



**ALTAIR'S COMPLEMENTARY SOLUTIONS FOR
MODELING PARTICLE-FLUID SYSTEMS**

Jerrin Job Sibychan, Karthik Datta



Altair-at-a-Glance

\$613M, FY23
NASDAQ | \$7B market cap

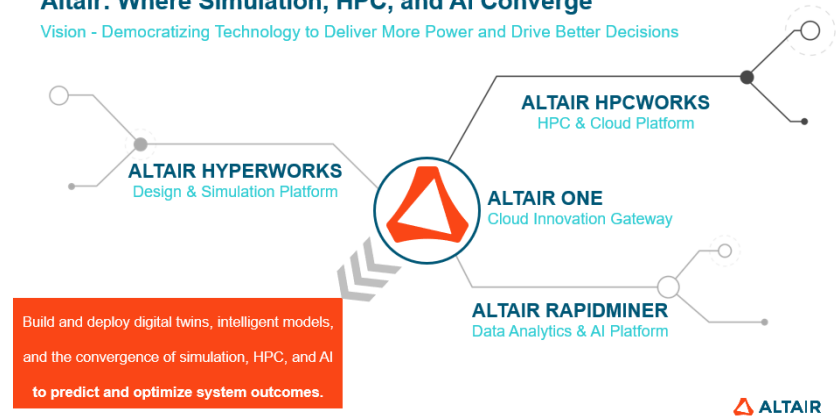
3,000+
 Engineers, Scientists,
 and Creative Thinkers

16,000+
 Customers Globally



Altair: Where Simulation, HPC, and AI Converge

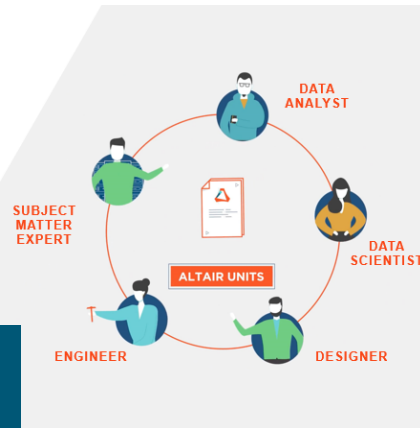
Vision - Democratizing Technology to Deliver More Power and Drive Better Decisions



Altair Units

Revolutionary business model to enable customers to get more from Altair software.

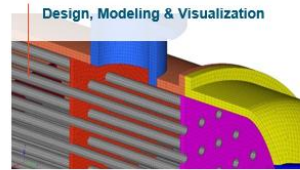
1. Buy a pool of units
2. Use those units for any Altair software or Altair Partner Alliance solutions
3. Transfer the units between people so anyone can use the software



73 Software Products +state-of-the art CFPD



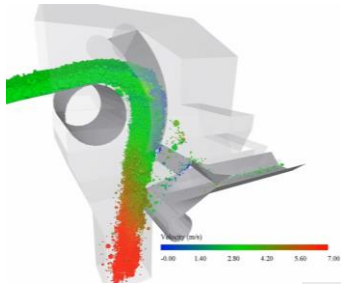
Broad Solutions Portfolio



Altair EDEM and AcuSolve

EDEM

- EDEM is a high-performance software for granular material simulation and it is powered by the Discrete Element Method, also known as DEM.
- EDEM simulates and analyses the behaviour of bulk materials such as coal, mined ores, soil, grains and powders . It provides engineers with crucial insight into how bulk materials interact with equipment in a range of different operating conditions.

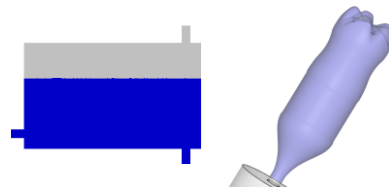


AcuSolve

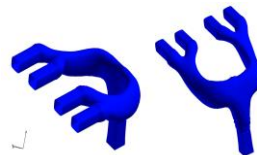
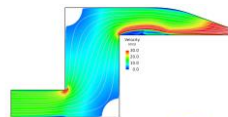
- FEM-based CFD solver supporting a variety of industrial applications
- Highly scalable and robust solver with broad feature set
- Offers additional multi-physics capabilities via interaction with other Altair solvers



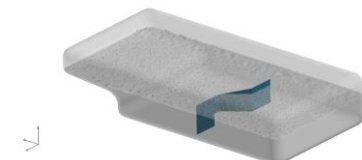
Thermal management



Multiphase flows



Optimization



Multi-physics simulations



Altair's Particle and Flow Modeling Solutions



EDEM

- Granular material simulation powered by Discrete Element Method (DEM) technology.
- Can simulate a wide range of material flows across a broad range of industries.



AcuSolve-EDEM one-way coupling

- High-fidelity particle-particle interaction in a steady flow field.
- Best suited for dilute phase flows

AcuSolve-EDEM two-way coupling

- For high-fidelity fluid-particle simulations
- Each particle is tracked individually.
- Two-way interaction between particles and fluid.

AcuSolve Eulerian granular multiphase

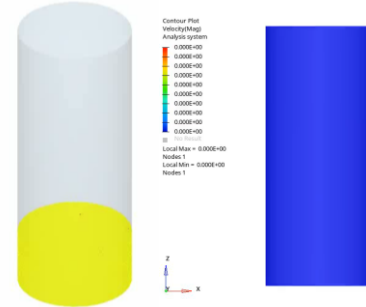
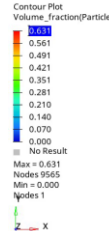
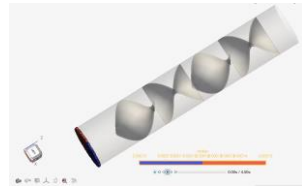
- No individual tracking of particles
- Both solid and fluid phases are modeled within a Eulerian frame of reference.
- Solid phase effects are modeled through kinetic theory of granular flows

AcuSolve disperse phase model

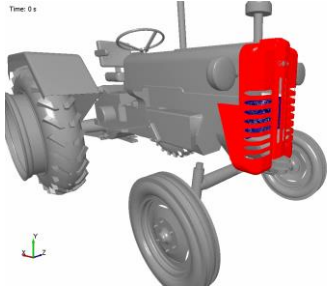
- Both carrier and dispersed fields are tracked as Eulerian fields.
- Dispersed fields do not interact with each other.

