



"Where Engineering meets Biology"

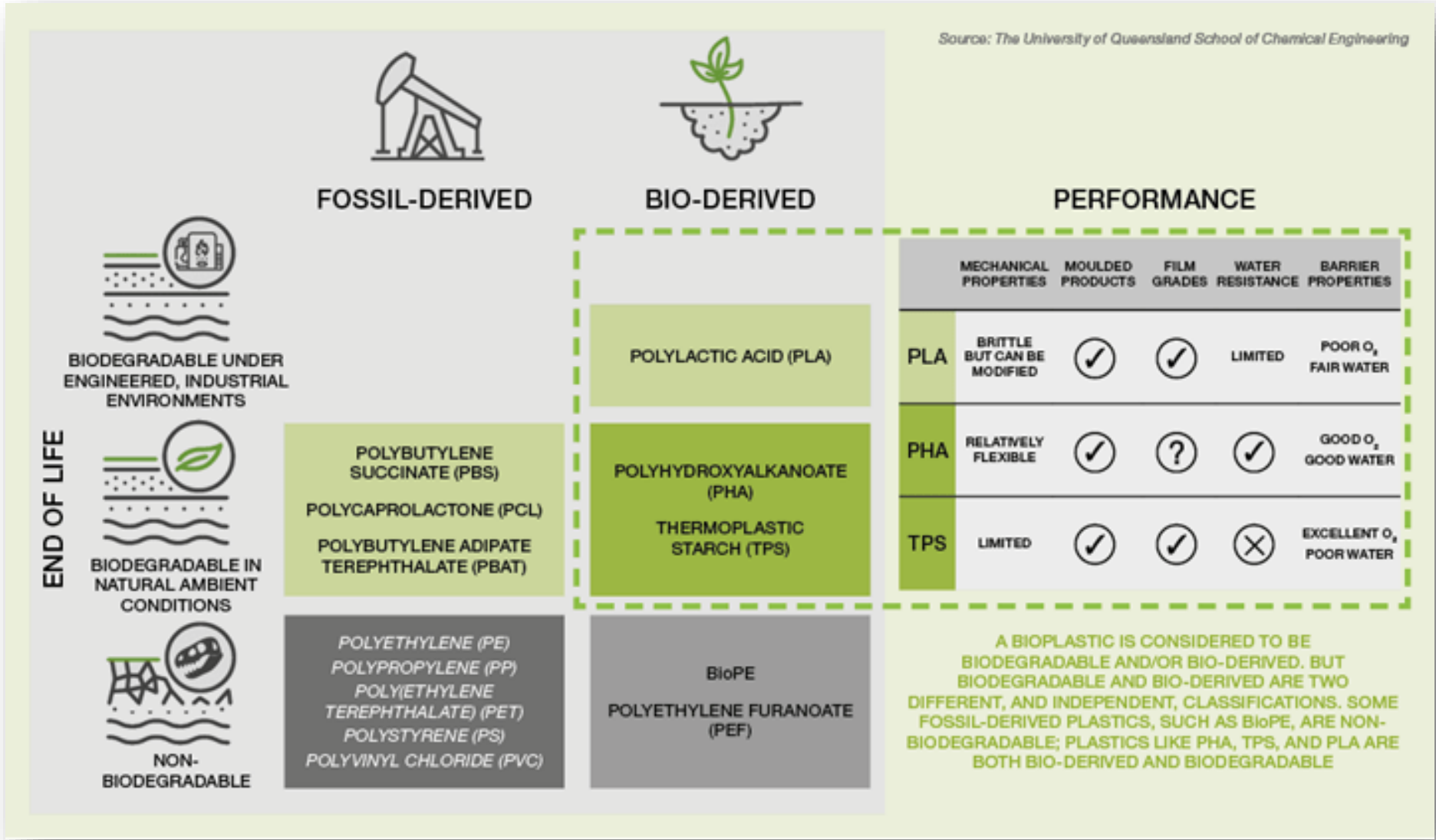
Biorefinery Pilot Plant @EECi

*Plastic and Rubber Thailand 2024
15th May 2024 Bitec, Bangkok*

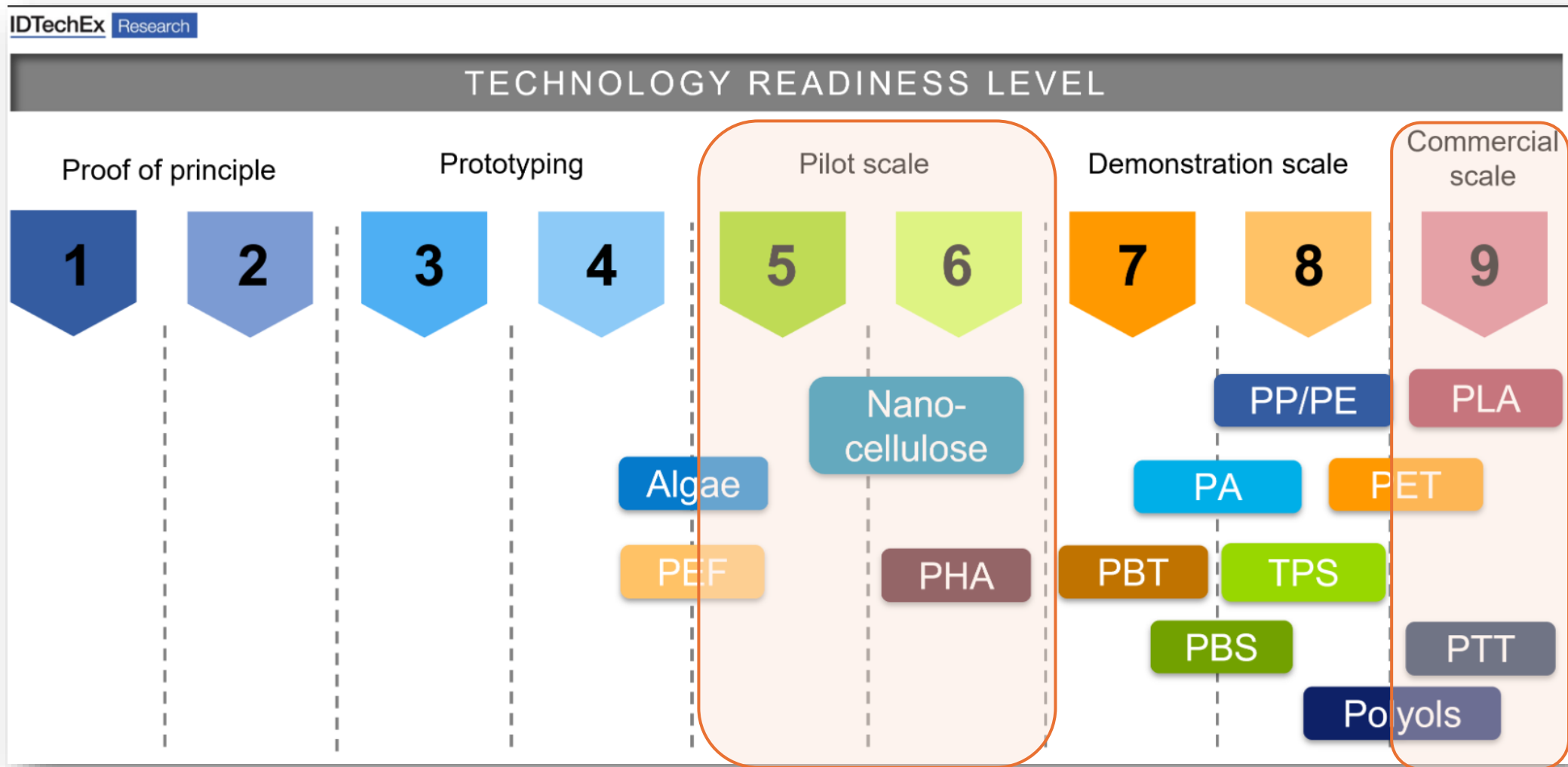
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Senior Engineer

