

24 M annual meeting

FuturEnzyme Technologies of the FUTURE for low-cost ENZYMES for environment-friendly products



FuturEnzyme: 24M annual meeting

Start date: 1 June 2021 - End date: 31 May 2025

Proposal number: 101000327 - Consortium: 16 partners

Requested EU Contribution: 5,995,035.13 €

Call & Topic: H2020-FNR-2020; FNR-16-2020

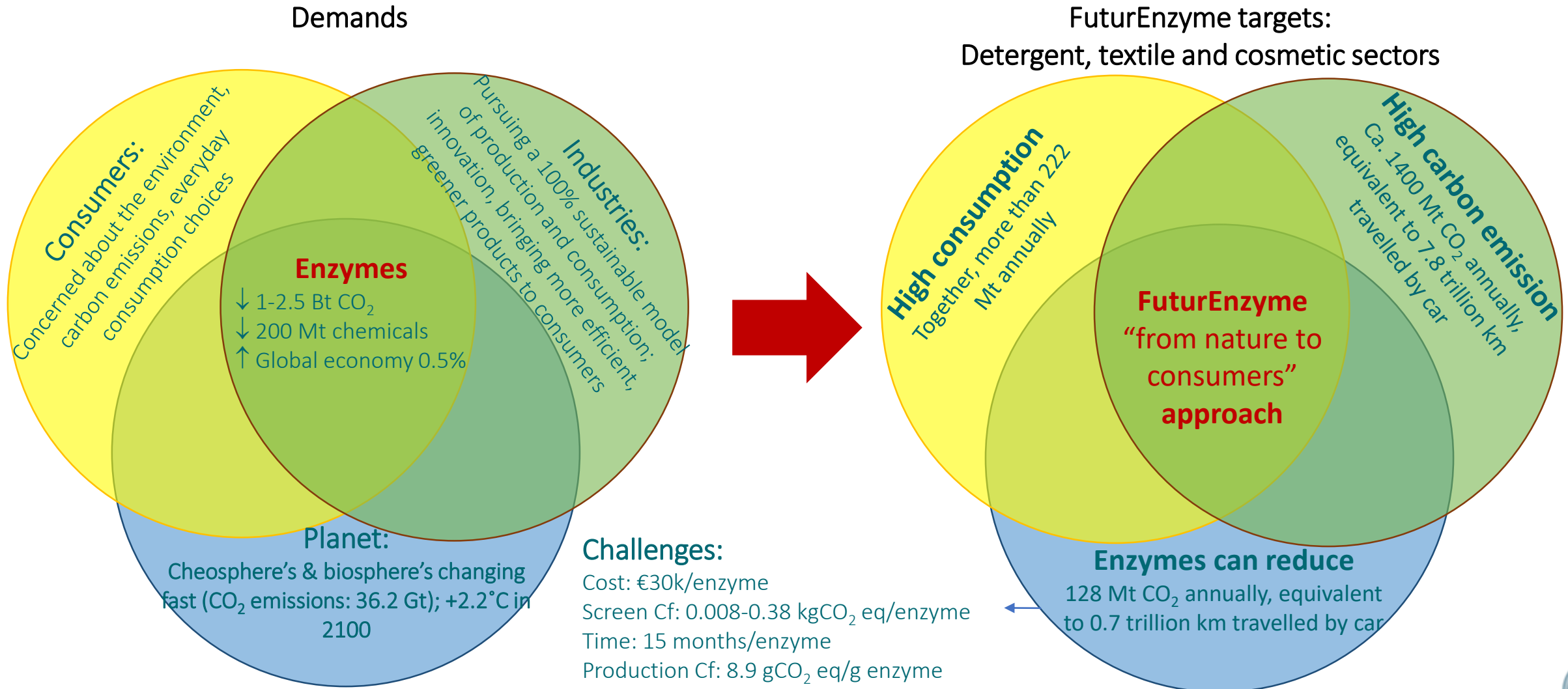


Project funded by the European Union's Horizon 2020
Research and Innovation Programme under grant agreement No [101000327]





A project that meets demands: consumers', industries' and planets' demands





General Objective:

Greening consumer products already in the market



To establish and combine a series of **technologies to retrieve highly powerful, stable and low cost microbial enzymes ...**

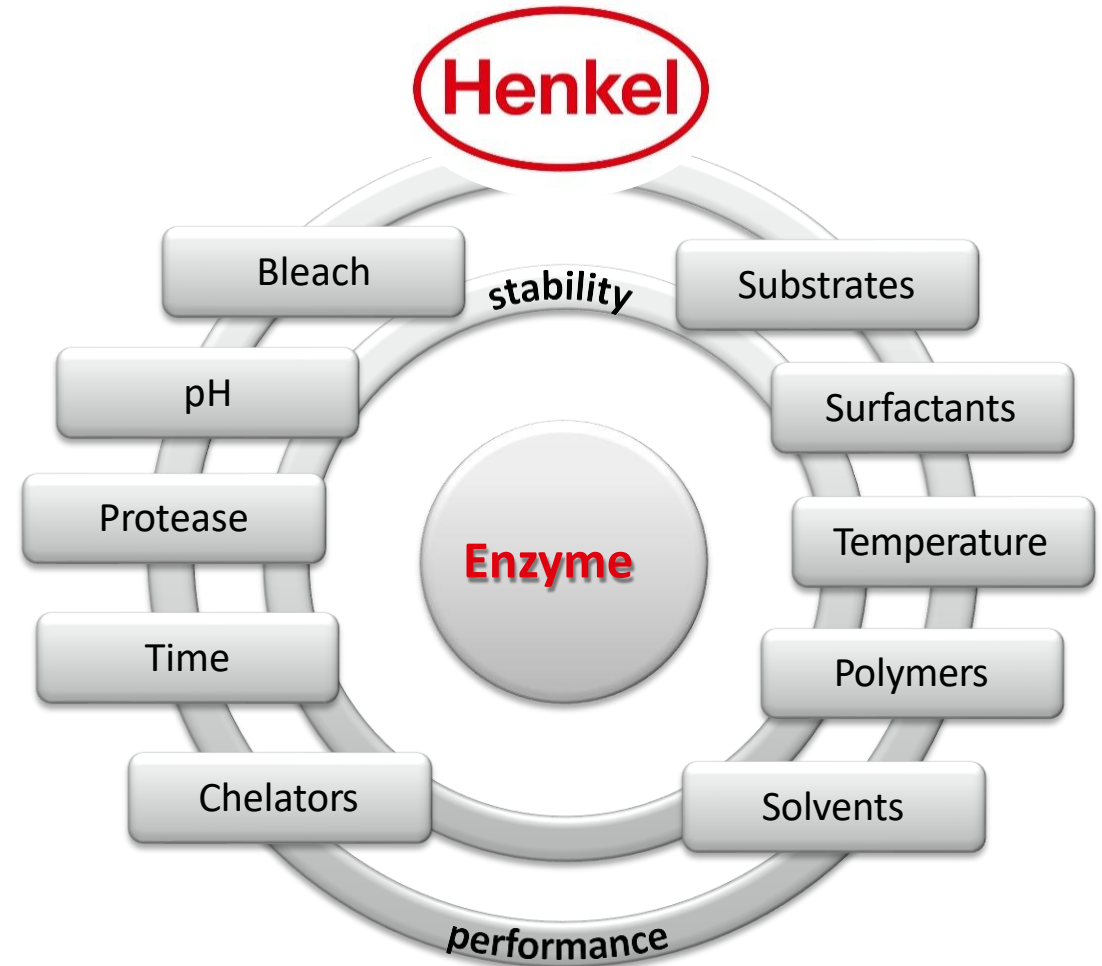
With them, we aim to approach the complex reality and challenges of real consumer products in the **detergent, textile and cosmetic sectors ...**

With the ambition of **greening products already in the market**, making them more environmentally friendly, valuable, functional and sustainable.