AcuSolve Single Phase Fluid Flow

- Supports wide range of use cases including steady, transient flows, and heat transfer.
- Also supports particle tracing for very dilute phase flows.

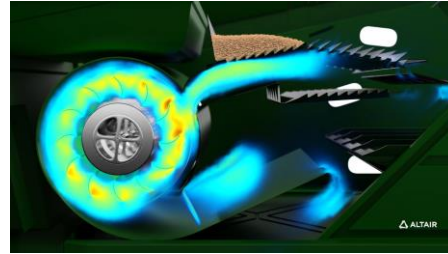


Example Applications for AcuSolve-EDEM Coupling

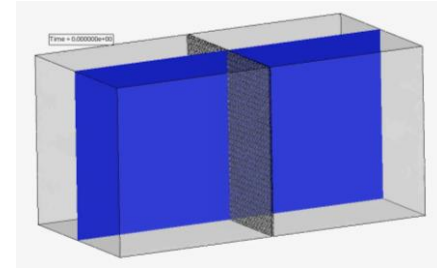


Debris Modelling

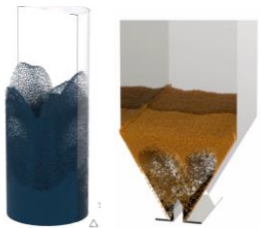
Air-debris-equipment interaction



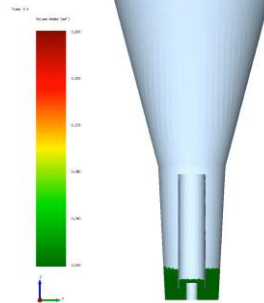
Agricultural Harvesting Equipment



Screen dust accumulation



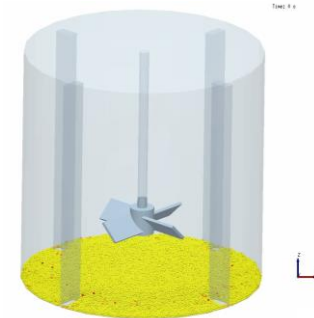
Fluidized beds



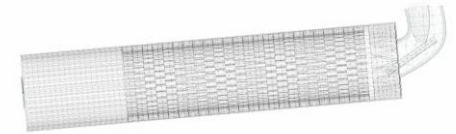
Wurster coater