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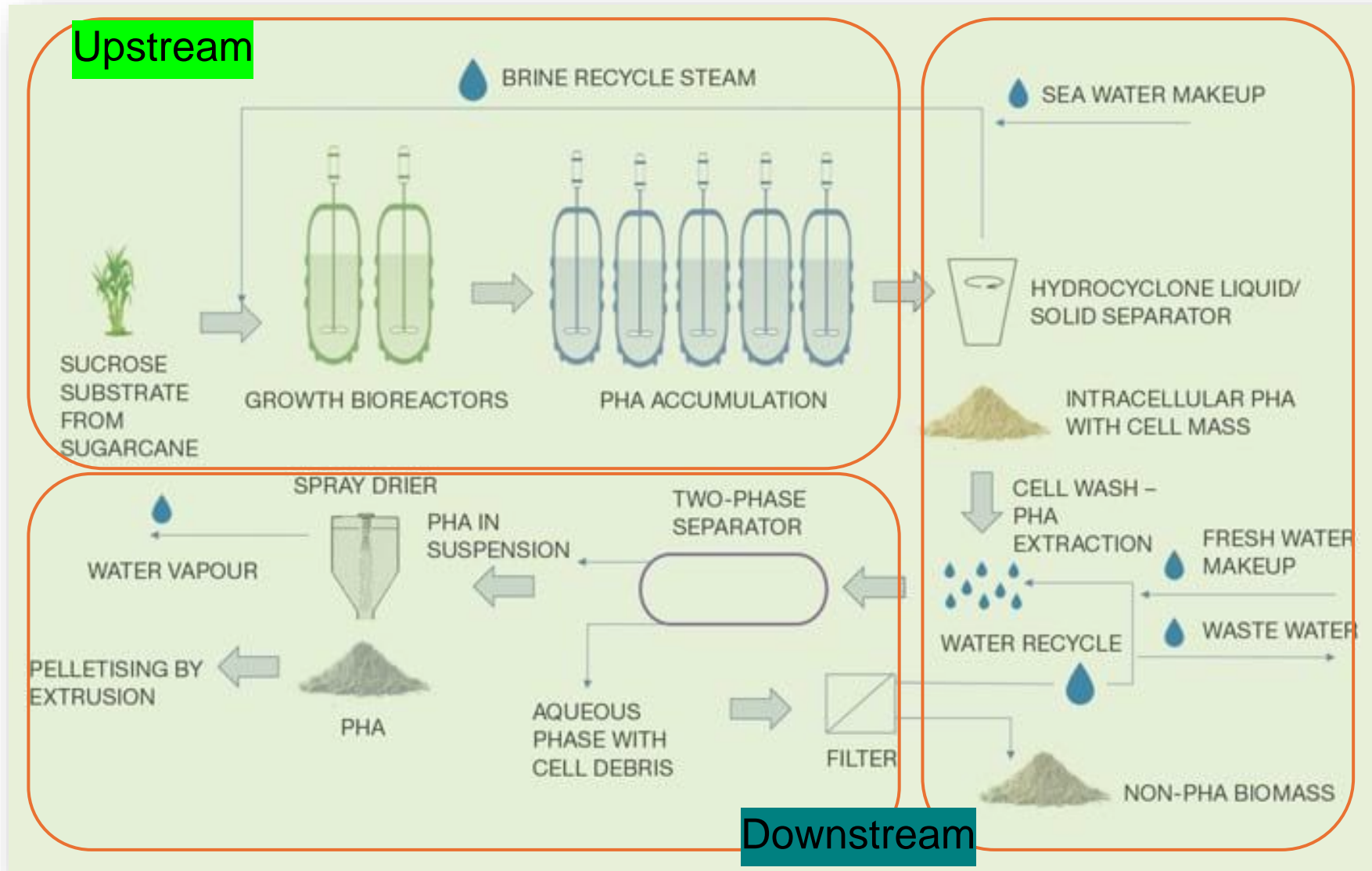
Bio-derived polymers



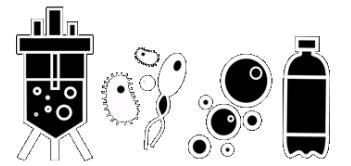
Climbing out the valley of death



Manufacturing Process of PHA



Concept of Design



“Multipurpose pilot plant that uses biomass as a feedstock”

Many different units and processes



Flexible and multipurpose pilot plant

How?

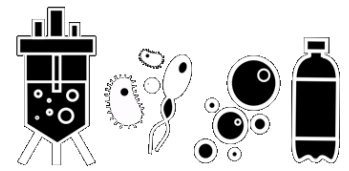
1. Multi-purpose tanks/reactors
2. Mobile shared equipment
3. Flexibles + Distribution panels
4. Prompt CIP/SIP station and mobile equipment



Proposed Commissioning by 2026!



How can EECi serve biopolymer manufacturing?



Central Utility

HVAC, Process chill water, Steam, Hot water, RO water, Thermal Fluid, CIP, Wastewater treatment



