



Enzymaster

Green magic happens here

Company presentation

General overview

Enzymaster - Where Green Magic Happens



International consortium of founders



**Zhenlin
Lv
President**



**Yong Koy
Bong, PhD
Chairman**



**Dr. Thomas
Daußmann
EVP**



**Haibin
Chen, PhD
VP**

Enzymaster (Ningbo) Bio-Engineering Co., Ltd. in Ningbo (China):

Lab space: ca. 3000 m²

Fermentation pilot plant: up to 1000 L

Employees: ca. 100 (60% in R&D and Tech)

Enzymaster Deutschland GmbH in Düsseldorf (Germany):

Employees: 4



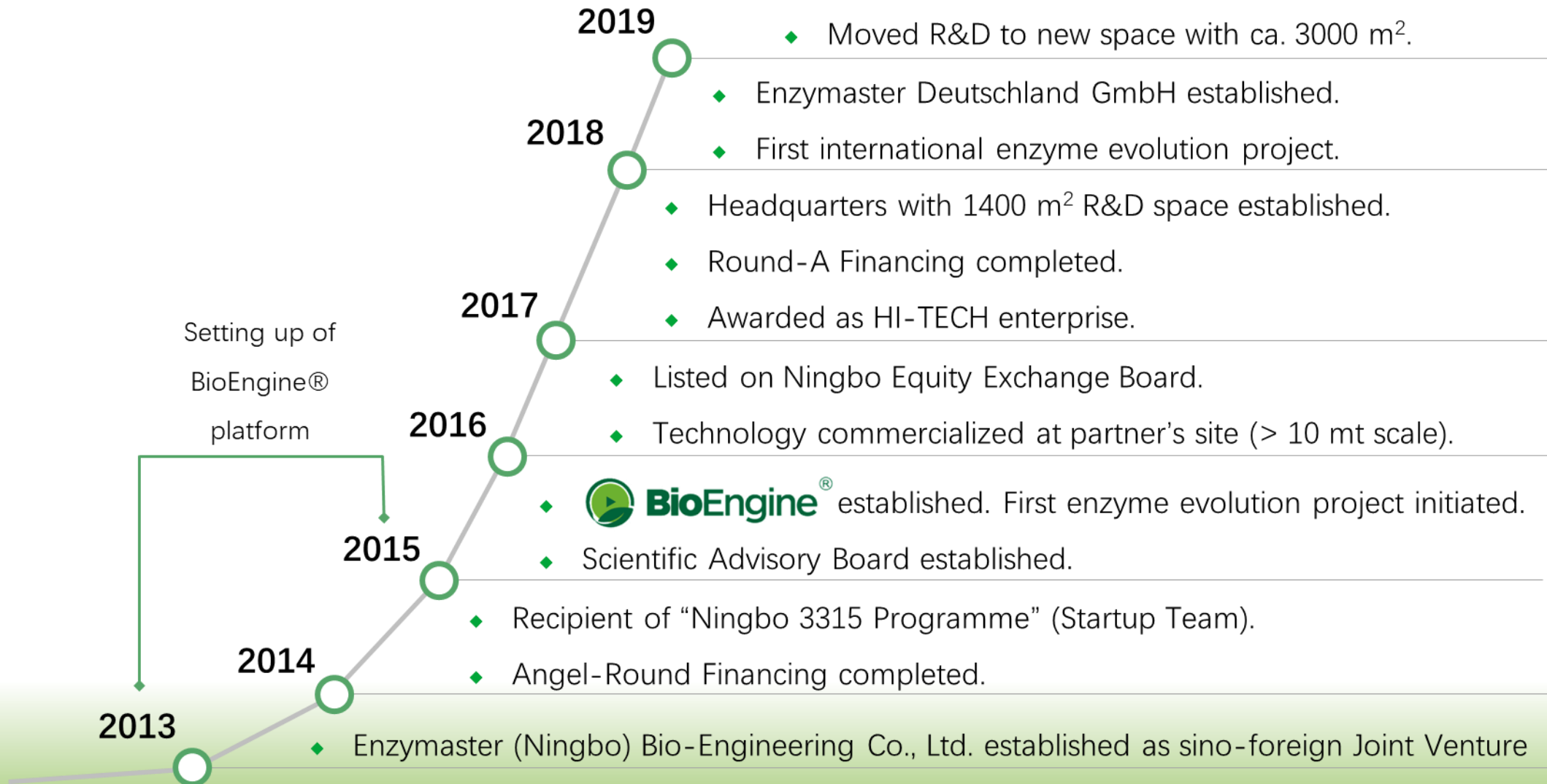
Shanghai:

