

CCSI

Carbon Capture Simulation Initiative

NETL CO₂ Capture Technology Meeting

David C. Miller

Technical Team Lead

National Energy Technology Laboratory

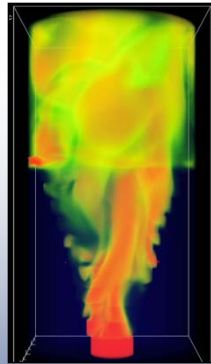
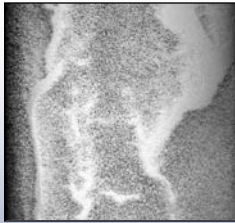
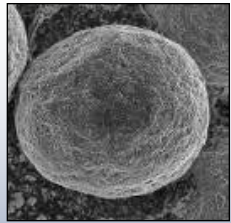
9 July 2012



The U.S. DOE's Carbon Capture Simulation Initiative for Accelerating Commercialization of CCS Technology

- CCSI Toolset
- 5 Year Development Plan
- Technical Accomplishments
 - How these computational tools can be used today

Carbon Capture Simulation Initiative



Identify promising concepts



Reduce the time for design & troubleshooting



Quantify the technical risk, to enable reaching larger scales, earlier



Stabilize the cost during commercial deployment

National Labs



Academia



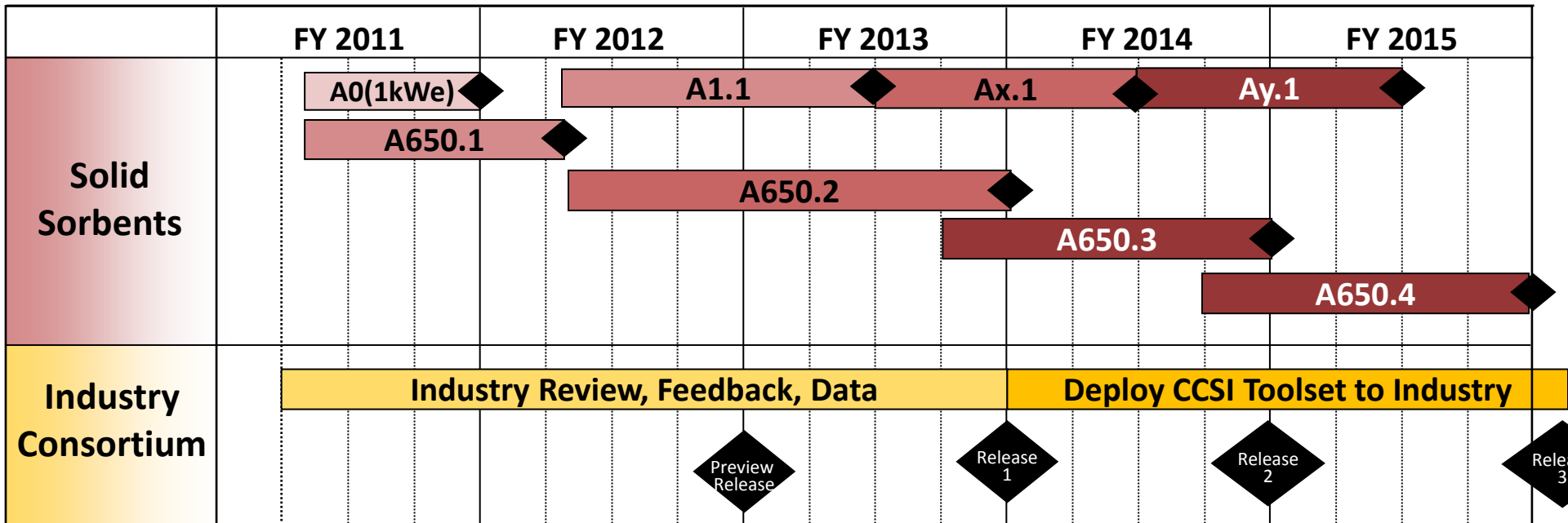
Industry



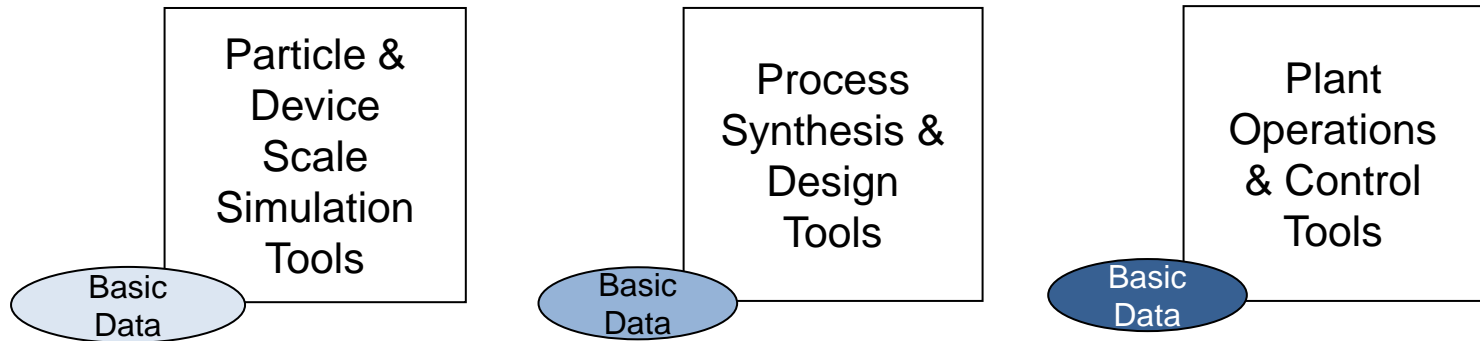
CCSI Timeline

- Organizational Meetings
 - March 2010 - October 2010
- HQ organized Scientific Peer Review
 - January 25, 2011
- Technical work initiated
 - February 1, 2011
- Industry Advisory Board Workshops
 - February 2011
 - September 2011
 - April 2012
- Board of Directors Review
 - January 2012
- SCC Merit Review (ASME)
 - April 2012
- Preliminary Release of CCSI Toolset
 - September 2012