**Biomass
Pretreatment**



**Upstream
Fermentation**



**Downstream
Process**



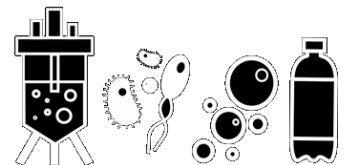
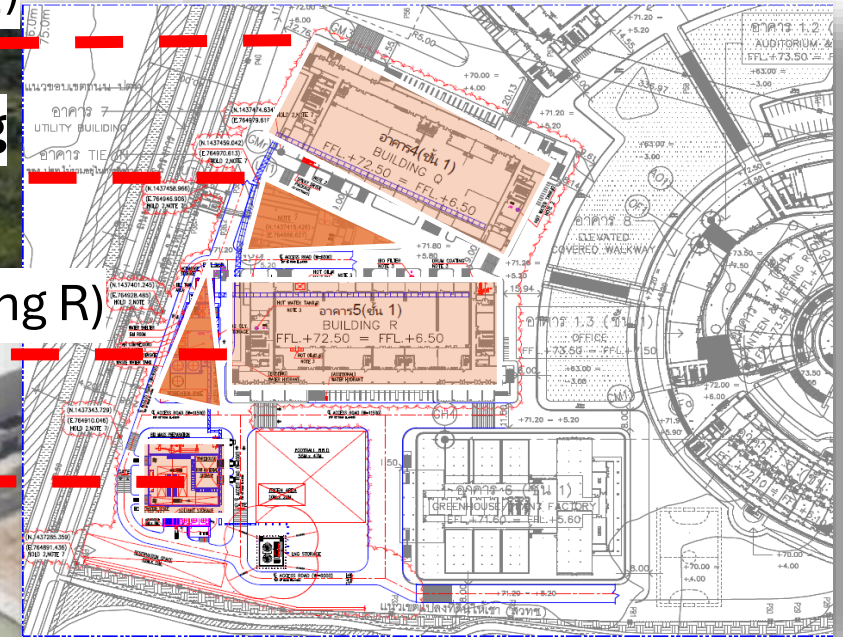
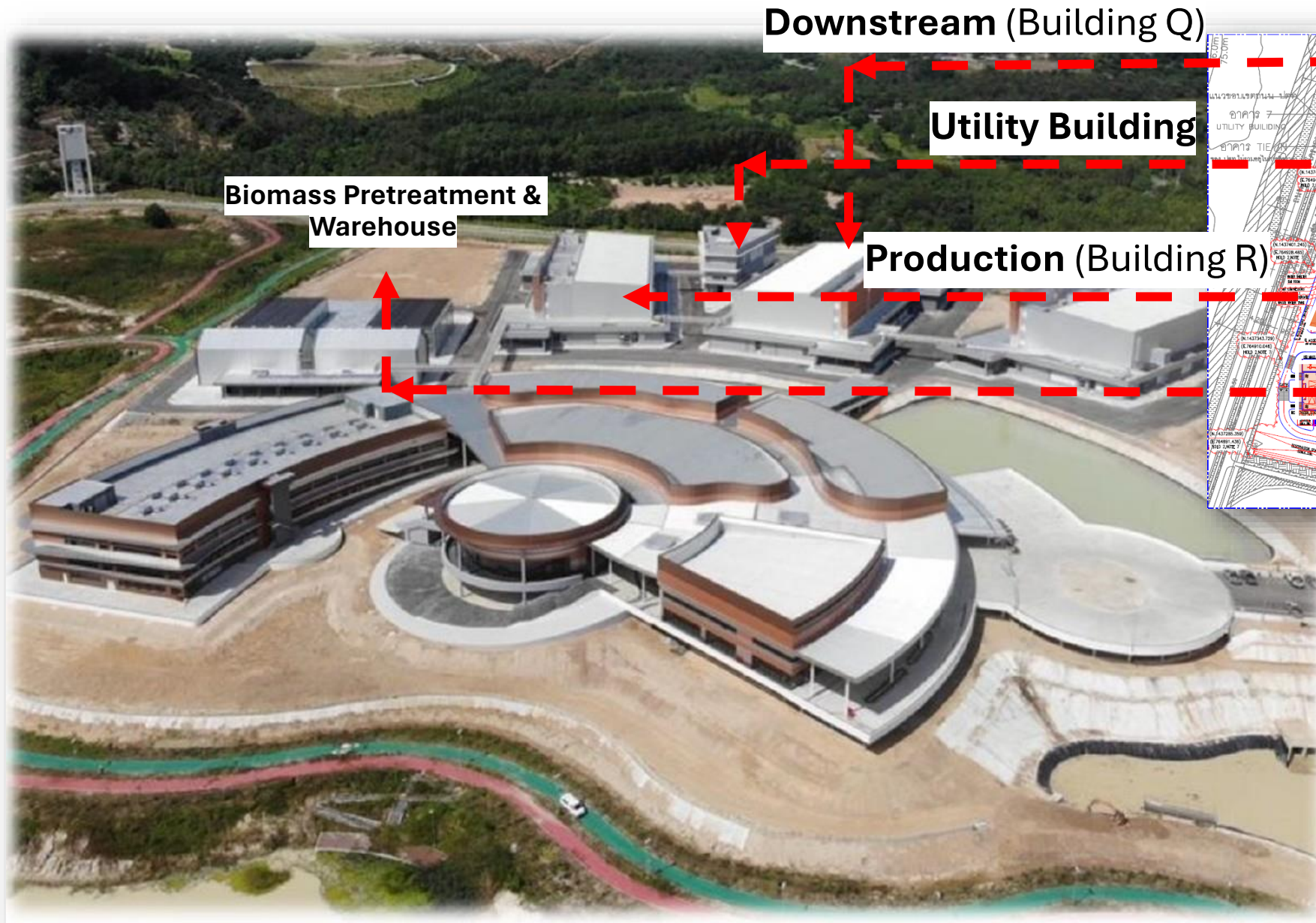
**Green
Chemistry**

- **P**hysical pretreatments.
- **E**nzymatic Hydrolysis.
- **A**cid Hydrolysis
- **I**onic Liquid extraction
- **B**iomass modification

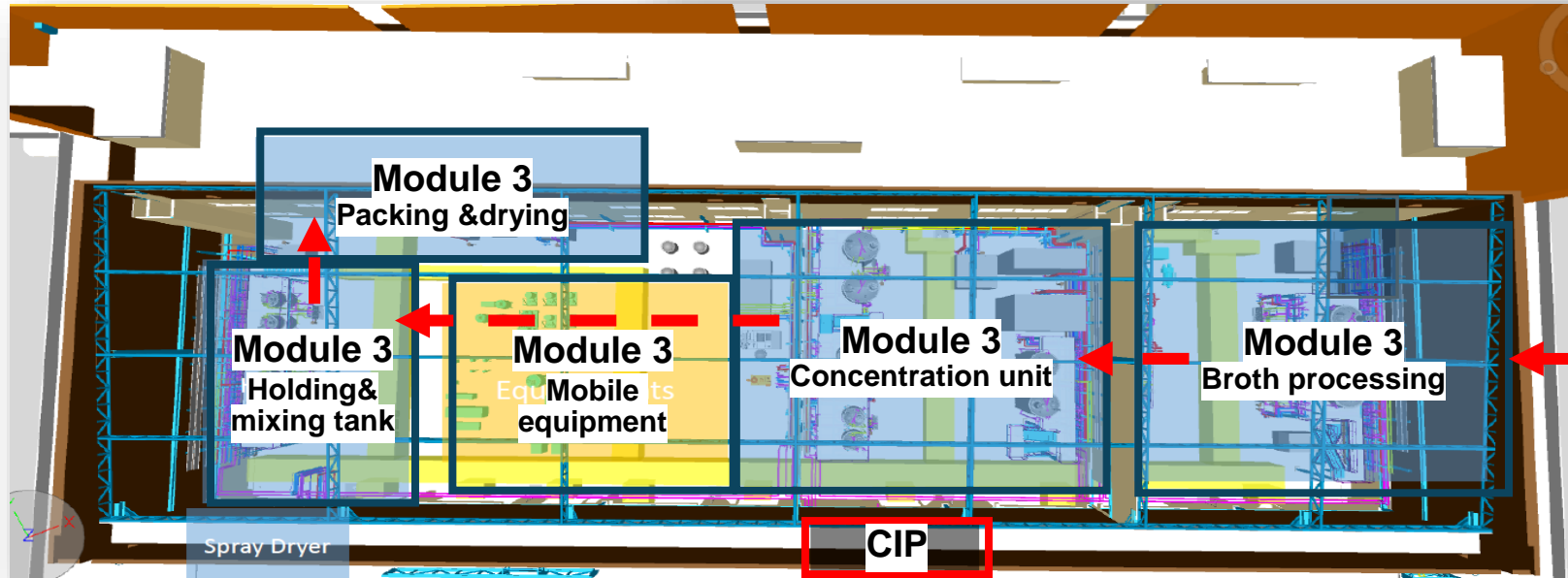
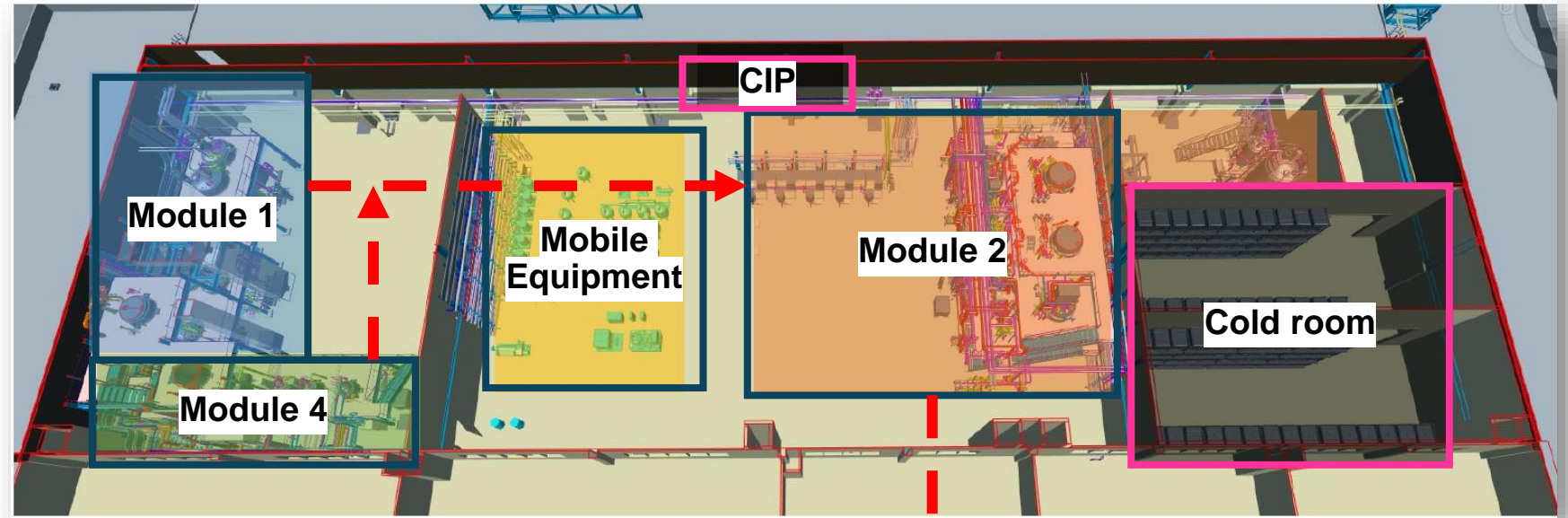
- **U**p to 15,000 L of fermenter.
- **G**MP Coverage for food and supplementary grade products.

