

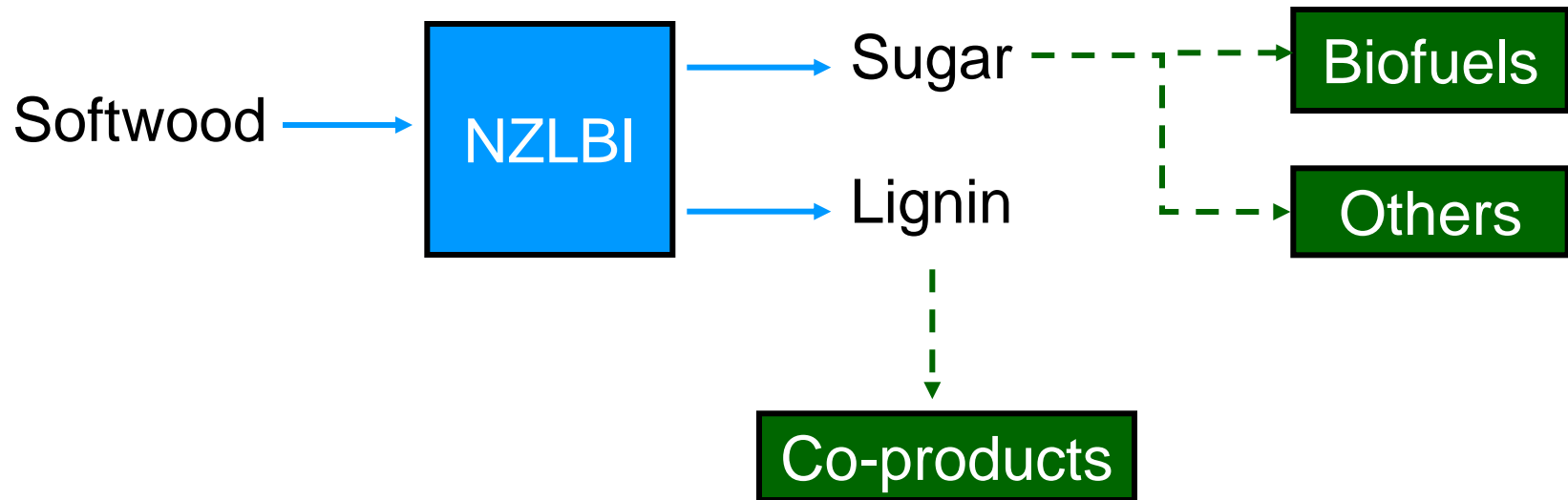
Improving Saccharification of Pretreated Radiata Pine in NZ Lignocellulosic Biofuel Initiative

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New Zealand Lignocellulosic Biofuel Initiative

Aim: Demonstrate cost effective and environmentally sustainable conversion of **softwoods** to monomeric **sugars** and functional **lignin** using a proprietary process