SJTU π -Supercomputer account

Computational enzyme engineering

500,000 CPU hours/year

Enzymaster - History



The Benefits of Enzyme Catalysis

Chemical Process

Shorter Synthetic Routes

- No need for protective group chemistry
- No need for prior substrate activation

Enabling use of Alternative Substrates

New Feedstock

- e.g. Bio based or Cheaper materials

Problem:
Natural enzymes are often industrially not applicable



Solution:
Enzyme engineering by directed evolution

Extraordinary Selectivity

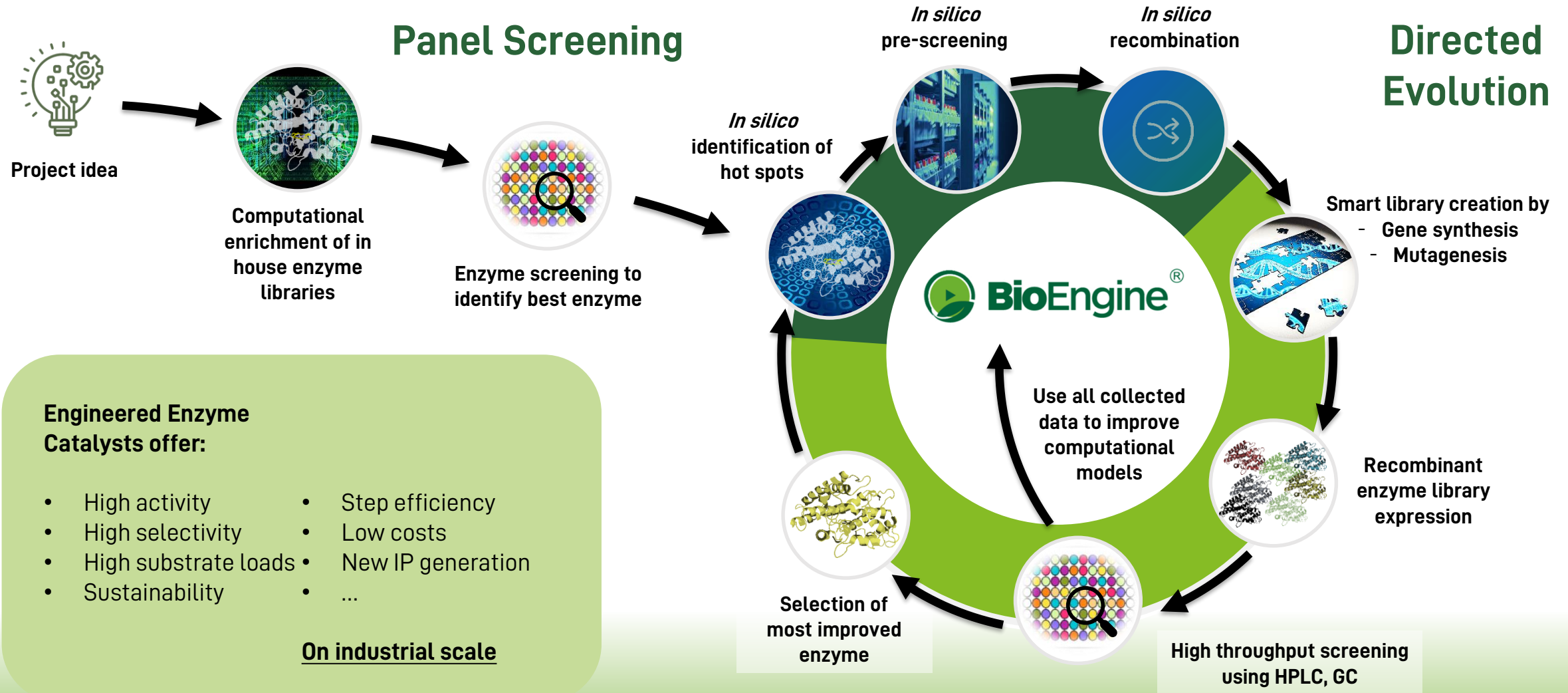
- Stereo Selectivity
- Regio Selectivity
- Chemo Selectivity