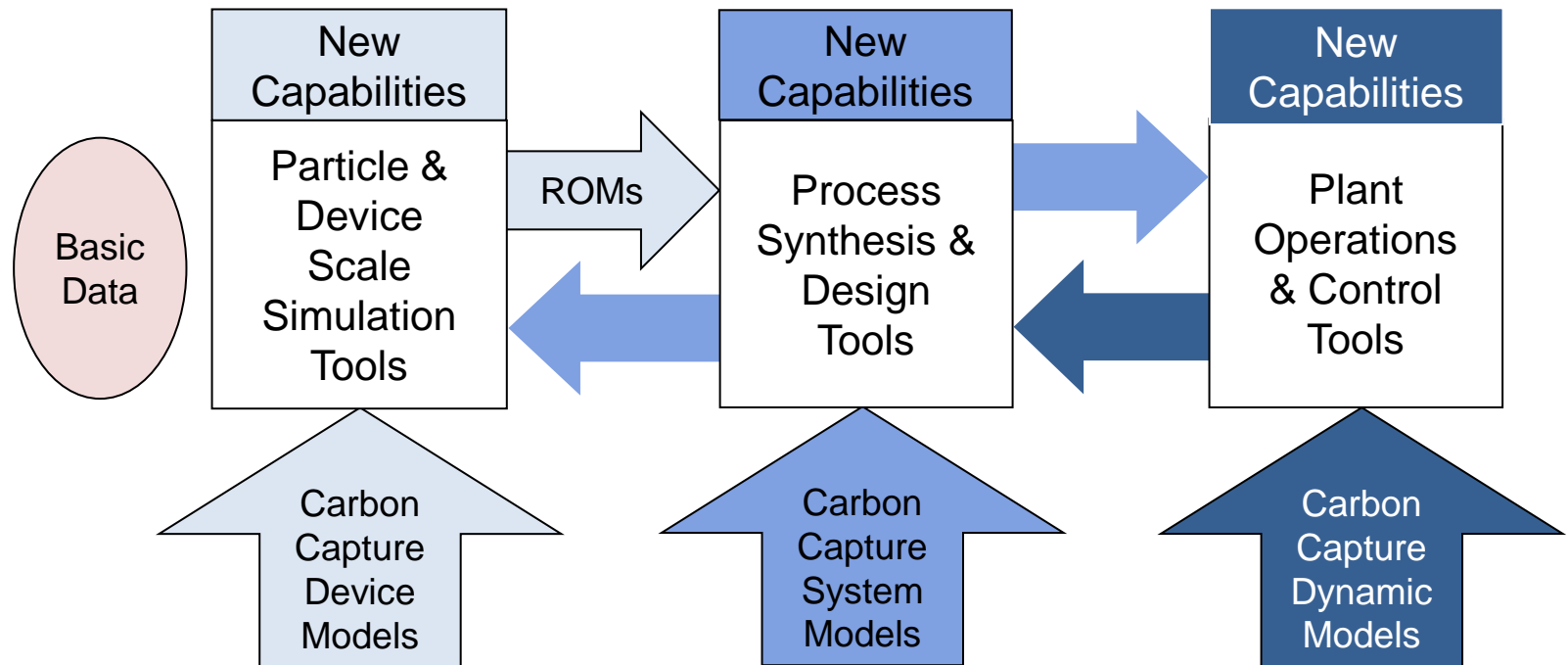
5 Year Plan for Demonstrating CCSI Toolset