- **S**eparation, concentration, and purification by various types of unit operations.

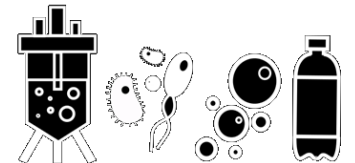
- **N**on biological processes which relevant to biorefinery.
- **E**nvironmental friendly process equipment supported.



Building R; Pretreatment, Fermentation + Green Chemistry



Building Q; Downstream



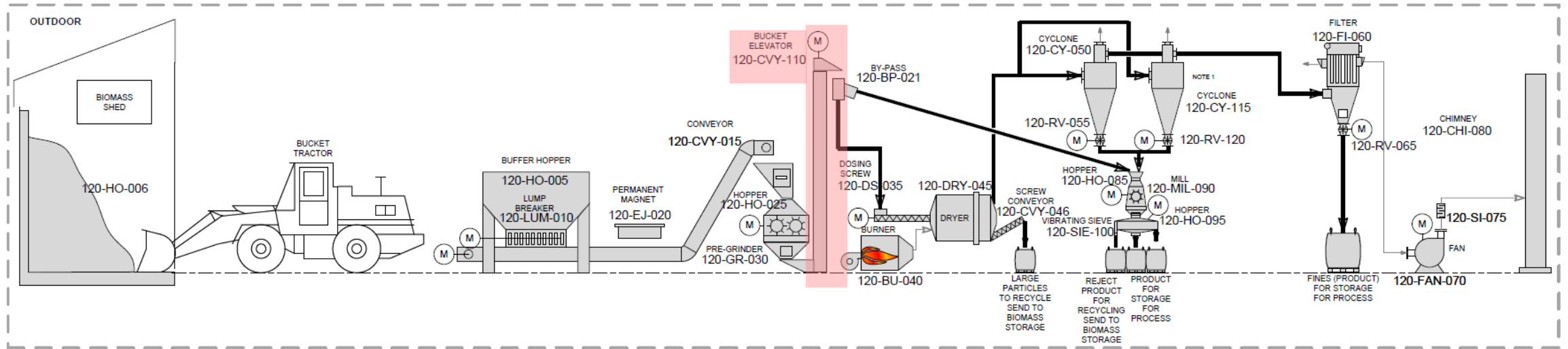
Module 1

Biomass Pretreatment Process

Biomass Pretreatment Process (Module 1)

Process Flow Diagram

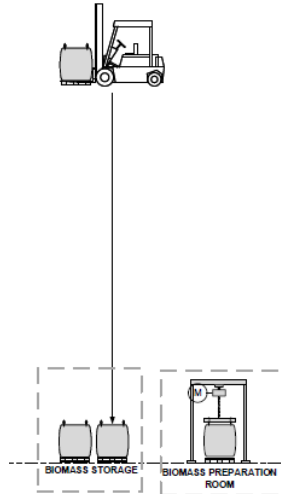
Biomass Grinder and Dryer



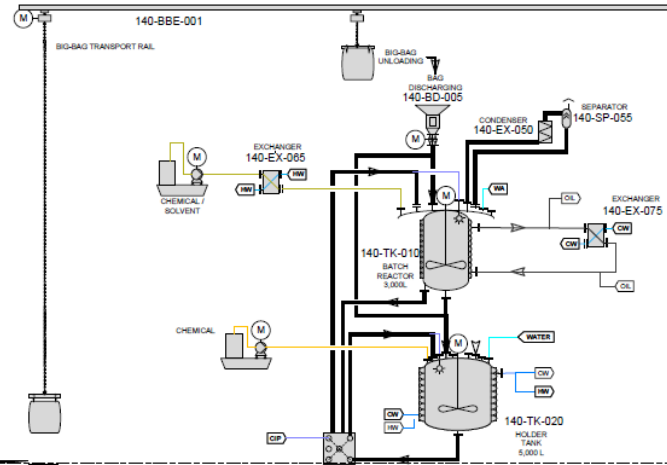
Biomass Pretreatment Process (Module 1)

Process Flow Diagram

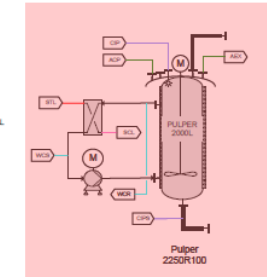
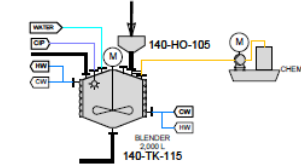
Biomass Preparation



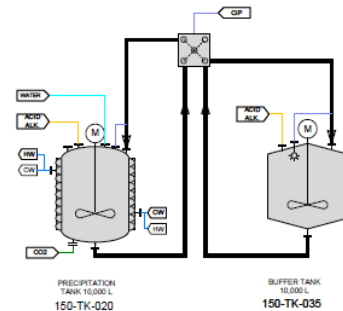
Batch Reactor & Holder Tank



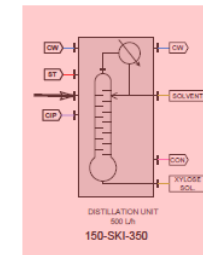
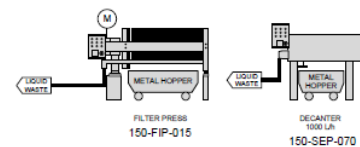
Blender Tank