By specific substrate binding

Mild Environment Friendly Reaction Conditions

- e.g. Ambient temperature
- No heavy metals

Our Asset - Enzyme Directed Evolution

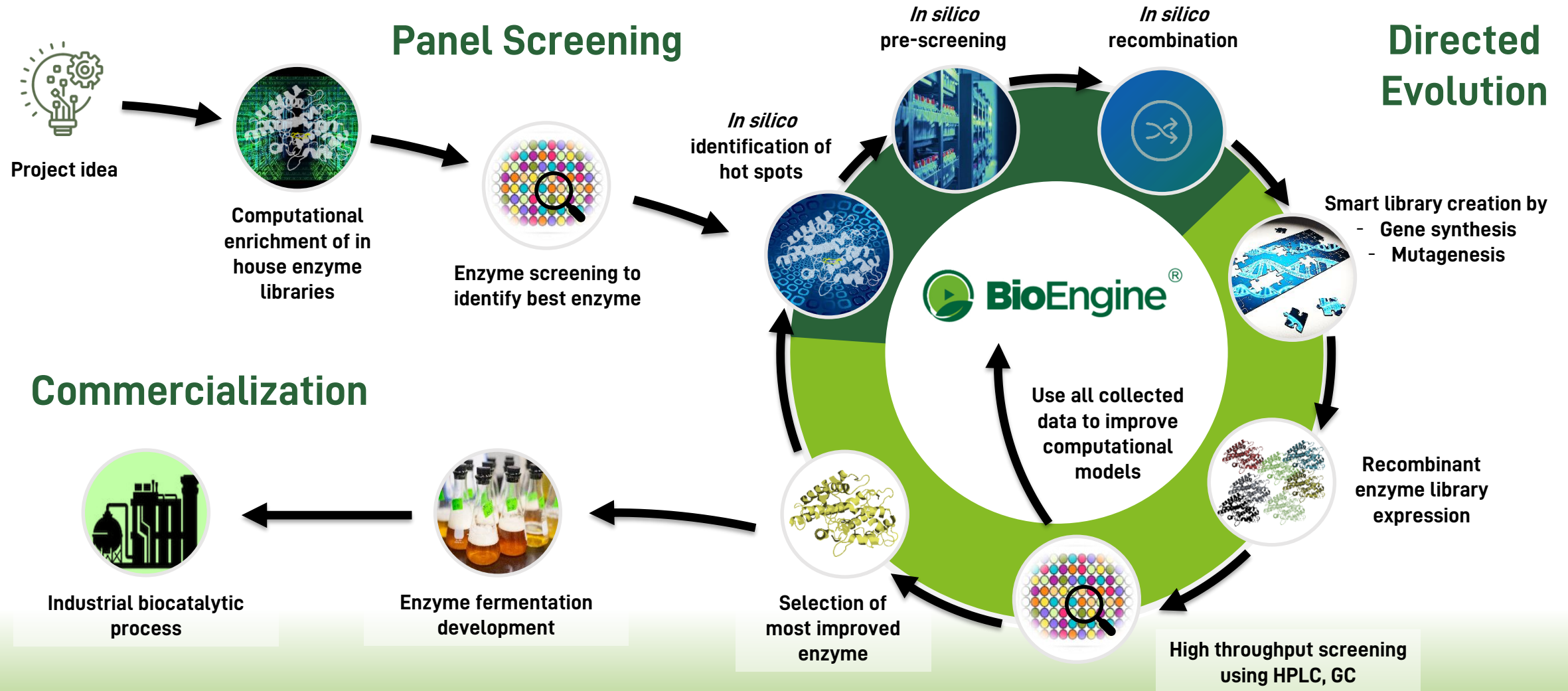


Engineered Enzyme Catalysts offer:

- High activity
- High selectivity
- High substrate loads
- Sustainability
- Step efficiency
- Low costs
- New IP generation
- ...

