

# Scion – Developing Commercial polymer solutions

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Alec Foster

# Development of Bioplastics

From Feedstock to product



# From art, to polymer products to opening pilot plants



**NEW INSIGHTS: BIODEGRADABLE APPLICATIONS, SUSTAINABLE BIOTECH, AND INNOVATIONS**  
October 10-11, 2022

Heidi, Angela, Sarah, David

With Amanda Pua Emmons, the PUK Application Development Officer

with Christophe Collet and 5 others

**SOON** 14,015 followers  
1hrz

Scion's collaborative work in French Polynesia is an example of solution-focused thinking and partnership.

**Rob Whitton** • 1st  
Team Lead, Additive Manufacturing and Emerging Technologies  
1hrz

Many thanks to **Nabila Mazroui**, **Tuhea R.**, **Margaux Crusset**, and **Christophe Delpont**, for hosting us during the recent deployment of the BioPlate oyster collectors. It was fascinating to see how pearl oysters are farmed in Frei ...see more



## Potential bioplastics plant for Marton gets Government research funding



Regional Economic Development Minister Shane Jones announces funding for initiatives in the Horowhenua region. Photo: iStockphoto

## NZ Expo in Dubai features David Trubridge biomaterial pendant by Scion



The Biomimetic pendant light. Photo: iStockphoto

**SOON** 14,015 followers  
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**WINDTRENDS**  
Christchurch-based PolyNestl is set to export biodegradable vine clips to fully eliminate non-recyclable vine clips for more sustainable practices on their ...see more

**Kiwi-made eco-friendly vine clips going global**  
1hrz



**A VINE IDEA**  
Thirty million. That's how many conventional vine clips are used by the New Zealand wine industry every year, and they're generally plastic. Employed to hold onto over-ripening grapes to keep out birds, the clips eventually fall to the ground, creating piles of non-degradable plastic litter - not a great look for an industry wanting to adopt more sustainable practices. Enter Christchurch-based biotech outfit PolyNestl, which has commercialised a biodegradable vine clip after a long research journey in partnership with Crown Research Institute Scion. The new 100 percent bio-based clip is a material that comes from waste generated by wood processing, and will fully degrade, given the right soil conditions. Following successful trials by a number of New Zealand winemakers, the eco-friendly vine clip is poised for export, with the South Australian wine industry first cash off the rack. [@polynestl](#)

**SOON** 14,015 followers  
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This week in Bioplastic Week

Scion is a global leader in fibre-based and protein-based packaging innovation

**New biodegradable plant pots offer alternative to plastic trays**  
1hrz

**Stuff** environment

**Plentyful options for plastic packaging alternatives**

GreenSpace Global Association Award Ceremony celebrates Scion's work in Dunedin on Thursday

A viable alternative to plastic packaging will soon be produced in Rangitikei.

**COMIFORME** BIODEGRADABLE POLYESTER

**Engineered Wood Fibre for the New Generation of Biocomposites**

Comiforme, the engineered alkyl poly(ester) fibers, exceptional reinforcement to Polypropylene composites.

**Paeroa's world first: Seaweed nanocellulose facility announced for AgriSea**

1hrz

## Scion innovation leads to flexible 4D printing filament



**Scion** 17 Nov, 2022 (1:41 PM) 17 mins to read

Our biodegradable 4D printing filament named 'scipol' is the world's first thermochromic and flexible, meaning it changes color from black to yellow. ...see more

**Children probing natural solutions to big problems**

November 10, 2022 • by Bioresources



# La BioMATA – Associated lab for biobased resources for Products of tomorrow.



## Scientific cooperation extends biobased research

Home • About us • About Scion • Corporate publications • Scion Connections • Past Issues  
• Scion Connections Issue 43, June 2023 • Scientific cooperation extends biobased research



Dr Claire Mayer-Laigle (left), pictured with Dr Marie Joo Le Guen, has been working at Scion on a three-year research programme exploring the use of plant material in 4D printing.



# Chemicals and Polymers will be impacted by Biotechnology and genetic engineering

NEWS | SUSTAINABILITY

## Biden Order Aims to Replace 90% Fossil-based Plastics with Bio-based Polymers

A new report from the White House details President Biden's executive order on biotechnology and biomanufacturing, which will significantly impact petroleum-based plastics for packaging.