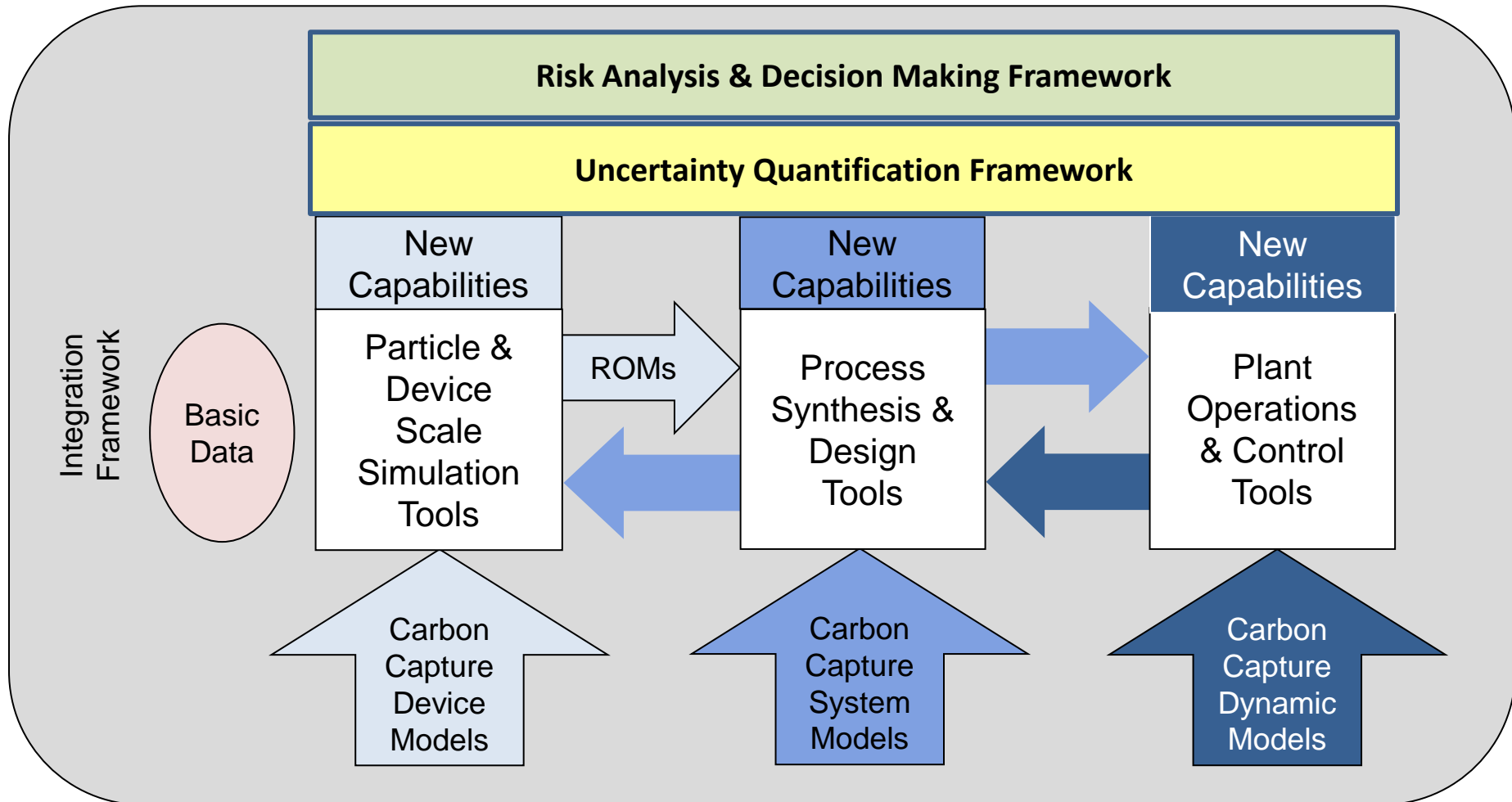
CCSI Toolset Overview



CCSI Toolset Overview

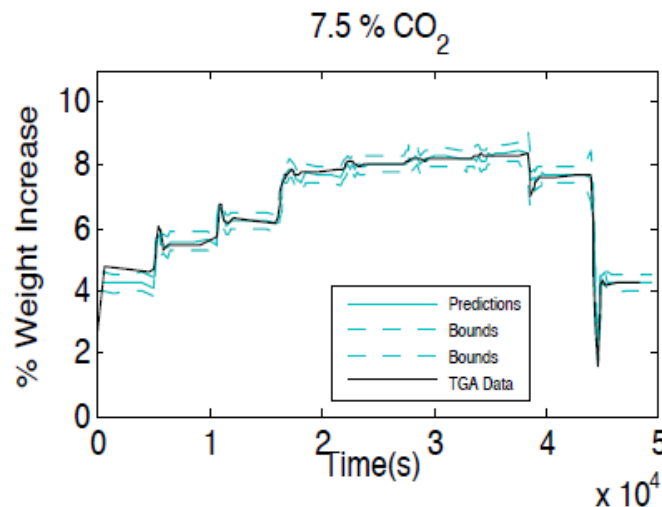
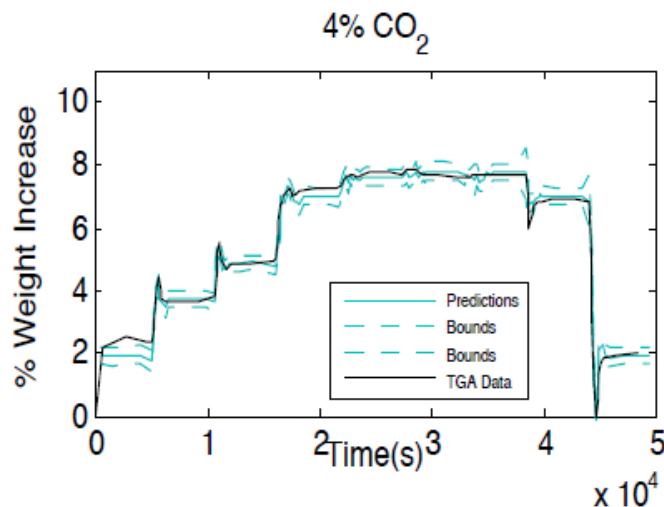
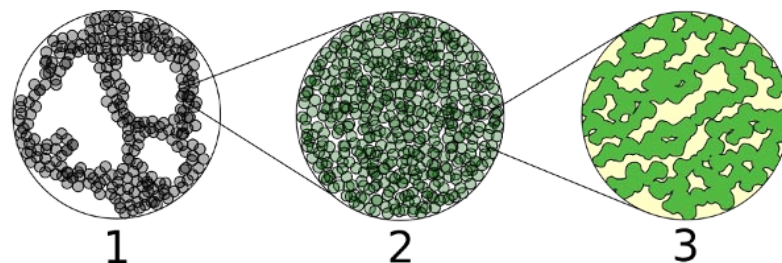
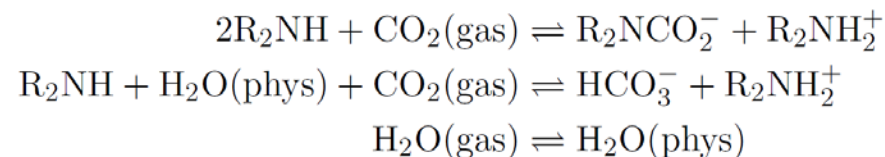