On industrial scale

All in One Package- From Idea to Process



The Benefits of BioEngine®

Enzymaster



In silico studies/simulations provide **high sequence space coverage**

Continuous online improvement of *in silico* methods

All screenings and studies under **real process conditions**

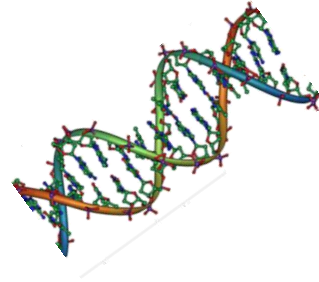
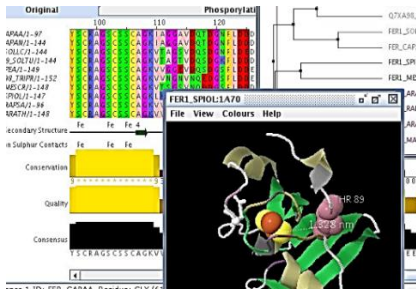
HPLC/GC analytics provide **comprehensive reaction insights**

Only **4-5 weeks per round** of evolution

Capacity for up to **6 evolution projects** in parallel

Comprehensive Technology Platform

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Bioinformatics

Molecular Biology

Automation

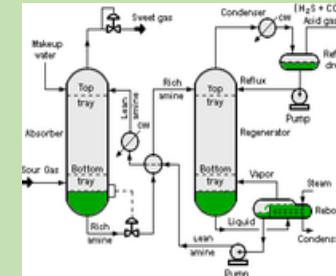
Laboratory Data Management

Strain Engineering

High-Throughput Biochemistry



Enzyme Directed Evolution



Process Dev. and Downstream

Production

Microbiology and Fermentation

Quality Assurance



Commercialization

Enzymatic Process Dev. and Production

Enzymaster - Service Offer



Enzyme panel screening



„Smart“ enzyme directed evolution



Enzyme preparation by fermentation



Enzyme catalytic process development



Custom biocatalytic manufacturing



Idea

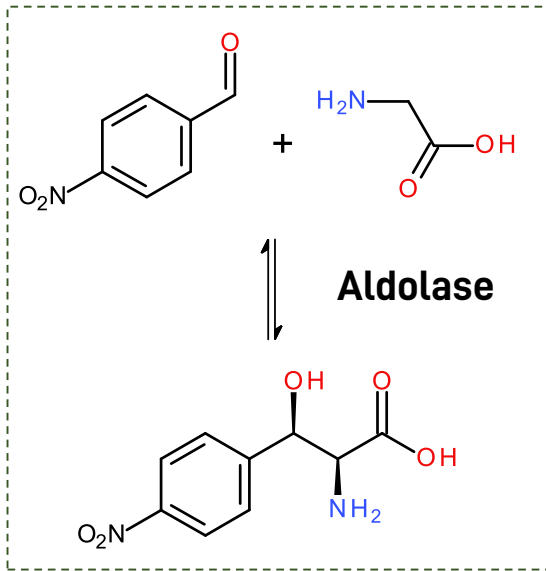


R&D



Industrial process

Enzymaster - Success Stories



Wild Type Enzyme:

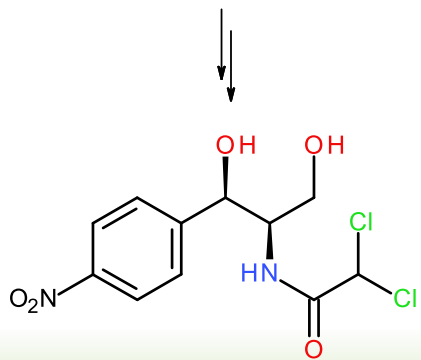
- de 50%
- 10% conversion in 8 h
- 40 g/L substrate load



