

PROCESS DEVELOPMENT METHODOLOGY

Isolation 2,3-BD generated from syngas fermentation. Projection at industrial scale

SYNPOL's Course on "Biopolymers from bacterial fermentation of syngas"

Auditorio del Centro de Investigaciones Biológicas (CIB-CSIC)

Madrid, 9 September 2016



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1. BIONET
2. Process development methodology for “Isolation 2,3-BD generated from syngas fermentation. Projection at industrial scale”.
3. Conclusions



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BIONET is an independent SMEs. We are specialists in bioprocesses engineering, founded in 1999. Located in Murcia, in SE of Spain.



a) Bioprocess Equipment

- Bioreactors/fermentors
- Membrane filtration systems
- Cleaning-in-place systems
- Ancillary vessels (harvest, media preparation, extraction..)
- Process automation

b) Services

- Process development
- Process engineering
- Turnkey of process lines
- Training
- Maintenance and troubleshooting

Series F Bioreactors and Fermentors



Series M Membrane Filtration Systems



Series C Cleaning In Place Systems



- From pilot to industrial scale
- For microbiology and cell culture
- Available in Food/Industrial grade (A) and cGMP (P)



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1a. Process development

The **objective** of BIONET process development services is:

- Define feasible processes
- Reduce risks in the scale-up
- Reduce “time-to-market”
- Ensure the viability of new developments.



Resources:

- Dedicated process department.
- Pilot plant with fermentors, bioreactors, downstream equipment to work from 2 L to 200 L.
- Network of scientific and technological partners.



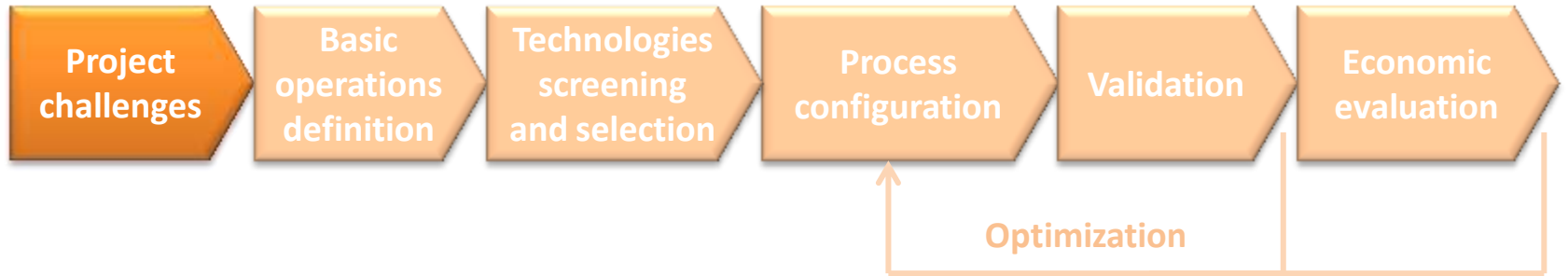
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2. Process development methodology



Project challenges

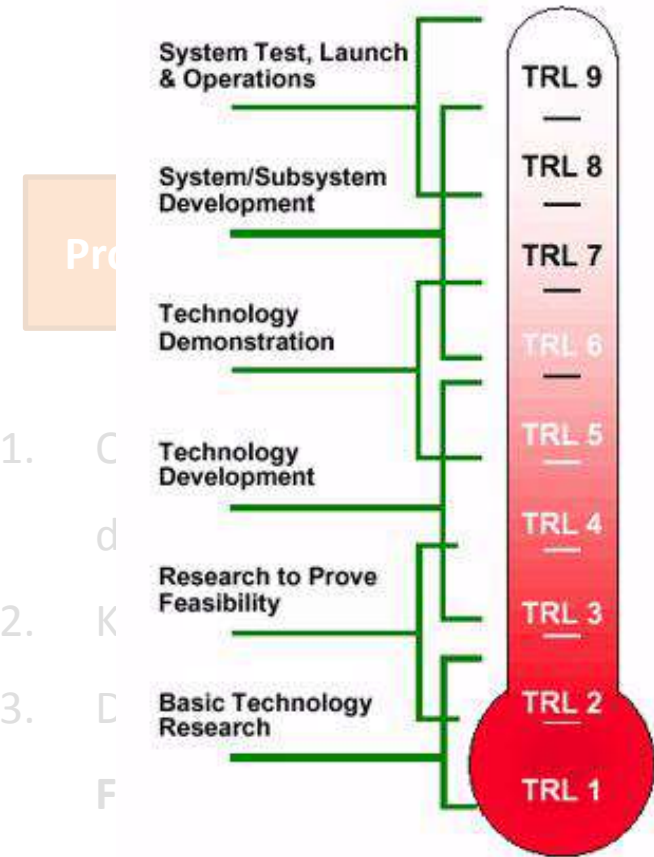
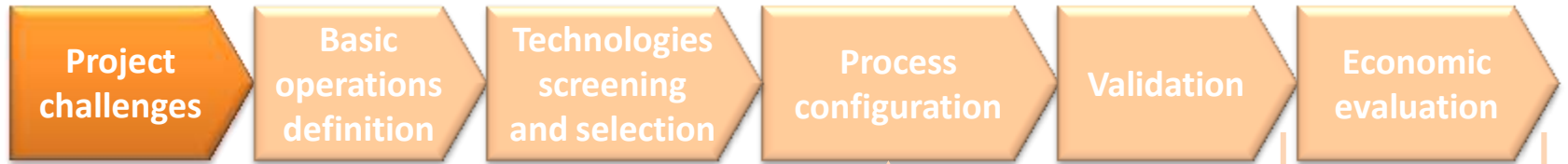
Objective: **2,3-BD isolation from fermentation broth**

Main KPI: **% 2,3-BD recovery**

1. Operating conditions and limitations definition: **not defined**
2. Design bases definition: **120 h, FB composition**
3. KPIs definition: primary and secondary

Primary KPIs	Secondary KPIs
Operating costs	2,3-BD purity
Investment costs	Water consumption
TRL	Energy consumption
%2,3-BD recovery	Specific operations vs widely applied

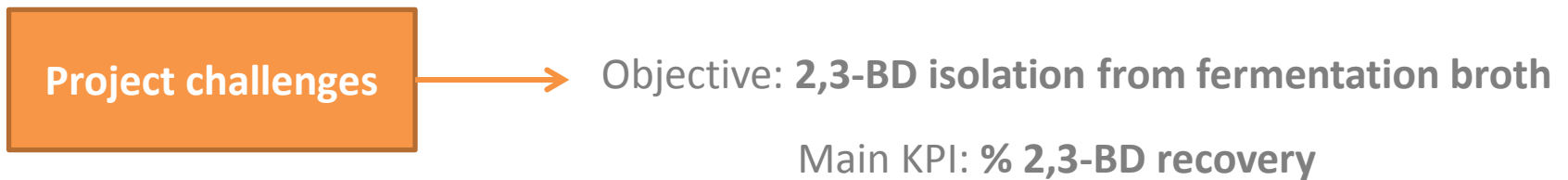
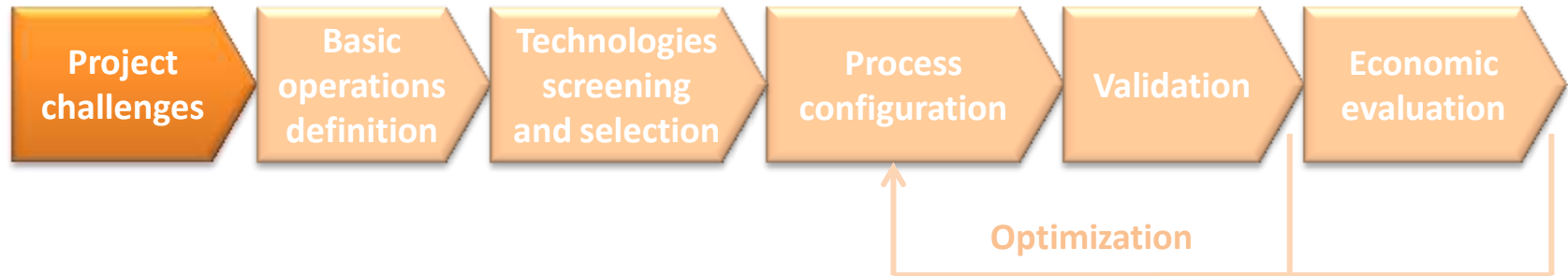
2. Process development methodology



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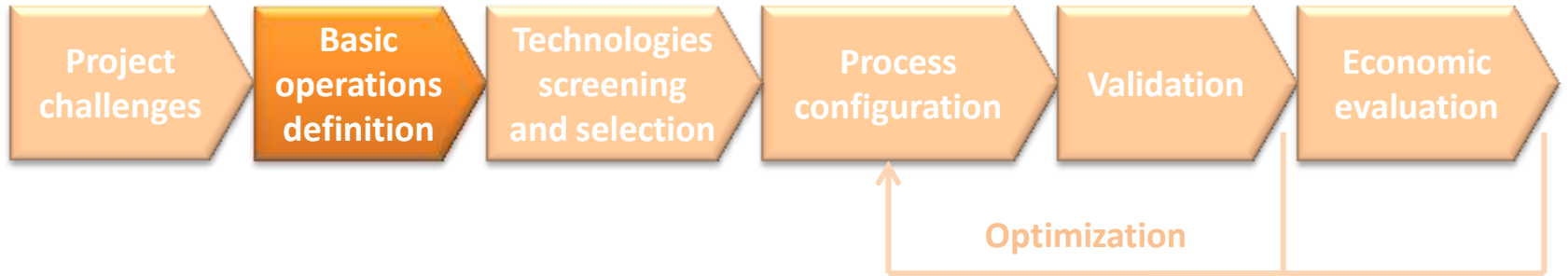