By — Anne Marie Mohan

Apr 20, 2023

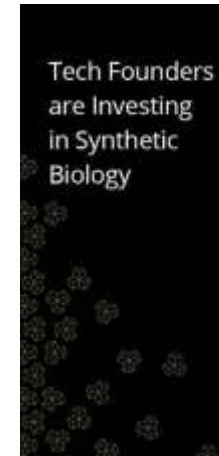


Executive Order 14081 from President Joe Biden calls for displacing 90% of today's petroleum-based plastics with recyclable-by-design bio-based polymers over the next 20 years.

### LEADERS — IN PACKAGING 2024 —

#### SUSTAINABILITY

- Aagard
- Amcor Flexibles North America
- BELL-MARK
- Brenton
- Busch Vacuum Solutions
- Charter Next Generation
- Clysar, LLC
- Columbia Machine, Inc.
- Douglas Machine Inc.
- Econocorp Inc.
- EDL, a Massman Company
- FANIR America



Projects | November 15 2023

## Carbios' PET Biorecycling Plant, Longlaville, France

Carbios is developing the world's first PET biorecycling plant in Longlaville, France.

# New Zealand needs to adopt alternatives to petrochemical products and reduce CO<sub>2</sub>

## First Shoe Made from Carbon Emissions

© 16 September 2022



- Generation of renewable monomers
- Generation of natural polymers
- Enzymatic recycling
- Carbon neutral or negative products

# Generating Nylon from CO<sub>2</sub>



The technology exists and it is scalable

# Scion is rapidly shift focus on biotechnology



- Helping SMEs go to Pilot scale
- Expanding the team
- New Equipment
- New Labs
- International collaborations and research bids (Sweden, Finland, Iceland, France, UK, Australia).
- Developing new microbes, fermentation processes, GE tool kits.



Scions Industrial fermentation team who are supported by broader group of bioinformaticians, chemists, and bioprocess engineers



# Industrial Biotech Open innovation approach



- IngENZA Company that developed Ginkgo Bioworks primary genetic toolkit
- RISE large libraries
- University of Sheffield as they are developing toolkits non model organisms.
- CSIRO AI/foundry for enzyme engineering
- CPI who scaled Calysta fermentation process and VAXA who have scaled geothermal gas fermentation process.
- Professor/Entrepreneur who headed up research at Google DeepMind and expert in modelling.
- University of Nottingham as best in class C1 fermentation and have some genome scale models

# Biggest barrier is cost – We need new non-model microbes

- Most biotech polymers from sugar only make sense when oil >\$100 per barrel. There need to decrease cost of feedstock.
- Big focus upon scale and commodity materials. Low cost, high volume feedstock.
  - Gas fermentation (CO<sub>2</sub> and CH<sub>4</sub>) :
    - Feedstock consistency, ease of downstream processing, and availability (Geothermal, Chemical manufacturing, Biogas)
  - Primary Industry and Plastic waste:
    - Wood Sugars, Dairy industry, Coffee waste, Various lignocellulosic agriculture waste streams, utilising enzymes to break polymers back into monomers.