Consumer products in FuturEnzyme

Challenges and bottlenecks for the target sectors and products





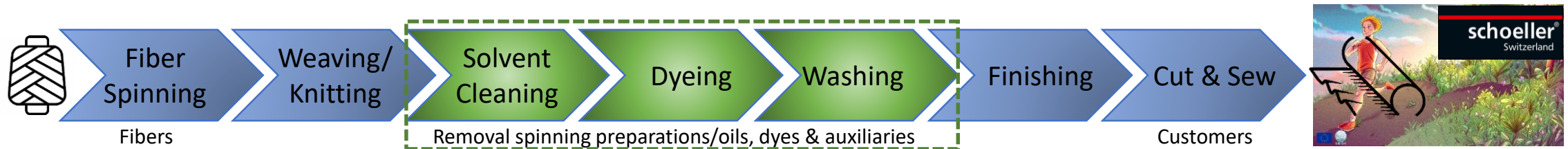
Consumer products in FuturEnzyme



Challenges and bottlenecks for the target sectors and products

■ Textile sector

- **Enzymes** (esterases, lipases, oxidoreductases and poly-ester hydrolases) in the textile production unit can have an **effective impact to save energy, time and water and reduce CO₂ emissions** in three steps:
 - The removal of the spinning oils (mineral oil, silicone and fatty acids) during the solvent cleaning step.
 - The removal of the dyes after the dyeing/fixing of the textile materials.
 - The degradation of textile waste after the end-use.
- The textile's complexity, in the base material used and different oils & dye recipes & variants in color, make it quite complex to find only one enzyme in their removal and discoloration and neutralization of the wastewater.





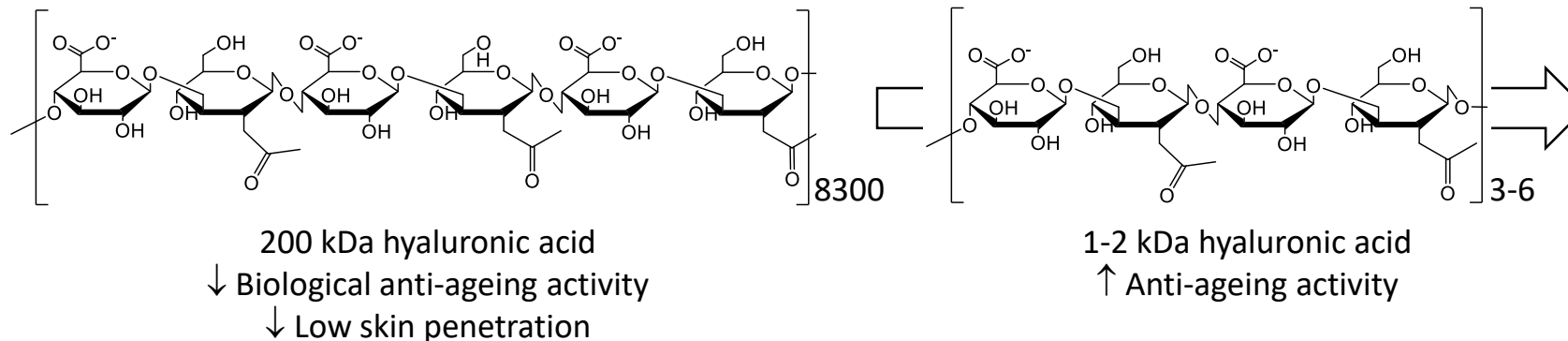
Consumer products in FuturEnzyme



Challenges and bottlenecks for the target sector and products

■ Cosmetic sector

- **Enzymes** can have an effective **impact** to hydrolyze the long hyaluronic acid in a short defined molecule that is key to the production of **anti-ageing cosmetics**. Here there are two basic challenges.
 - Have a repeatable defined molecule size, because pro-inflammatory responses have been reported for 5-15 kDa fragments.
 - For a complex molecule like hyaluronic acid it is not so easy to find an enzyme that cleaves/hydrolyzes at the right place to yield 1-2 kDa fragments.
- This is why we are interested in identifying such an enzyme with which to produce the short-, long- and mid-size molecules. Most likely these will be **hyaluronidases**.