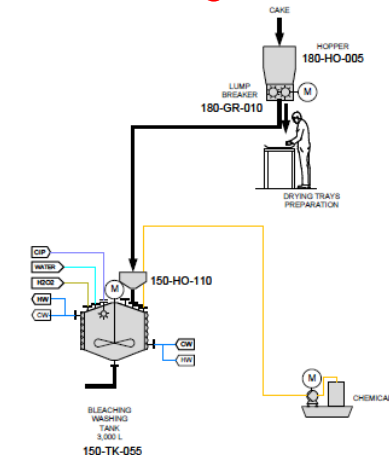
Precipitation & Buffer Tank



Mobile Equipment



Bleaching/Washing Tank



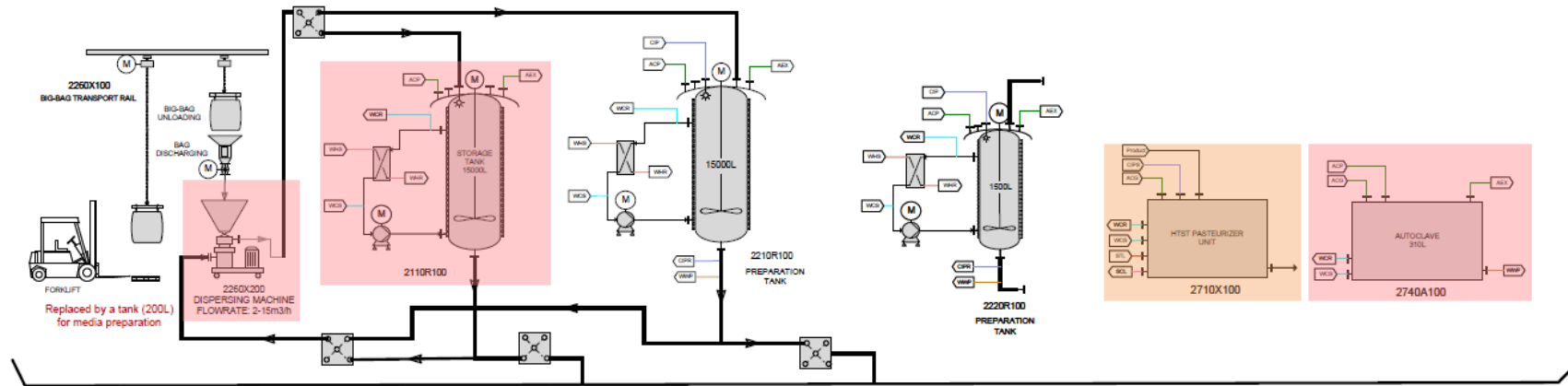
Module 2

Upstream Process

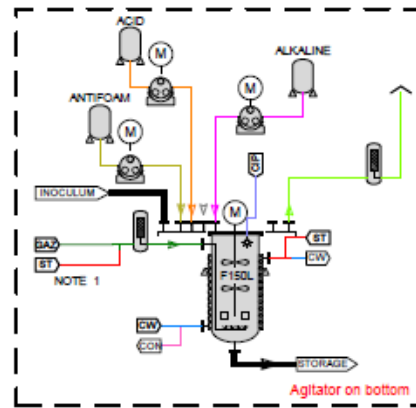
Upstream Process (Module 2)

Process Flow Diagram

Preparation Tank

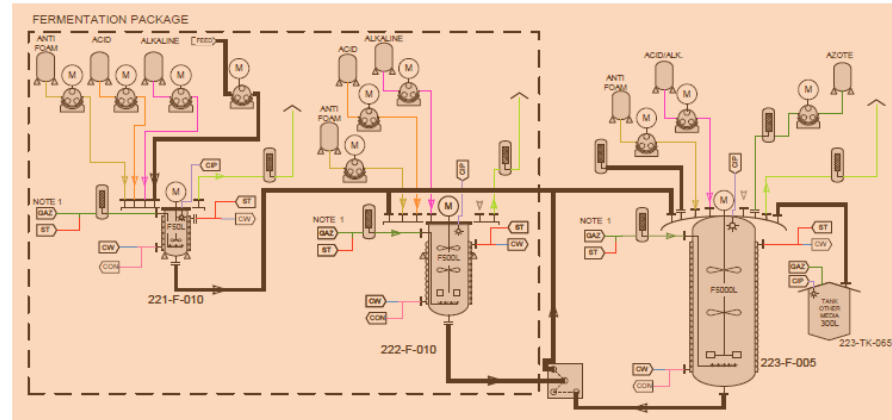


Fermenter 150L



STAND-ALONE
FERMENTERS
226-SKI-005
227-SKI-005
228-SKI-005
2320C100
2360C100
x5

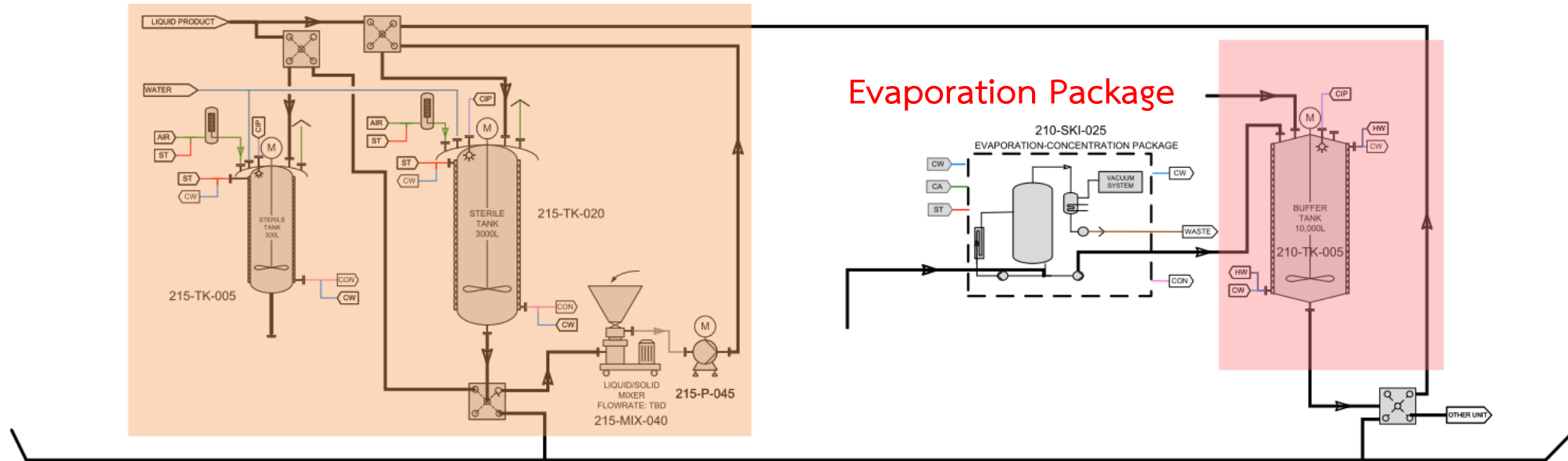
Fermenter 50L & 500L & 5000L



Upstream Process (Module 2)

