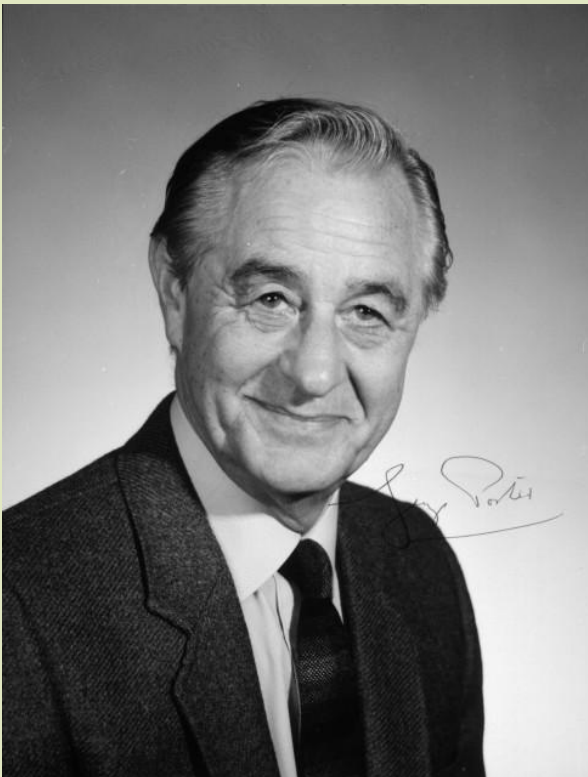


Why disciplinary approaches to clean energy research

Richard Templer



The alliance



**Imperial College
London**



Over 130
scientists, engineers, economists and
policy experts.



Plants that fuel the future



- Transport fuel
- Chemicals
- Materials
- Heat and power
- Land remediation



Mission

Devise economically, socially and environmentally sustainable routes to the production of energy and materials from plants with a positive impact on climate change and energy security.

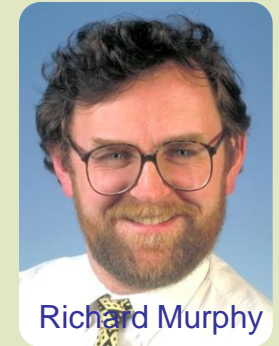
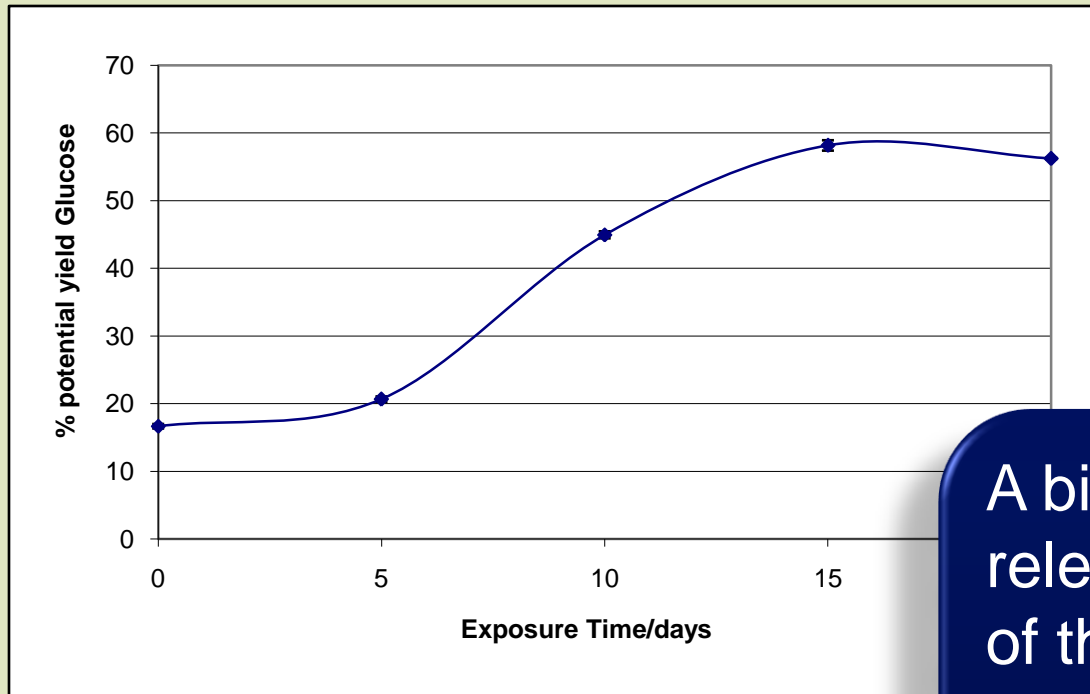