Pneumatic Conveying



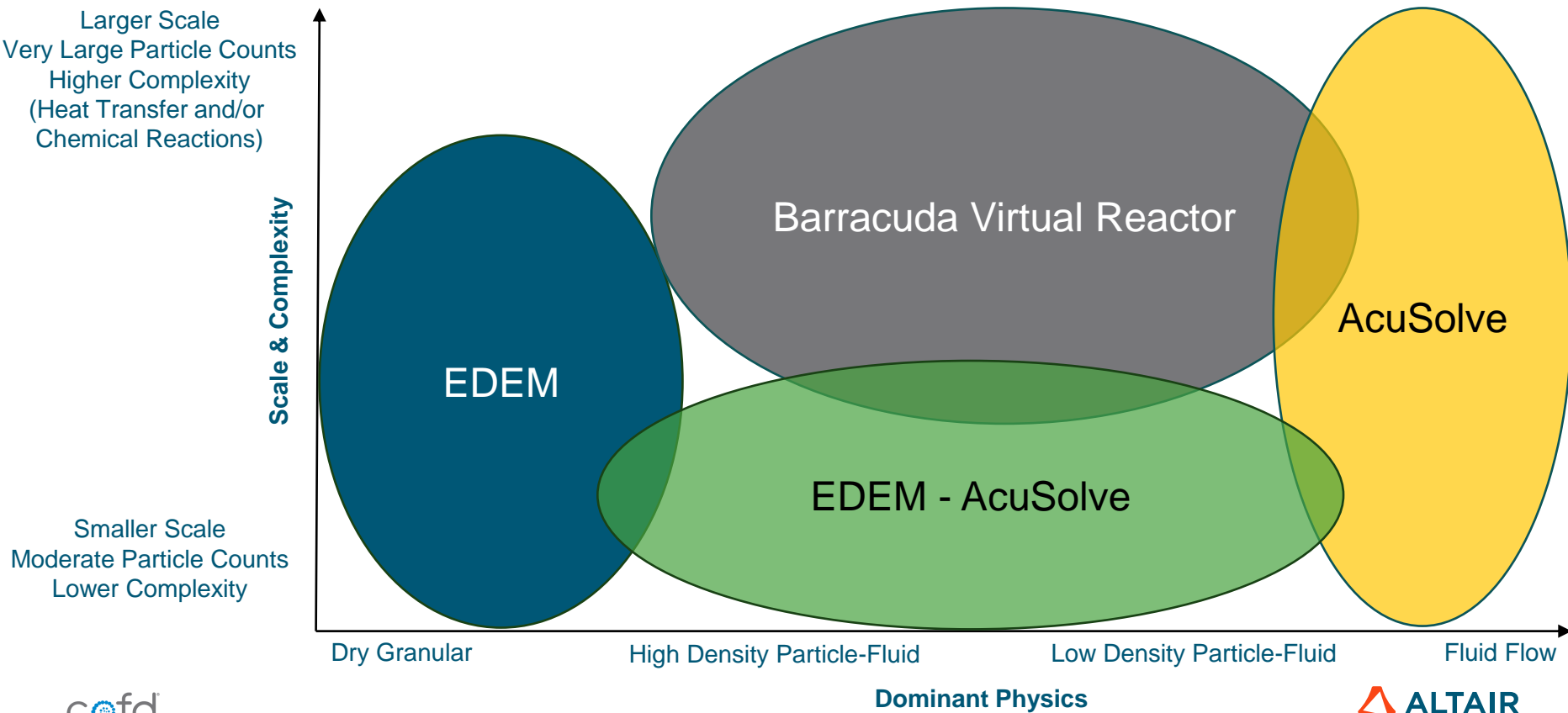
Mixing



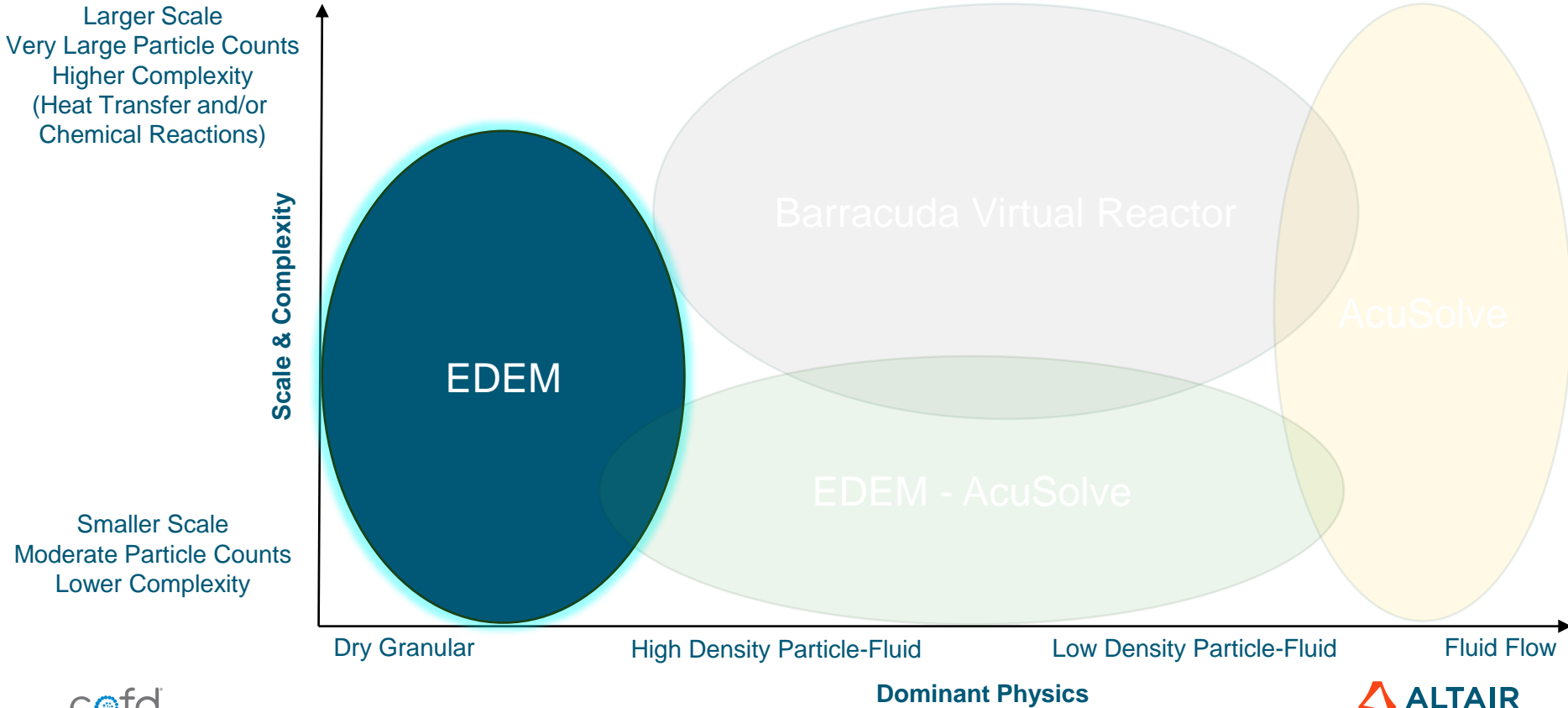
Rotary dryer

Altair EDEM™

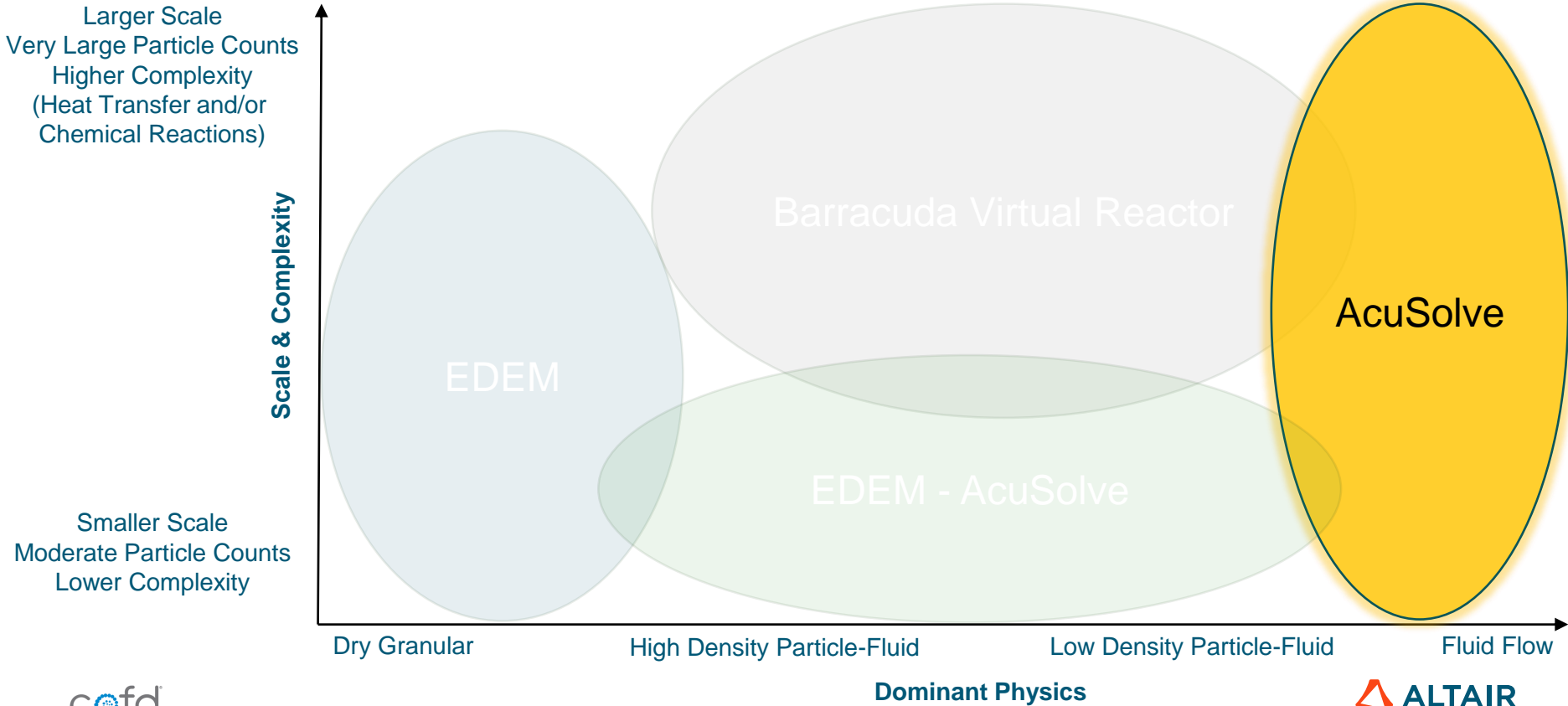
Barracuda Complements EDEM and AcuSolve Solutions



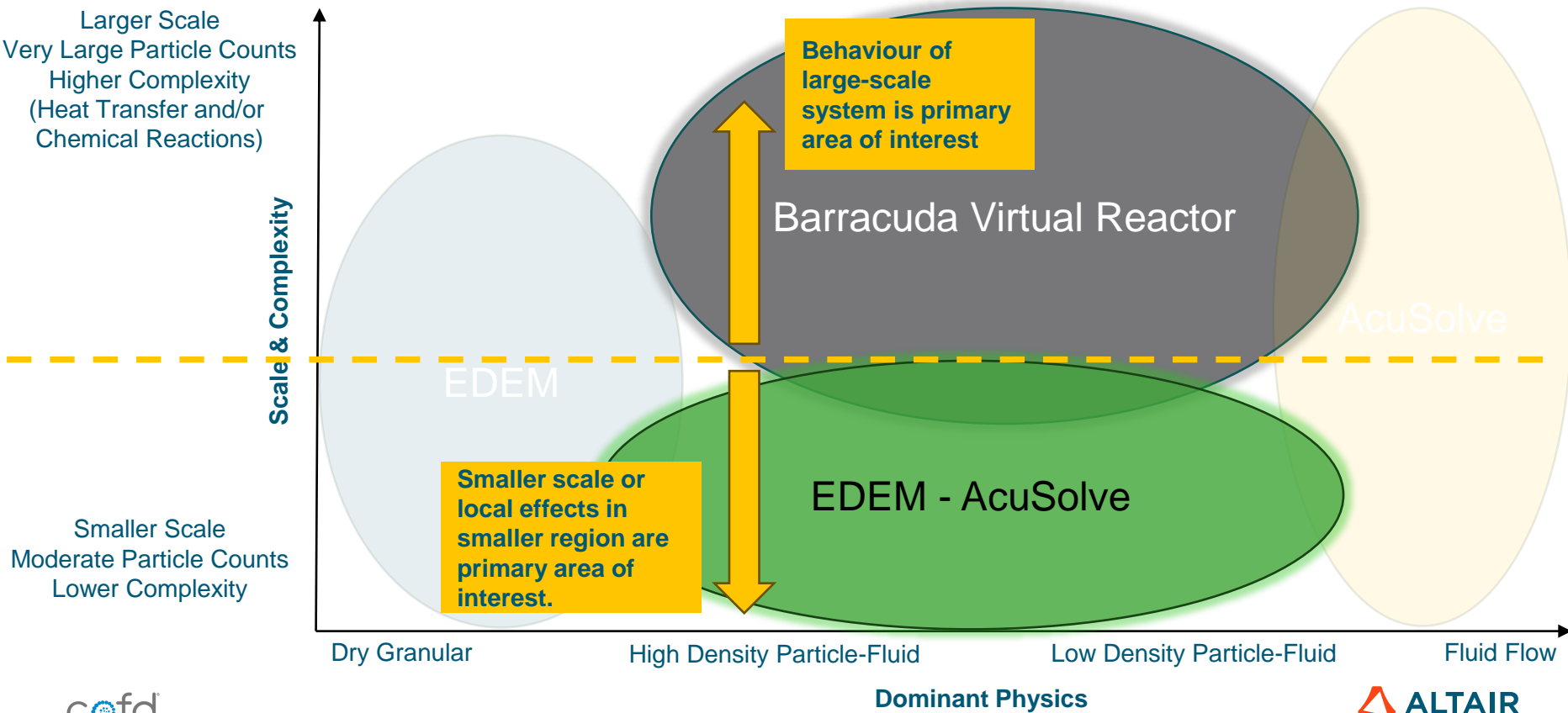
Granular Systems Only, No/Negligible Fluids