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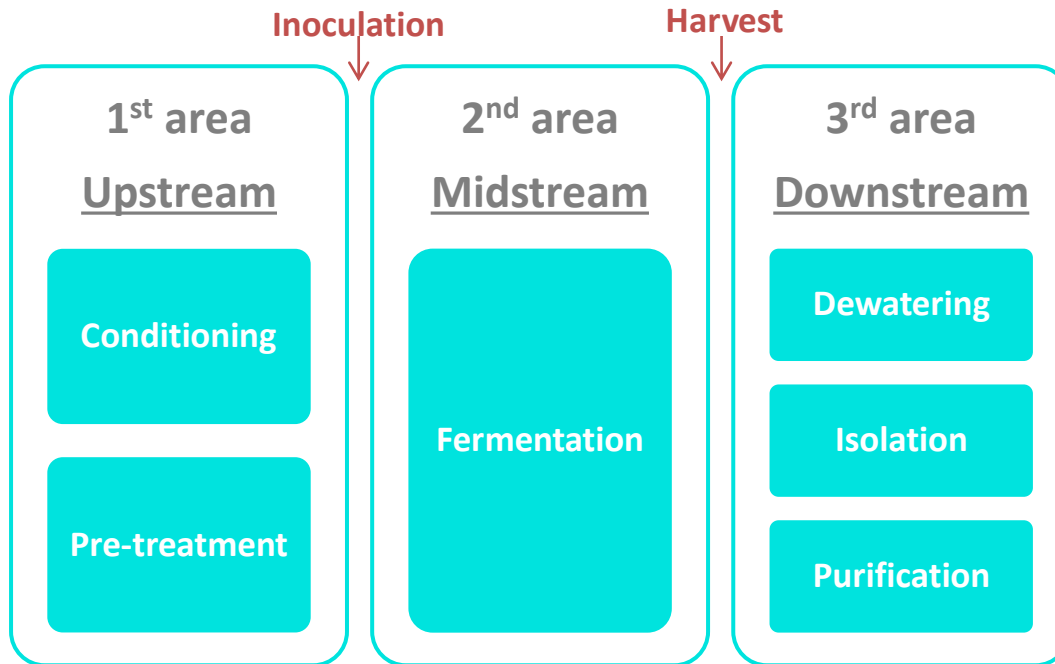
Primary KPIs	Secondary KPIs
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2. Process development methodology