Challenges

- Increase biomass yields
- Reduce threats to and from biomass
- Increase processable biomass
- Create optimised processing
- Create flexible, modular biorefining
- Create integrated delivery pipelines



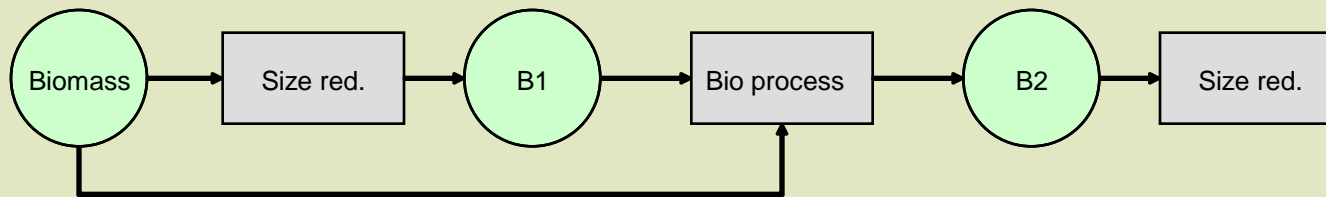
Why integrate?



A biological agent that releases 60% or more of the glucan from pine sapwood with minimal energy cost or CO₂ emission.



Why integrate?



- What is the optimal wood chip size?
- Crucial to energy balance – size reduction “costs” 2.5 times as much as heat
- Crucial to economics – can be 30% of plant operating cost



Why integrate?

$$\frac{kd}{D} = 0.50 \left([GR * Sc]^{0.25} + 0.48Re^{0.5}Sc^{0.33} \right)$$

$$\frac{kd}{D} = 44 + 0.48Re^{0.5}Sc^{0.33}$$

$$D(t) = D_0 \left(1 - \left(1 - \frac{1}{\alpha} \right) \left[\frac{c\sqrt{t} + \left(1 - \frac{1}{\alpha} \right) \frac{t}{\theta}}{\left(1 - \frac{1}{\alpha} \right) + c\sqrt{t} + \left(1 - \frac{1}{\alpha} \right) \frac{t}{\theta}} \right] \right) \quad (6)$$

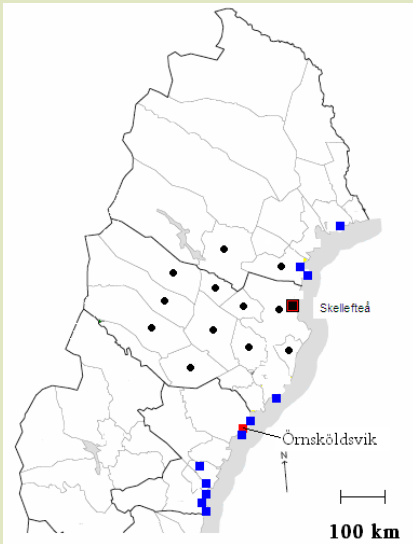
$$ED = \frac{\phi D}{1 - \frac{1}{2}Ln\phi}$$

$$J = \frac{dn}{A dt} = K \Delta C$$

Balancing the optimal size for the bio-agent to diffuse into the wood against the energy required to make fragments is a chemical engineering problem.