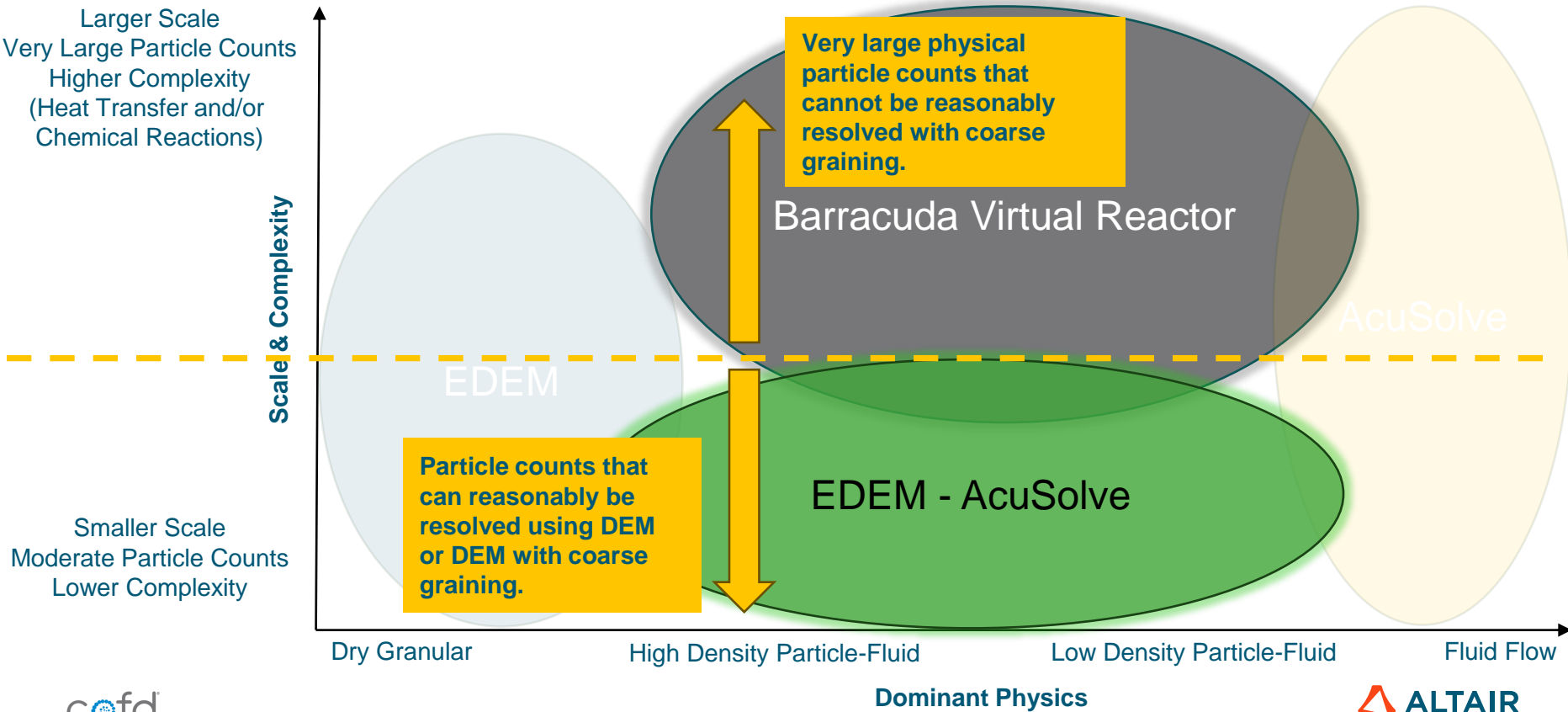
Fluid Systems Only, No/Negligible Particles