CCSI Toolset Overview

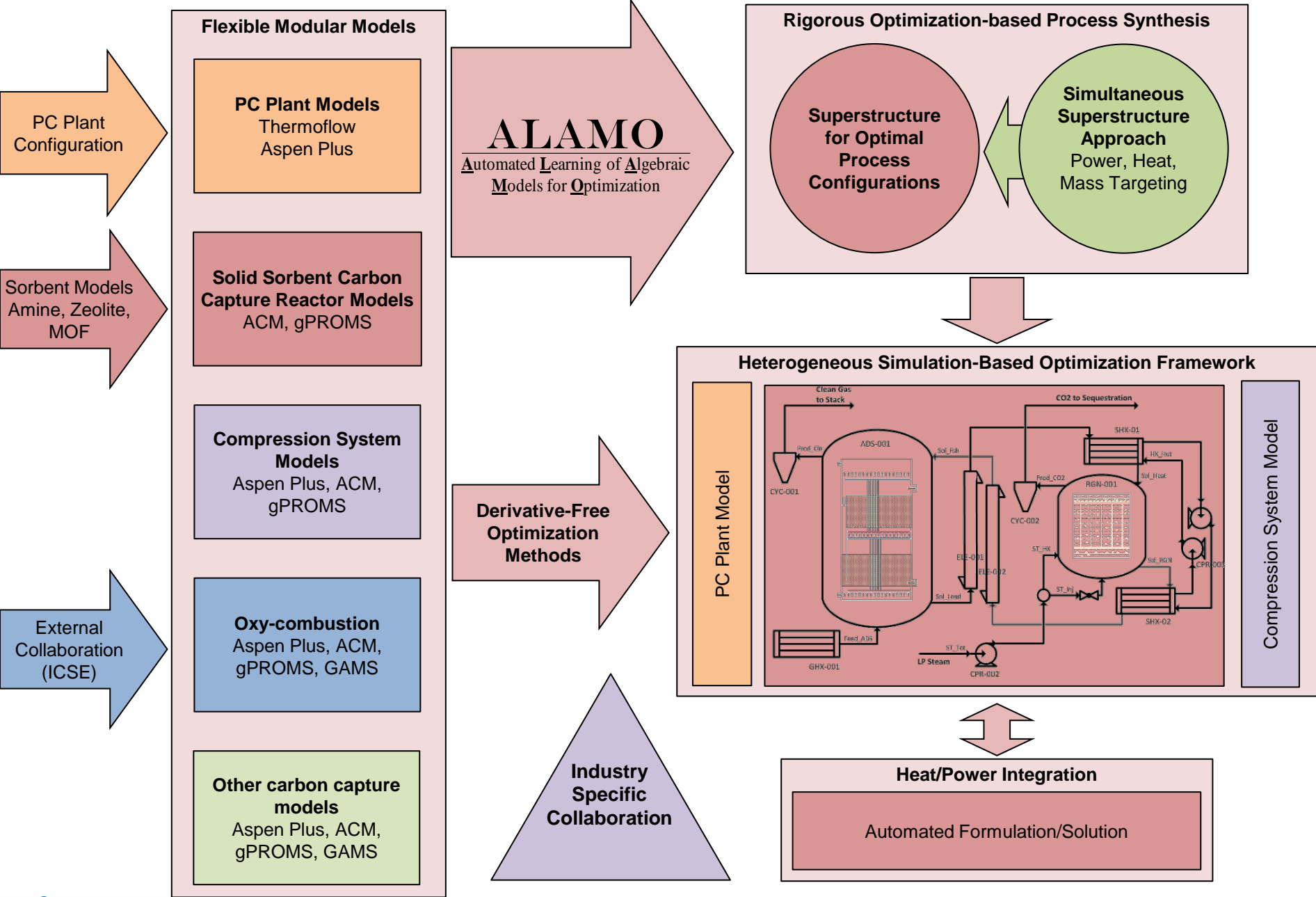


Sorbent Reaction Model with Bayesian-based UQ

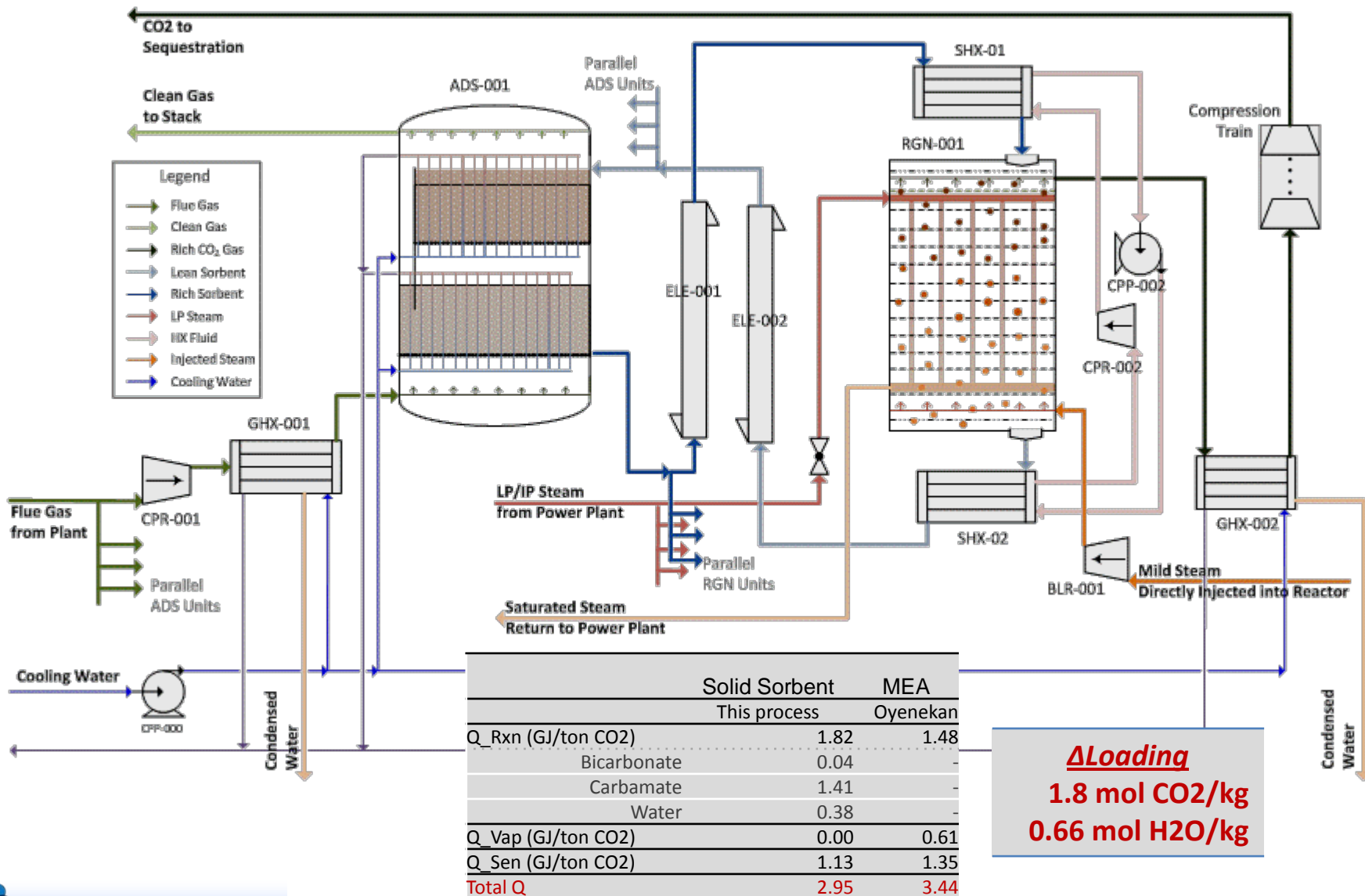
- A general lumped kinetic model, quantitatively fit to TGA data, needed for initial CFD and process simulations
- High-fidelity model:
 - Sorbent microstructure broken down into three length scales
 - Separate treatment of gas-phase and polymer-phase transport
 - Accurately describes TGA features arising from bulk CO₂ transport effects

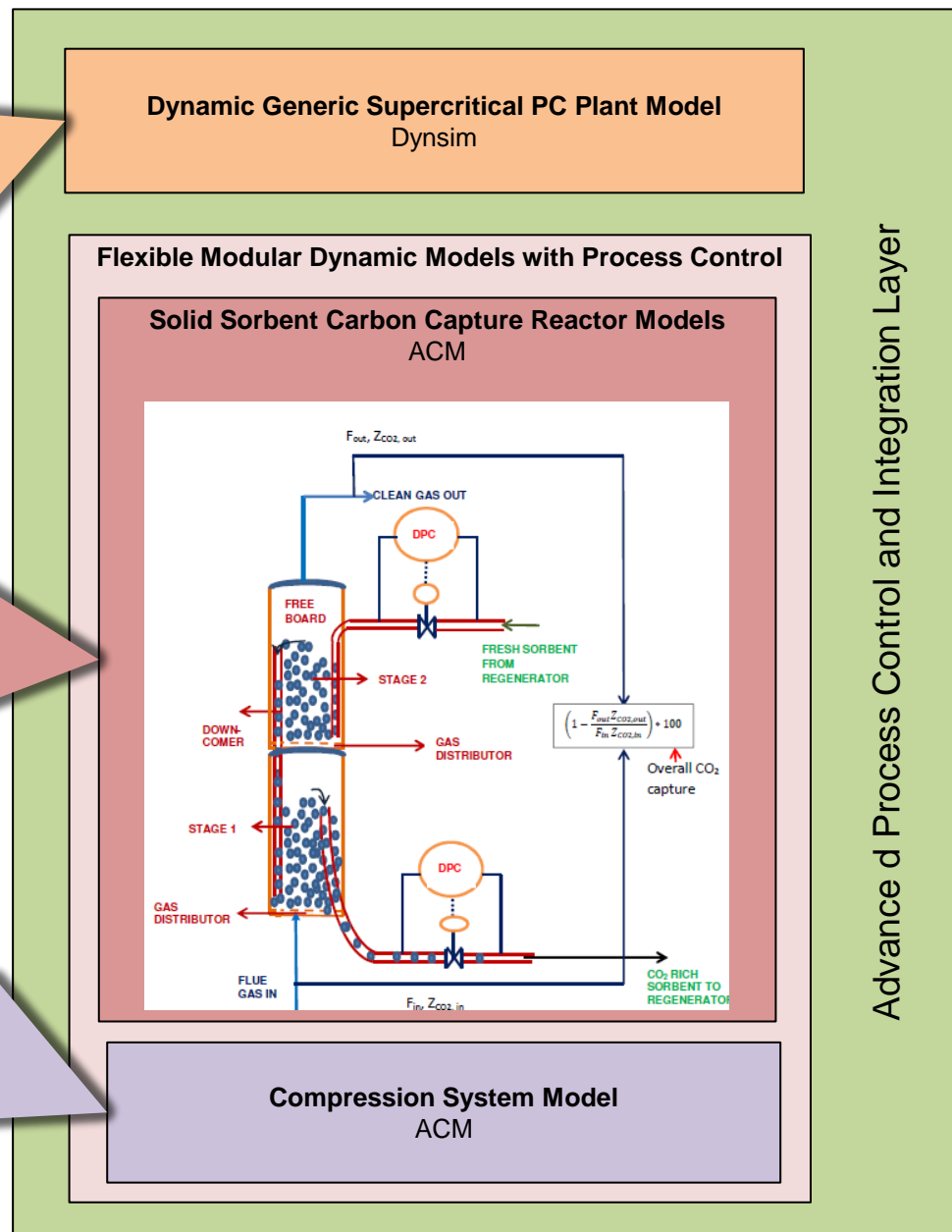
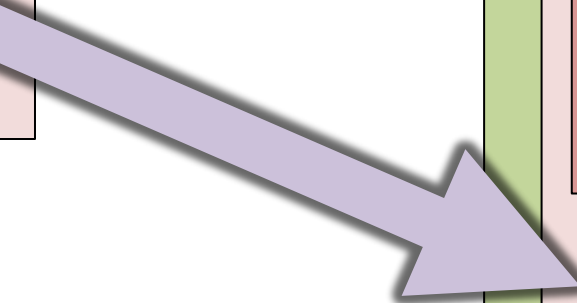
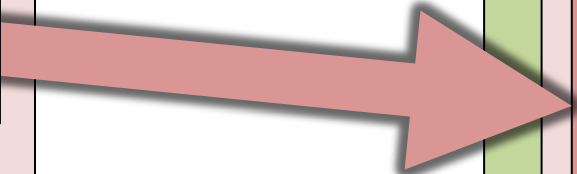
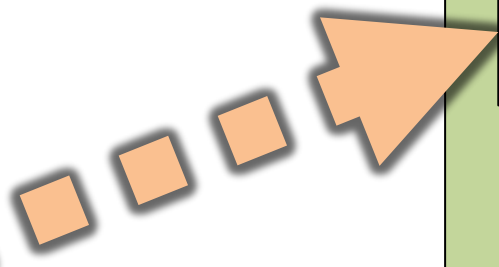
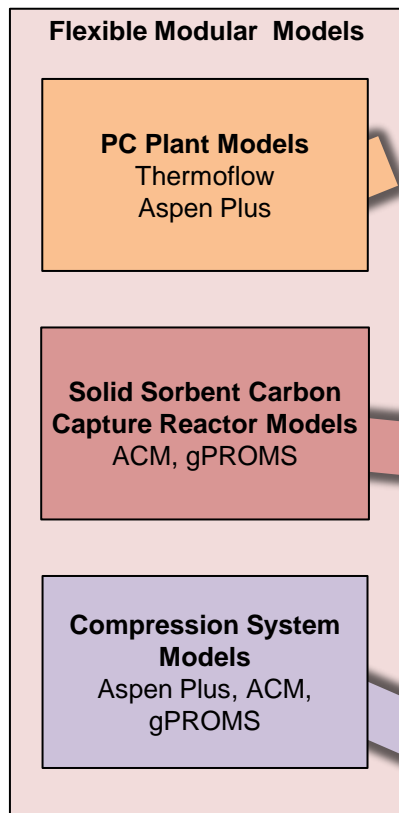


