

# Scale-Up of Chemical Engineering Process

## Chapter 1: Introduction of Scale-Up Processes

by

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# Definition of Scale-up

“The successful startup and operation of a commercial size unit whose design and operating procedures are in part based upon experimentation and demonstration at a smaller scale of operation”

(Source: Bisio & Kabel 'Scaleup of Chemical Process)



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# Definition of Scale-up

“Indeed, to a very significant extent, scale up *is* Chemical Engineering”

Source: Prof. G. Astarita (Scaleup of Chemical Processes)



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# Why Scale-Up

- Market growth
- Introduction of new processes
- Reduction in making expensive errors in design and operation
- Concentrate on attacking areas of doubts and uncertainty
- Economic feasibility



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# Scale-up



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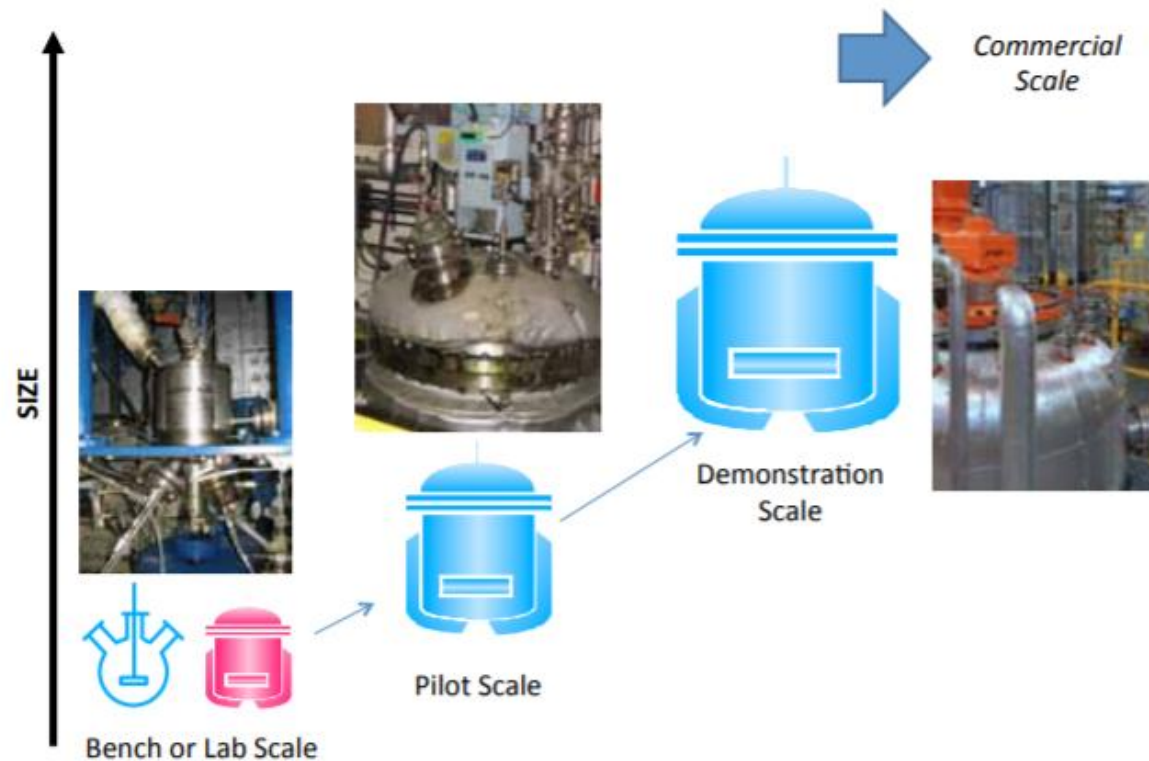
# Scaling up Step by Step

- Product and process development for scaling up typically move in small steps
  - From lab scale to bench scale, move to pilot scale and finally to commercialization scale.
  - This may lessens the risk with large investments.



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# Conventional Scale-up Procedure



(Source: Biofuels International Magazine, November 2012)



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# Scale-up Procedure

- Bench or laboratory scale
  - early-stage tools to assess and scaling new product or technology
- Pilot Scale
  - First view into continuous processing
- Demonstration scale
  - Process flowsheet closely resemble commercial scale operations.



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# Production Capacity

Scaling factor	Typical production capacity
Bench/ Laboratory	0.001 – 0.1 kg/h
Pilot Plant	10 – 100 kg/h
Demonstration Plant	100 – 1000 kg/h
Commercial Plant	> 1000 kg/h



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