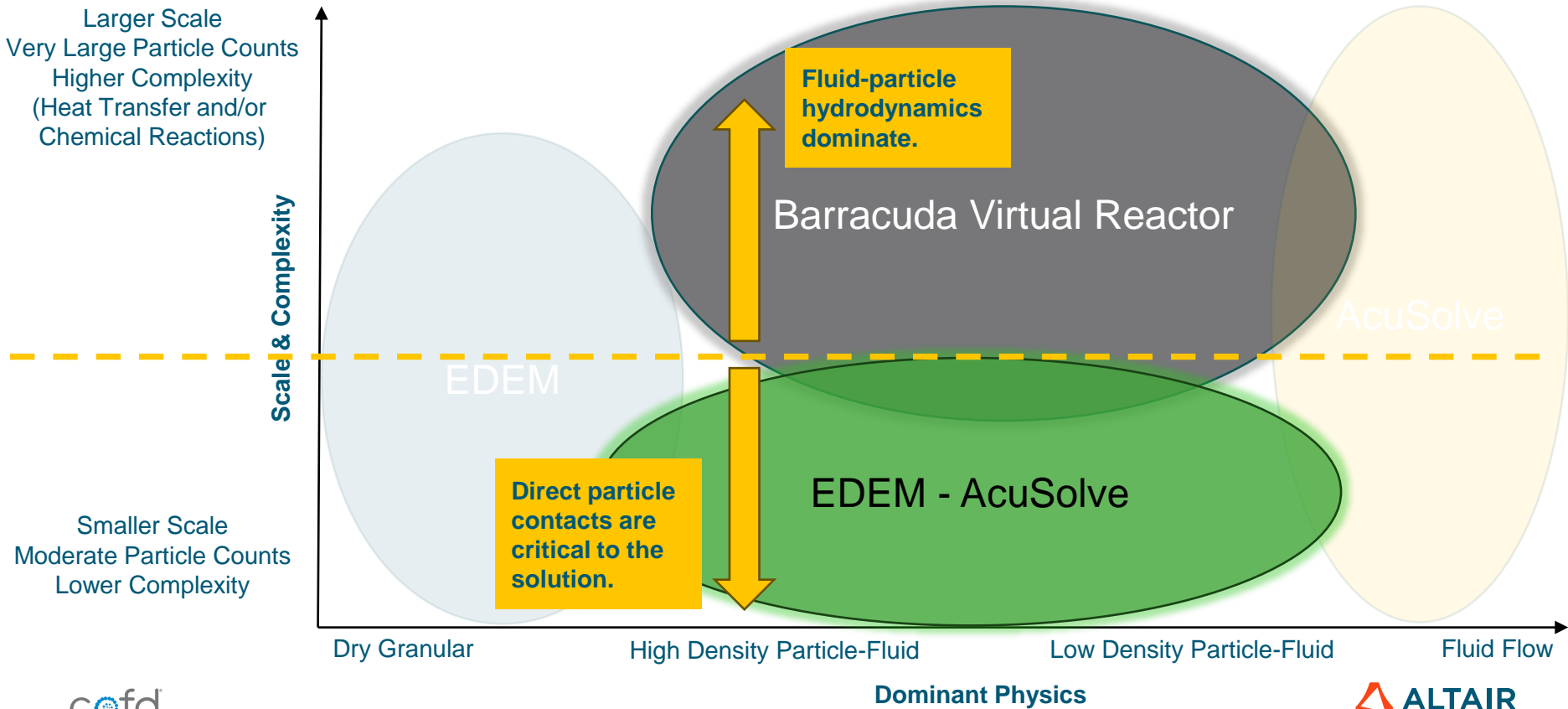
Fluid-Particle Systems: Physical Scale



Fluid-Particle Systems: Number of Particles to Model



Fluid-Particle Systems: Particle Interactions vs. Fluid-Particle Drag

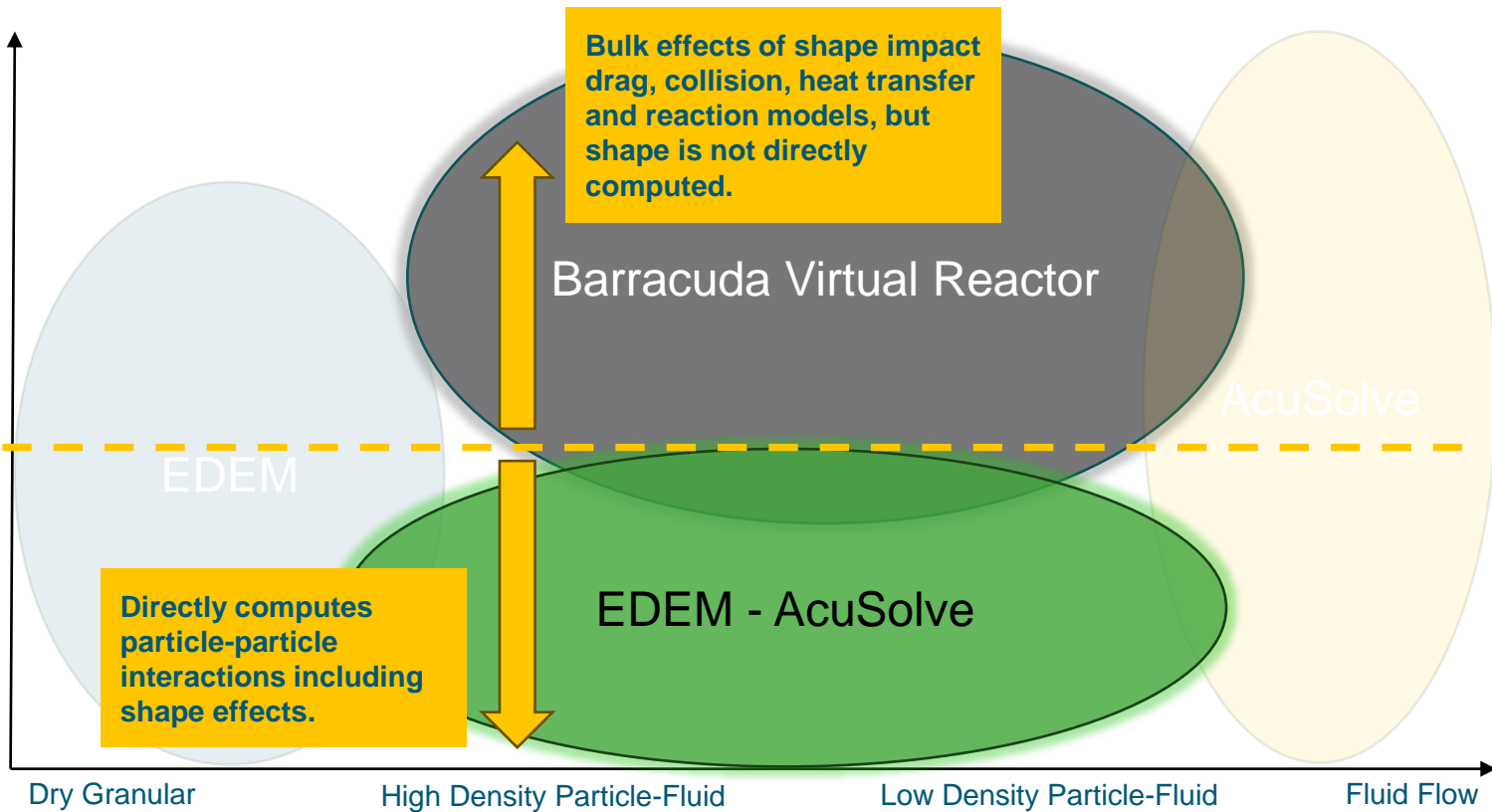


Fluid-Particle Systems: Particle Shape

Larger Scale
Very Large Particle Counts
Higher Complexity
(Heat Transfer and/or
Chemical Reactions)