Turning biomass into biofuels – biochemical route



**AGRONOMICS
BIOMASS
COLLECTION**



PRETREATMENT



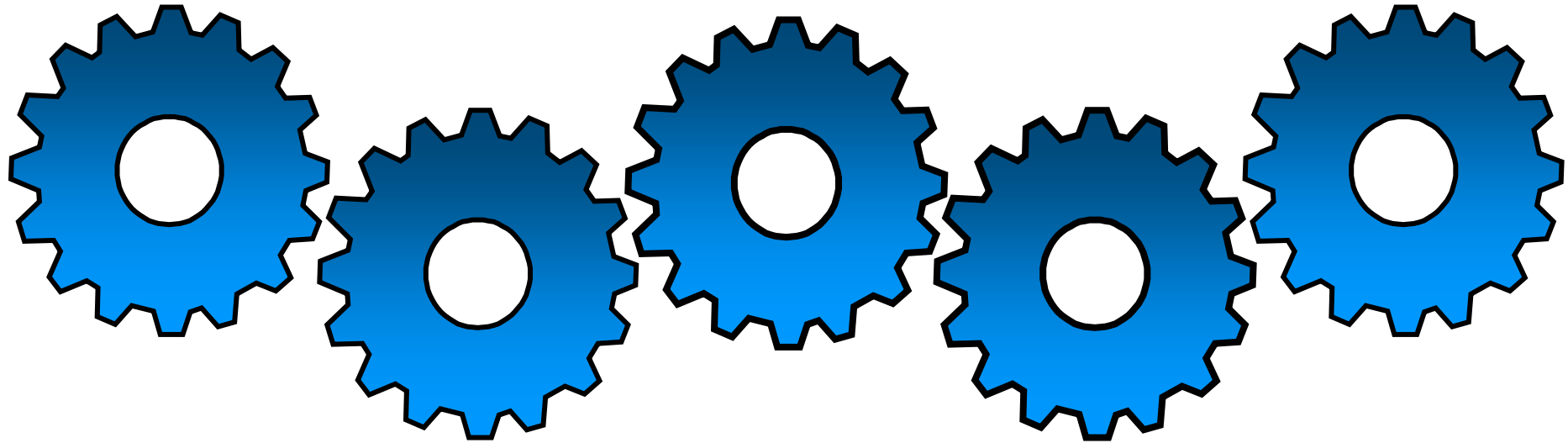
**ENZYMATIC
SACCHARIFICATION**



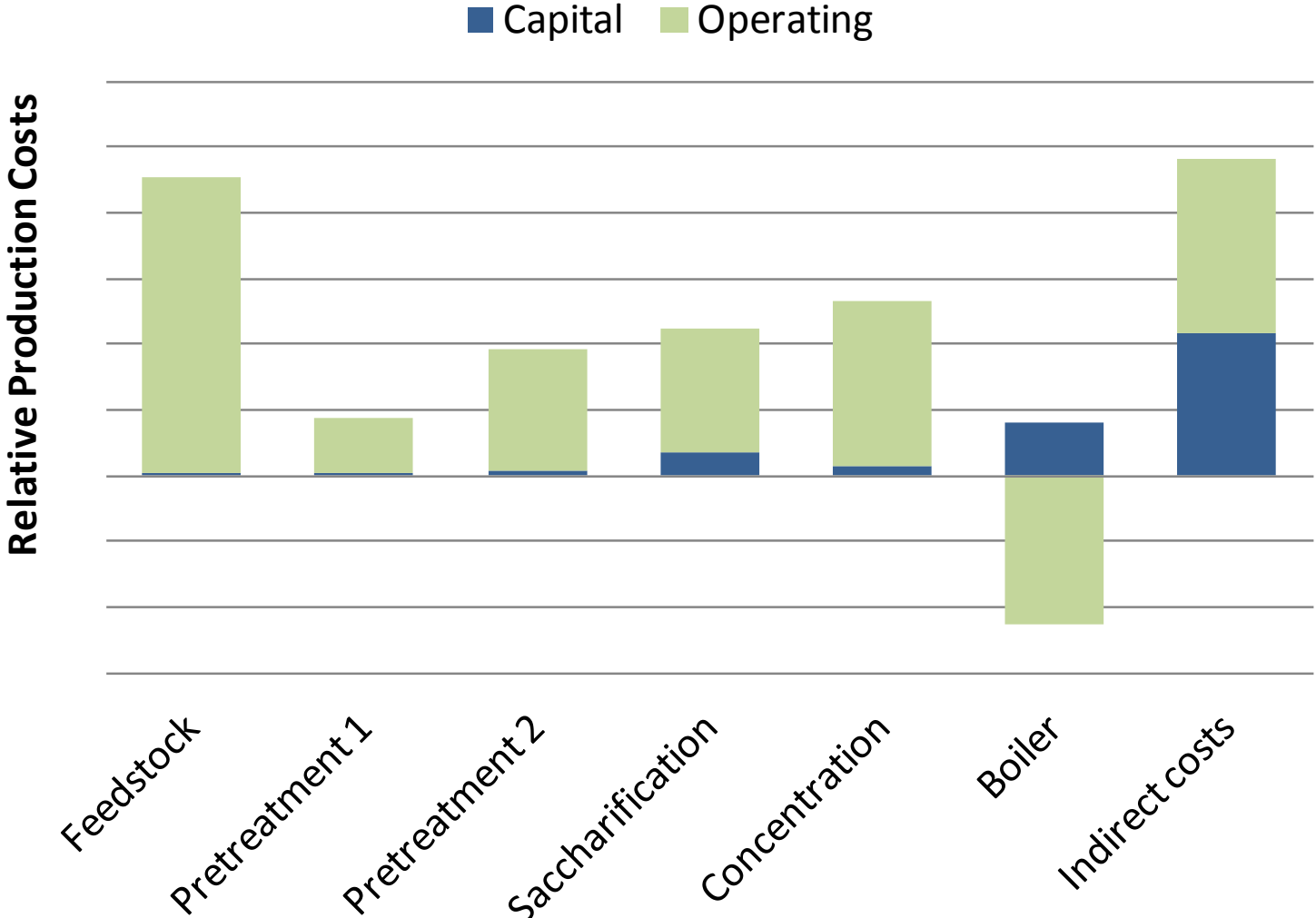
FERMENTATION