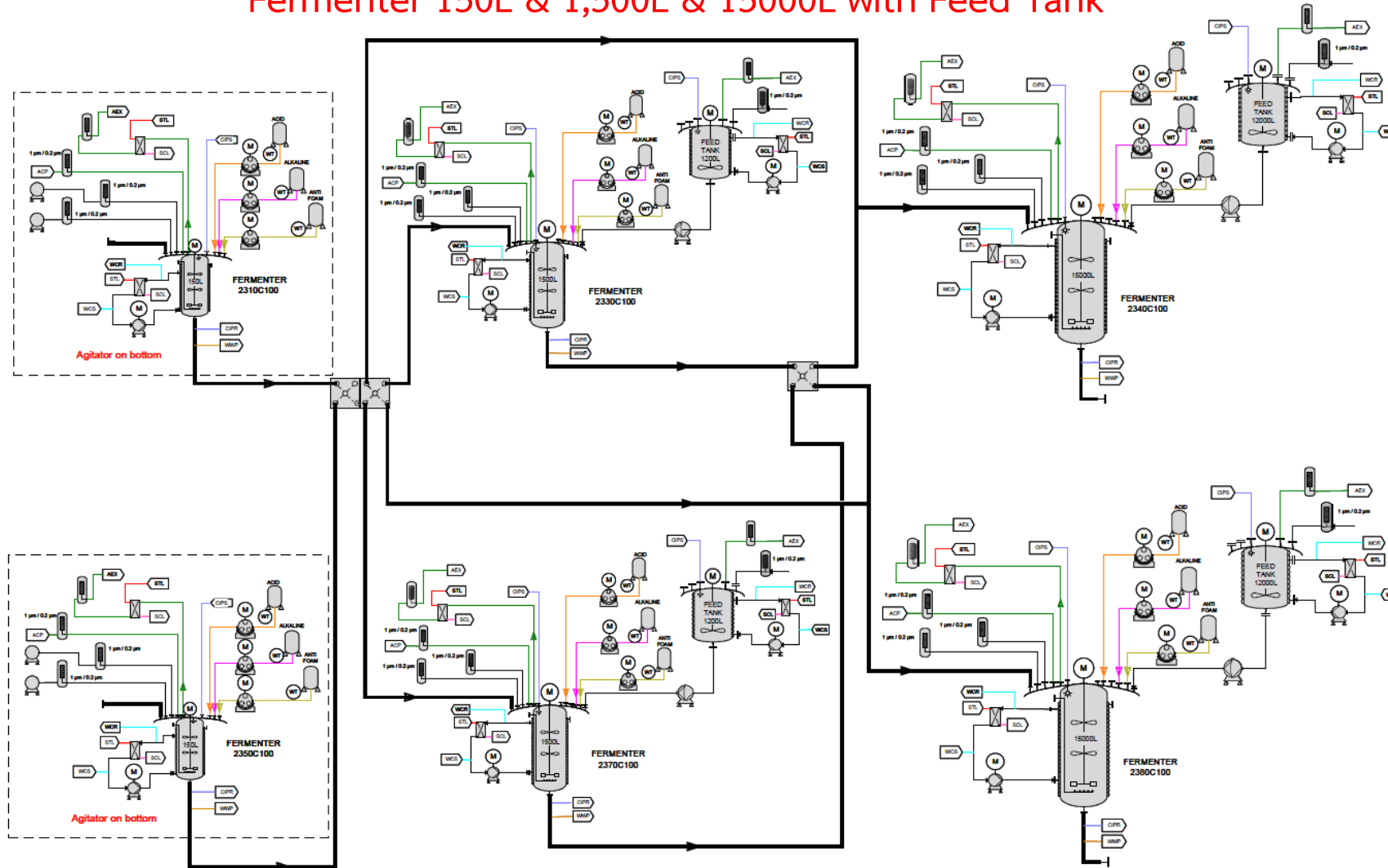
Process Flow Diagram

Sterile / Buffer Tank & Liquid solid mixer



Process Flow Diagram

Fermenter 150L & 1,500L & 15000L with Feed Tank



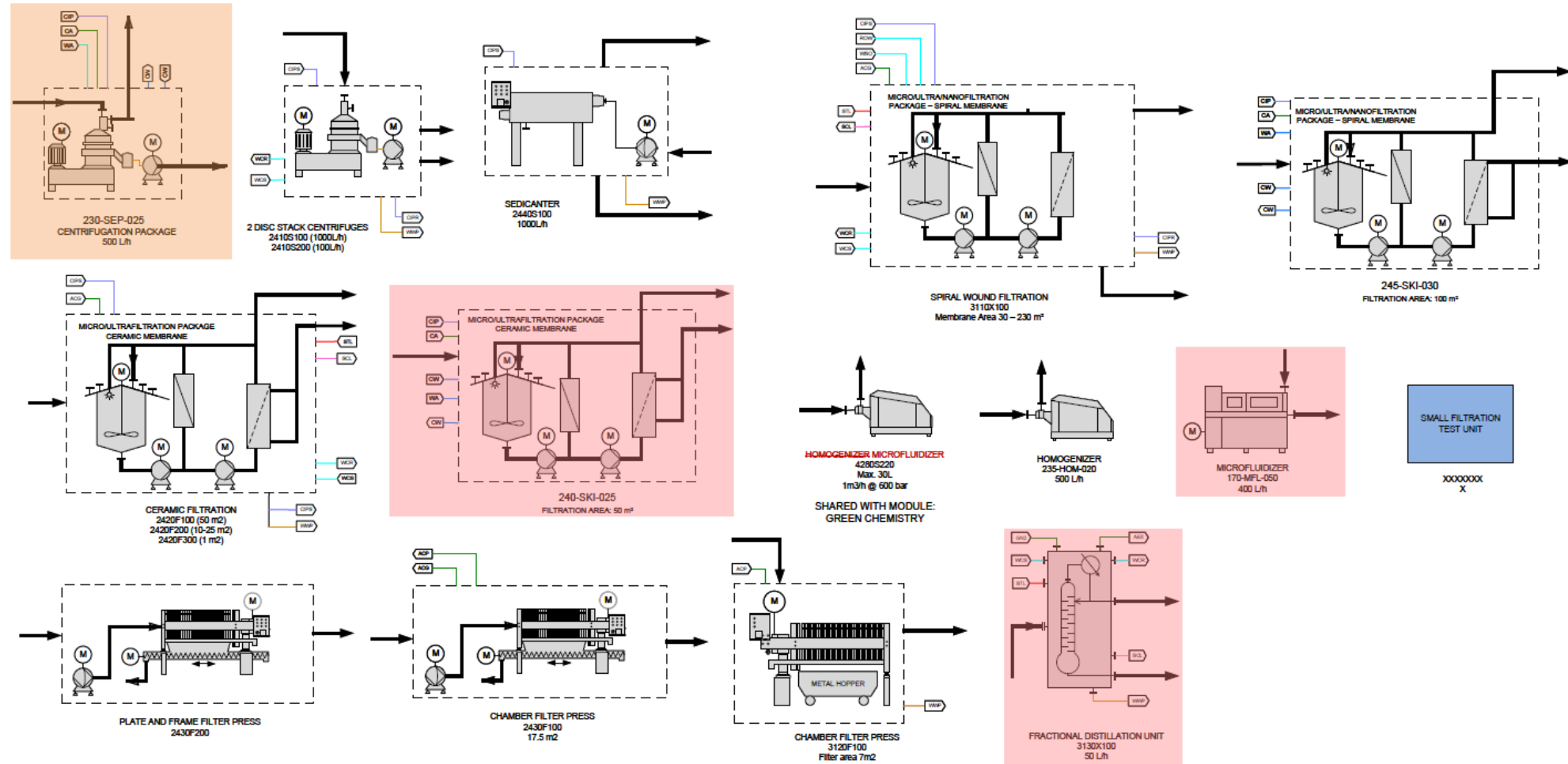
Module 3

Downstream Process

Downstream Process (Module 3)

Process Flow Diagram

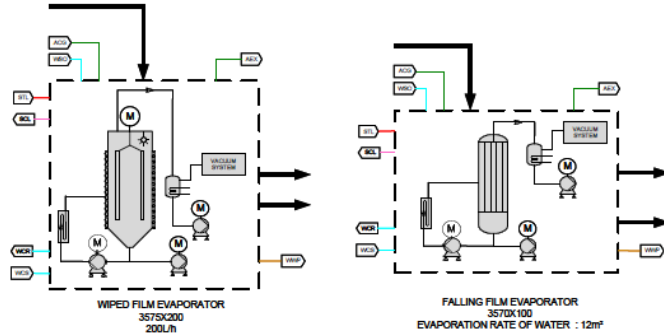
Downstream Process for Clarification & Concentration



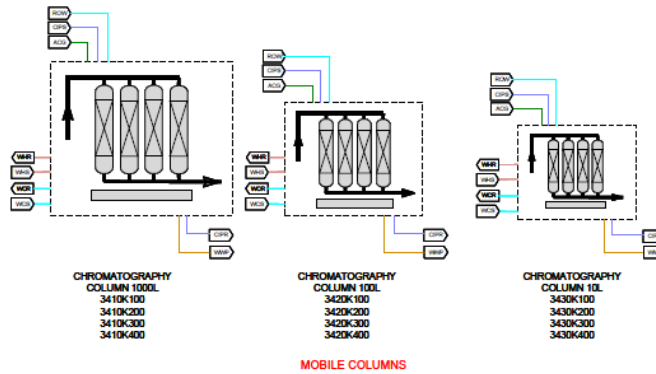
Downstream Process (Module 3)

Process Flow Diagram

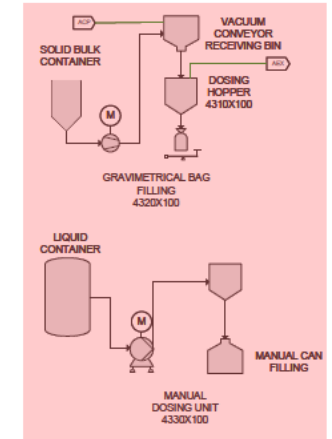
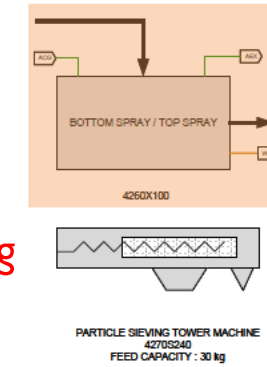
Evaporation