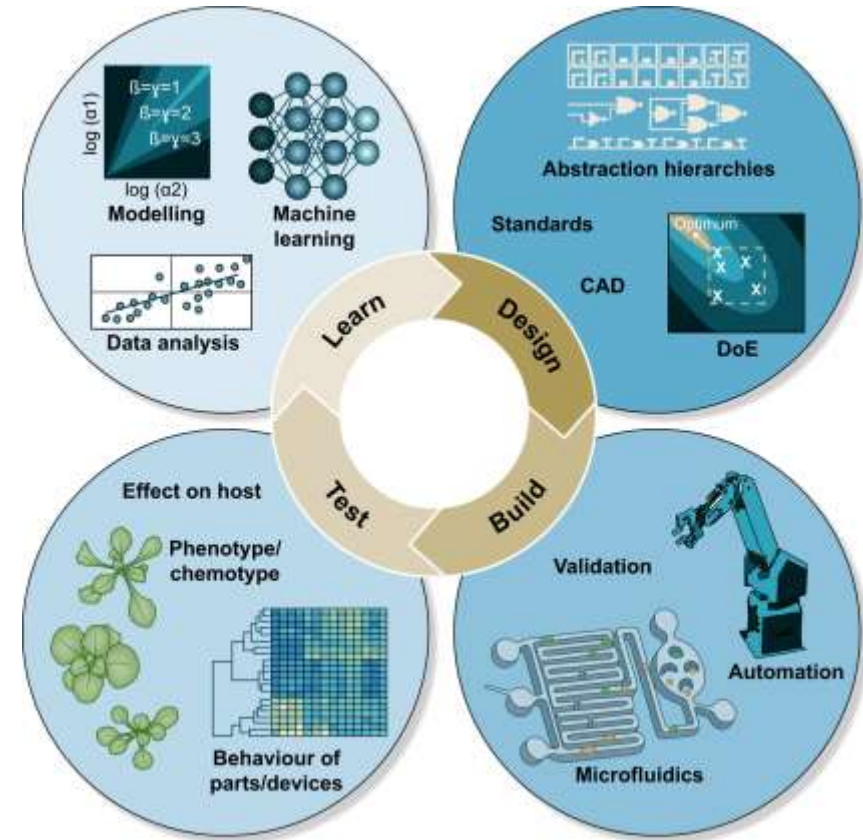


# Why now ? (Synthetic Biology) and a glimpse of technologies we are implementing at Scion)

Cost of DNA technologies

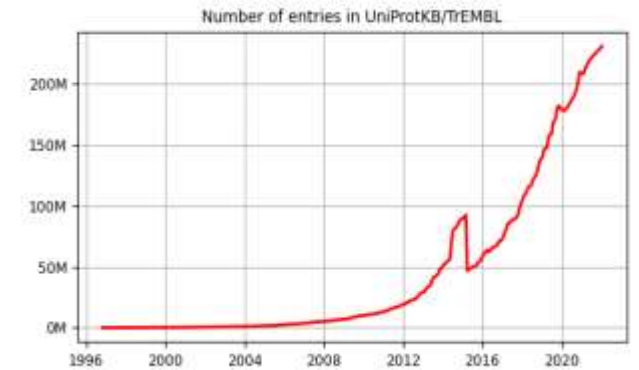
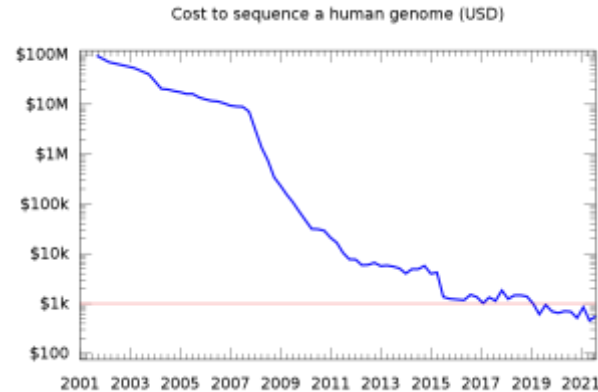
Convergence of:

- Biology and Engineering
- Biology and Computer Science
- Biology Chemistry and Data Science
- Biology and Automation
- Biology and AI



# Cost of DNA Technologies

- Moores law is the principle that computing power doubles every 2 years. Biology is far outstripping that.
- Today human genome sequencing costs just \$399 USD, down from \$100M USD 20 years ago.
- Home/school DIY kits for \$179 to insert jelly fish DNA into yeast.



**Genetically Engineer Any Brewing or Baking Yeast to Fluoresce**  
\$499.00-\$179.00

**klarna** 4 interest-free payments of \$44.75. [Learn More](#)

(No reviews yet) [+ Write a Review](#)

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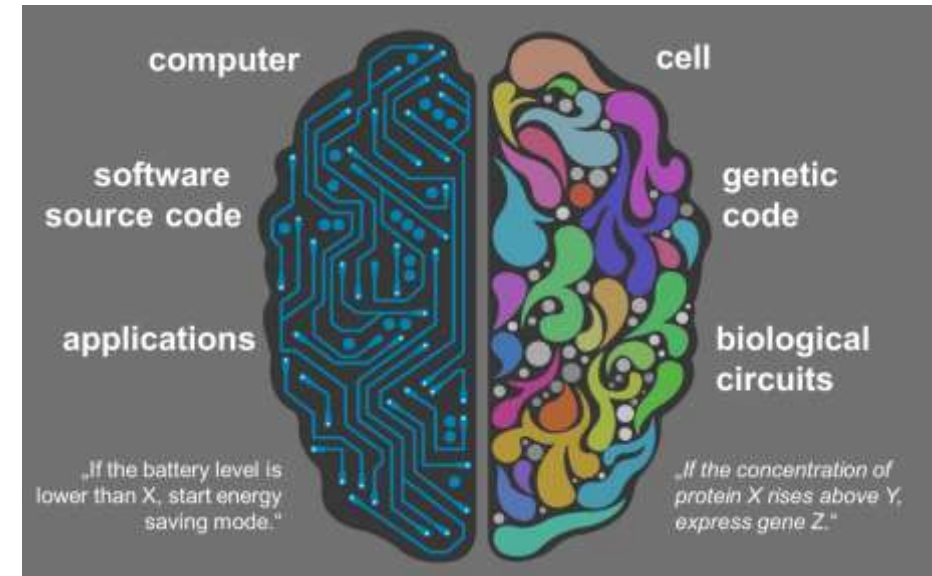
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f e t in p