Scale & Complexity

Smaller Scale
Moderate Particle Counts
Lower Complexity



EDEM

Bulk effects of shape impact drag, collision, heat transfer and reaction models, but shape is not directly computed.

Barracuda Virtual Reactor

AcuSolve

Directly computes particle-particle interactions including shape effects.

EDEM - AcuSolve

Dry Granular

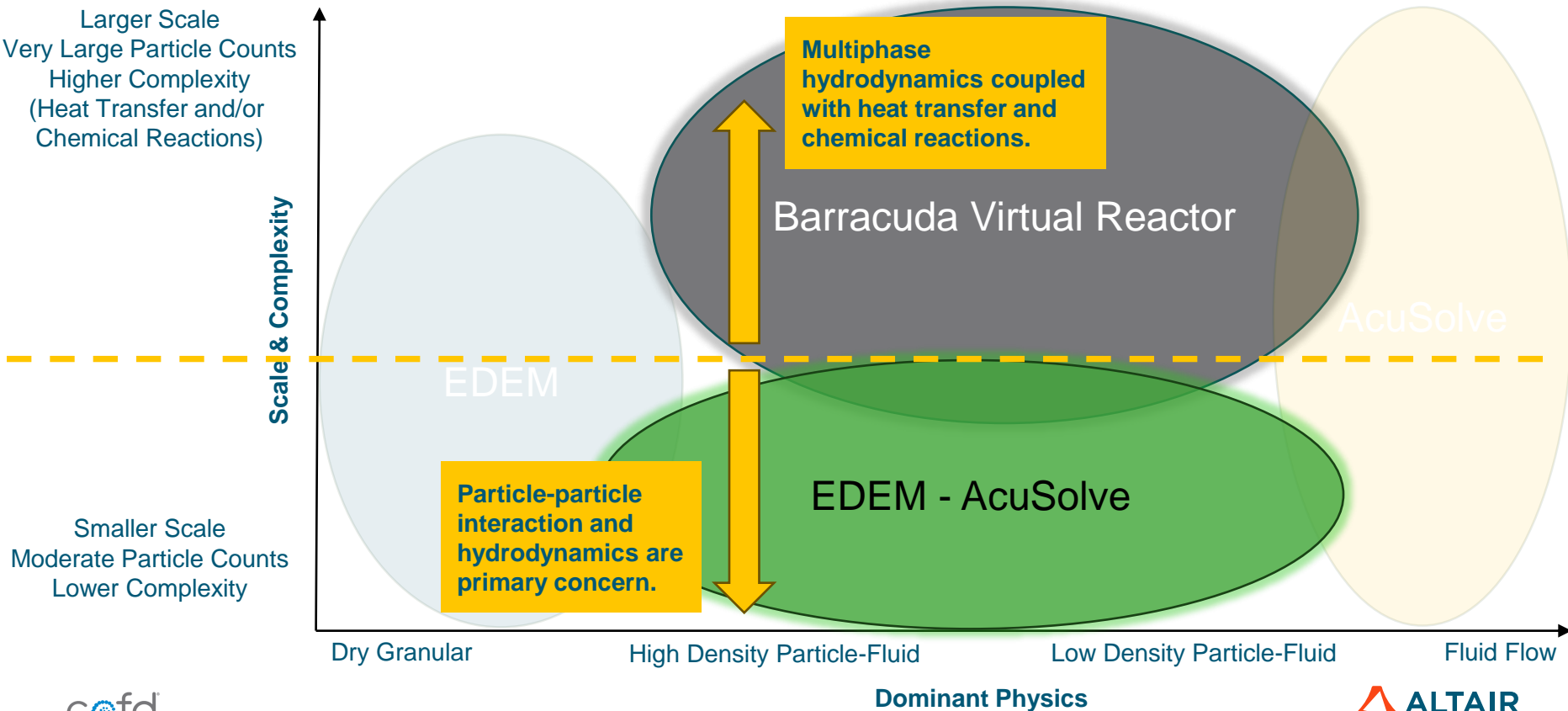
High Density Particle-Fluid

Low Density Particle-Fluid

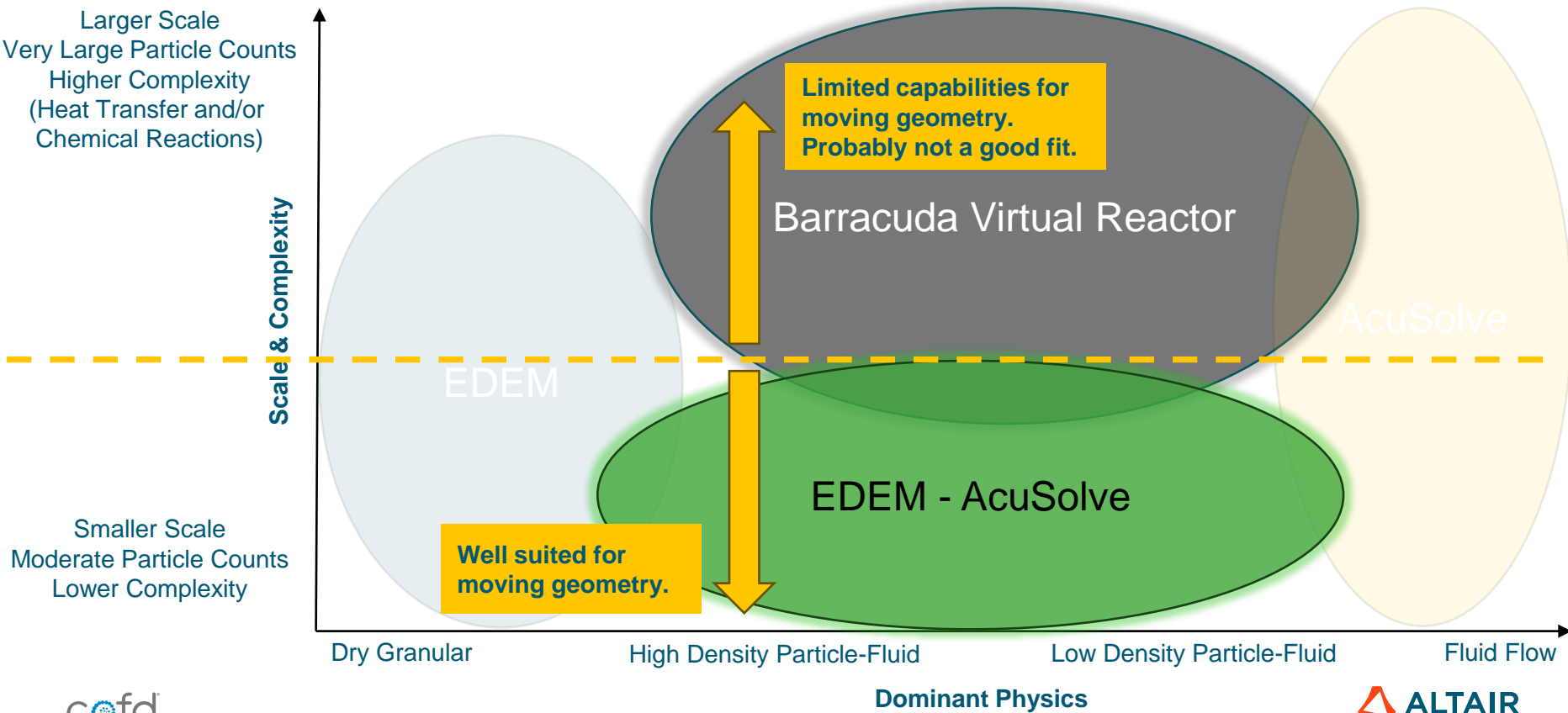
Fluid Flow

Dominant Physics

Fluid-Particle Systems: Additional Physics & Chemical Reactions

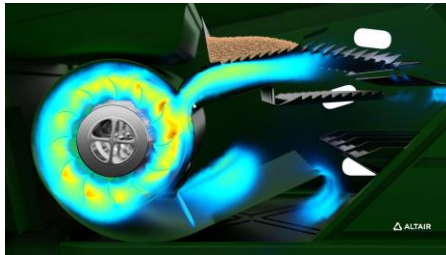


Fluid-Particle Systems: Moving Geometry