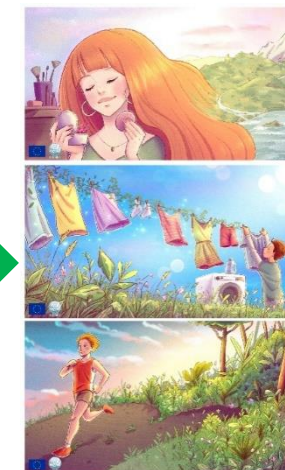
The FuturEnzyme integrated approach



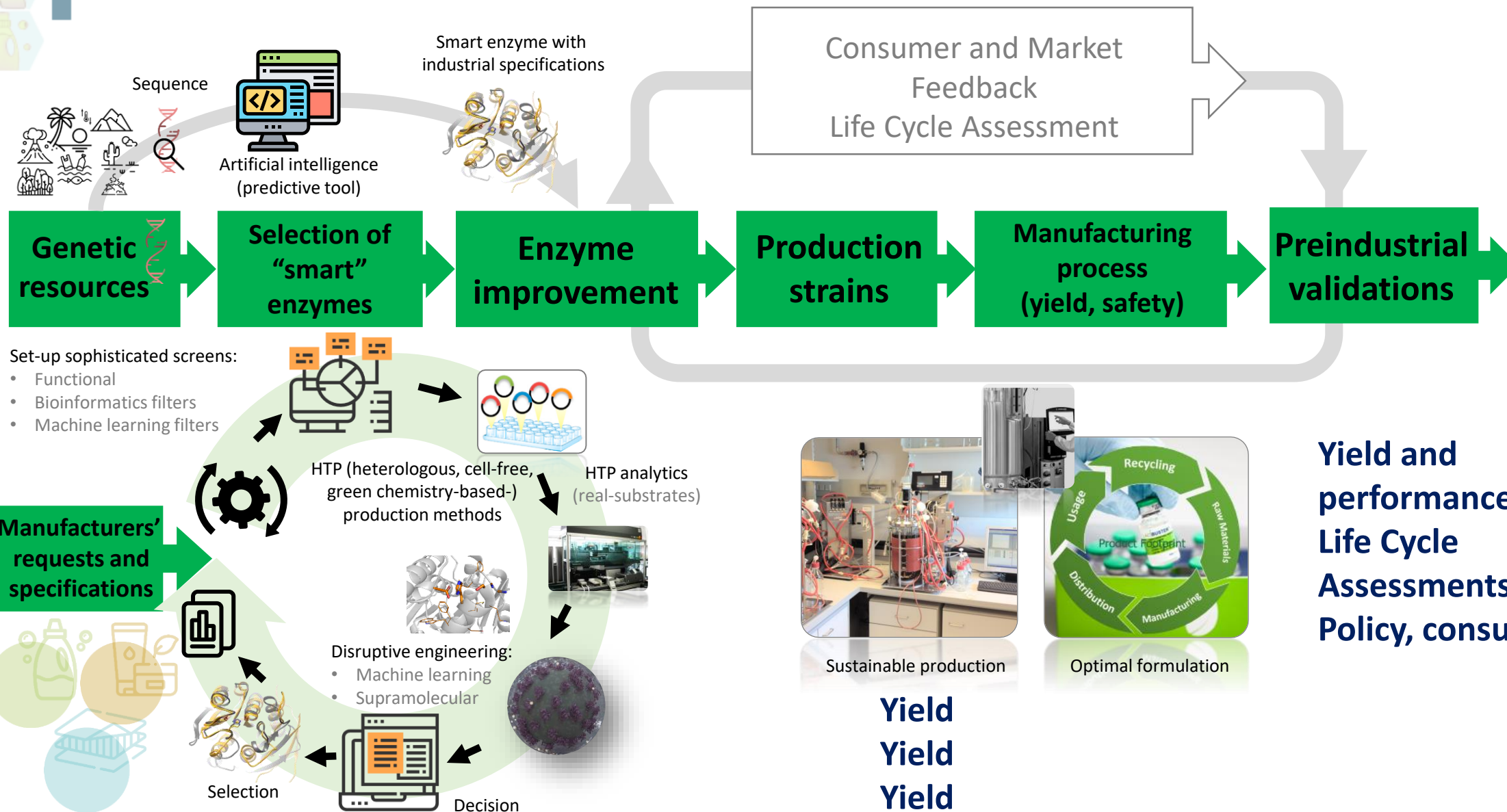
The FuturEnzyme integrated approach



www.futureenzyme.eu

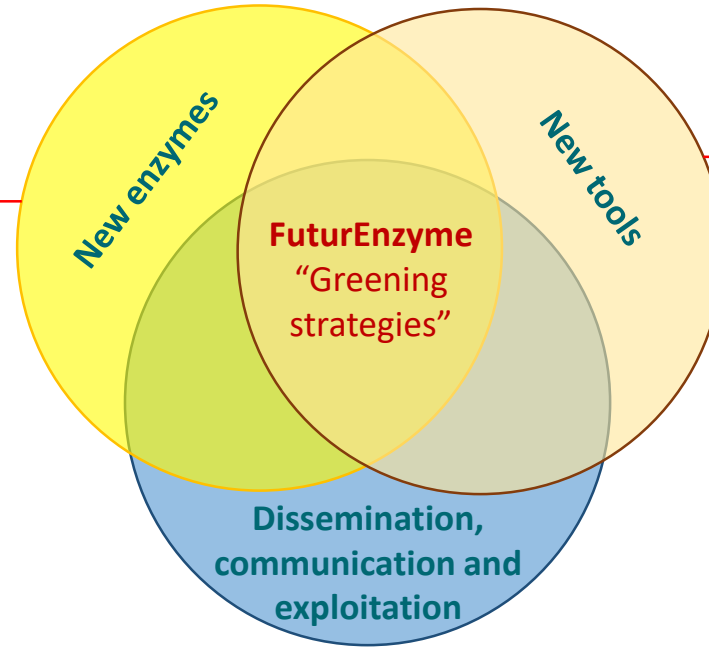


**Yield and performance
Life Cycle
Assessments
Policy, consumers...**





The FuturEnzyme expected results



Microbial enzymes (+1,000) with manufacturers' requirements for «target» products (detergent, textile, cosmetic)

18 Enzymes active and robust enough to outlast the product and process conditions

9 Verified and safe enzymes produced at scales required to approach the pre-industrial tests

4 Products

- LHC detergent (+1) with new enzymes.
- Enzyme-processed textiles (+3) A4 size.
- Leading cosmetic (+1) with hyaluronic products made with enzymes.
- Enzymes

2 Innovative bioinformatics & computational platforms

- 2 web-based resources to screen for enzymes required by the target sectors

- Impact on policymaking
- Impact on dissemination, communication, exploitation
- Impact on training
- Impact on recruitment
- Impact on gender dimension
- Impact on internationalization, cooperation activities

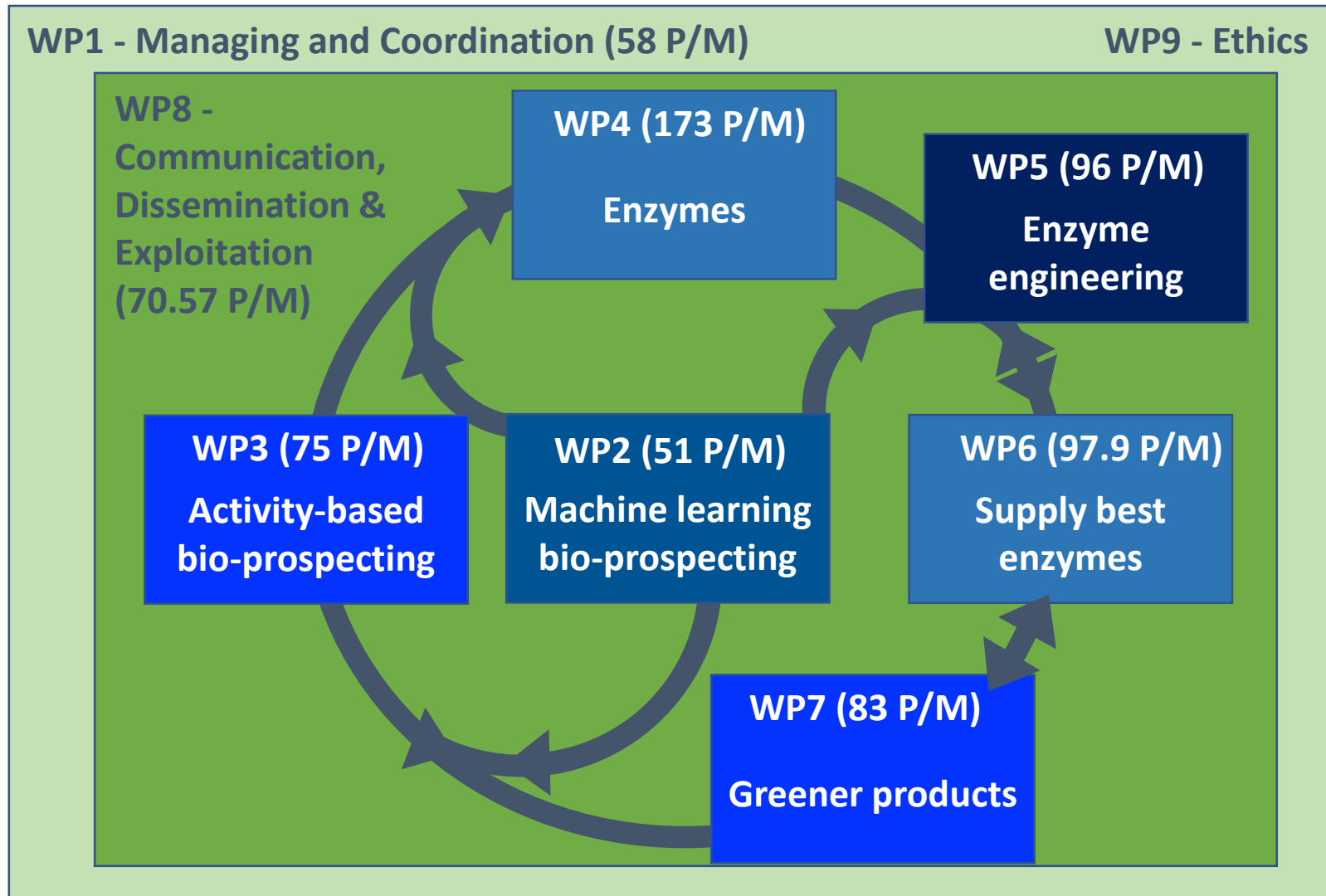
- +1,050 Visualization activities (social media, web, short movie, images, newspaper/TV/radio appearances)
- +104 Articles (peer-reviewed and divulgative)
- +27 Events organized (workshops, technical courses, scientific seminars, training, conferences, webinars)
- +2 Policy briefs
- +3 Technical bulletins, briefings
- +3 Patents
- +130 Events assisted (workshops, technical courses, scientific seminars, training, conferences, webinars)
- +1 Customer survey & product test
- +2 Policy events & policy briefs
- Etc.