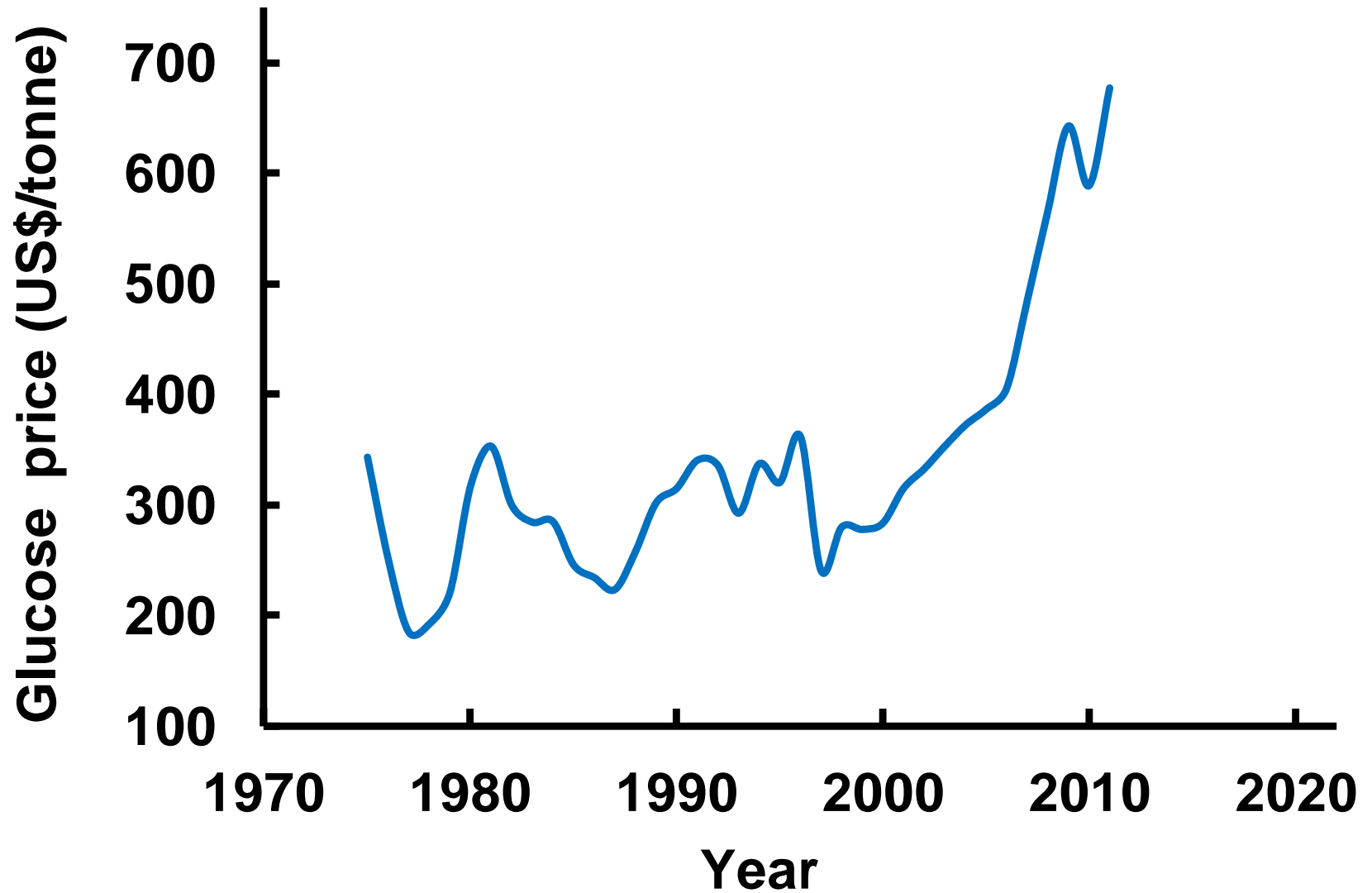
DISTILLATION



Breakdown of sugar production costs



Glucose syrup prices

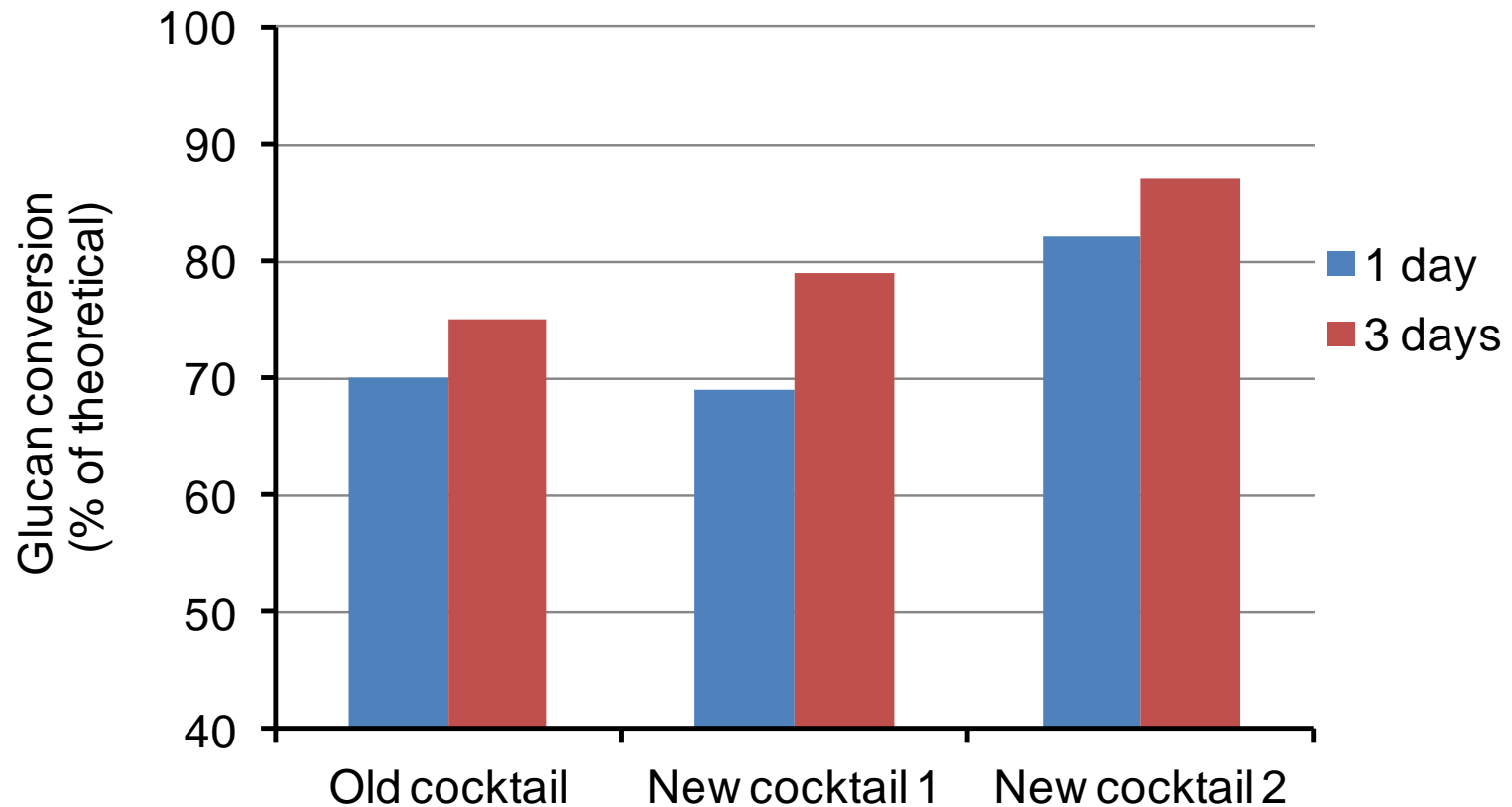


Cost reduction opportunities

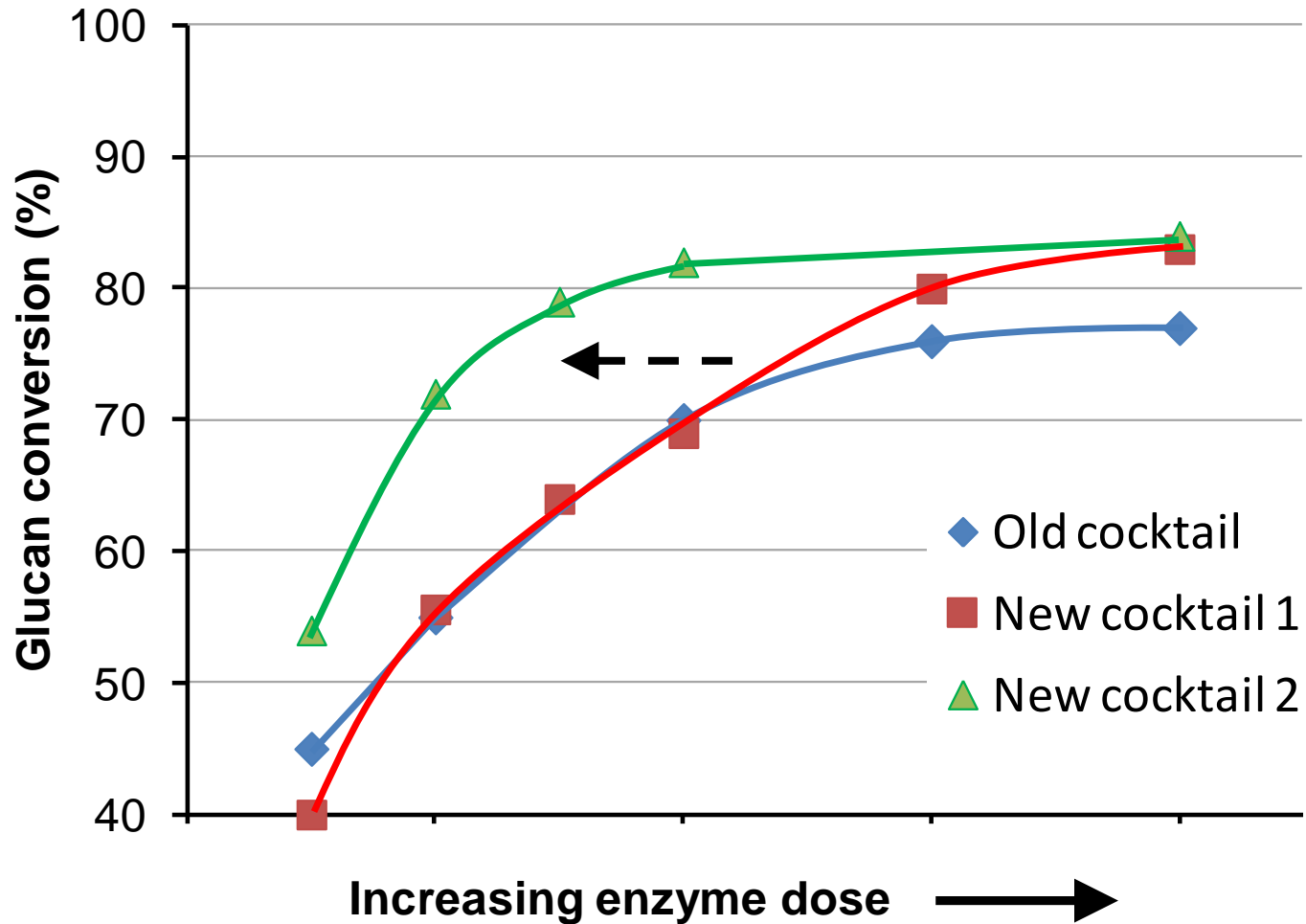