- 9 rounds of evolution
- 12 months
- 5 steps (60 %) shorter synthetic route

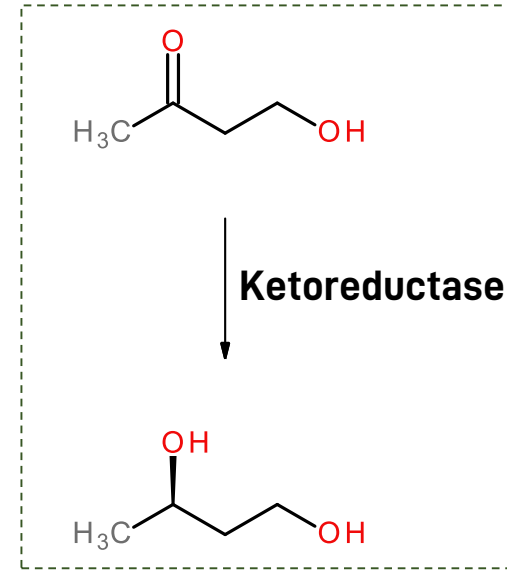
Industrial Enzyme:

- de >90%
- >80% conversion in 8 h
- 200 g/L substrate load



Chloramphenicol

Patent application No.:
PCT/CN2018/086227



Initial Enzyme:

- 48 h
- 57% conversion
- 60 g/L substrate load



- 3 rounds of evolution
- 3 months

Industrial Enzyme:

- 24 h
- 99% conversion
- 400 g/L substrate load

**50 MT scale
Production
of
(R)-1,3-Butanediol**

Patent application No.: 201811537509.4
Yet to be published

Key Reaction Types & Enzyme Classes



Transamination



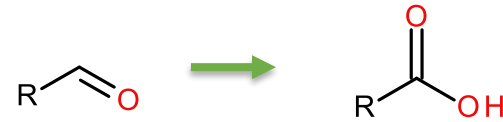
Alcohol Oxidation



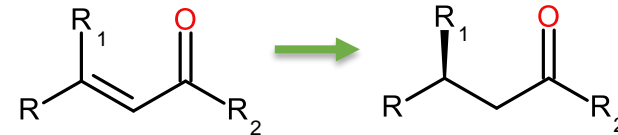
Hydroxylation



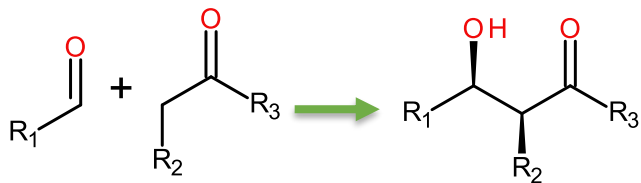
Ketone Reduction



Aldehyde Oxidation



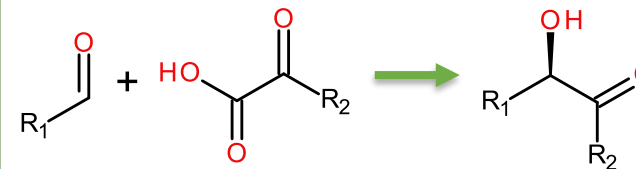
Enoate Reduction



Aldol Reaction



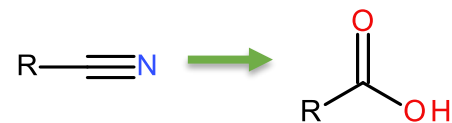
Aldehyde Cyanation



Carboligation



Decarboxylation



Nitrile Hydrolysis



Imine Reduction

Key Enzyme Classes

Aminotransferases

Ketoreductases/ADHs

Aldolases

Esterases/Lipases

Decarboxylases

Oxynitrilases

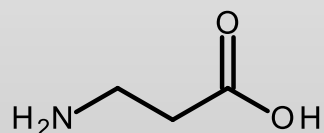
Nitrilases

TPP-dep. Lyases

Target Industries

Pharma, Fine Chemicals, Cosmetics, Food

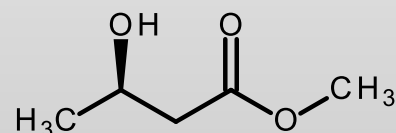
Building block and food supplement:
 β -Alanine