- Impact on the enzyme supply to industry
- Impact on greening consumer products (environmental, economic, employment...)
- Impact on the bio-based sector



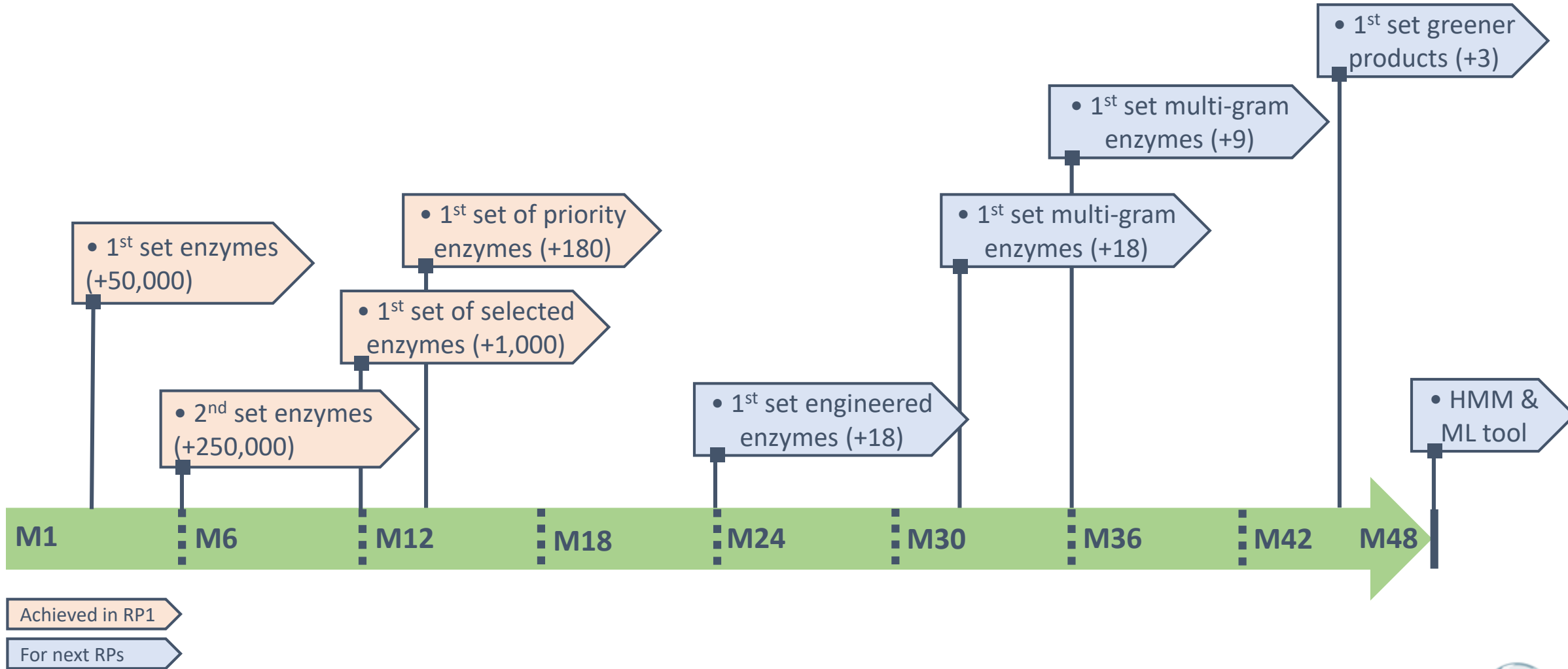


The FuturEnzyme workplan



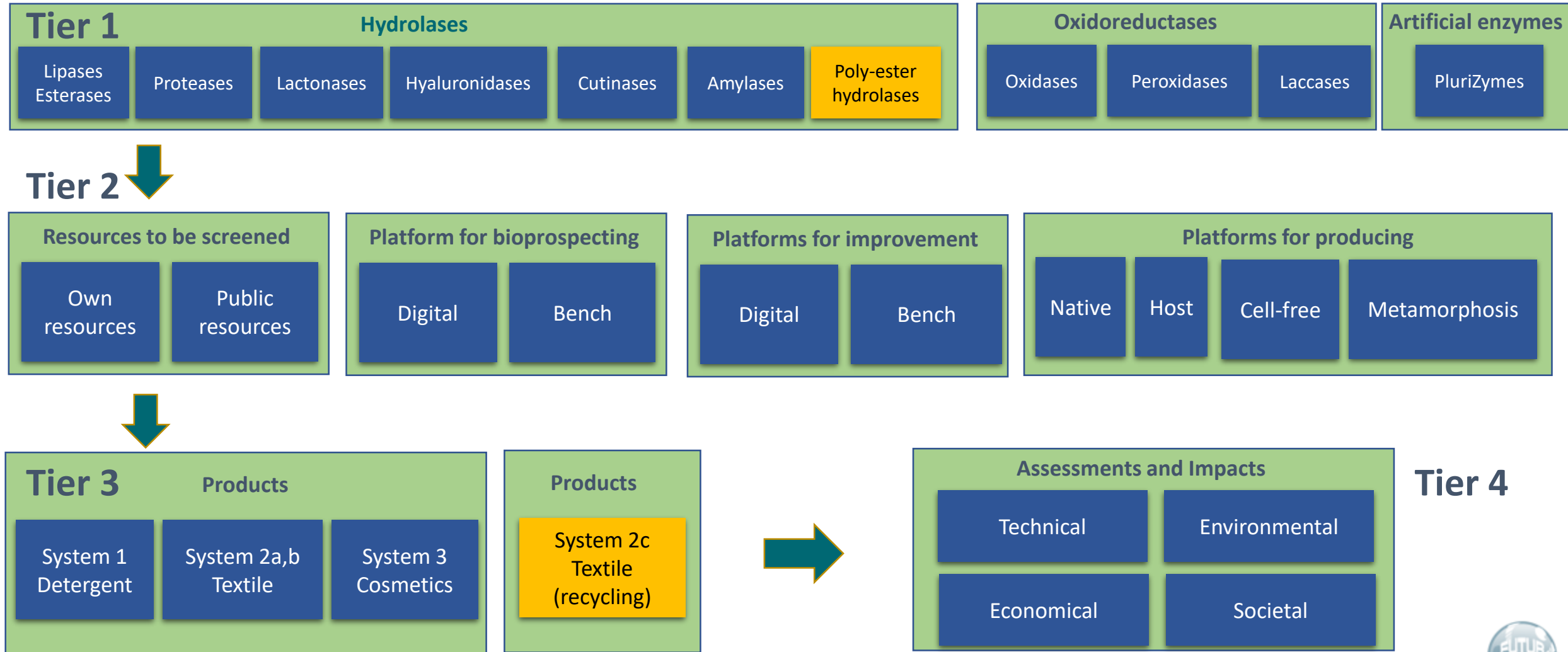


The FuturEnzyme key technical indicators





FuturEnzyme: main results achieved



The FuturEnzyme impact

Impact at the technical and technological level

Access to broad diversity

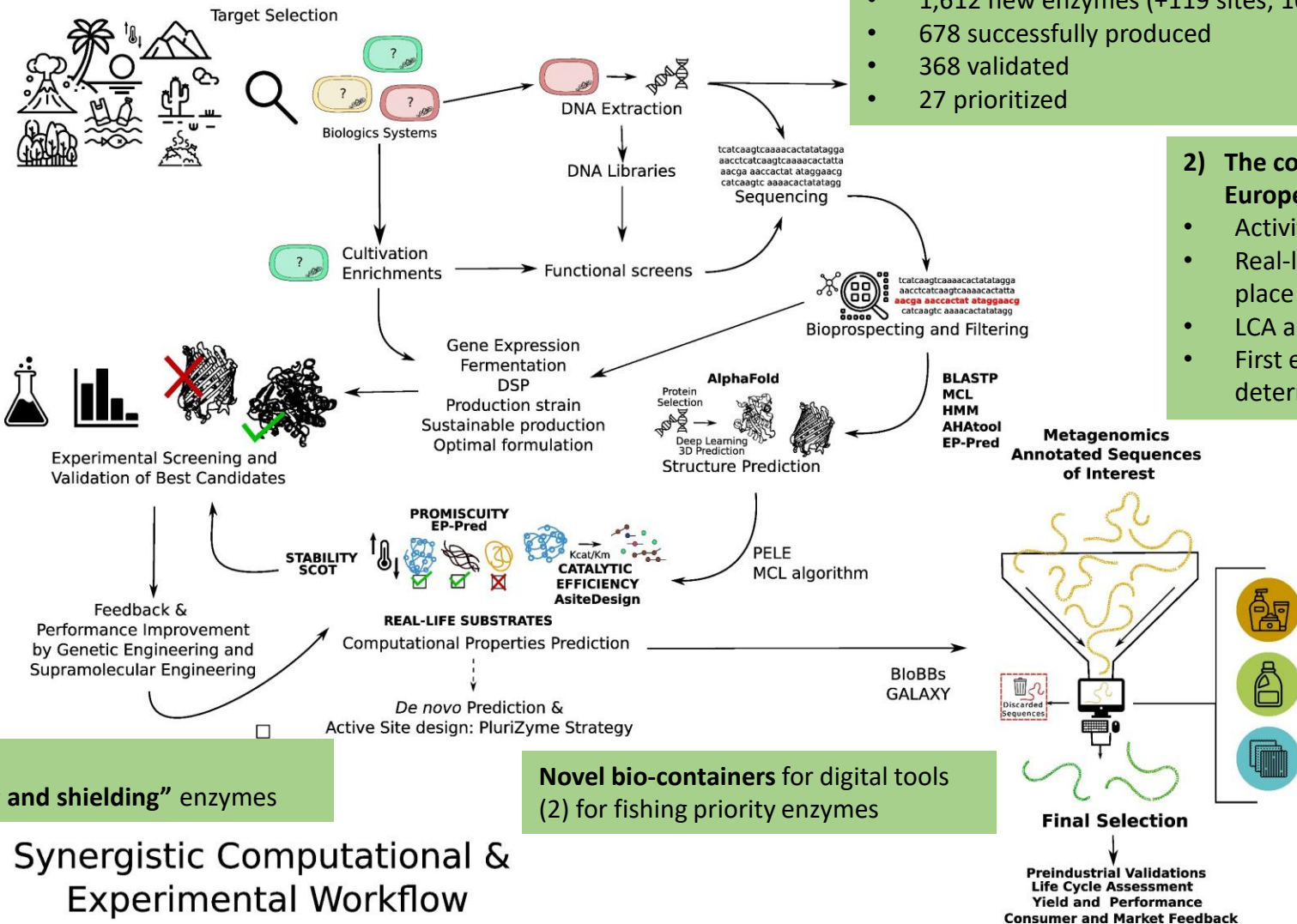
- +293 different locations
- +51 environmental samples
- +1700 isolates, +858 species
- +52 enrichments
- +42 clone libraries
- +223 genomes
- +64 metagenomes
- +400 million sequences
- +1 billion public sequences

Novel bench (34) and digital methods and algorithms (5) for enzyme bio-prospecting and pre-selection

Multiple expression systems, e.g. expression via in vitro, metamorphosis, plasmid design, fermentation optimization

Heuristic algorithm, AsiteDesign
Strategy for “fishing, immobilizing and shielding” enzymes

Novel bio-containers for digital tools (2) for fishing priority enzymes



1) Enzymes for consumer products with ↓ environmental impact

- 1,612 new enzymes (+119 sites; 100-37% homology)
- 678 successfully produced
- 368 validated
- 27 prioritized

2) The competitiveness and sustainability of European industry enhanced

- Activities and objectives priority & relevant
- Real-life products, priorities & needs on place
- LCA and experimental requirements set up
- First enzymatic tests (ongoing) will determine real impacts