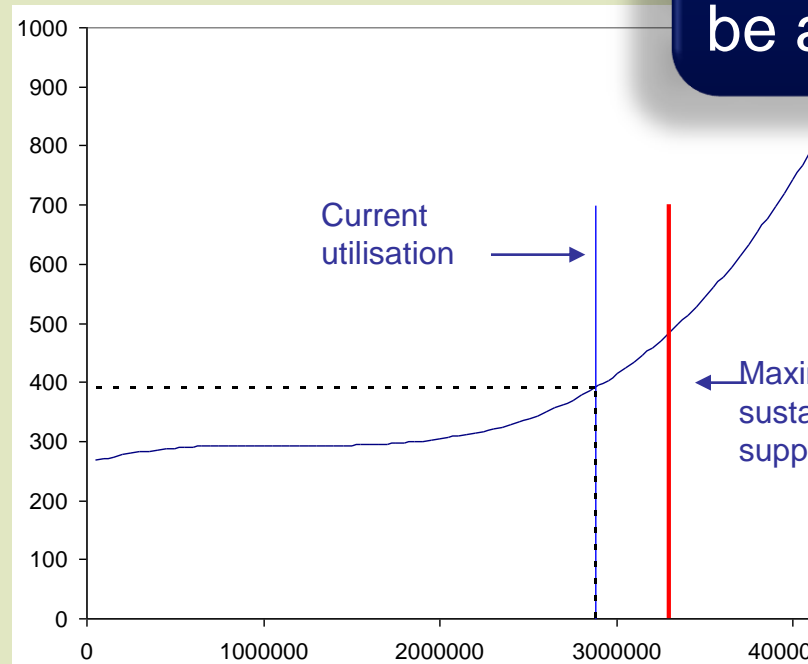
Why integrate?



■ Pulp mill

■ Power plant

Price
(SEK)