KS Bhat, DS Mebane, H Kim, et al., submitted.



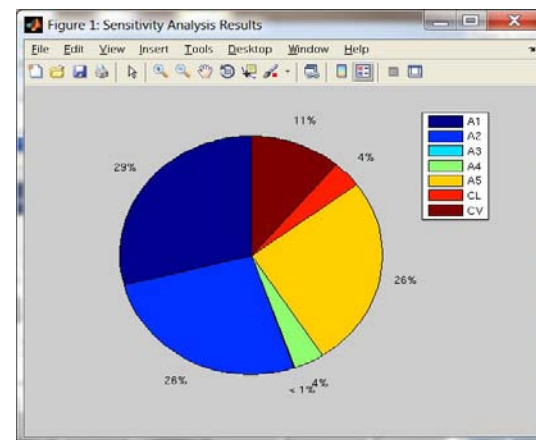
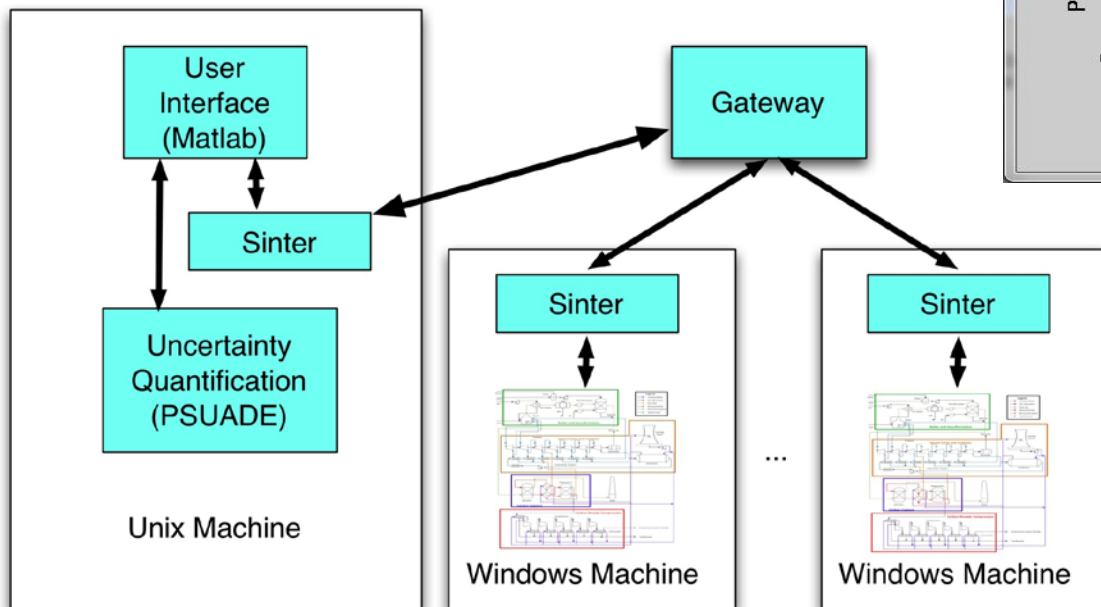
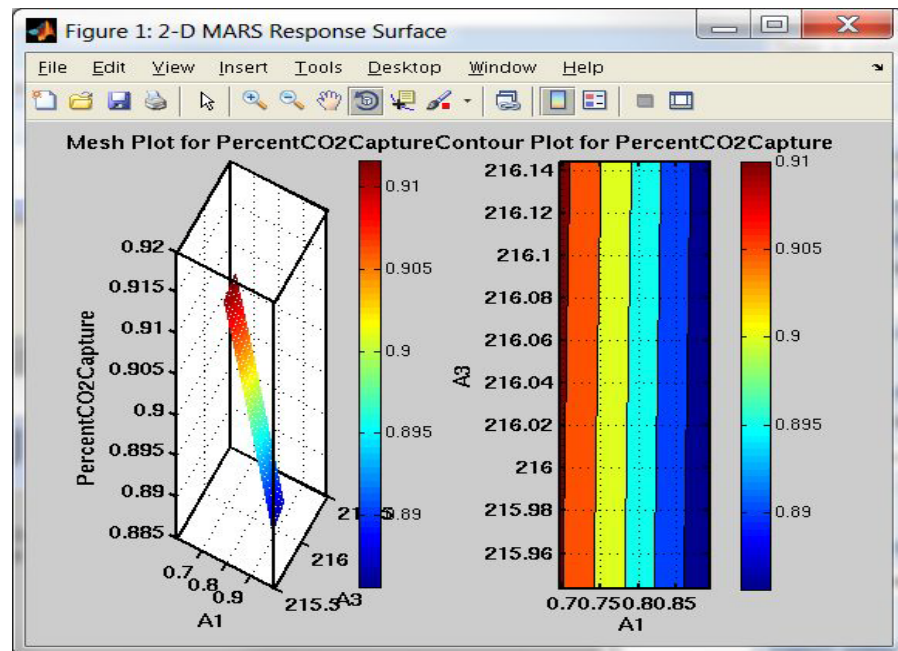
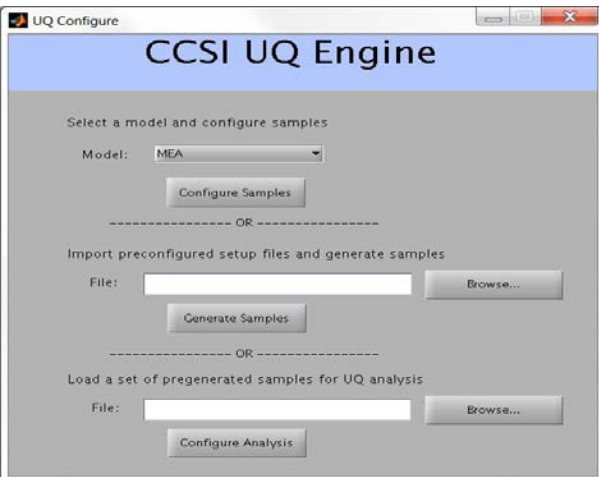
Optimized Capture Process