Synergistic Computational & Experimental Workflow



The FuturEnzyme impact

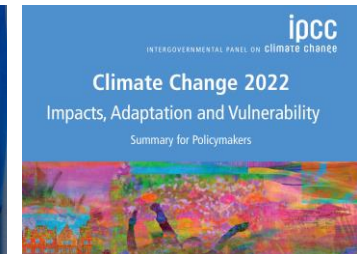
Impact at the policy level

- Efficient feedback into policymaking in research, innovation and technology
- A better framework for systemic innovation through increasing broad stakeholder engagement

- Large dissemination and communication network that allow approaching diver multi-actors
- We have implicated a member of a consumer organization (Altroconsumo) in our AB
- A Policy Working Group (PWG) built on the frame of the collaboration with other FNR-16-H2020
- The preparation of a policy document

FuturEnzyme's response and influence on EU policies, include at least the following

- Zero Pollution Action Plan, 8th Environmental Action Program, European Green Deal, Circular Economy Action Plan, 2018 EU Bioeconomy Strategy and Action Plan (EU-BS), EU Strategy for Sustainable and Circular Textiles, EU Blue Bioeconomy and EU Blue Growth, IPCC 6th Assessment report: Impacts, Adaptation and Vulnerability



Funded by the
European Union
NextGenerationEU





The FuturEnzyme impact



Impact on dissemination, communication and exploitation of results: Audience of at least 35,000 people

- Audience of at least 35,000 people, counting:

End-users	Dissemination, communication and exploitation channels
Broad audience	1 Website (Free access) – Done 1 on-line meeting platform (Task 8.2) – Done 5 Visual identity guidelines, pictures, artistic animations (Task 8.3) – +6 2 Film, film footage, comic (environmental+product... thematics) (Task 8.3) – ongoing 1,000 Social media (e.g. LinkedIn + Twitter, etc.) notes and events (including Open days) (Task 8.3) – 114 posts and 4 open days 40 Newspapers/Radio/TV appearances (Task 8.3) – 14
Scientific/academic community	100 Scientific publications & research datasets (Open Access) (Tasks 8.3, 8.6) – 21 1 Brochure – 1 1 Policy brief (Task 8.3) - ongoing 4 Scientific workshops (e.g. including RRI-based) (Task 8.4) – 2 1 Technical courses – ongoing 2 Training activity for secondary school students (Task 8.4) – 1 25 Scientific seminars/webinars/talks (Task 8.4) – 37 40 Presentations in conferences and workshops (Task 8.3) – 38



The FuturEnzyme impact



Impact on dissemination, communication and exploitation of results: Audience of at least 35,000 people

End-users	Dissemination, communication and exploitation channels
SMEs and industries operating in the biotech sector (also scientific and academic community)	2 Online software (Tasks 2.2 and 2.4) – ongoing 2 News technical bulletins and understandable practice abstracts (Task 8.3) – ongoing 2 Articles in scientific magazines (e.g. OUP blog) (Task 8.3) – 2 1 Conference – 4 3 Online webinars (Task 8.3) – 1 3 Patents (Task 8.5) – not corresponding yet 1 Brochure – 1





The FuturEnzyme impact

Impact on dissemination, communication and exploitation of results: Audience of at least 35,000 people

End-users	Dissemination, communication and exploitation channels
Consumers & Policymakers	1 Legacy leaflet (Task 8.3) – 0 2 Consumer briefings – 2 2 Policy briefings – ongoing, final stages 2 Articles in non-scientific magazines (e.g. Ambianta) (Task 8.3) – 1 3 Industry/market/consumer-driven Workshops (Task 8.4) – 0 2 Policy events (1 with other call-consortia) – 0 2 Roundtables (Tasks 8.4, 8.7) – 0 1 Public event “EU Green Deal aligned to Rights, Ethics, Equality” (Task 8.4) – 0 1 Customer analysis – 1 1 Consumer survey and product test (Task 8.5)
Networks of other actors and of the FNR-16-2020 call	3 Demonstration events (in science festivals, etc.): prototypes (Task 8.5) – 0 4 Exhibitions and tours (in science festivals, etc.) (Task 8.3) – 0 2 Inter-consortia networks (Tasks 1.2, 8.7) – 2 (PWG, TheActiveSite)
Intra-consortium members	4 Exploitation workshops involving 7 operational groups ⁴ (Task 8.5) - 2



The FuturEnzyme impact



Impact on training, recruitment, gender dimension, internationalization activities

- The project has had a significant impact in **training** a new generation of scientists

- PhD completed: 3 (2 m, 1 f)
- PhD in progress: 11 in total (6 f, 5 m)
- Master Thesis completed: 1(f)
- Master Thesis in progress: 5 in total (4 f, 1 m)
- Bachelor Thesis completed: 1 (f)
- Gender ratio: 62% (f)



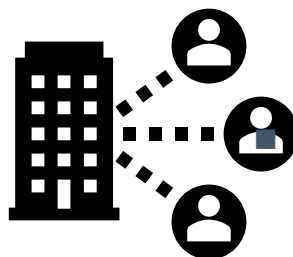
- The project has also had a significant impact in terms of human resources **recruitment**

- 1 Project manager and 14 researchers
- Gender ratio: 60% (f)



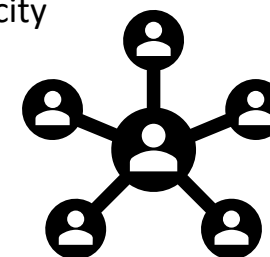
- It is also remarkable the impact on **gender dimension**

- Guarantee an equal gender ratio among project participants.
 - Initial gender ratio 46% female and after recruitment 50% female
- Events to promote gender equality
- Evaluating consumers' behavior by gender
- Graphic material preparation



- The project has also had a significant impact in terms of capacity to access new sources of **funding** (Funding: EU and national)