Production Scale:
100 – 150 mt/month

Application:
Pharma and Food

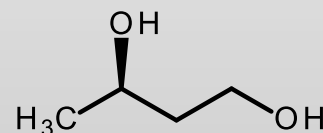
Chiral building block:
Methyl(R)-3-hydroxybutyrate
R-MHB



Production Scale:
Up to 100 mt

Application:
Pharma and Food

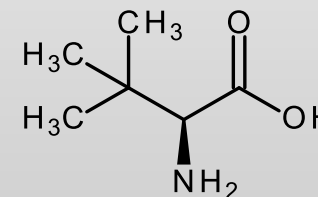
Chiral building block:
(R)-1,3-Butanediol
R-BDO



Production Scale:
Up to 50 mt

Application:
Pharma and Cosmetics

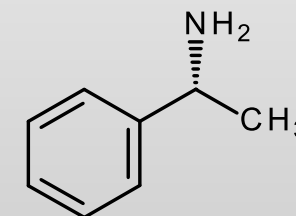
Chiral building block:
L-*tert*-Leucine



Production Scale:
Up to 10 mt

Application:
Pharma

Chiral auxiliary:
(R)- α -Phenylethylamine
R-PEA



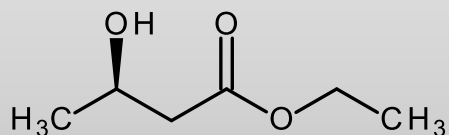
Production Scale:
Up to 10 mt

Application:
Pharma

Enzymaster - Further Commercial Products

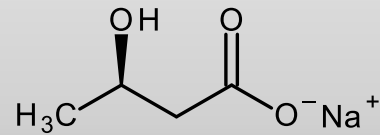
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**Ethyl (R)-3-Hydroxybutyrate
R-EHB**