Advanced Process Control and Integration Layer

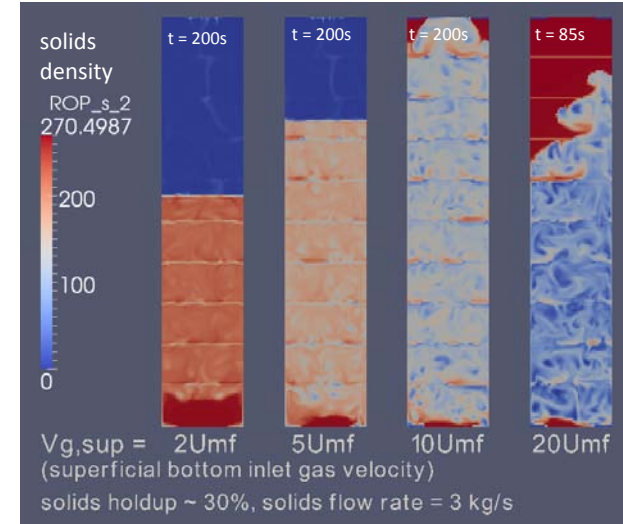
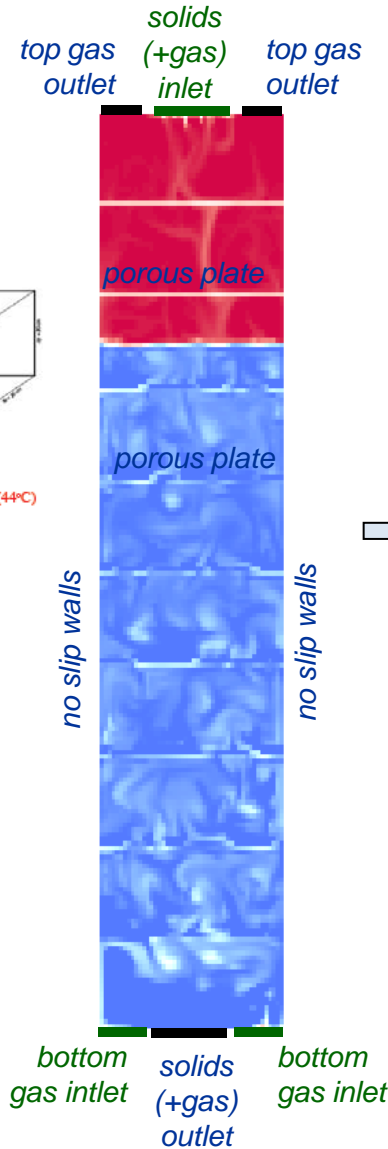
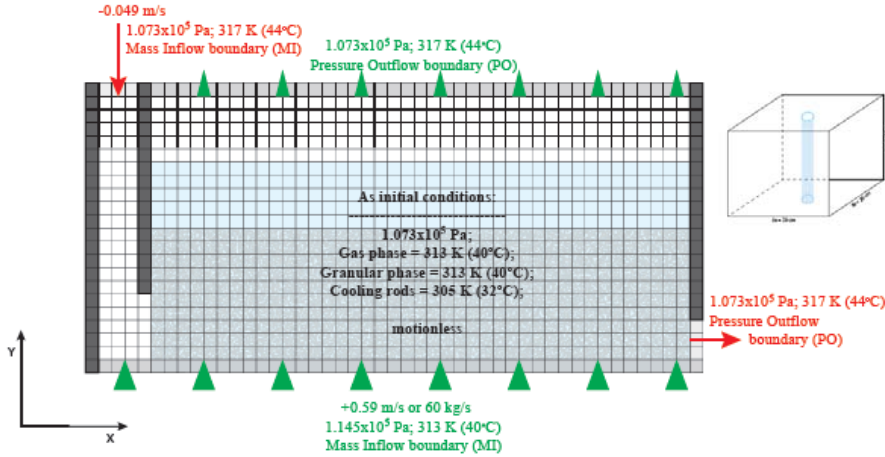
Link to Process Simulation for UQ Analysis



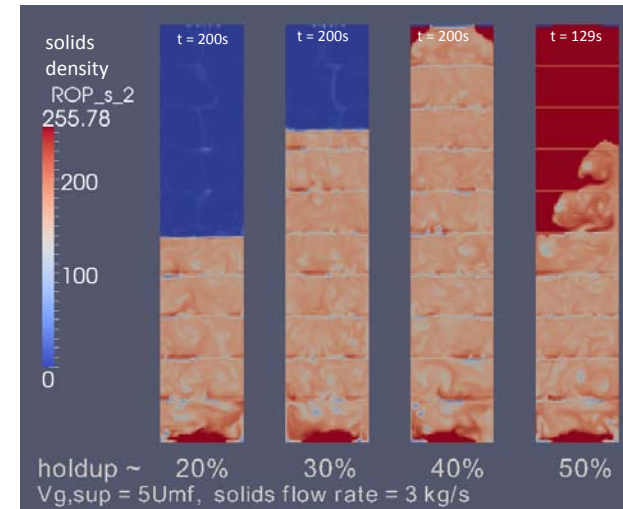
CFD of Adsorber & Regenerator (full scale, 1 MW)

- 3D a coarse grid model of bubbling bed adsorber
- 2D strip for moving bed regenerator
- Parametric studies