- Increase sugar yield
- **Lower enzyme usage**
 - ▶ Use of additives
- Reduce pre-treatment costs
- Develop value from co-products e.g. lignin



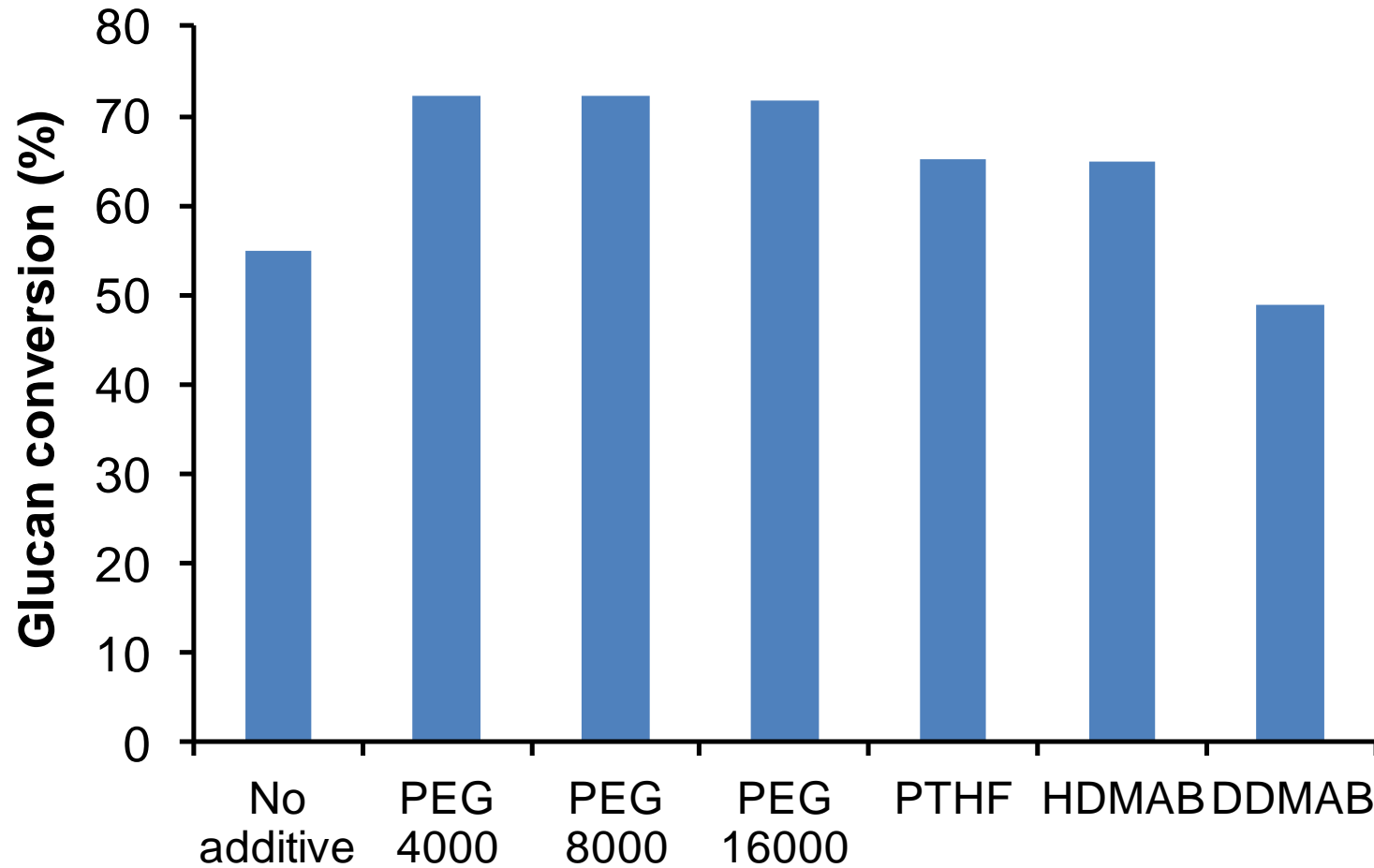
Increase sugar yield - newer generation enzymes