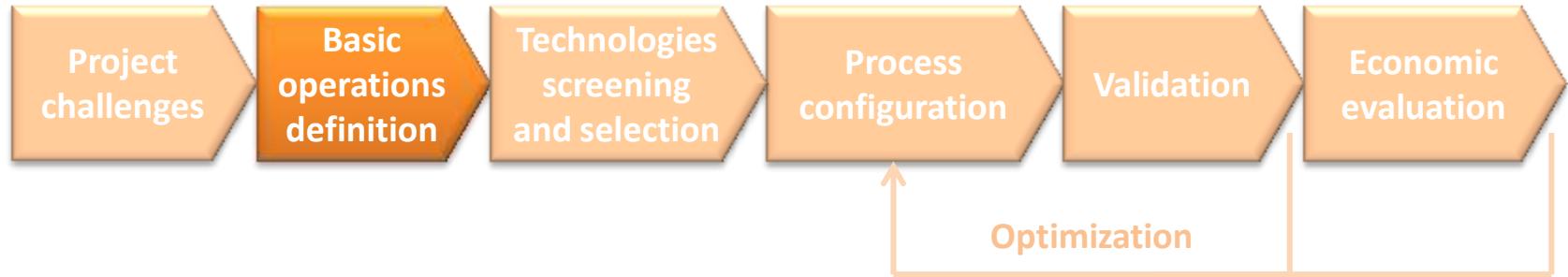


BASIC OPERATIONS DEFINITION

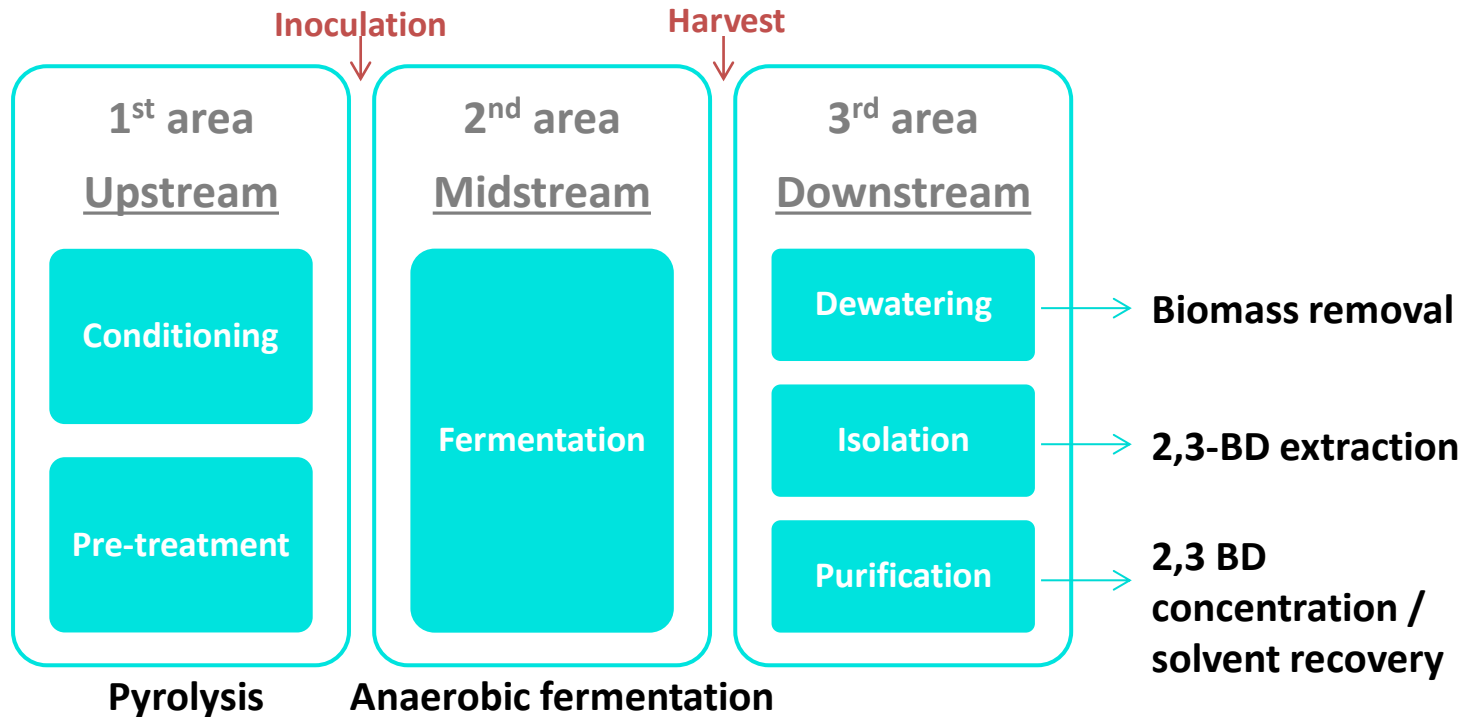


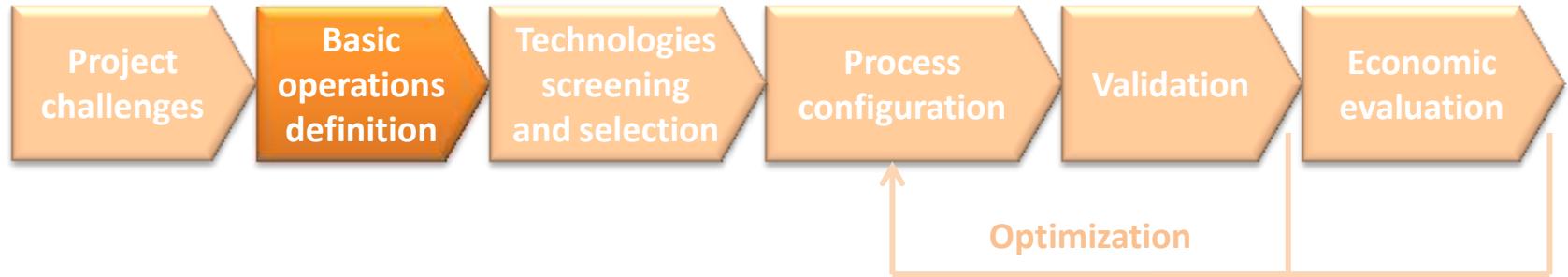


2. Process development methodology

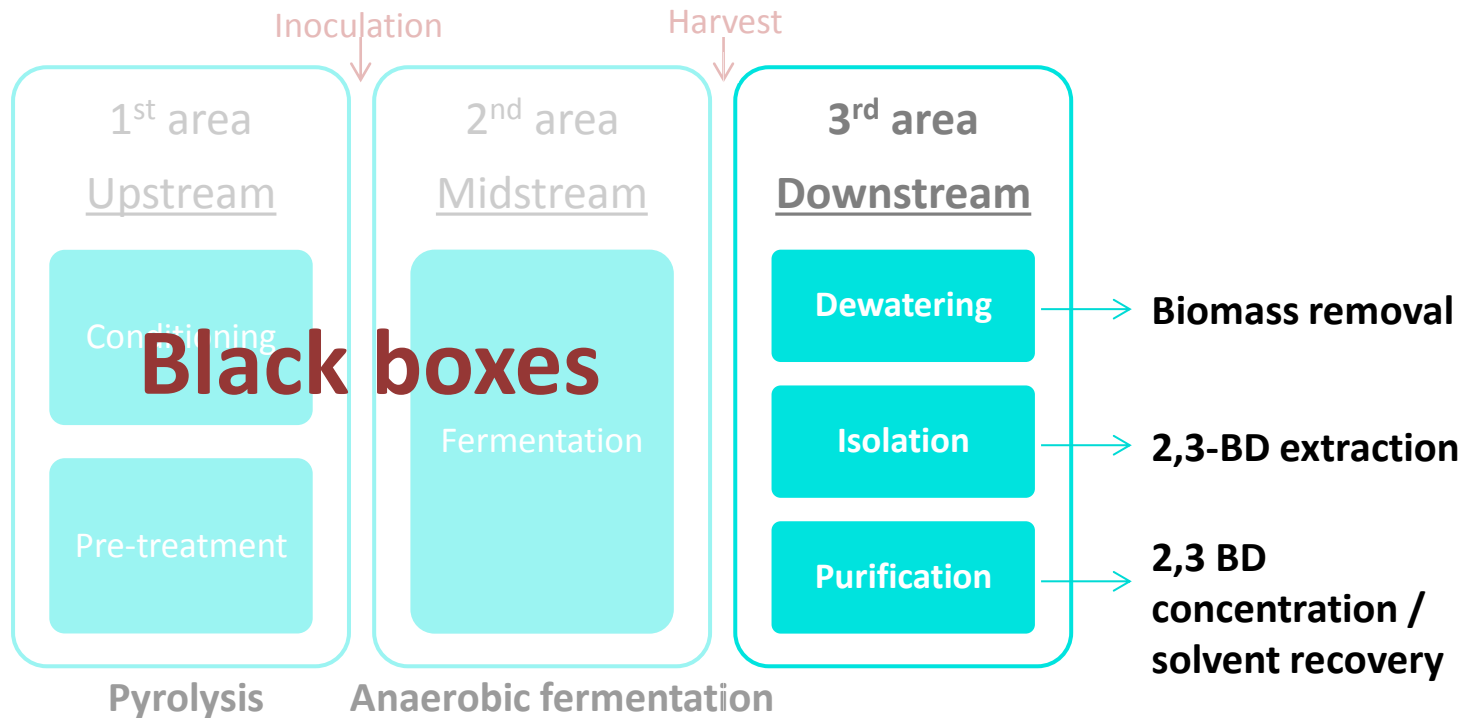


BASIC OPERATIONS DEFINITION



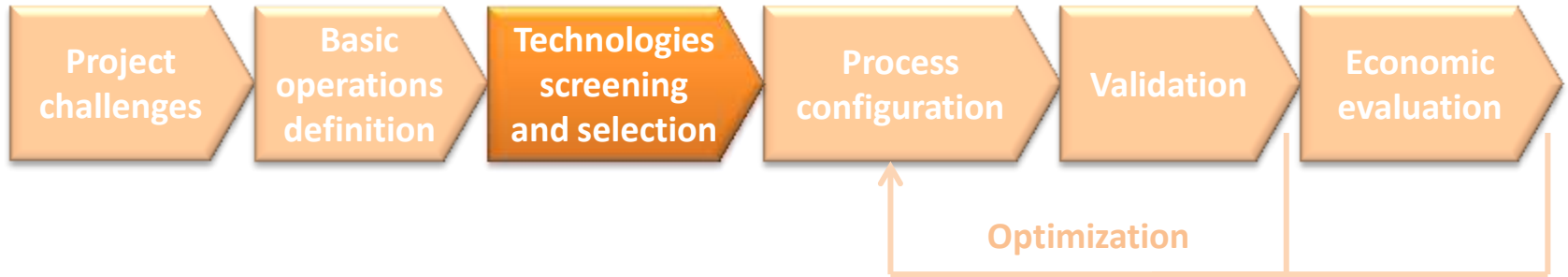


BASIC OPERATIONS DEFINITION

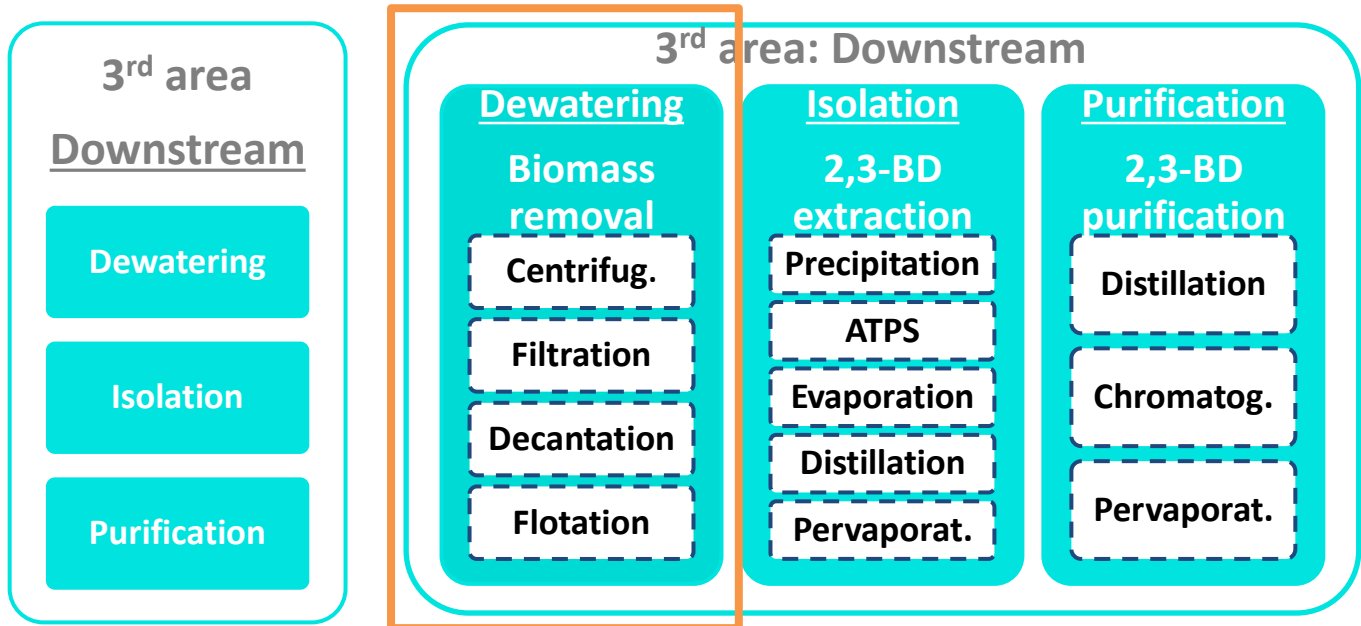




2. Process development methodology



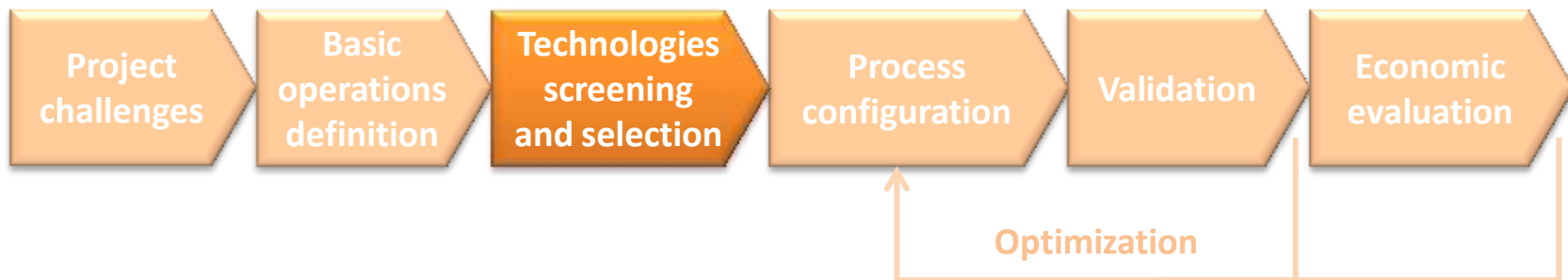
TECHNOLOGIES SCREENING AND SELECTION



Screening →

- ✓ Literature research
- ✓ Vendor consult.
- ✓ Patents search
- ✓ Training courses
- ✓ Visit existing plants
- ✓ BIONET background

2. Process development methodology



TECHNOLOGIES SCREENING AND SELECTION

Dewatering
Biomass removal

- Centrifugation
- Filtration
- Decantation
- Flotation

	Centrif.	Filtrat.	Decant.	Flotation
TRL	+++	+++	+++	+++
Oper. cost	--	---	-	--
Invest. cost	--	---	--	--
2,3-BD % recovery	+++	++	---	---
2,3-BD purity	+++	++	---	---
Energy consumption	-	---	-	-
Water consumption	0	-	0	0
Special requirements vs widely applied	Widely applied	Widely applied	Widely applied	Widely applied

KPIs ranking

Primary

1. %2,3-BD recovery
2. Operating costs
3. Investment costs
4. TRL

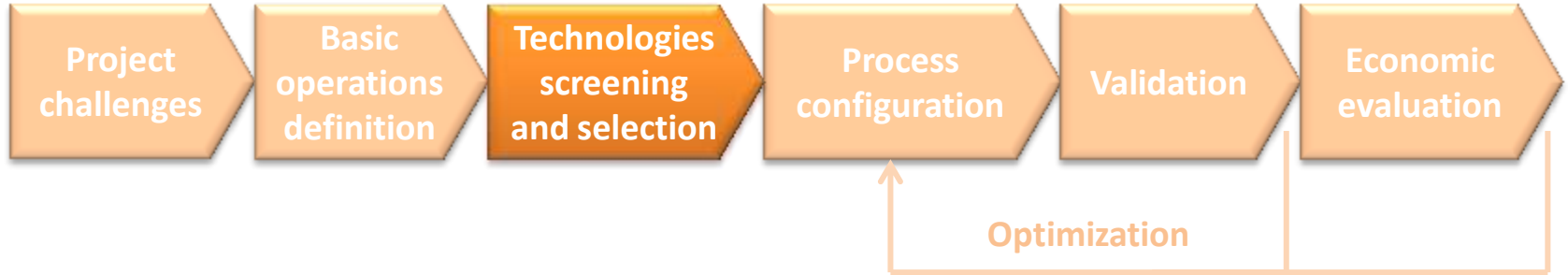
Secondary

1. 2,3-BD purity
2. Energy consumption
3. Water consumption
4. Special requirements