# Convergence of Biology and Engineering

- Engineering is about using DNA as parts. Start using logic gates. “IF, AND OR”
- Engineering is about standardisation. A standard reusable tool kits.
- Standardisation enables true apples to apples comparisons to be made.
- Standardisation unlocks automation

**We can now program our cells (DNA) like we program a computer (Code)**



*“DNA is like a computer program but far, far more advanced than any software ever created.”*  
Bill Gates



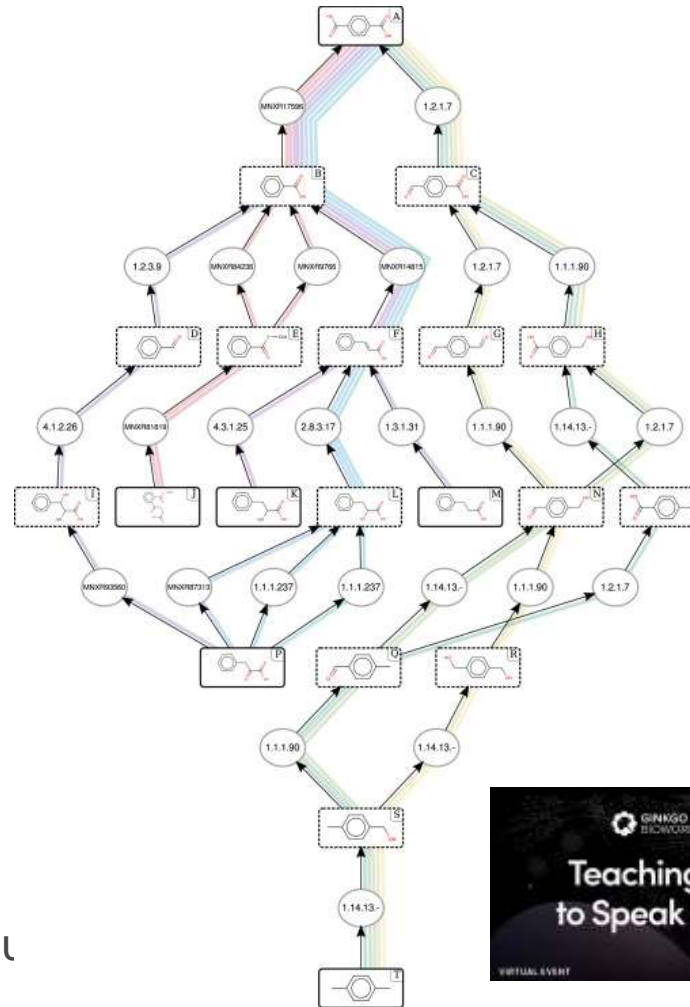
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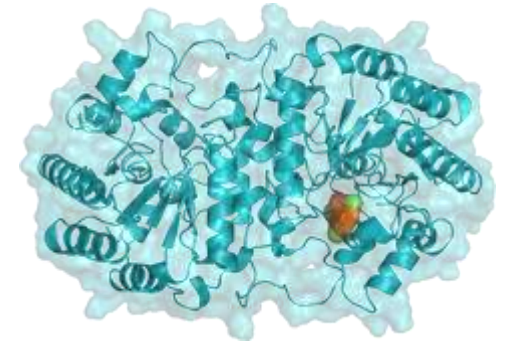
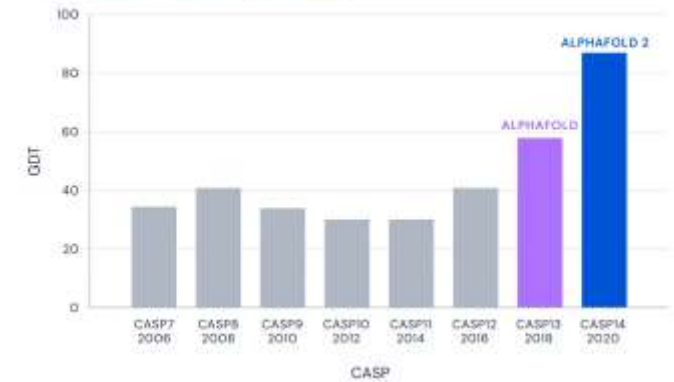
E.g. Can swap in different blue bricks easily