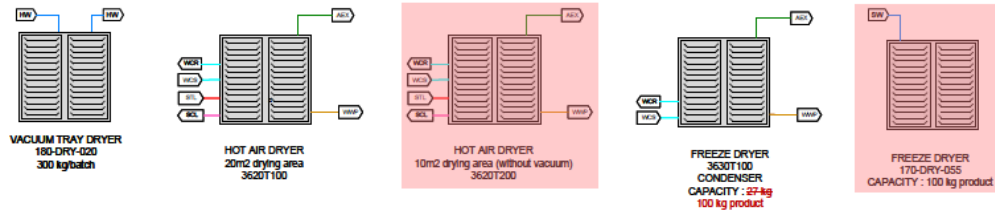
Purification



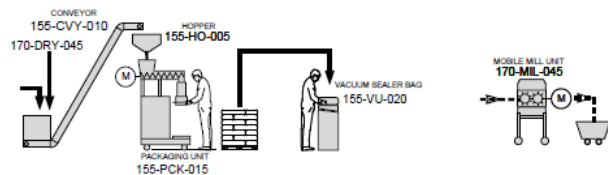
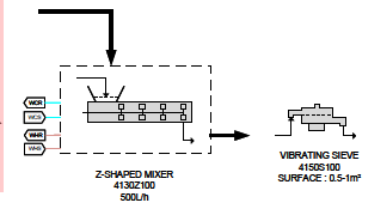
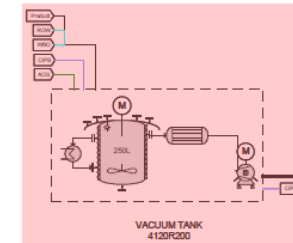
Filling



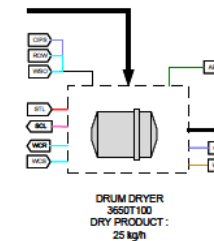
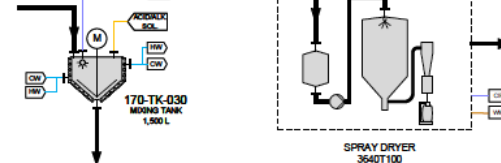
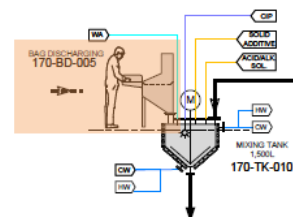
Drying



Formulation



SHARED WITH MODULE:
GREEN CHEMISTRY



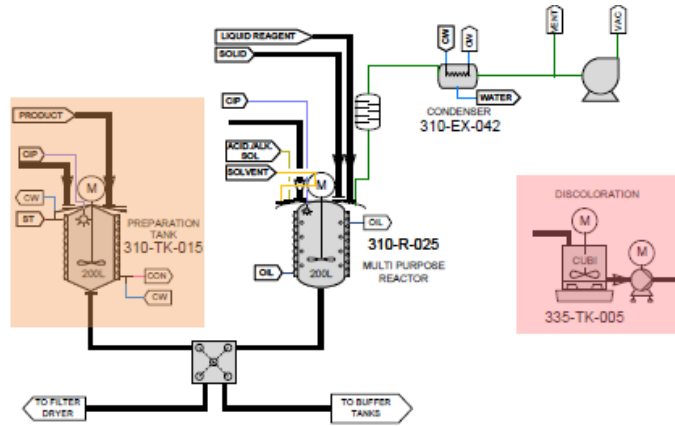
Module 4

Green Chemistry Process

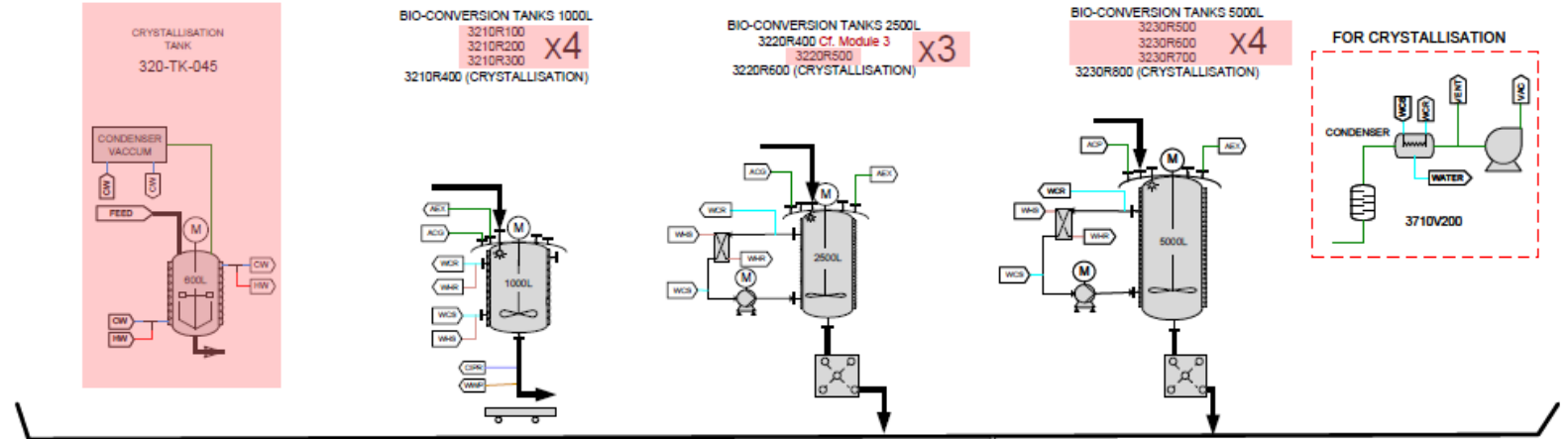
Green Chemistry Process (Module 4)