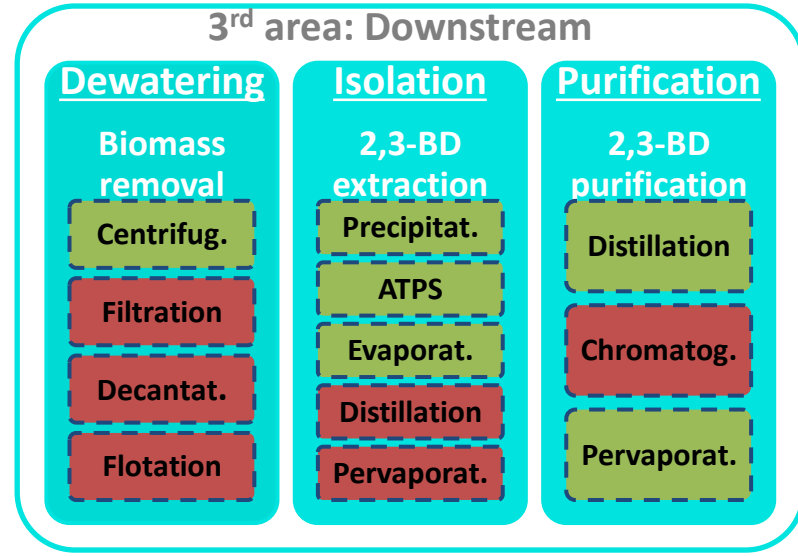
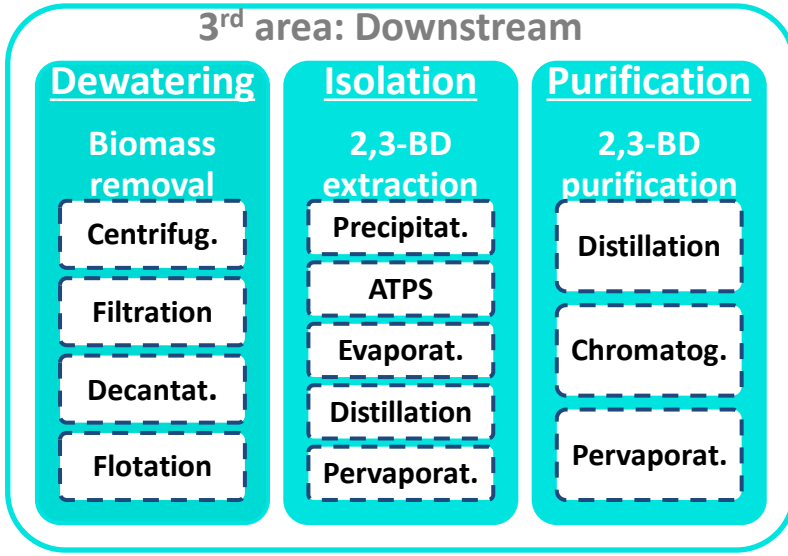
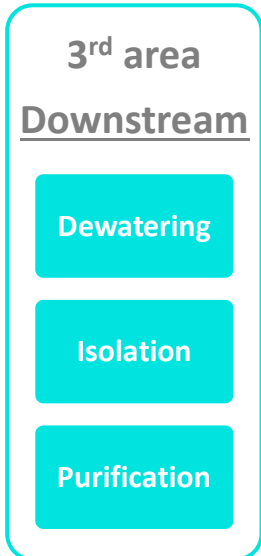
Technologies matrix



2. Process development methodology



TECHNOLOGIES SCREENING AND SELECTION

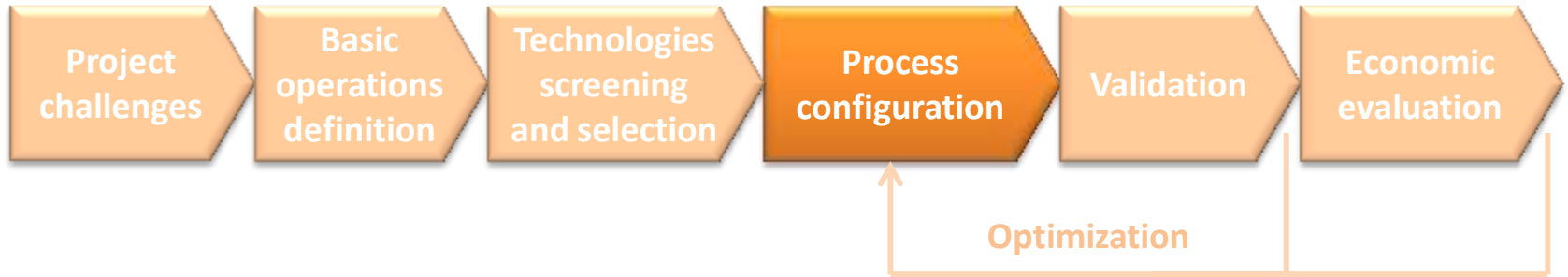


Screening →

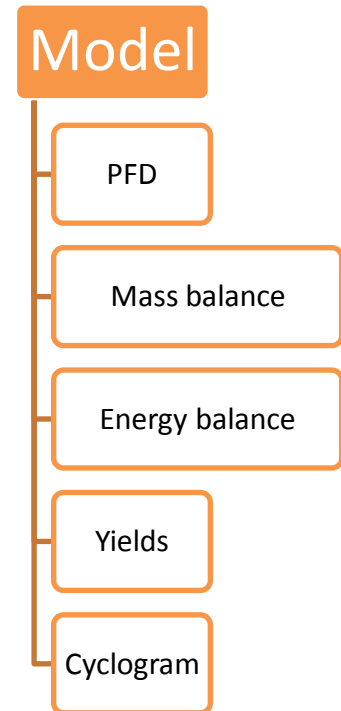
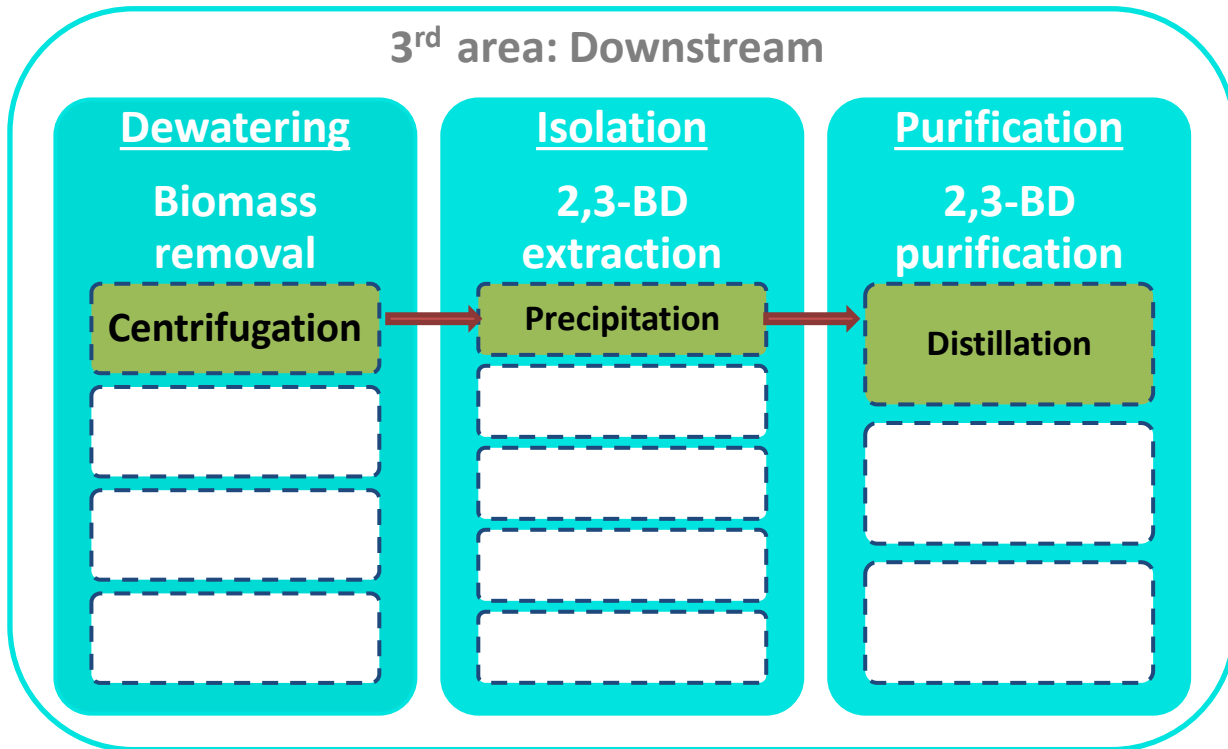
Selection →