# Convergence of Biology and Artificial Intelligence

- AI that allows the prediction of protein structures almost as good as experimental data
- AI can predict and design new pathways that don't exist in nature.
- Ginkgo Bioworks in announced partnership Google in September 2023 to use LLMs.
- Loop Learn, design, build test cycle automatically – That same standardisation enabling AI.
- Working with Australian research institute to combine AI and mutations with high throughput biofoundry.



Median Free-Modelling Accuracy

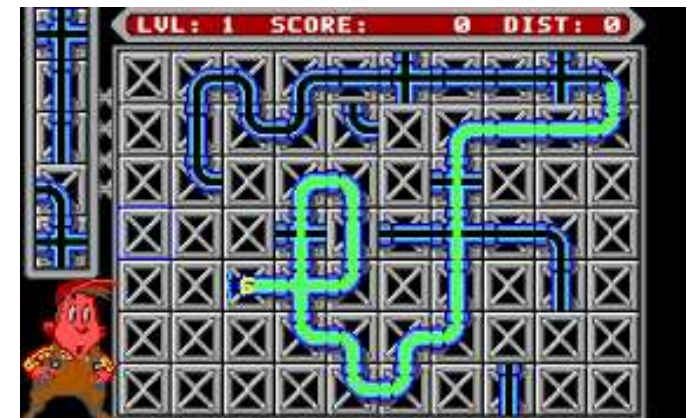
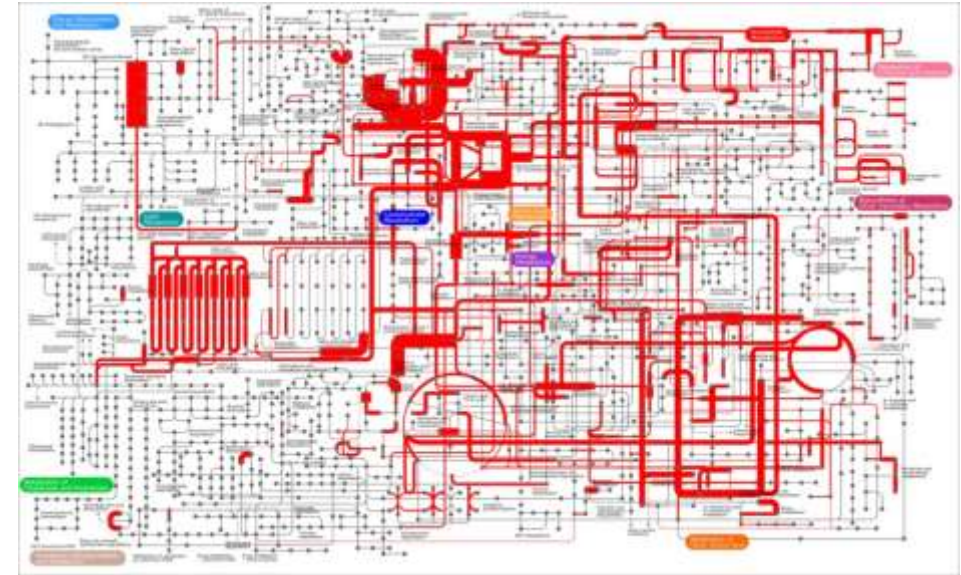


**'It will change everything':  
DeepMind's AI makes gigantic leap  
in solving protein structures**

Google's deep-learning program for determining the 3D shapes of proteins stands to transform biology, say scientists.