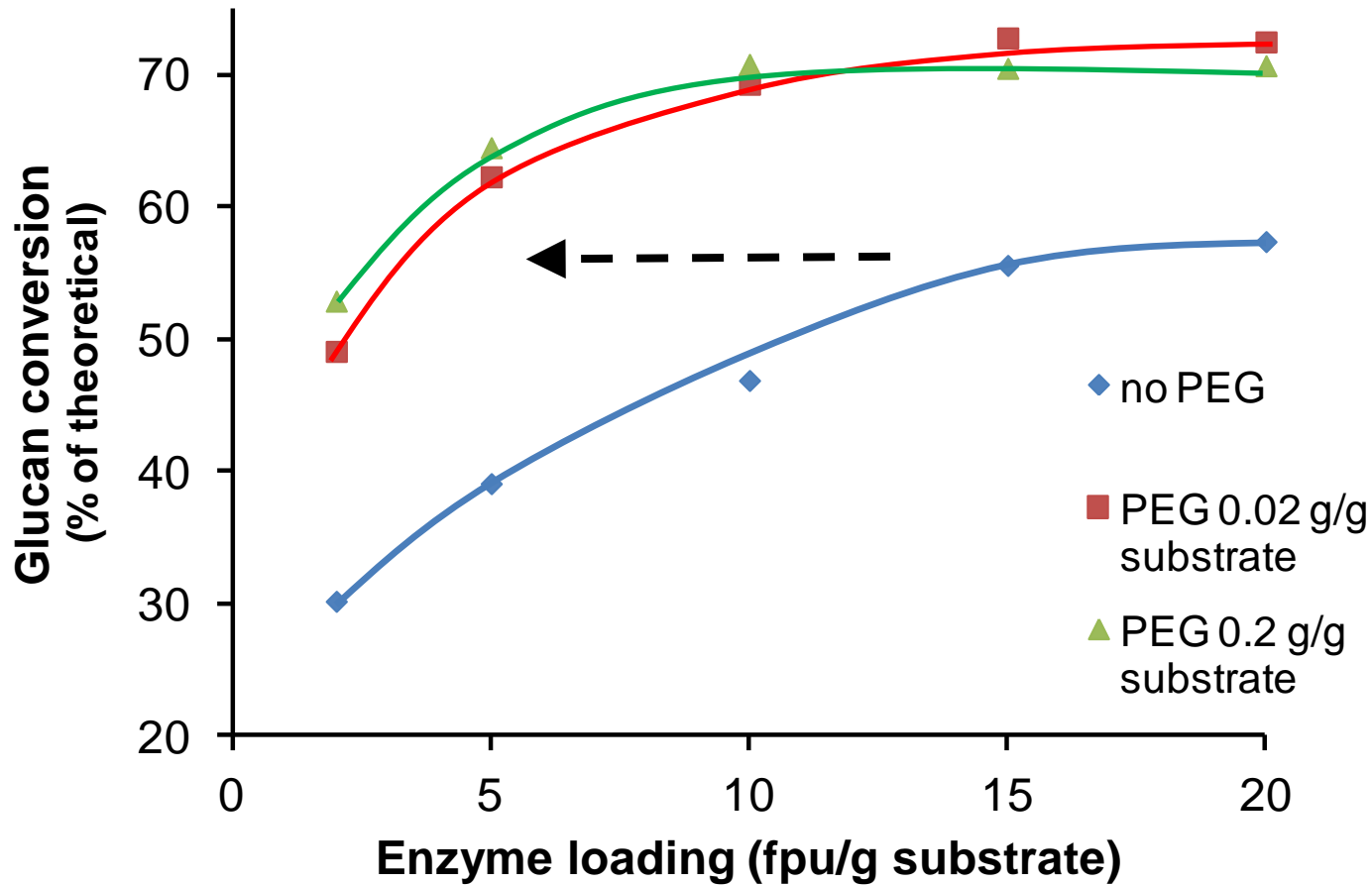
Lower enzyme usage - newer generation enzymes



Increase sugar yield - additives

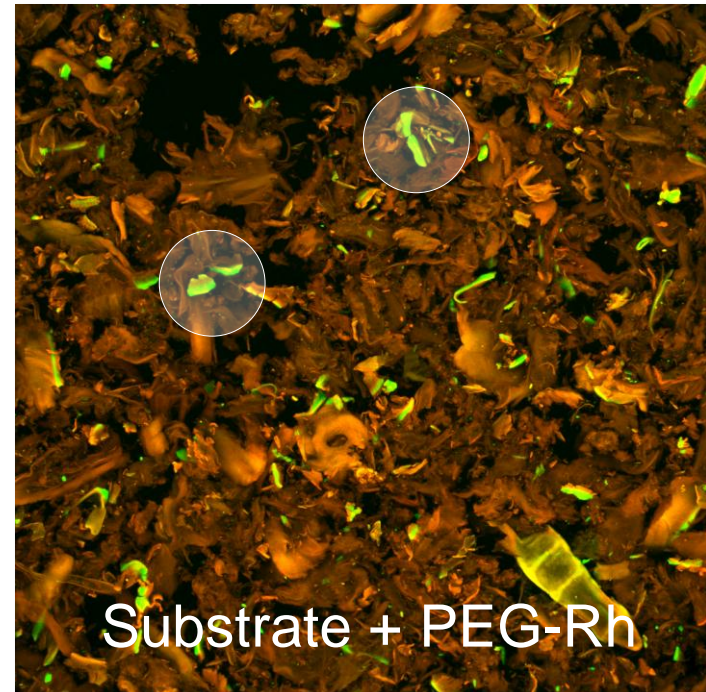
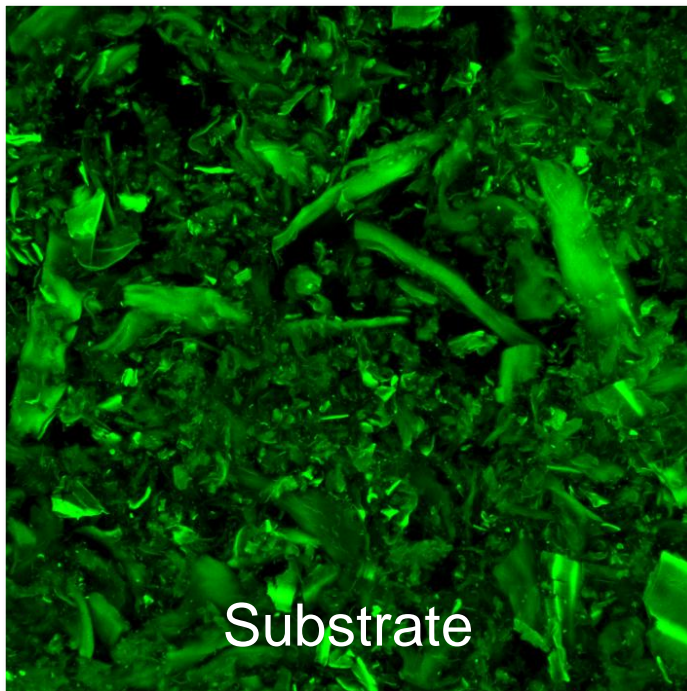


