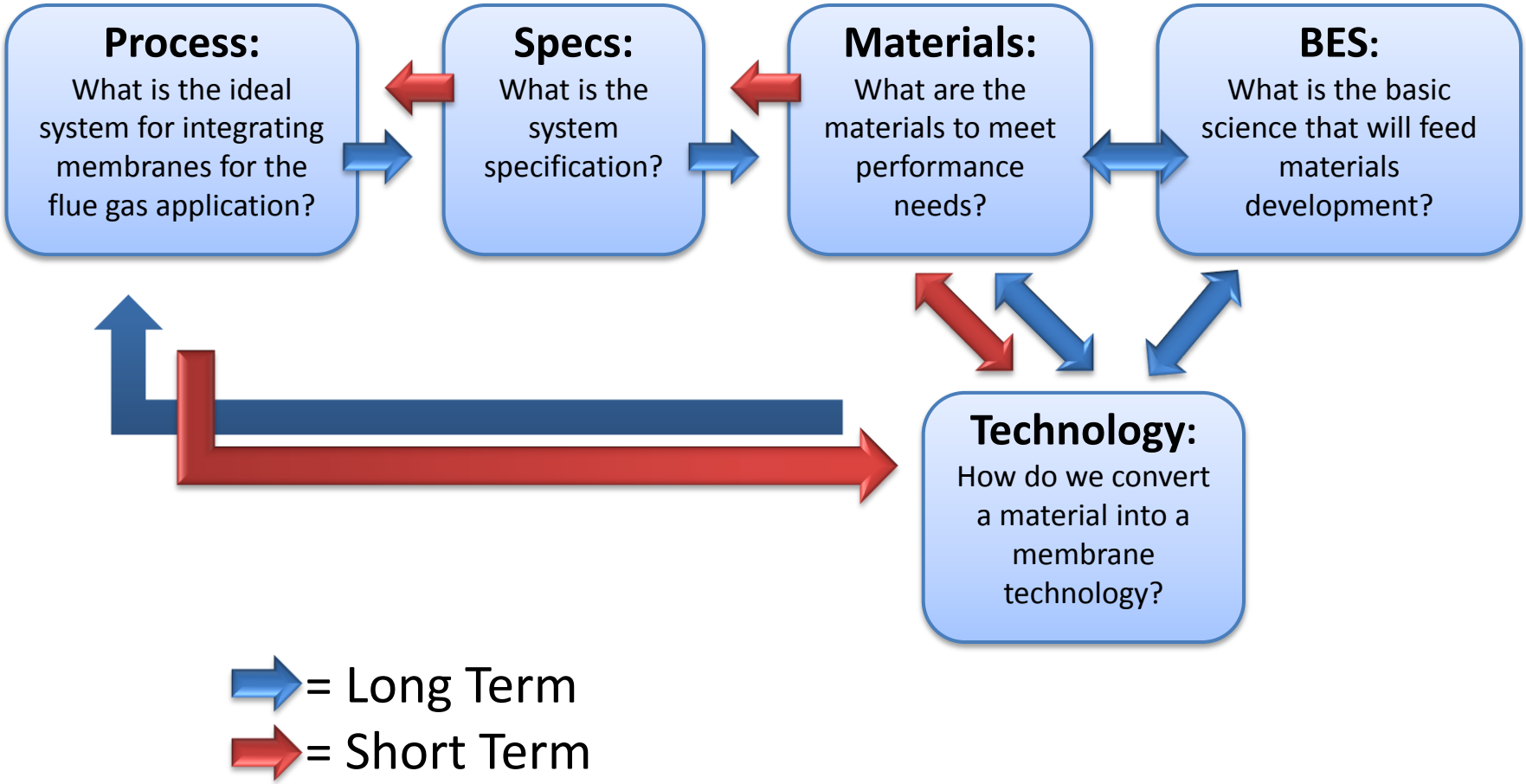
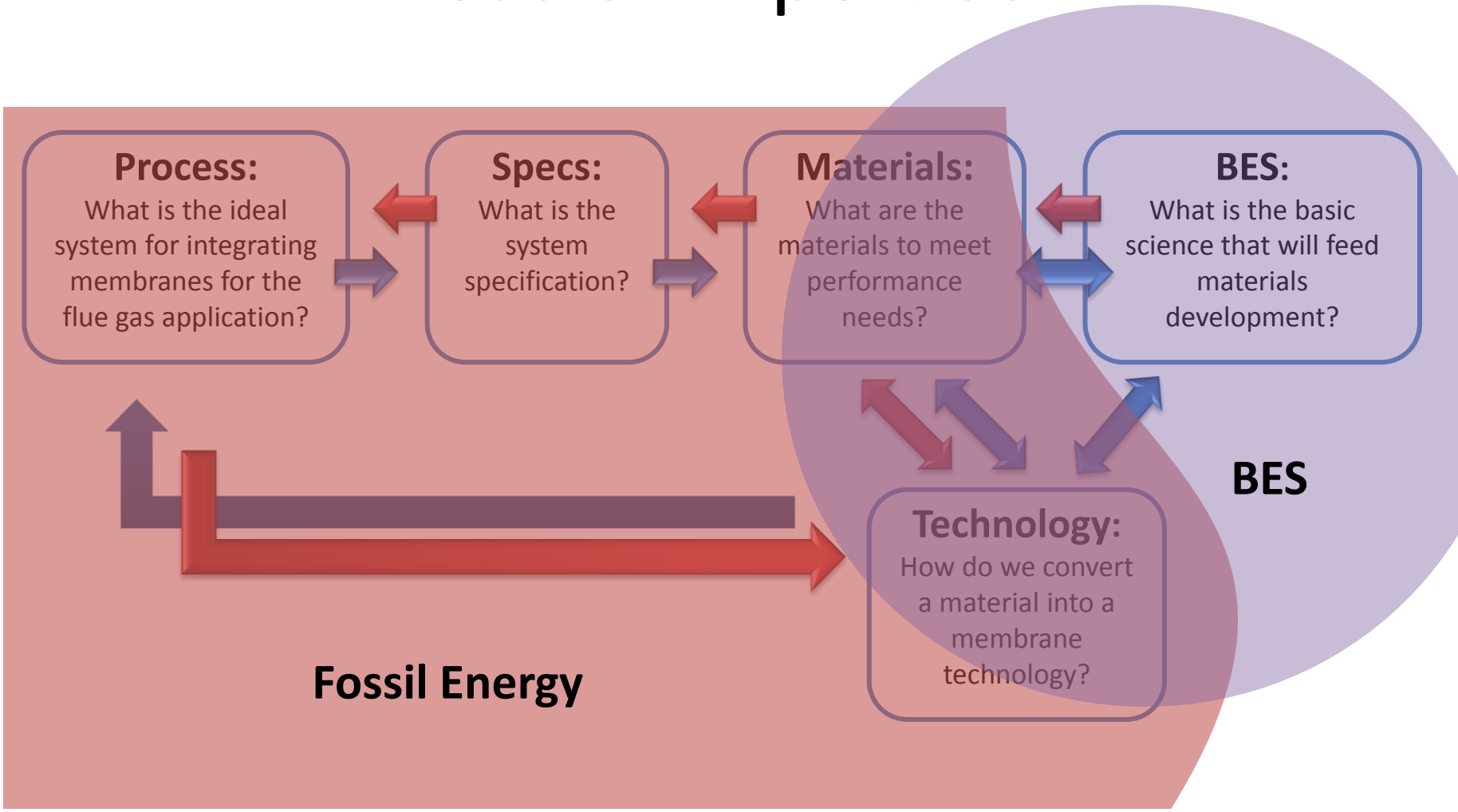
Short and Long Term