# Convergence of Chemistry, Biology and Data science

- We can measure every single chemical reaction in the cell . Thousands of them.
- We can measure every single gene that is turned off and on.
- If we plot them on a map, we can see and follow where the carbon and energy is going (just like a pipe)
- Using computers we can create models where we predict the butterfly effect of deleting a gene or adding a gene.
- We can target specific monomers. We have five in the pipeline



# Convergence of Biology and Automation

Standardisation, reusability, reduction in cost ultimately enables miniaturisation and automation.

Miniaturisation and automation lead to step change in throughput.

Example in practice. 3 years ago

- 20,000 enzymes screened
- 1000 pathway combinations built.
- Performed 200 fermentations

Achieved in 6 months

Scion is partnering with research centres in Sweden, Australia to do this.





# Fermentation Scale up

- To our knowledge the largest polymer fermentation run in New Zealand. 1000L run at Callaghan of polymer PHO. (still too small)
- A biodegradable polymer, made from waste
- Reliable transformation of methods from
- 250ml through to 1000L
- Next step is 10,000L run in the EU



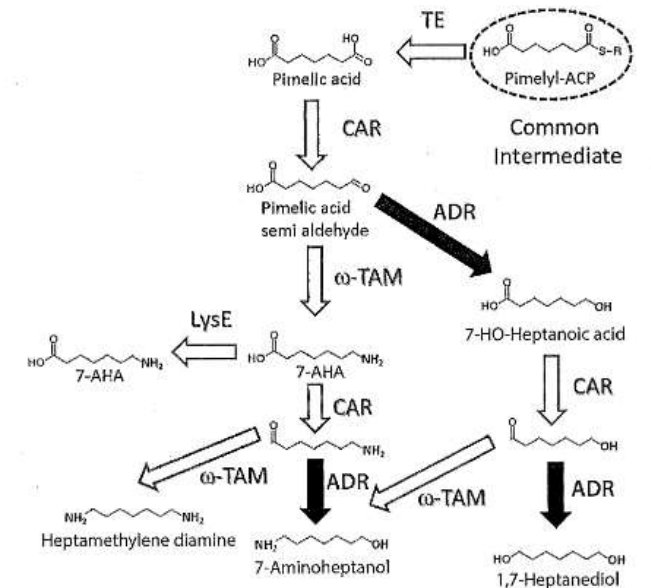
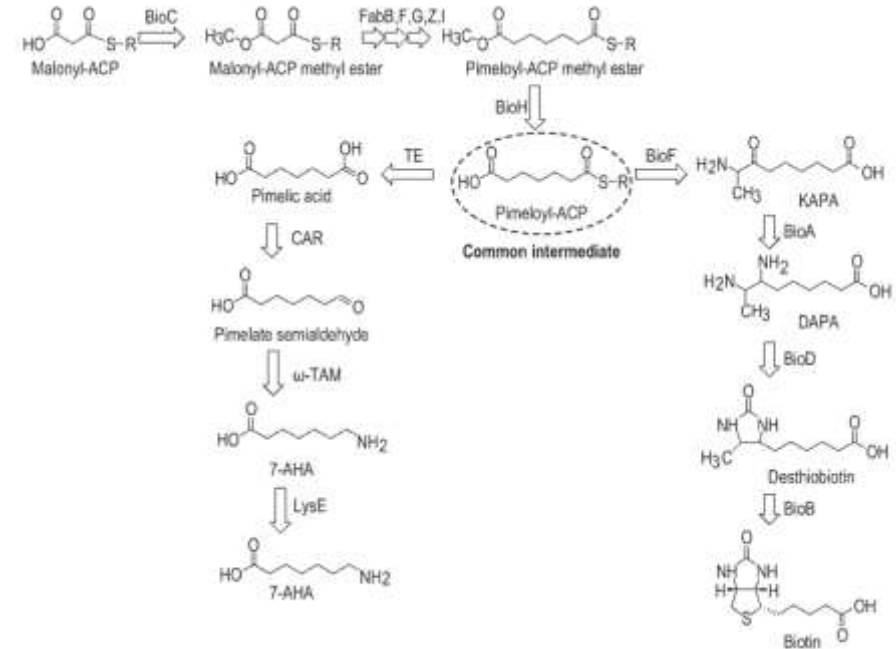
# Key targets to meet

- Productivity (grams of product, per litre, per hour)
- Product Titre (Concentration in the reactor)
- Yield (How much of feedstock converted to product)