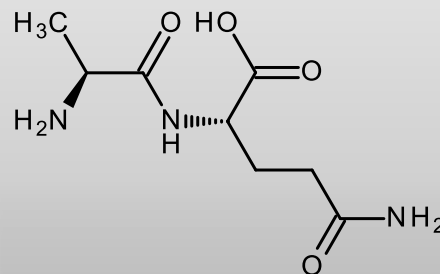
Food Supplement

**(R)-3-Hydroxybutyric Acid, Sodium Salt
R-BHB**



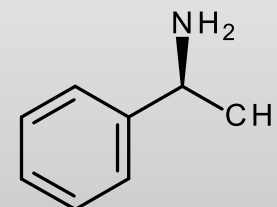
Food Supplement

Glutamine-S



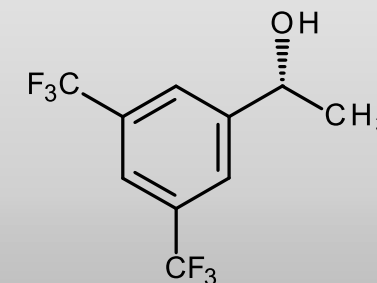
Food Supplement

(S)- α -Phenylethylamine



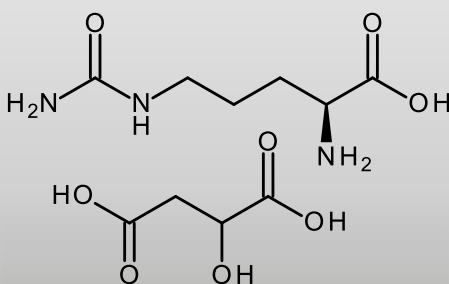
Chiral auxiliary

(R)-1-[3,5-Bis(trifluoromethyl)phenyl]ethanol



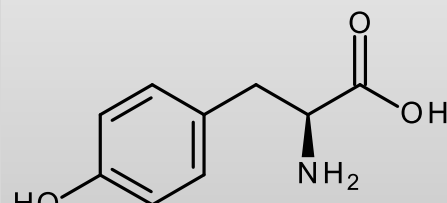
Aprepitant IM

**L-Citrulline DL-Malate
2:1**



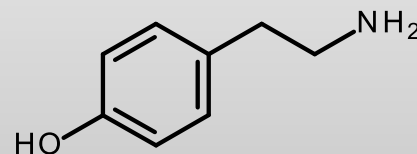
Food Supplement

L-Tyrosine



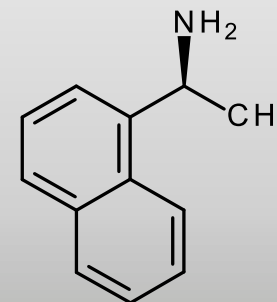
Food Supplement

Tyramine



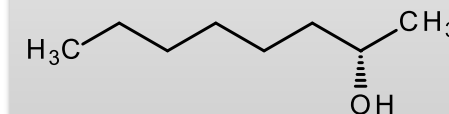
Food Supplement

(R)- α -Naphthylethylamine



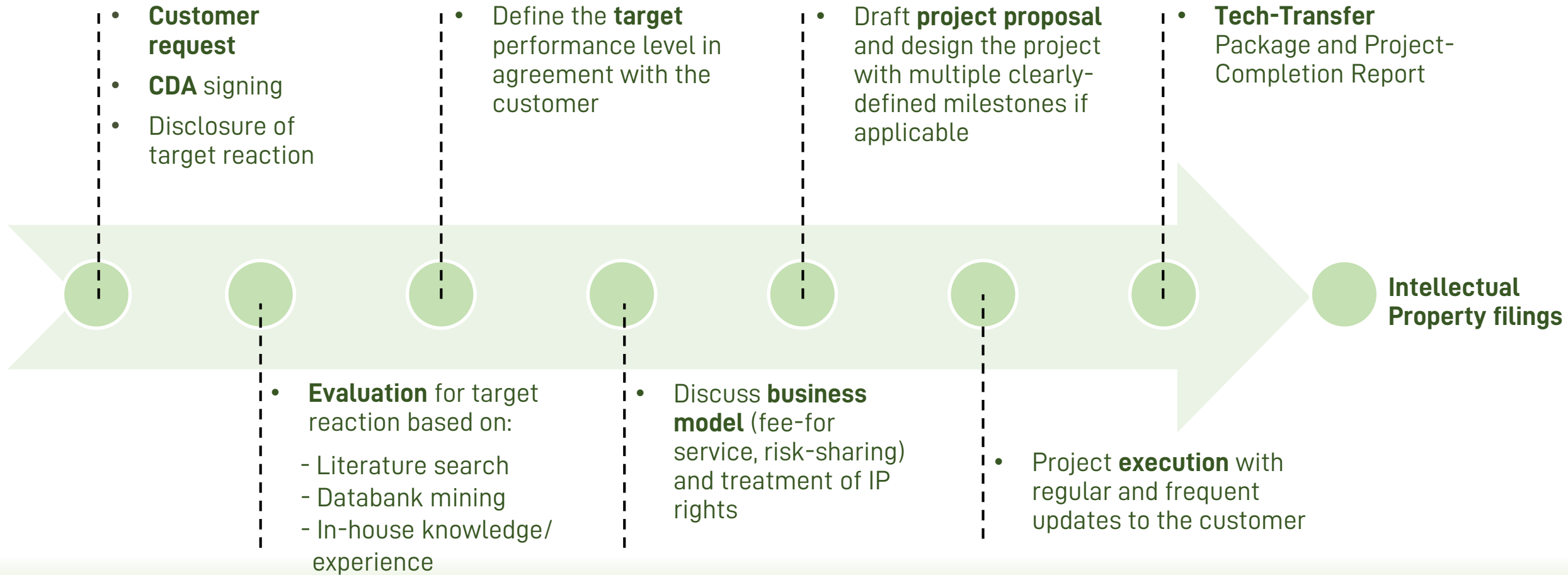
Cinacalcet IM

(S)-2-Octanol



Chiral building block

Enzymaster - Project Process



Enzymaster

Green magic happens here

We aim to contribute to a better societal and environmental future



Proprietary
Technology



Industrial
Innovation



Environmental
Impact