Areas of Expertise



Ideas &
Barriers to Their Advancement

Technical Barrier: Starting with Known Membranes

- At the highest level: Current thinking is based on “which membrane materials are available” and “what can we do with that.” Current processes are from: we have a membrane, where can we go from that.
- Not the best way, because it is constrained by the materials that are available; it prevents “out of the box” thinking.
  - Works, but does not lead to as beneficial of an end state as it could.
  - Desirable way to work in the short term (~5 years.)
  - Potential solution: Better approach would be to get the process engineers in the room, come up with an alternative system design that is not constrained by existing materials, but requires new materials.

Technical Barrier: Lack of a Common Measure

- A technical barrier: lack of a common measure of ranking or identifying how far new materials are from optimum.
  - Define a common measure for ranking or identifying how far the new materials are from optimum, for each of first 3 (process, specs, materials)

Barriers: Supported Ionic Liquid (Apply to Most Materials)

- Need to optimize ionic liquids for flue gas conditions
  - Lack of basic science to enable the selection of the best ionic liquid
- Turning ionic liquid into a practical membrane (applied science)
  - Solving this will move ionic liquids to the same level as the flourinated based polymer
- High throughput testing approaches for mixed gas
- Need to improve synthesis techniques (too slow)

Barriers: Develop flourinated based polymer with higher permeability and selectivity

Optimization:

- Need to increase permeability without losing integrity
  - Chemistry has high crystalinity, creating diffusion issues
- Need to raise selectivity to 30:50 CO2/N2
  - Raising permeability decreases selectivity
- Need for high throughput testing
  - Lack techniques; multiple steps; takes time to achieve steady state; first step and last step take the longest; expensive and not widely available