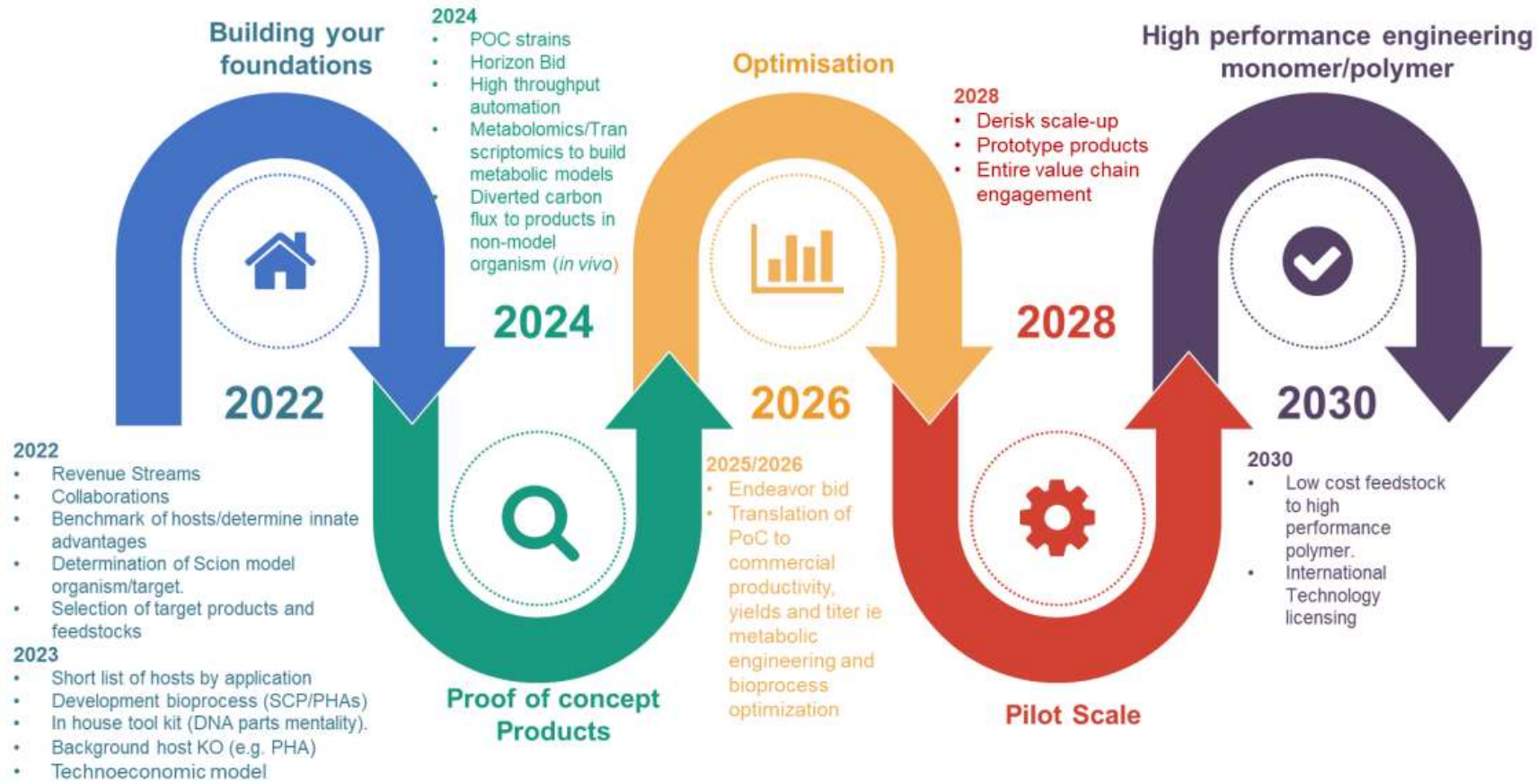
Different challenges from inhibitory concentrations, to diverting carbon flux

# Real Life Example:

- Pathways for making Nylon don't exist in nature (7-Carbon Nylon can't be made petrochemically)
- Designed new pathways, Designed new Enzymes, Developed new tool kits for non-model host.
- Knocked out 56 target aldehyde reductase and/or aldehyde dehydrogenase !
- Scaled to 100,000L from CO<sub>2</sub> and H<sub>2</sub>



# Scion Road map for novel polymers



[www.scionresearch.com](http://www.scionresearch.com)



Prosperity from trees *Mai i te ngahere oranga*

Scion is the trading name of the New Zealand Forest Research Institute Limited