Cross-sectional view: Initial and boundary conditions

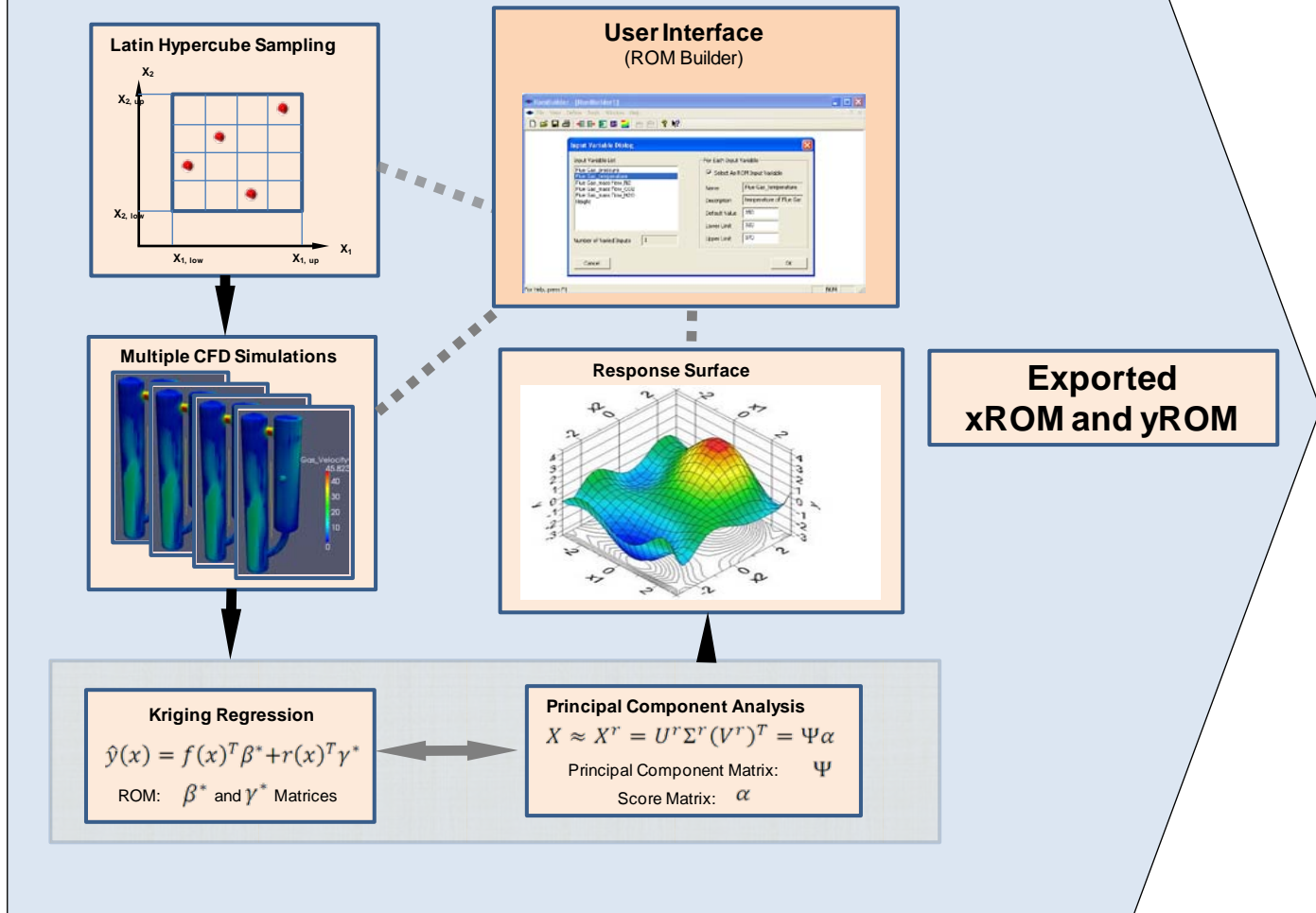


Increasing steam inlet velocity

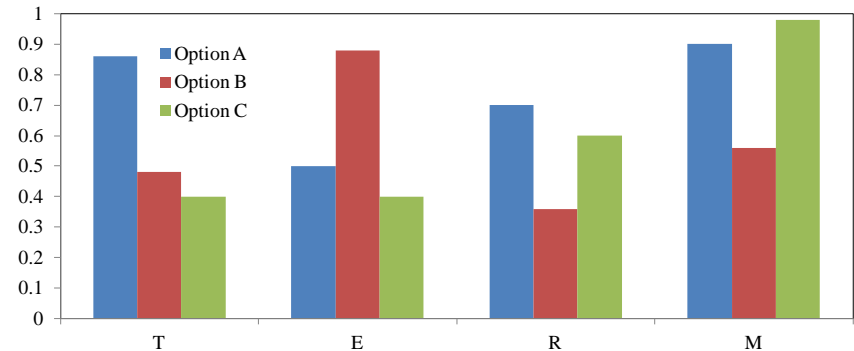
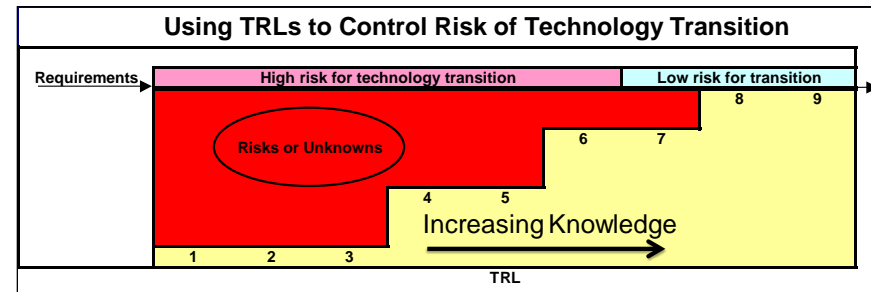
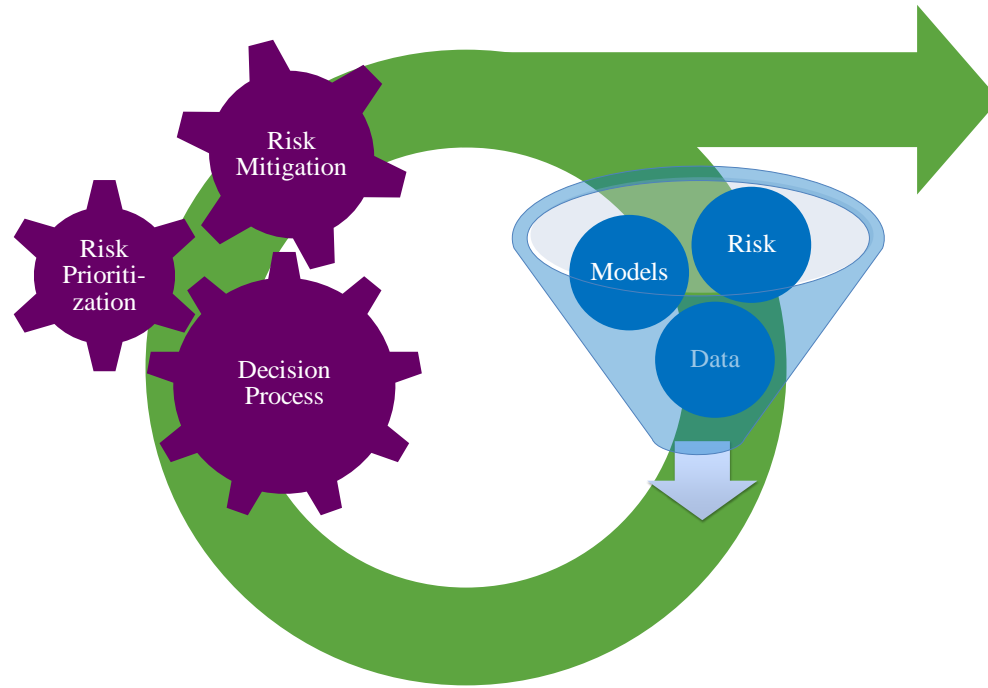
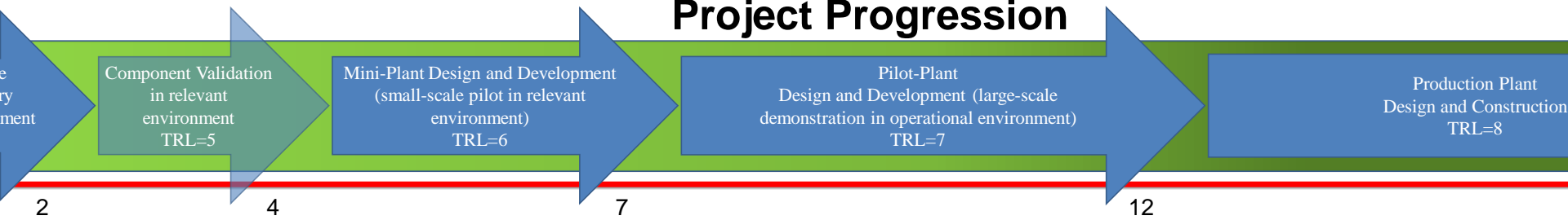