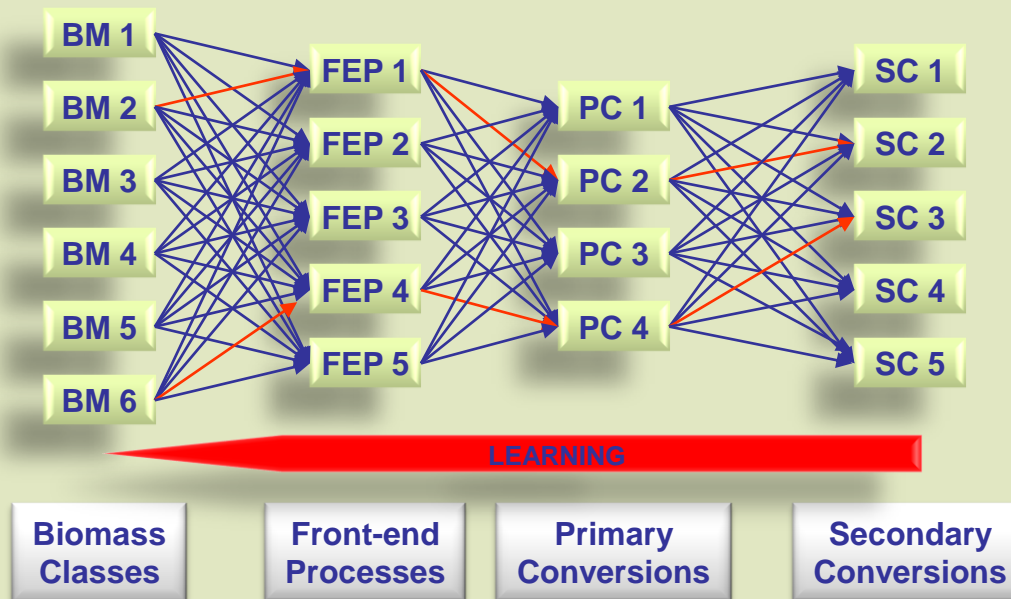
Resource competition can be anticipated



final felling
Volume m³

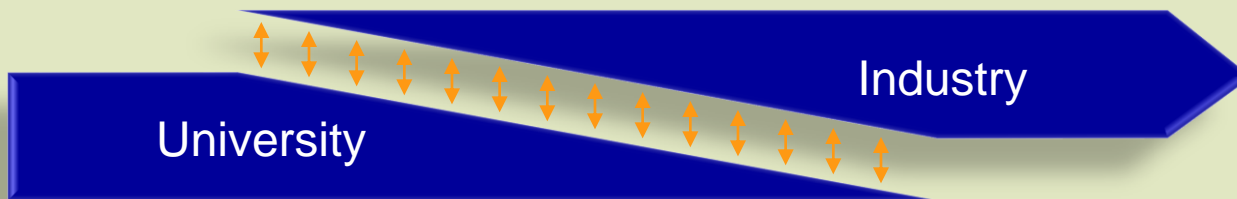


Integration and learning



Integration and delivery

Passing the baton is slow and ineffective



Integrating will speed innovation to market

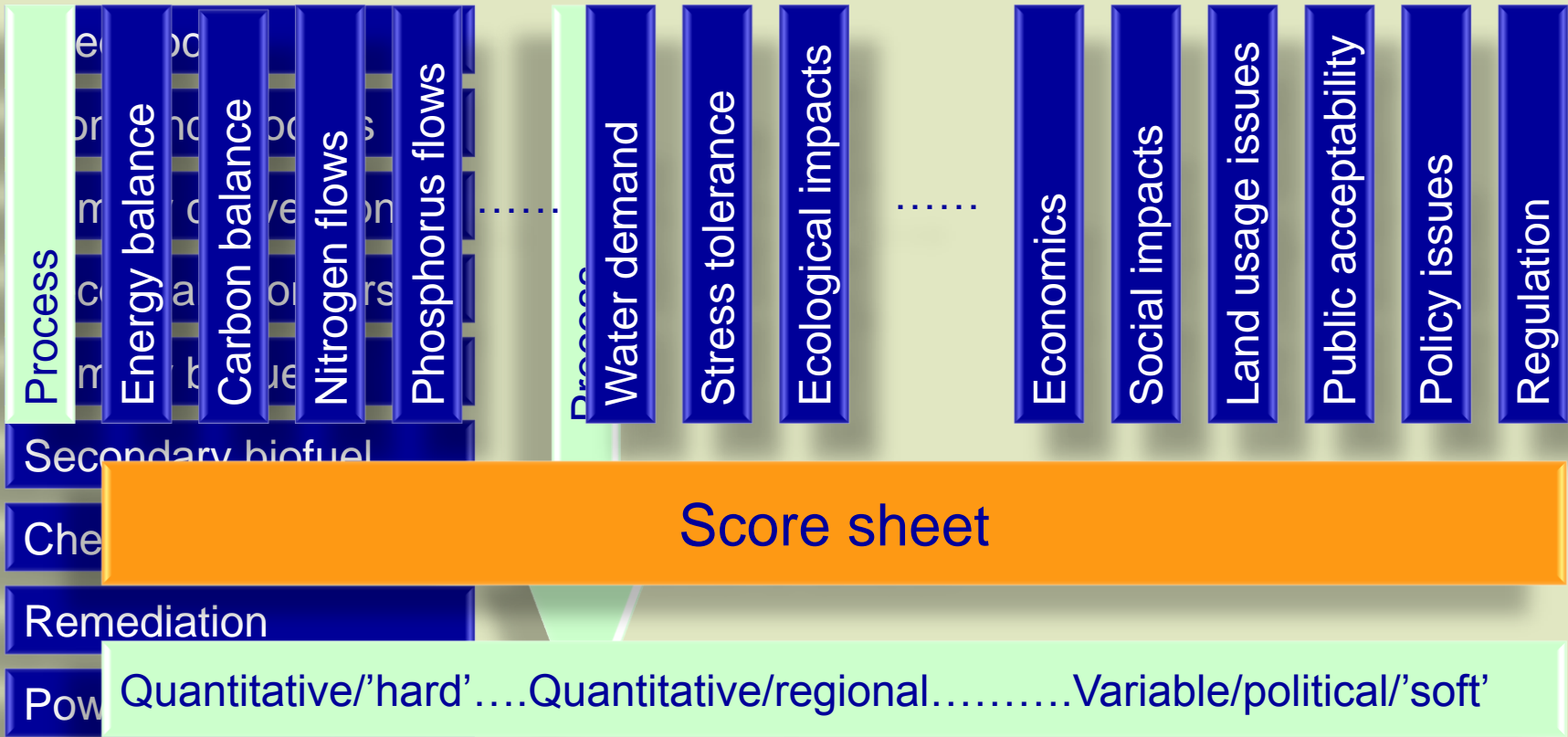


Managing integration

- Our sustainability toolkit helps us to find optimal processes.
- We use it to manage our research and development cycle, opening and closing lines of discovery, optimisation and innovation.



The sustainability matrix



Integration and sustainability



- Consider the whole process chain
- Integrate research and development
- Use quantitative sustainability criteria to manage research and development
- Deliver real processes



See more of us at

- www.porteralliance.org.uk