- Horizon Europe: 6
- National: 10
- Cooperations: 6



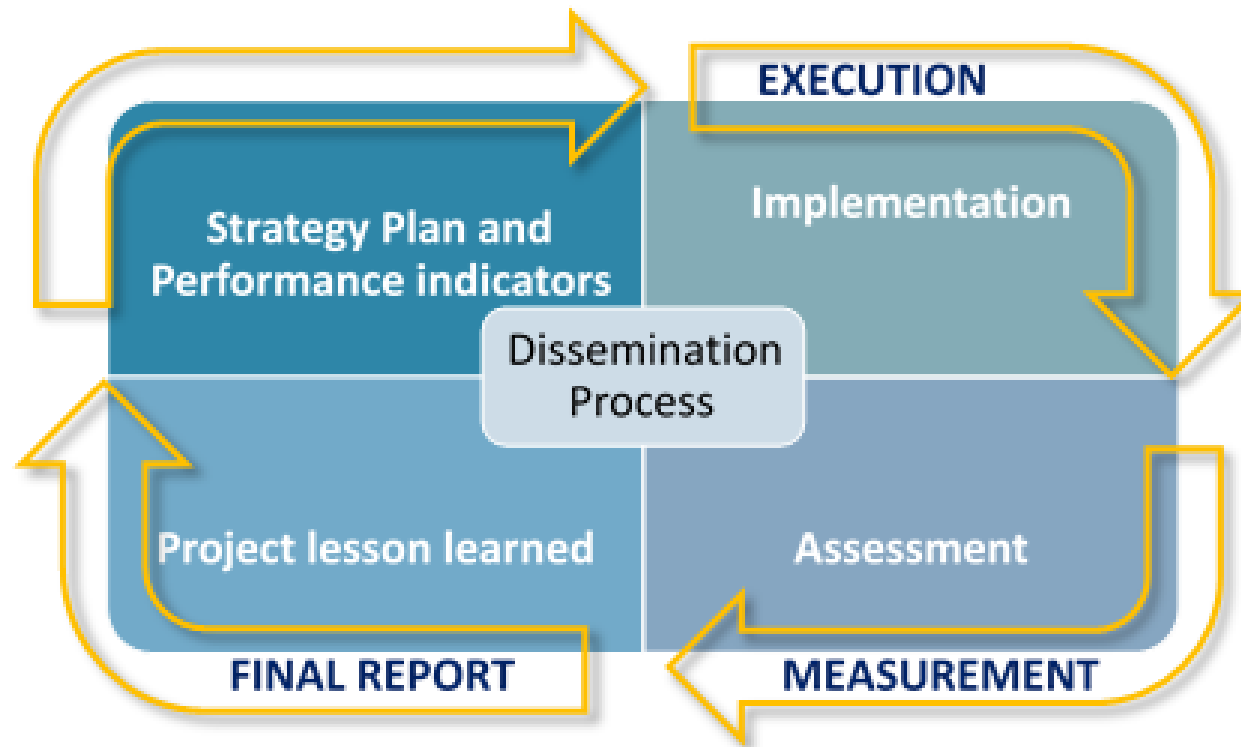
- The project has also had a significant impact for **collaborations**

- +16 international collaborations
- +34 consortium collaborations



The FuturEnzyme dissemination plan

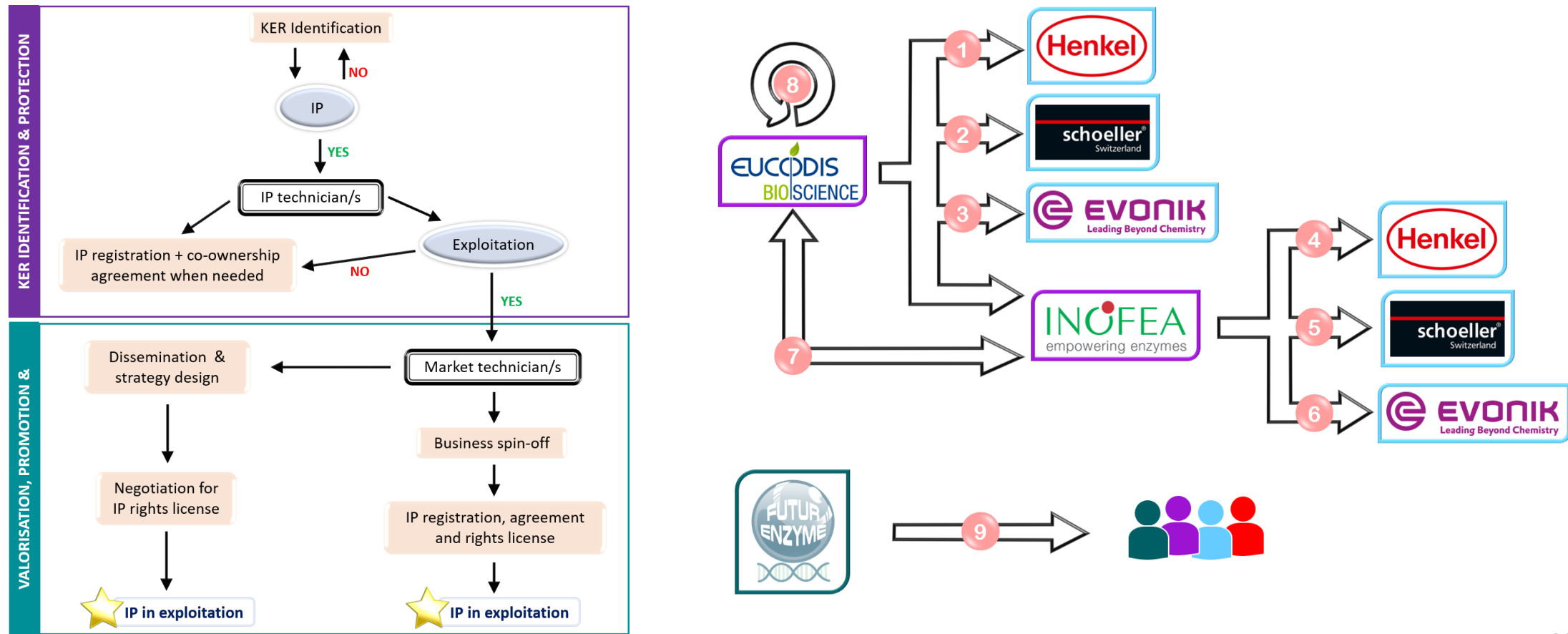
- A plan for using, communication and disseminating project information and knowledge (D8.3 at M3; Scheme 1), prepared and submitted.





The FuturEnzyme dissemination plan

- An Exploitation Plan (D8.6 at M12) prepared and submitted.