2. Process development methodology

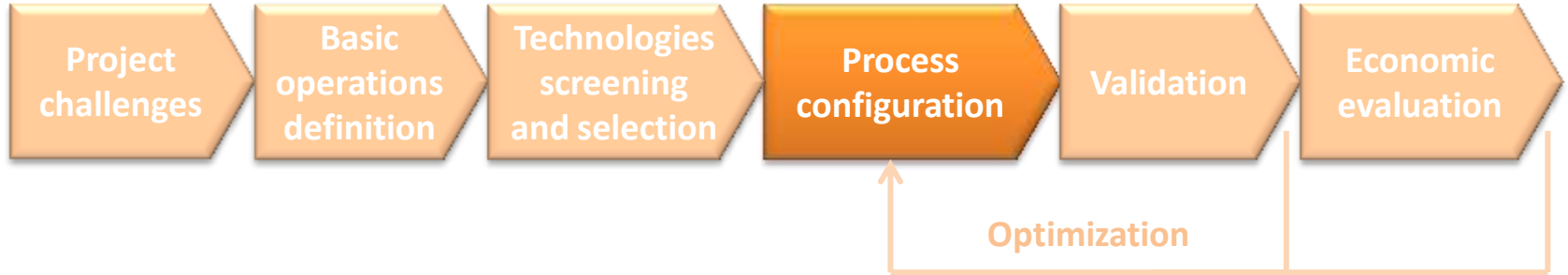


INDUSTRIAL PROCESS MODEL CONFIGURATION

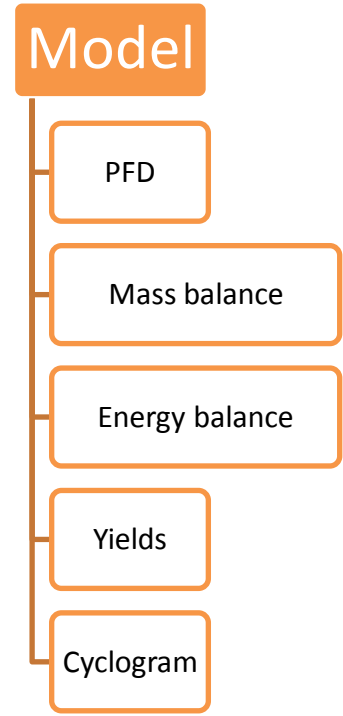
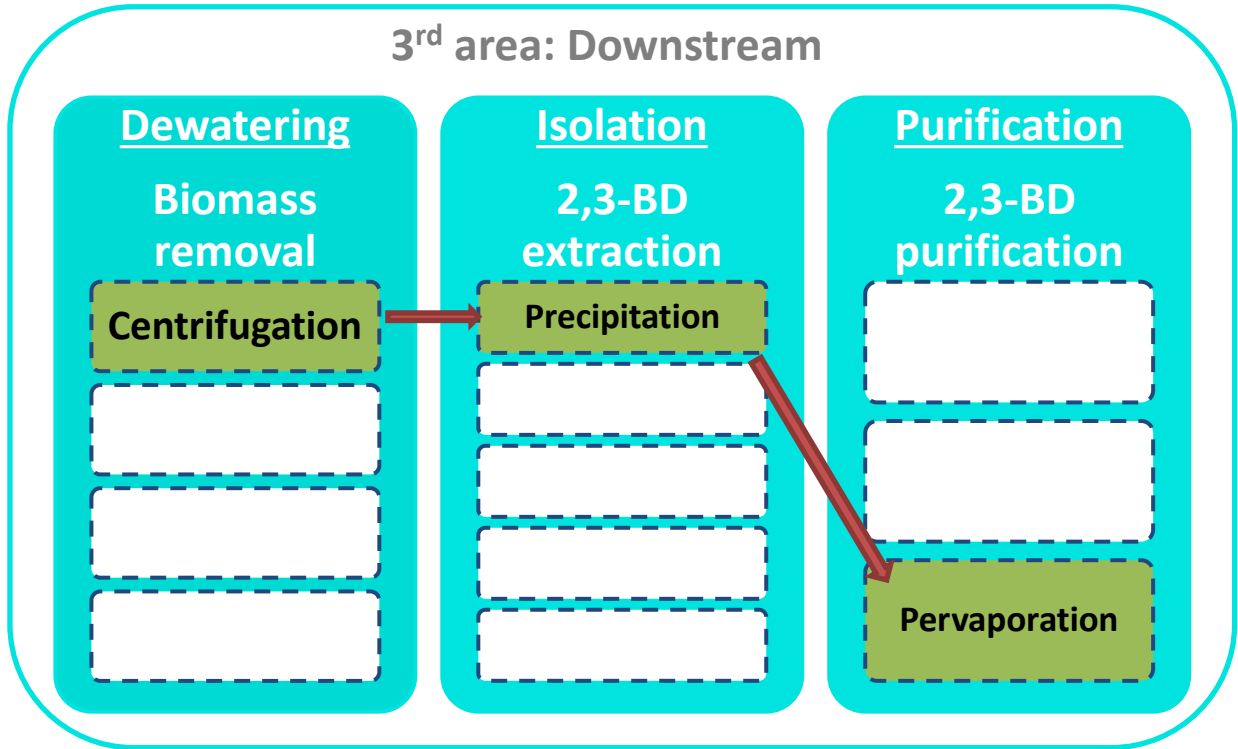




2. Process development methodology

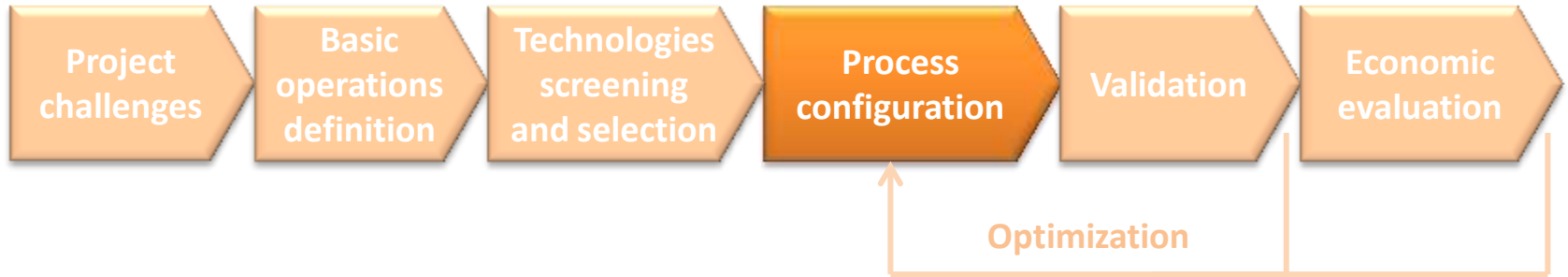


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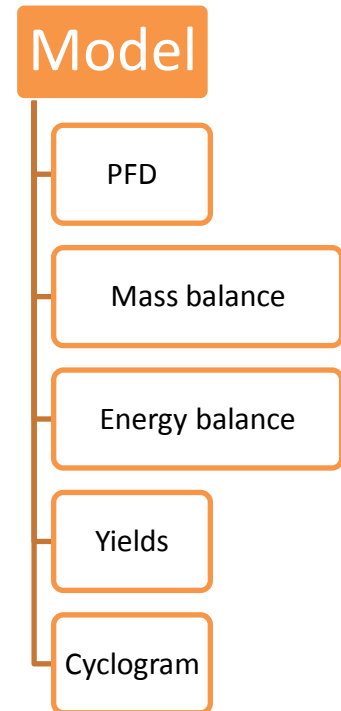
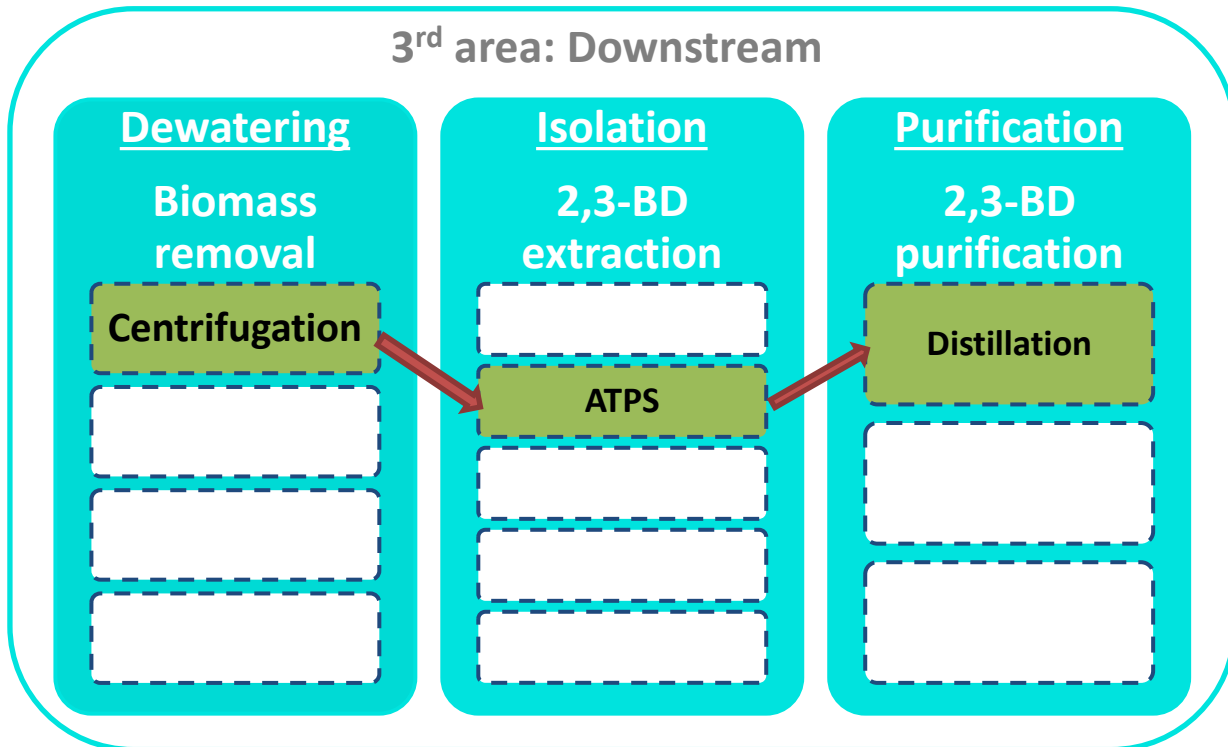




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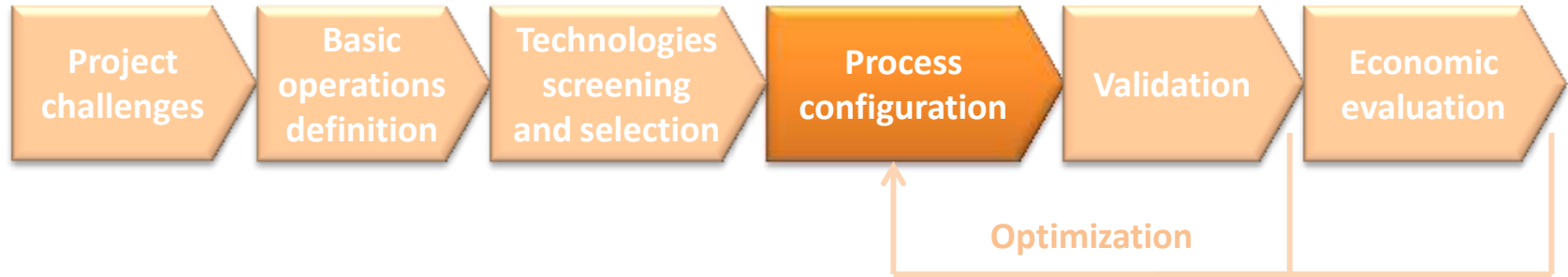


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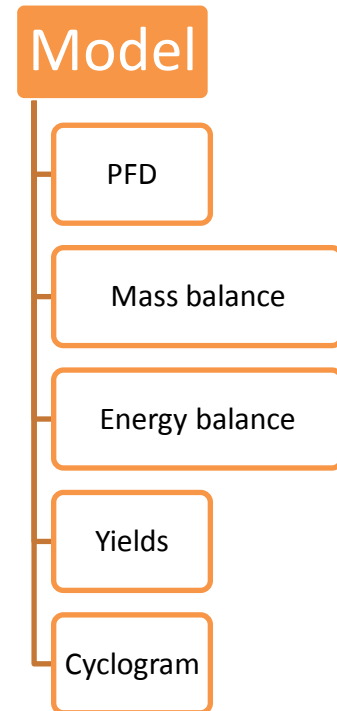
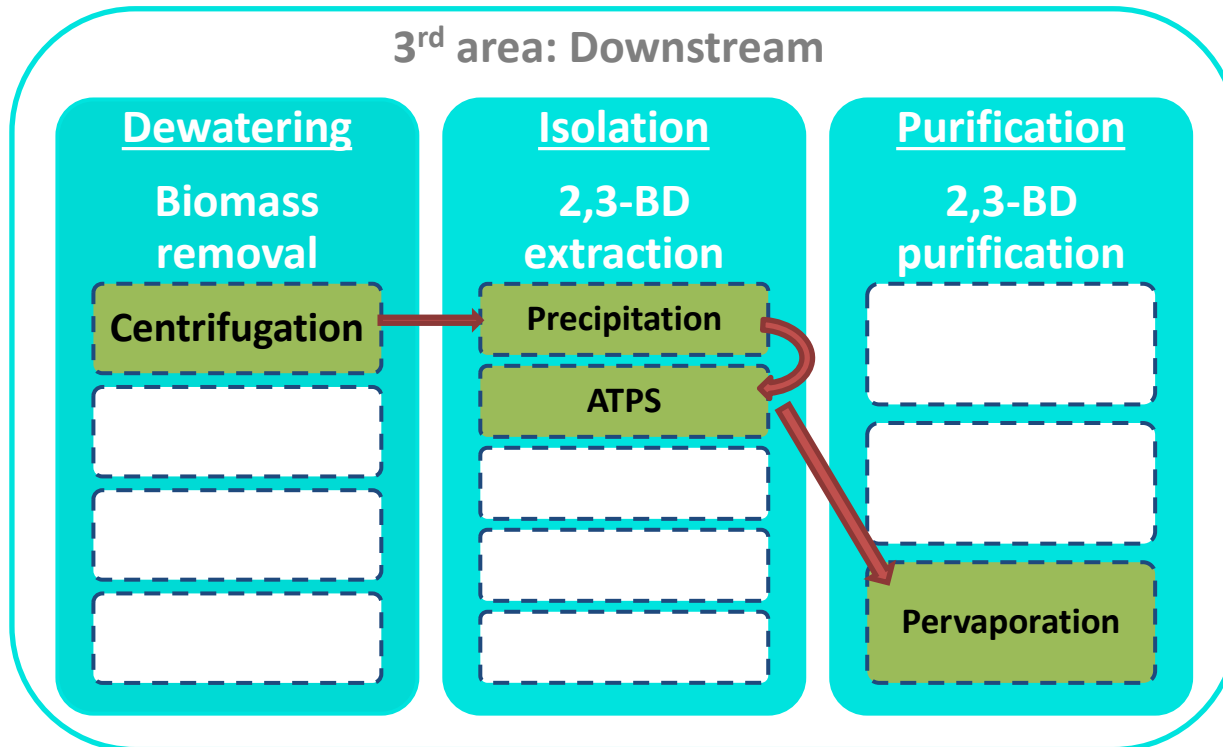