Lower enzyme usage - PEG

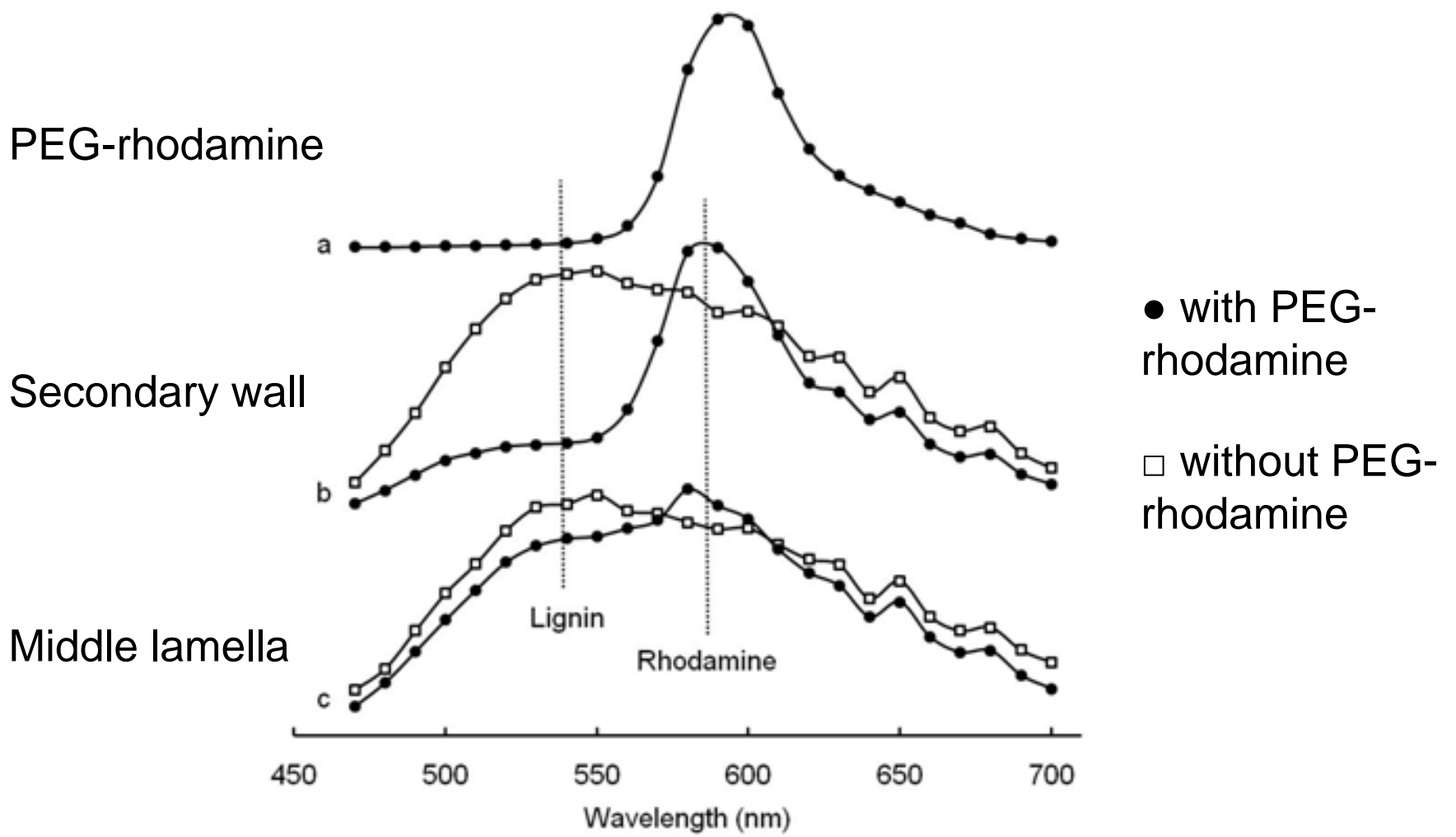


Interaction of PEG with substrate

- Using fluorescence microscopy
- Rhodamine-labelled PEG
- PEG binds to secondary wall but not the middle lamella