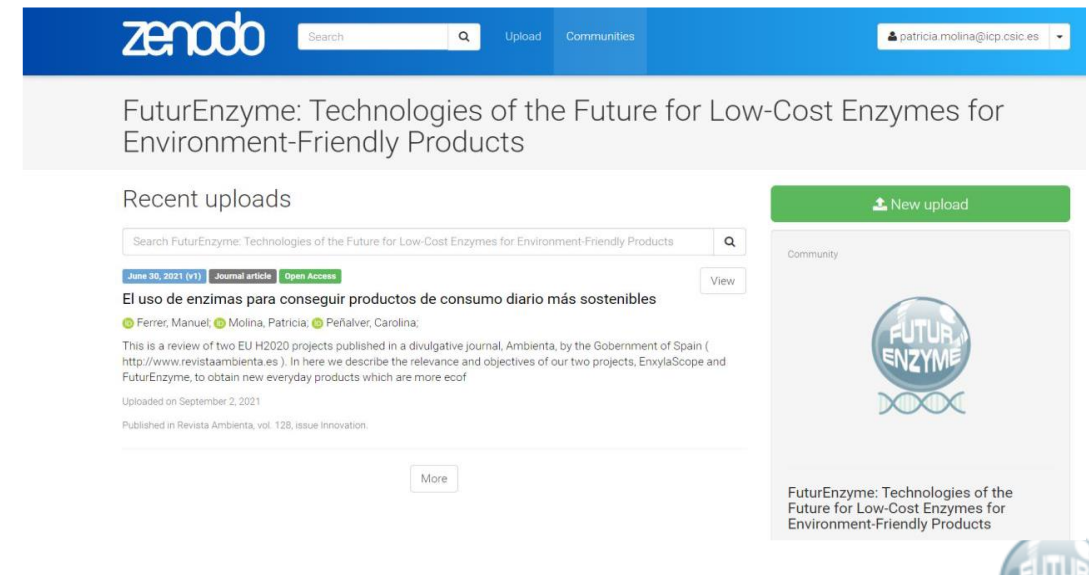
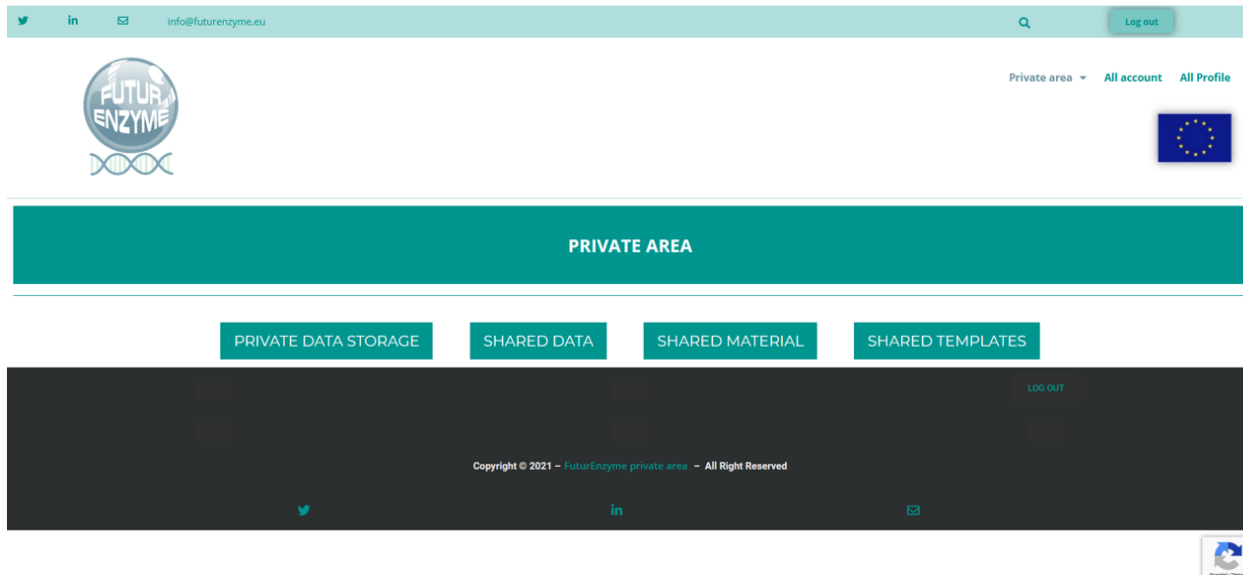




The FuturEnzyme data management plan



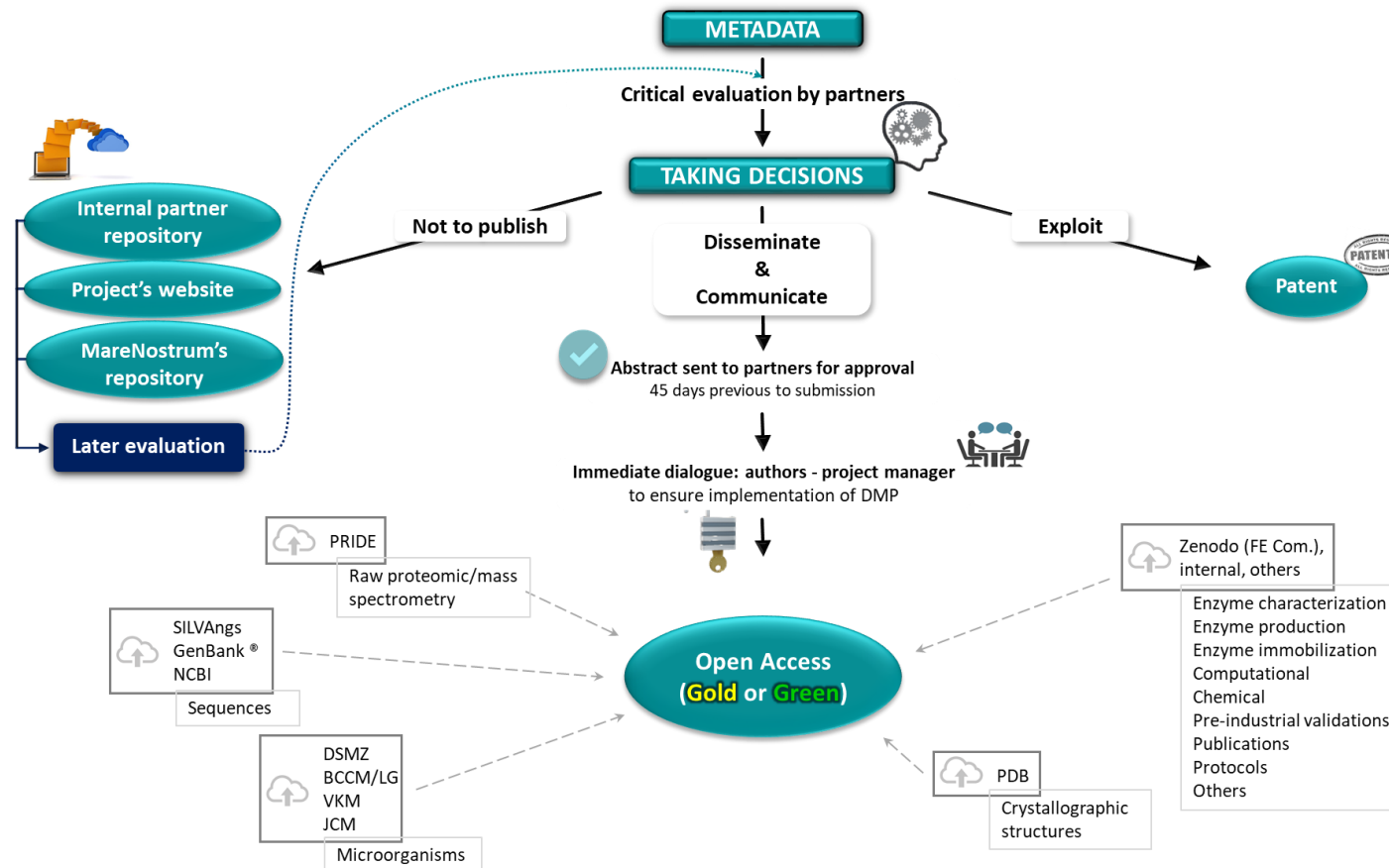
- A Data Management Plan (D8.4 at M4), was prepared and submitted.
 - Main repositories/databases for managing FuturEnzyme's data, metadata and information
 - Private area of the project's website.
 - Repository in MareNostrum 5 Supercomputer (BSC). 15 TB of storage. The storage space is granted free of charge offered by the European Commission, provided by the EOSC project [DICE](#)
 - The Zenodo Community FuturEnzyme





The FuturEnzyme data management plan

- A Data Management Plan (D8.4 at M4), was prepared and submitted; no update is needed.



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