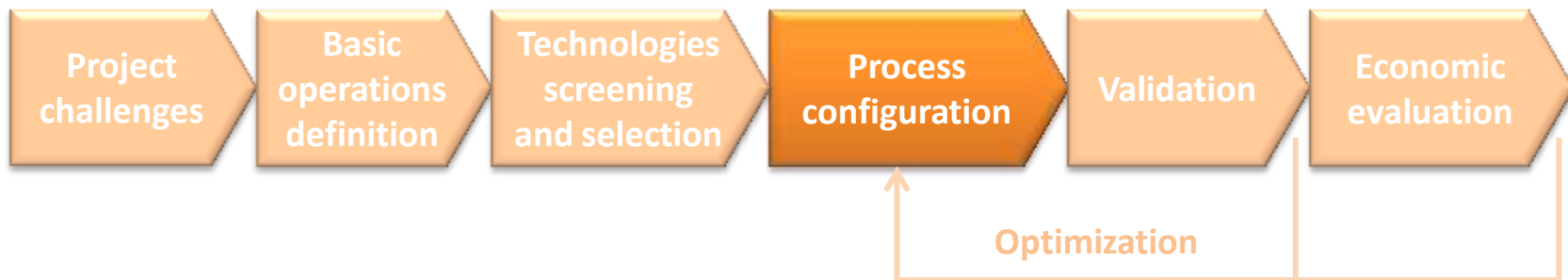
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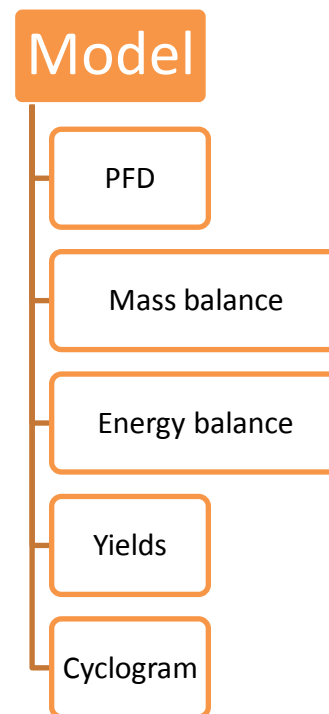
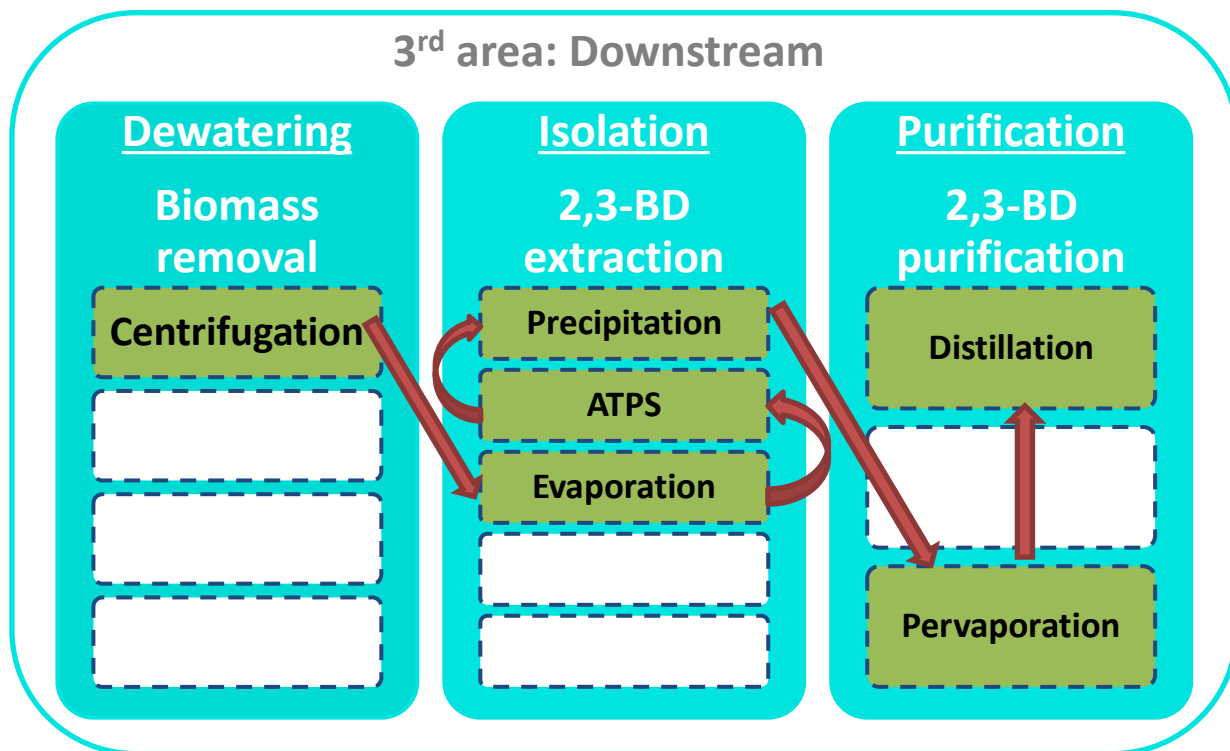
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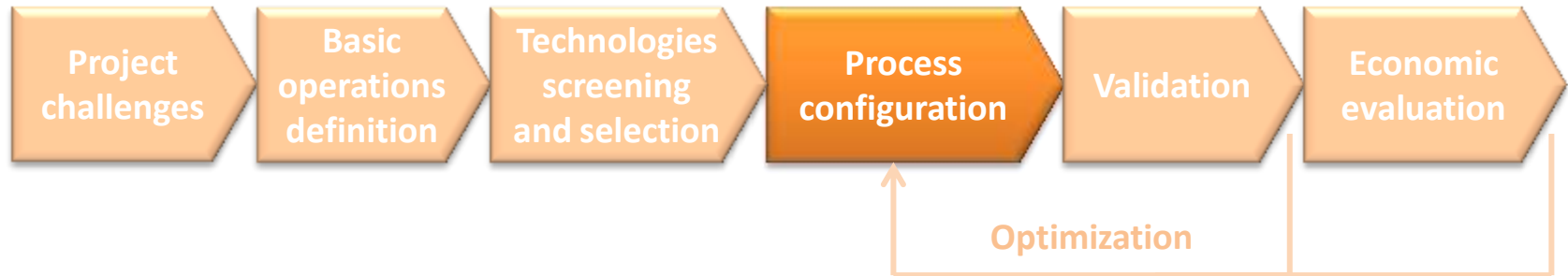


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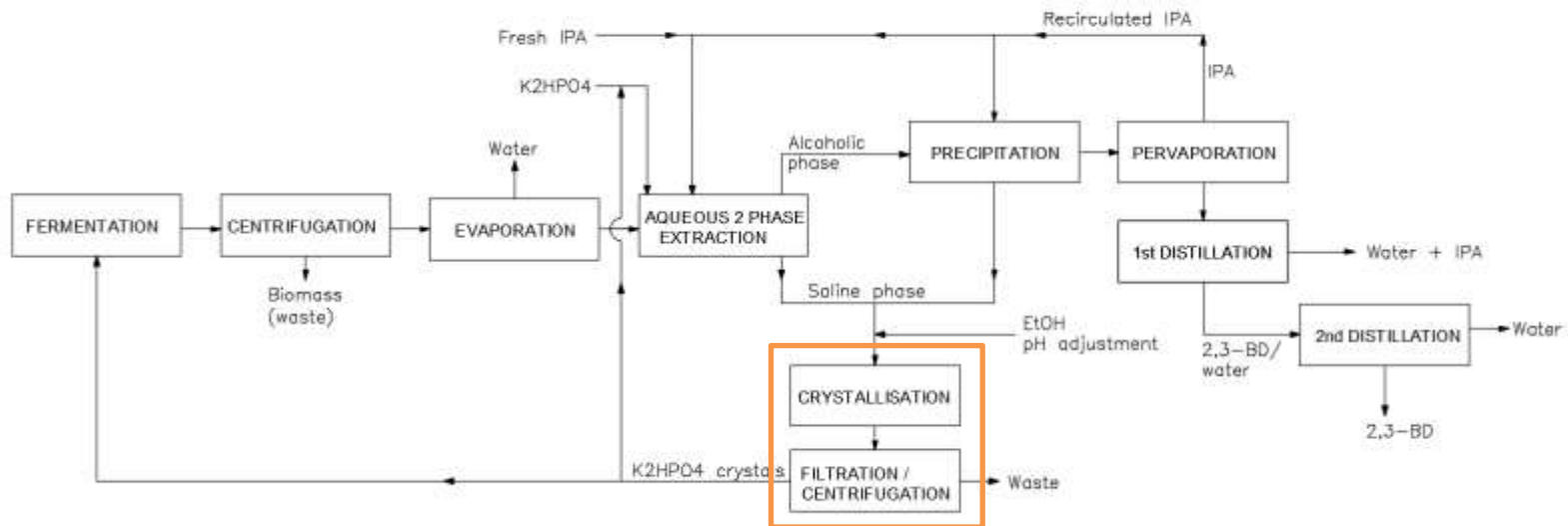
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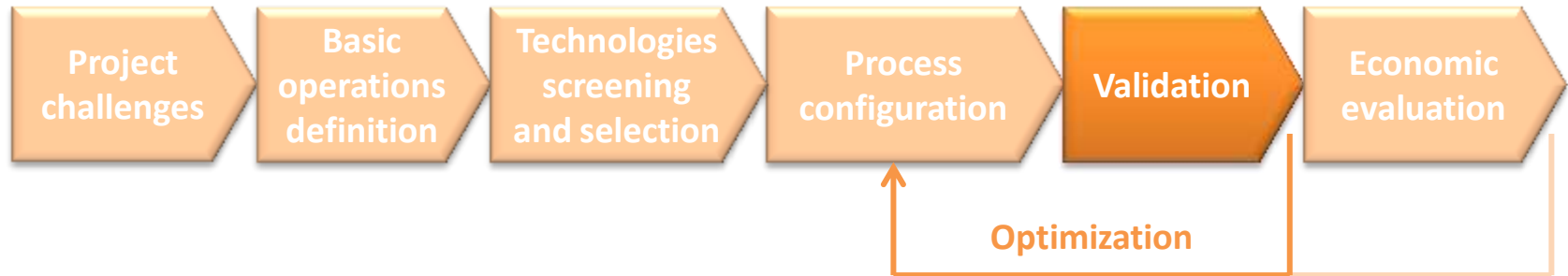