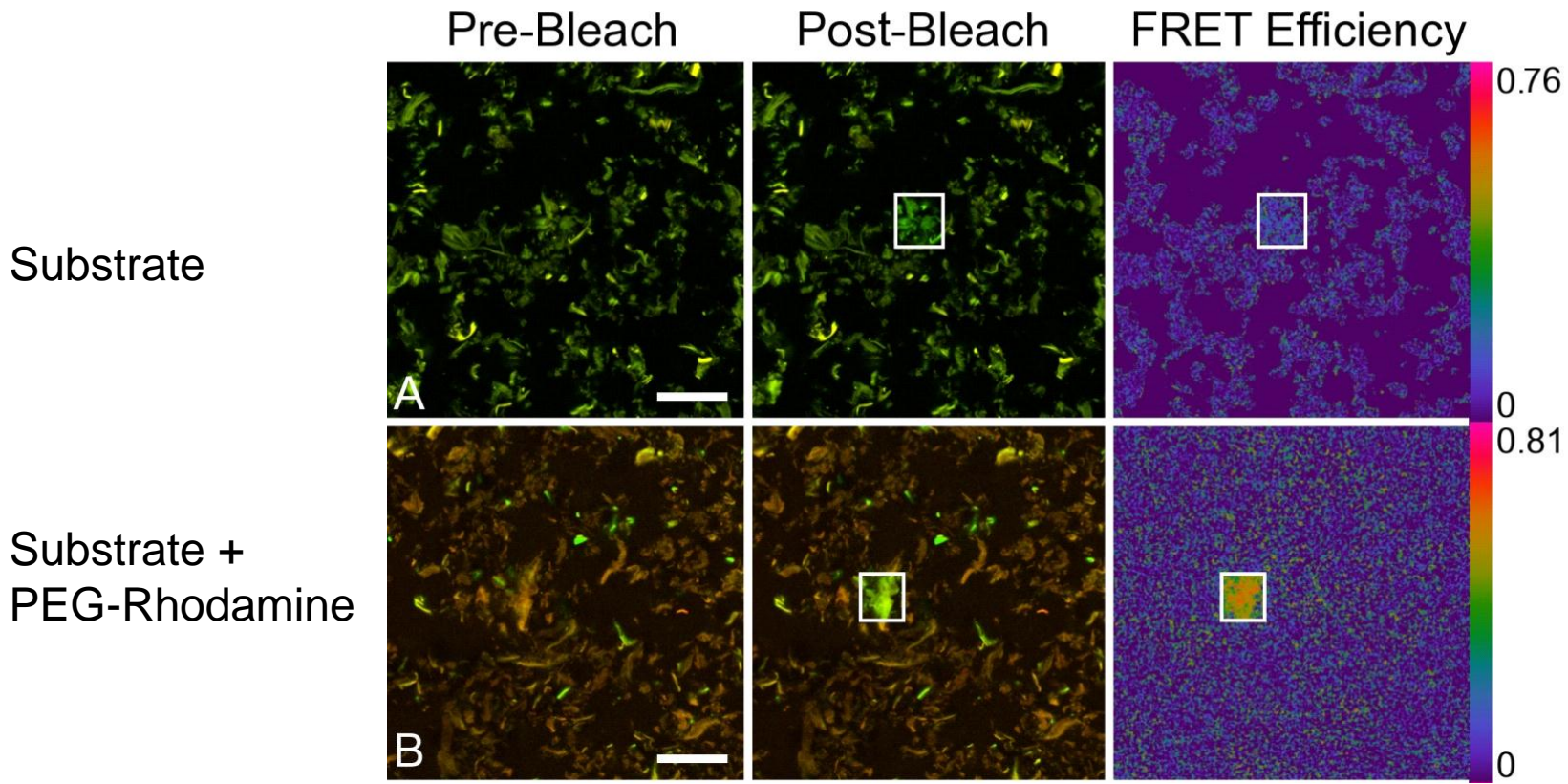
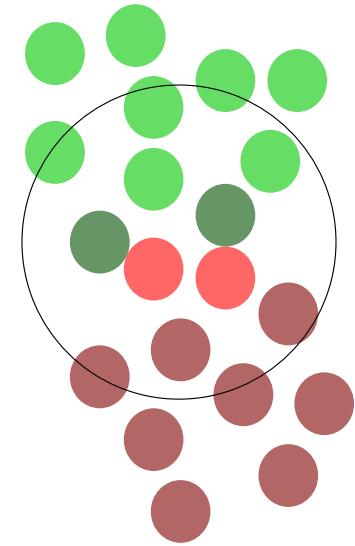


Fluorescence spectra – PEG-rhodamine and substrate



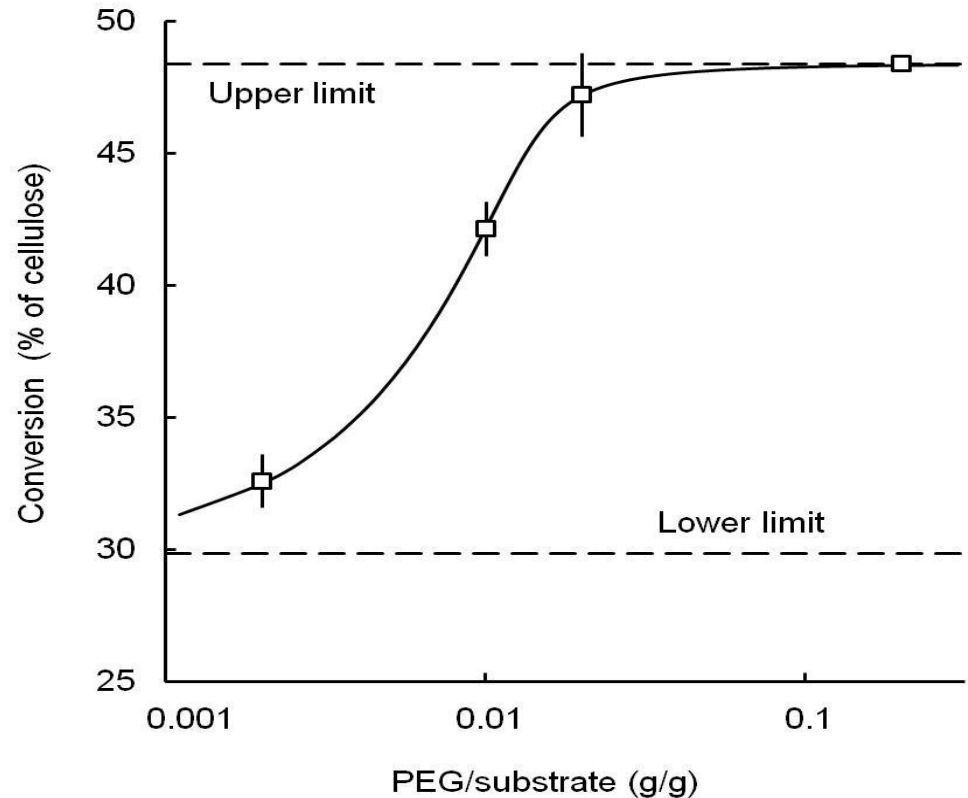
PEG-lignin interaction by FRET

- Forster Resonance Energy Transfer (FRET) measures close proximity of two fluorophores
- Demonstrated rhodamine and lignin were located within 10 nm