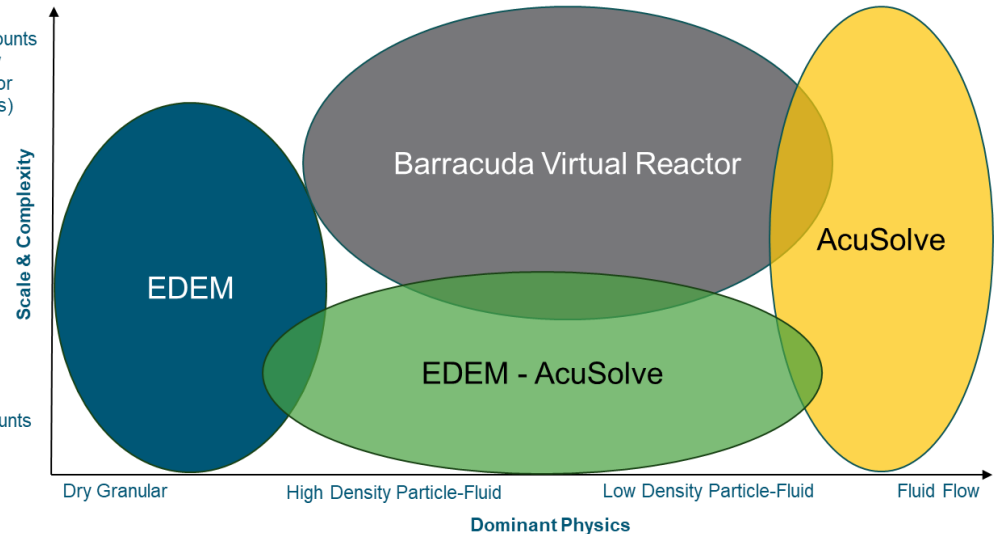
Summary

- Granular material – fluid problems are everywhere in industry and exhibit a wide range of complex behaviors
- Combining the powerful capabilities of AcuSolve, EDEM and Barracuda Virtual Reactor provides engineers a suite of tools to model fluid, particle, and fluid-particle flows right from lab to industry scale.
- All solutions are available today under the Altair Units license



Larger Scale
Very Large Particle Counts
Higher Complexity
(Heat Transfer and/or
Chemical Reactions)

Smaller Scale
Moderate Particle Counts
Lower Complexity





THANK YOU

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