Decreasing bed voidage

Reduced Order Model Development

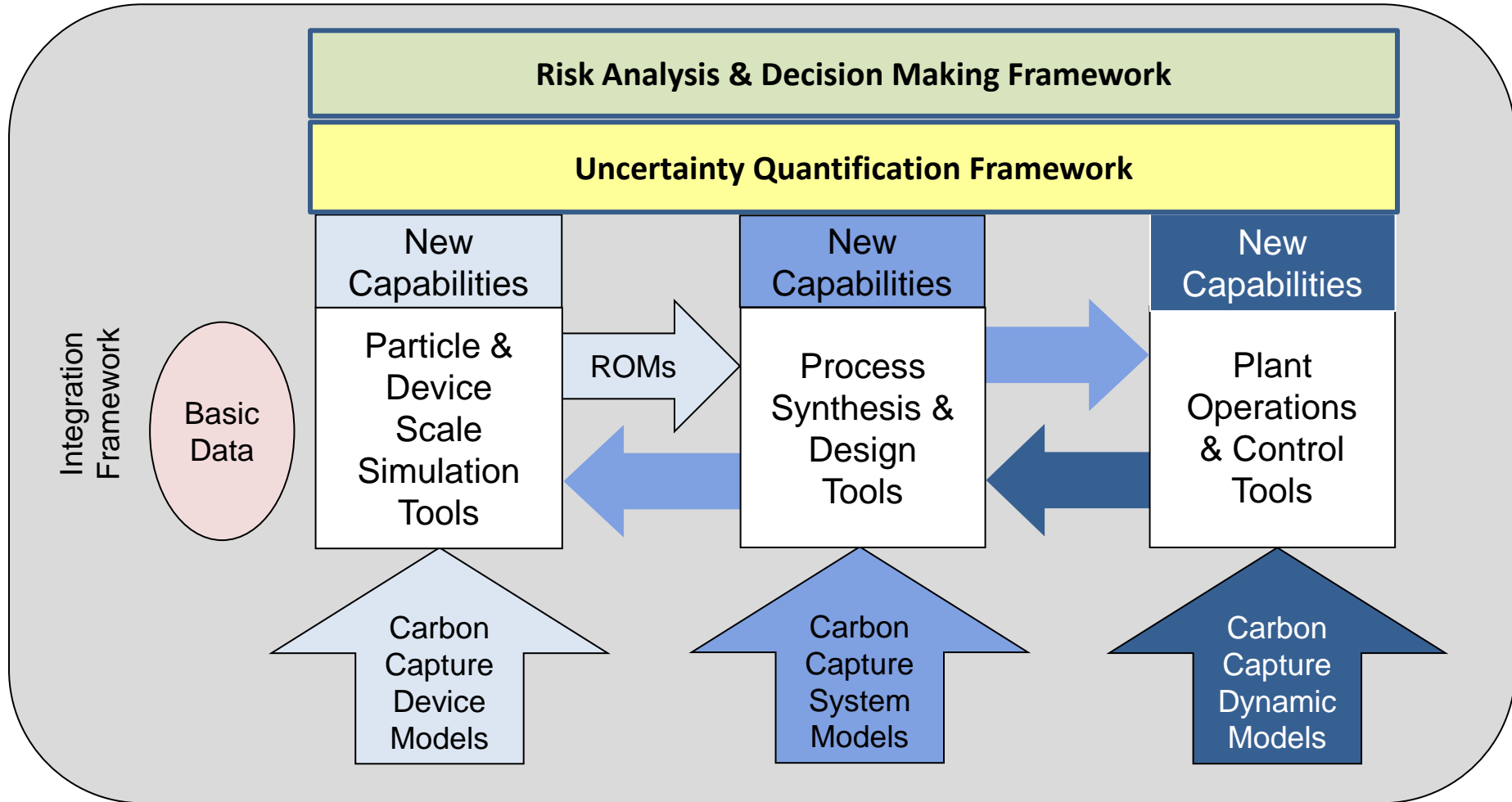


Formal Risk Metrics as Flexible Tools for Risk Analysis

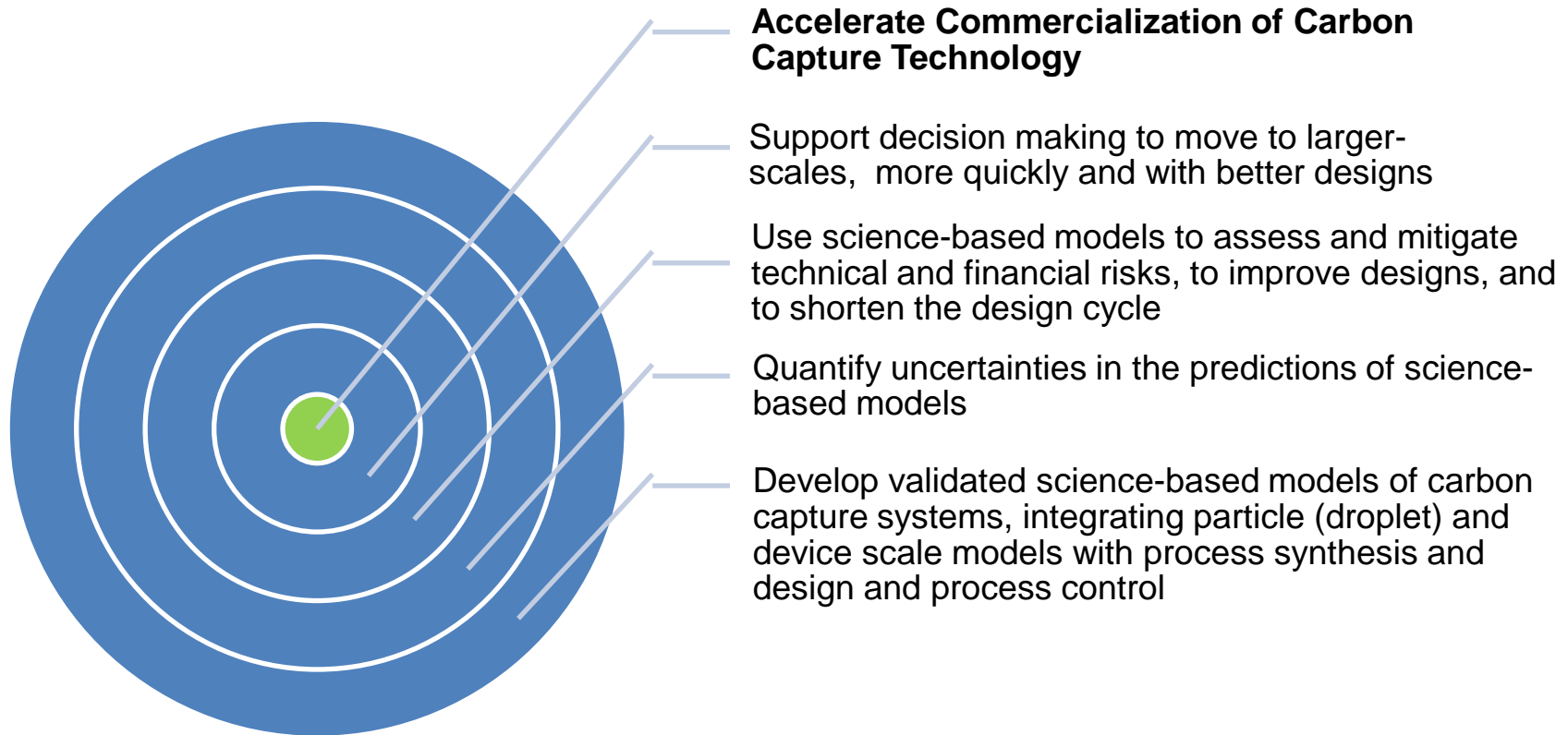


T : Technical performance against objective
E : Economic
R : Risk (includes uncertainty in *T*, *E*, *M*, etc.)
M : Maturity (TRL-based)

Computational Tools to Accelerate Technology Development & Scale up



Potential Benefits to Program



CCSI Collaboration Opportunities Roundtable - Woodlawn I

This evening @ 5 PM

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