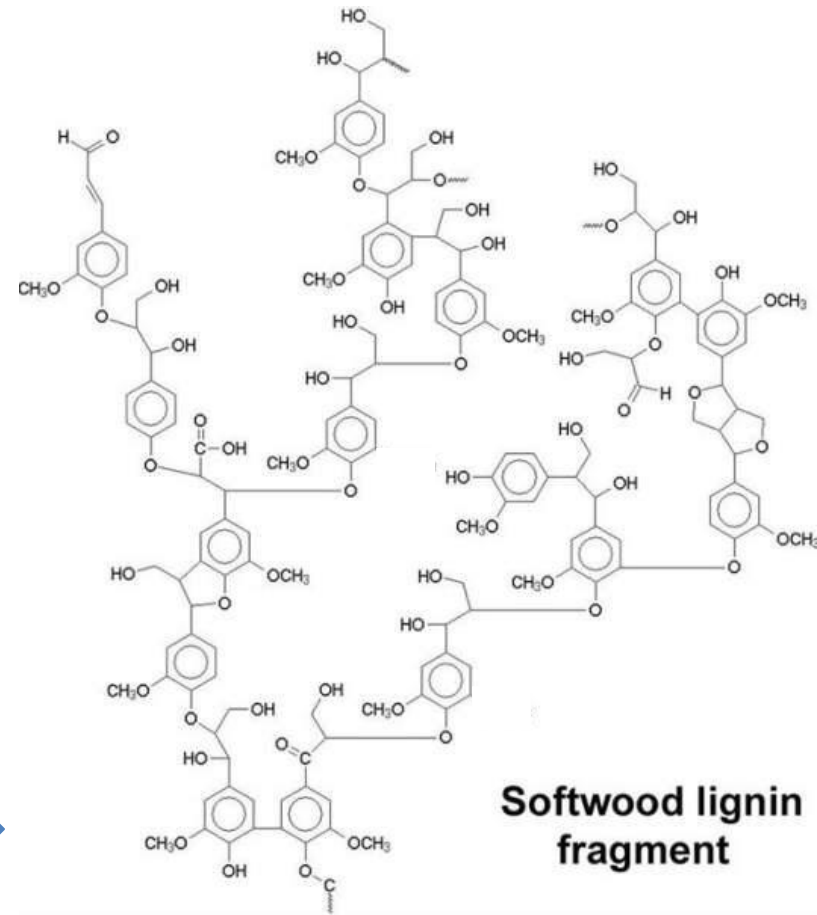
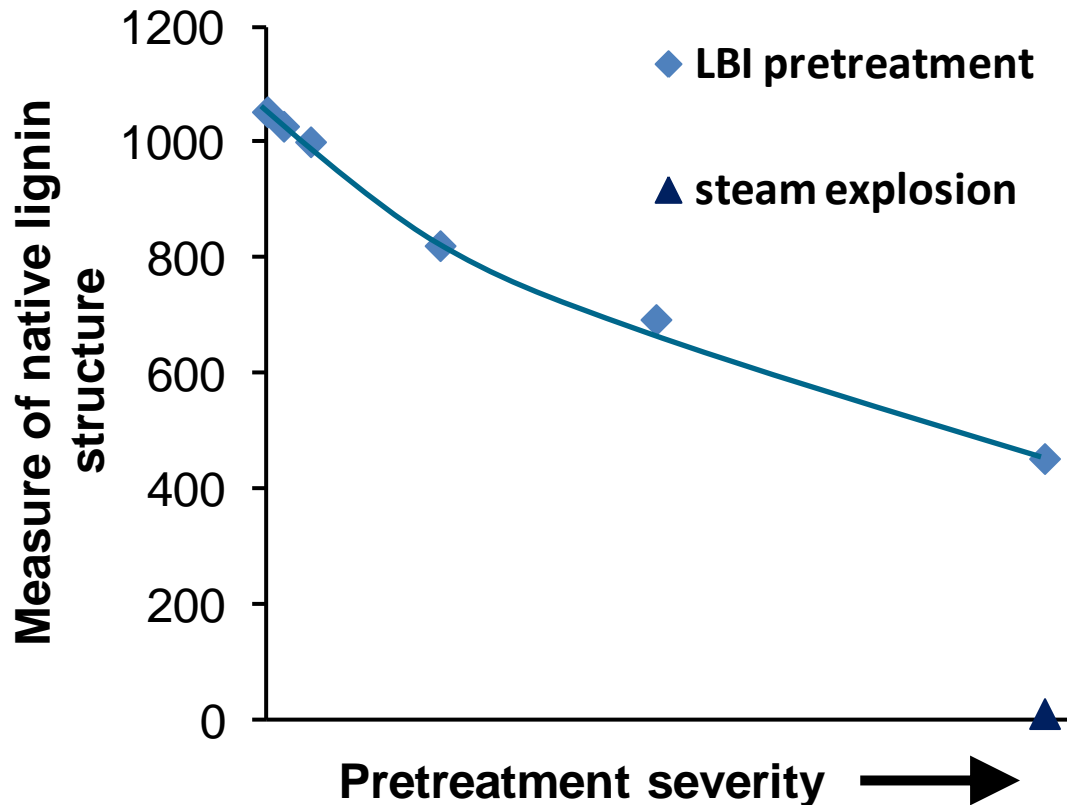
PEG binding to lignin

- Langmuir adsorption coefficient:
PEG = 40 l/g
Cellulase = 6 l/g
PEG binds 7× stronger
- Prevents non-productive enzyme binding
 - use less enzyme



Develop co-products: Lignin

- 1kg of lignin per litre of biofuel
- lignin functionality



Summary

- Using techno-economic model to drive the research
- Reducing enzyme usage is an important cost reduction opportunity
 - New generation enzymes
 - Saccharification additives e.g. low loadings of PEG
- PEG binds strongly to secondary wall lignin preventing non-productive enzyme binding



Acknowledgements

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