INDUSTRIAL PROCESS MODEL CONFIGURATION

FINAL INTEGRATION



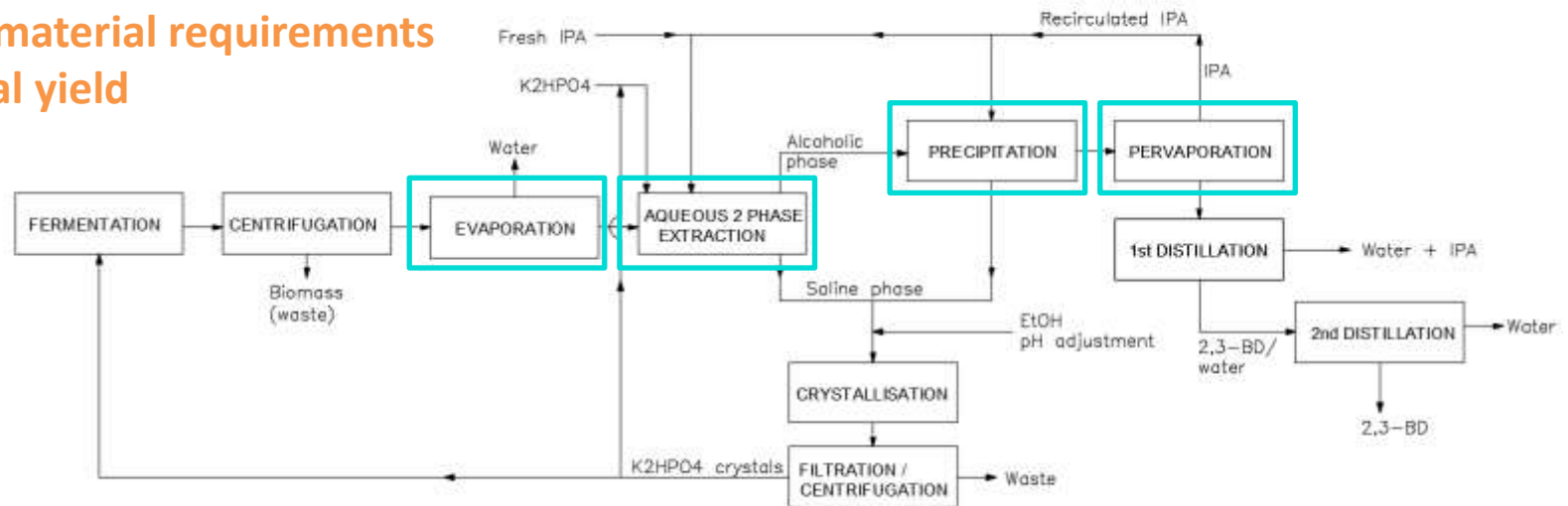
Ancillaries operations

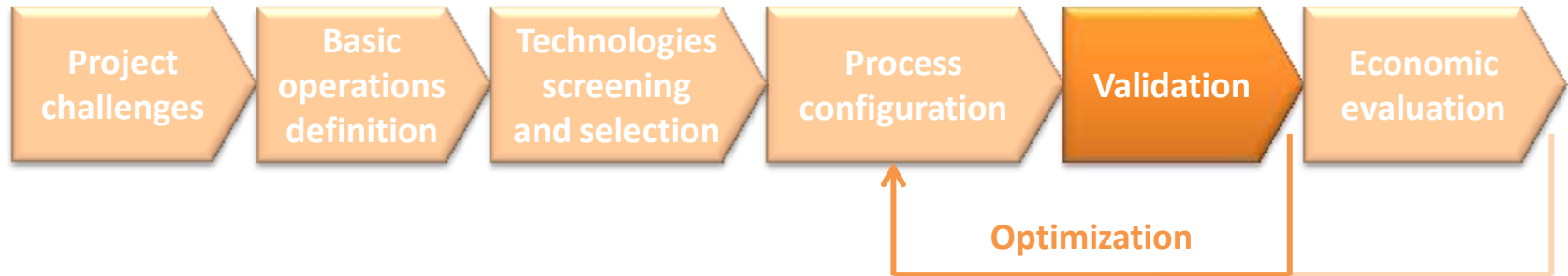


PROCESS VALIDATION AND OPTIMIZATION

- ✓ Operating conditions optimization
- ✓ Basic operations yields
- ✓ Raw material requirements
- ✓ Global yield