Process Flow Diagram

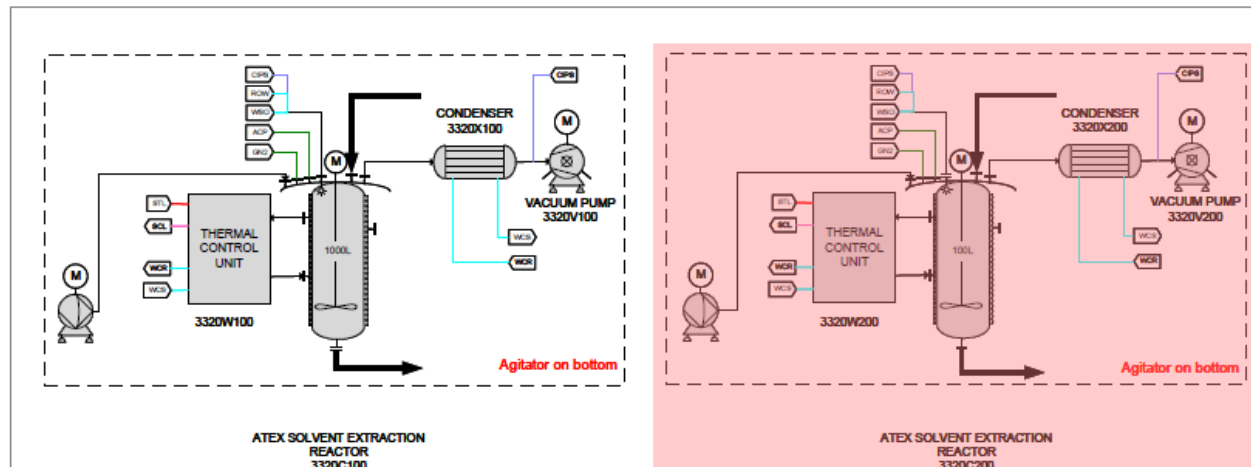
Fine Chemical



Processing Tank



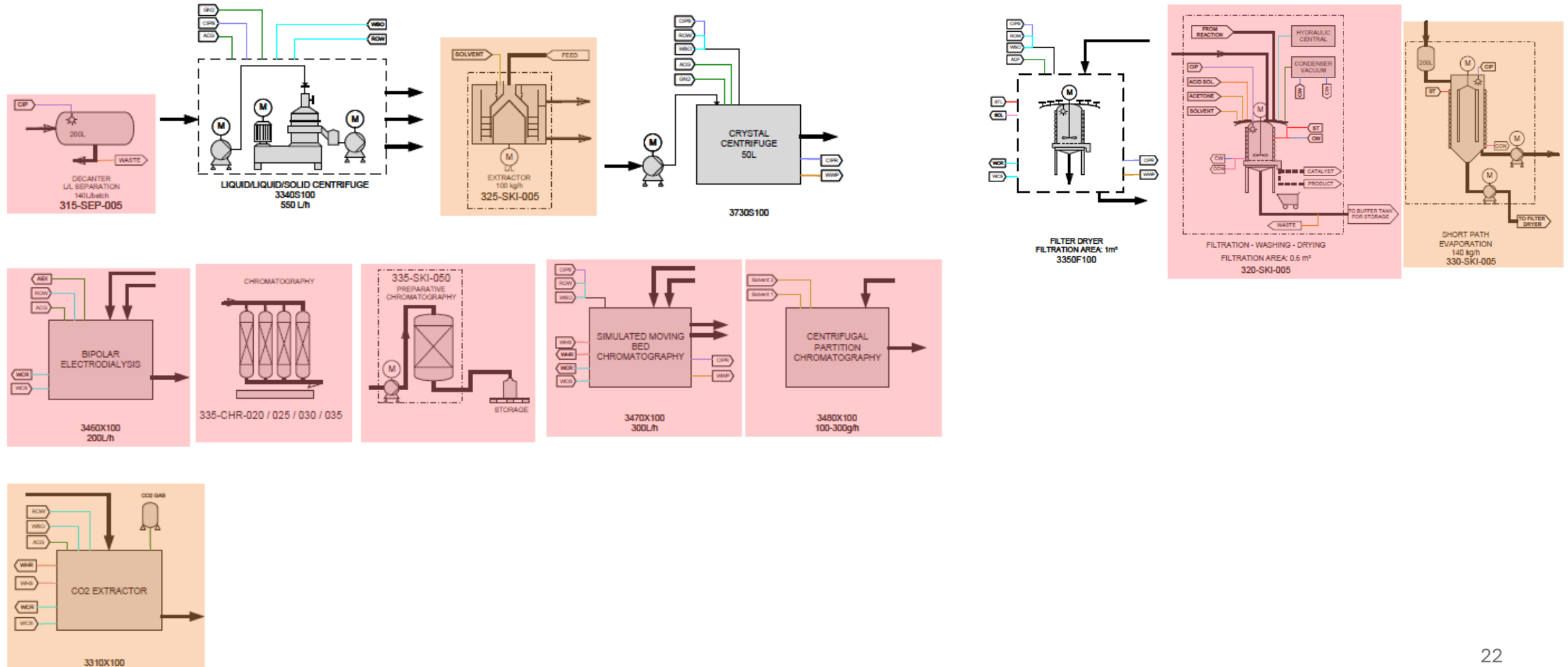
ATEX Solvent Extraction Tank



Green Chemistry Process (Module 4)

Process Flow Diagram

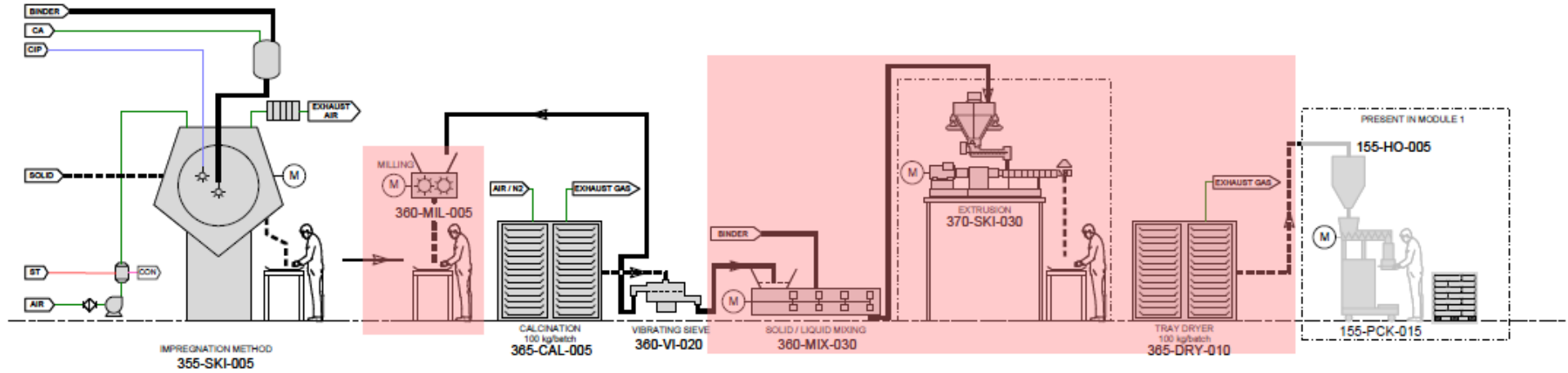
Separation / Extraction / Purification



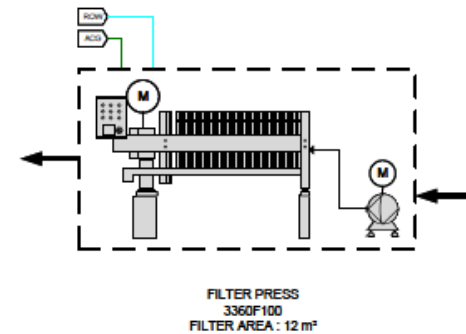
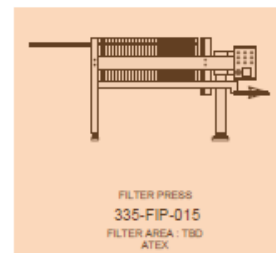
Green Chemistry Process (Module 4)

Process Flow Diagram

Catalyst Processing



Filtration



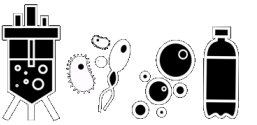
Other Equipment

Other Equipment

Transfer Panel and Accessories

- Transfer Panel 5 Units
- Process Flexibles Hose (3A Ferrule with Tri-Clamp & FDA Gasket)
- Extra Process Connection Pieces (3A Ferrule)
- Utilities Flexibles Hose
- Extra Utility Connection Pieces
- Operation / Commissioning Extra Adaptor
- Portable Type Ultrasonic Flow Meter (Clamp - on Detector and Transmitter)
- Infrared Thermometer (Temperature Gun)
- Portable Pressure Gauge
- Mobile Stainless-Steel Rack
- Stainless Steel Cupboard with Shelves
- Stainless Steel Storage Box for Extra Connection
- Flexible Hose for Solvent

Our team



TEAM MANAGEMENT



Dr Wut



Dr Sasawat



Dr Pitichon

Researcher



Dr Doungporn

Engineer



K'Rattanawan

Engineer



Dr Thammavit

Engineer



K'Komson

Engineer



K'Norabadee

Engineer



K'Chanin

Engineer



K'Natchapat

Assistant Researcher



K'Suriyaporn

Business Developer



K'Chiratchaya

Procurement



K'Passorn