If TRL < 6 → experimental validation

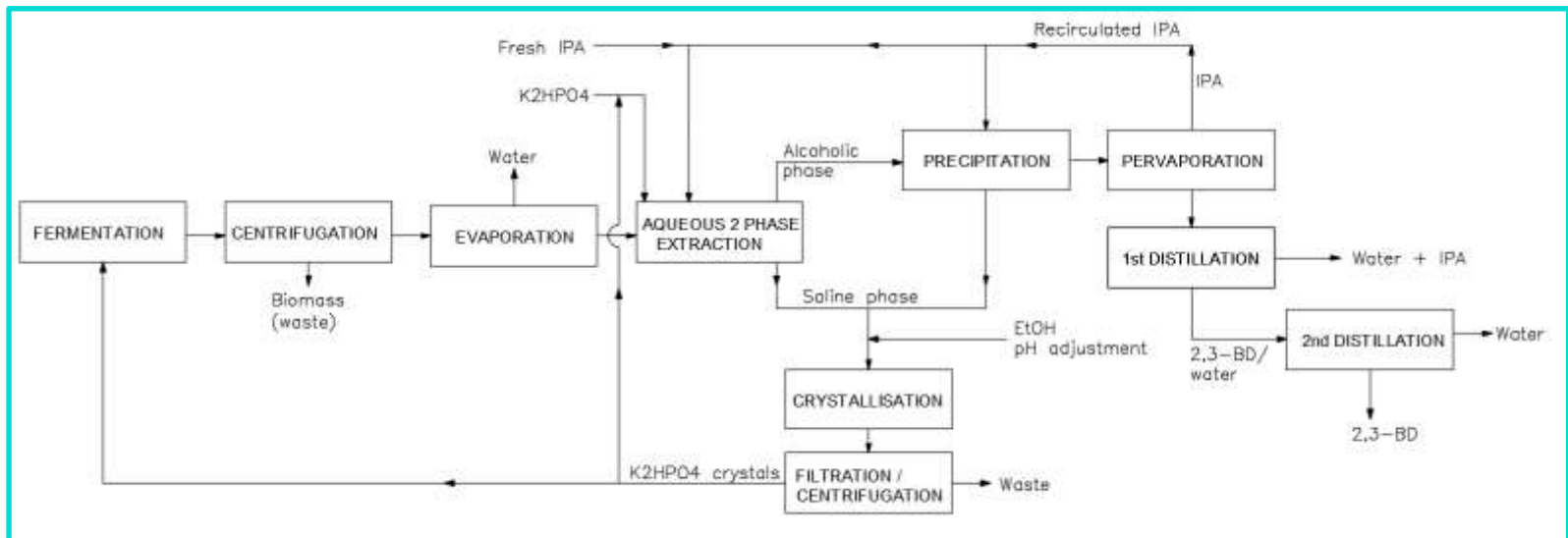




PROCESS VALIDATION AND OPTIMIZATION

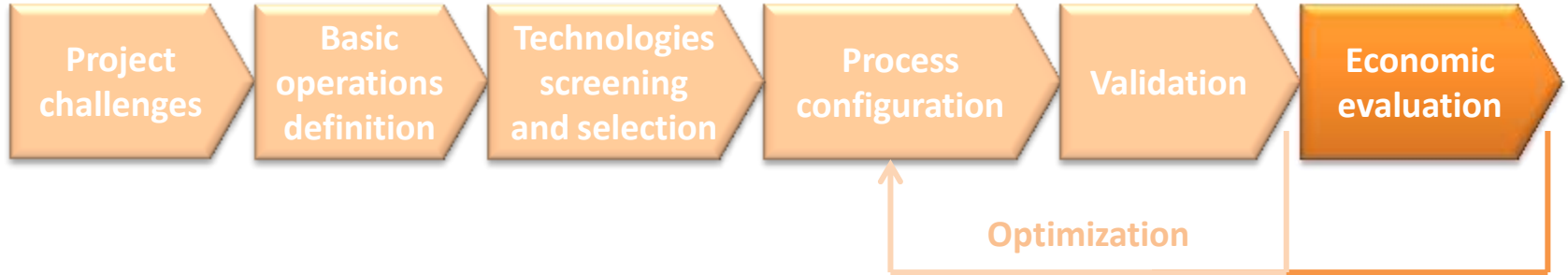
Feedback = upgrade

GLOBAL PROCESS VALIDATION

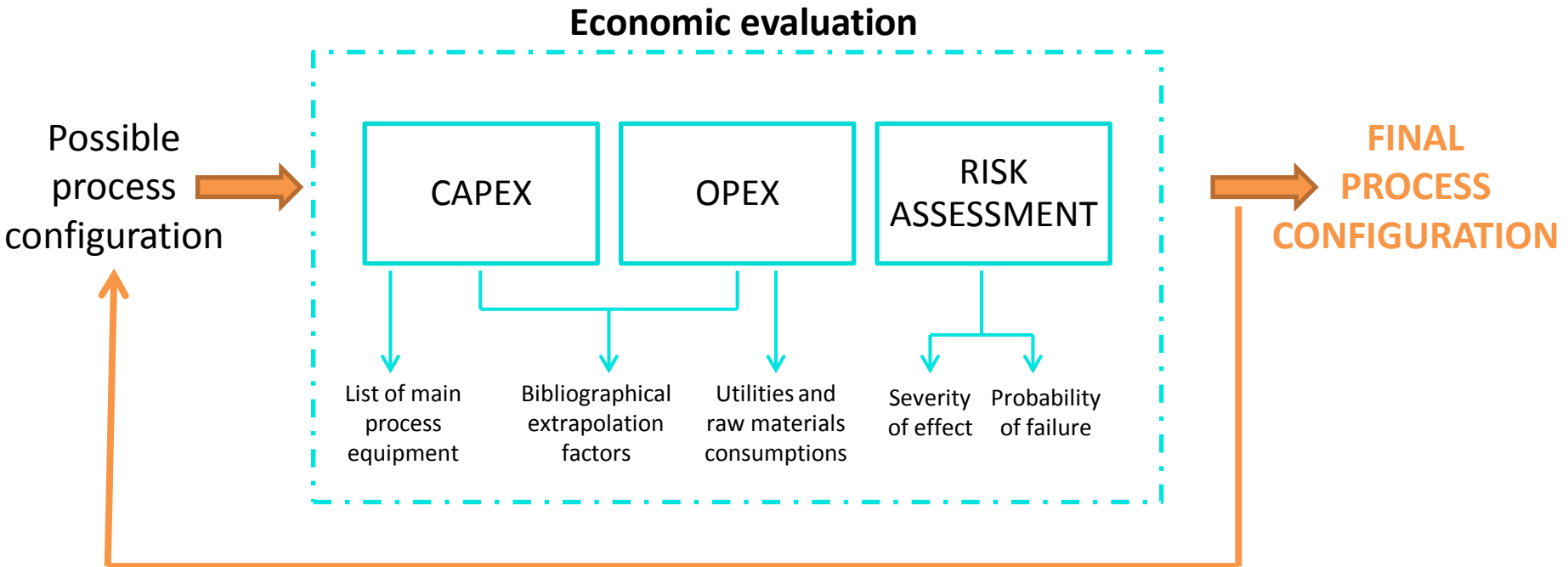




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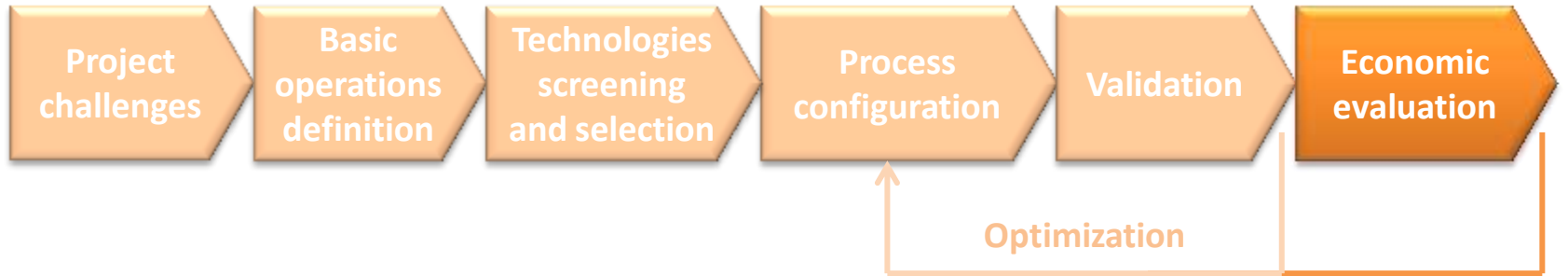


ECONOMIC EVALUATION

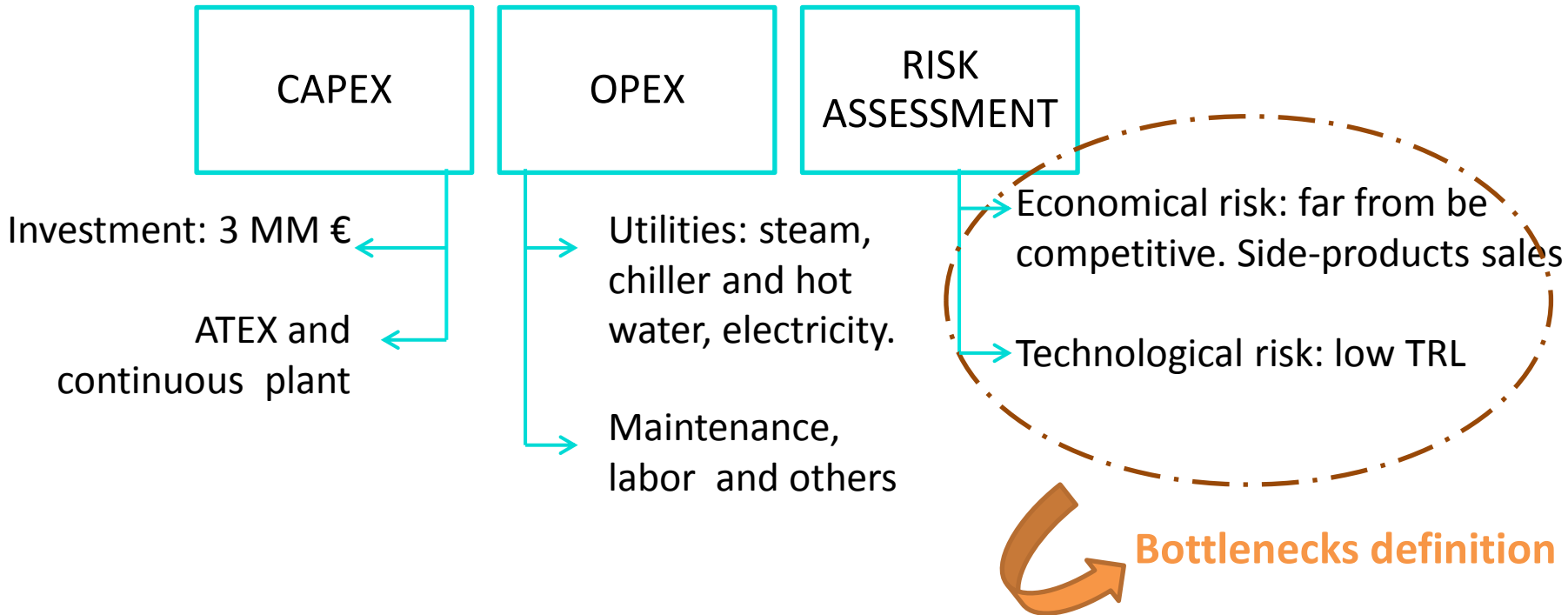




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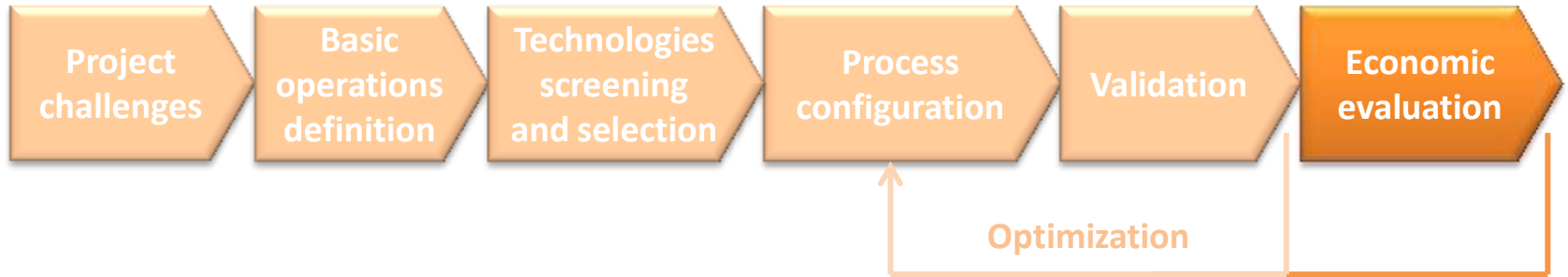


ECONOMIC EVALUATION





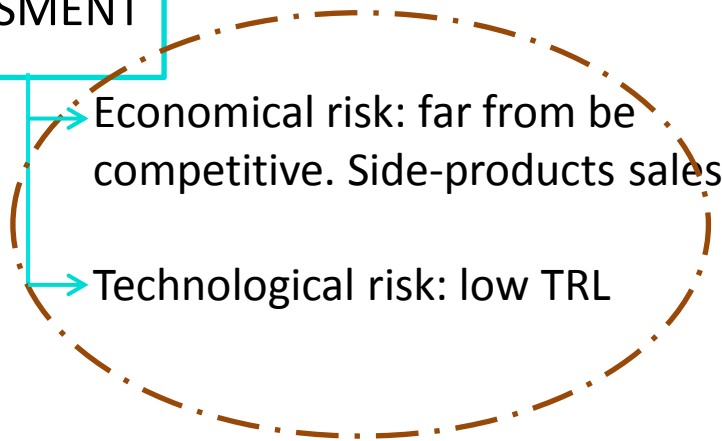
2. Process development methodology



ECONOMIC EVALUATION

Bottlenecks definition

- Low 2,3-BD concentration in harvest broth
- High raw materials consumption
- Technologies with low TRL and very specific
- Industrial production by synthesis widely applied



Investment: 3.301.200 €

ATEX and continuous plant

Utilities: steam, chiller and hot water, electricity.

maintenance, assembly.

≈400 €/kg 2,3-BD (6%)



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- Identify clear and measurable objectives
- Identify clear and measurable KPIs
- Establish a clear KPIs ranking
- Be methodical
- Know benchmarks
- Robust and reliable technologies
- Iterations = optimization





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THANKS FOR YOUR ATTENTION!!!!



QUESTIONS???

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