



Food Structures for a Sustainable World

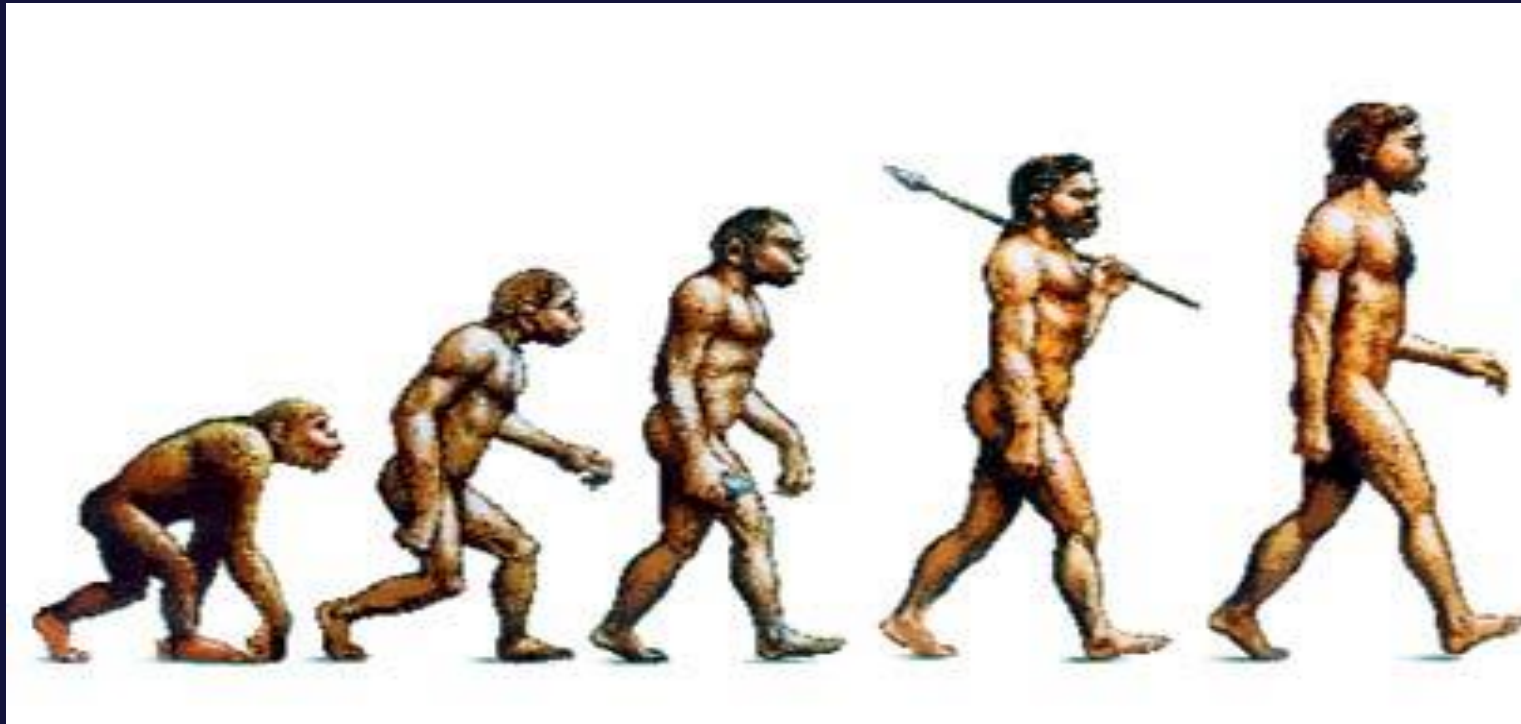
Seamus Higgins AFICHEM E, FHEA
Associate Professor Food Process Engineering
Chemical & Environmental Engineering



University of
Nottingham
UK | CHINA | MALAYSIA

Food & Us; Still Evolving

“everything that every person has ever done, throughout history, has literally been fuelled by food.” [Standage](#)



FOOD PRODUCTION DEFINES OUR SOCIETIES



100 000-10 000

**HUNTER-
GATHERER
SOCIETIES**



10 000-1700

**THE
AGRICULTURAL
SOCIETIES**



1700-2000

**THE
INDUSTRIAL
SOCIETIES**



The
Industrial Revolution
1760-1990

Food and Culture



The Chinese character for vitality, “Jing” (精), is made up of the characters “米” (rice) and “青” (plant or vegetable).



The word **Carnival**, is a folk etymology derived from the Latin words, Carne vale, "farewell to meat" and since 1192 AD it is still celebrated today by its original proponents, the Venetians, prior to fasting for what was then the 40 day catholic fasting period of Lent.

Food is a basic necessity of life!



From the time we are born, feeding a baby is one of the first acts of love a mother bestows on her child.

Growing up as children, our food and nutritional intake—or lack thereof—has a lifelong impact on our health and how we live, for better or worse.

The Global Food Industry;

Today's modern food Industry can best be defined as a complex, global collective of diverse businesses that supply most of the food consumed by the world population.

The \$12 trillion industry represents greater than 10 percent of global consumer spending and 40 percent of employment.

It's forecast to grow at a compound annual growth rate (CAGR) of 5.0% from 2020 to 2027.



UK Food Industry

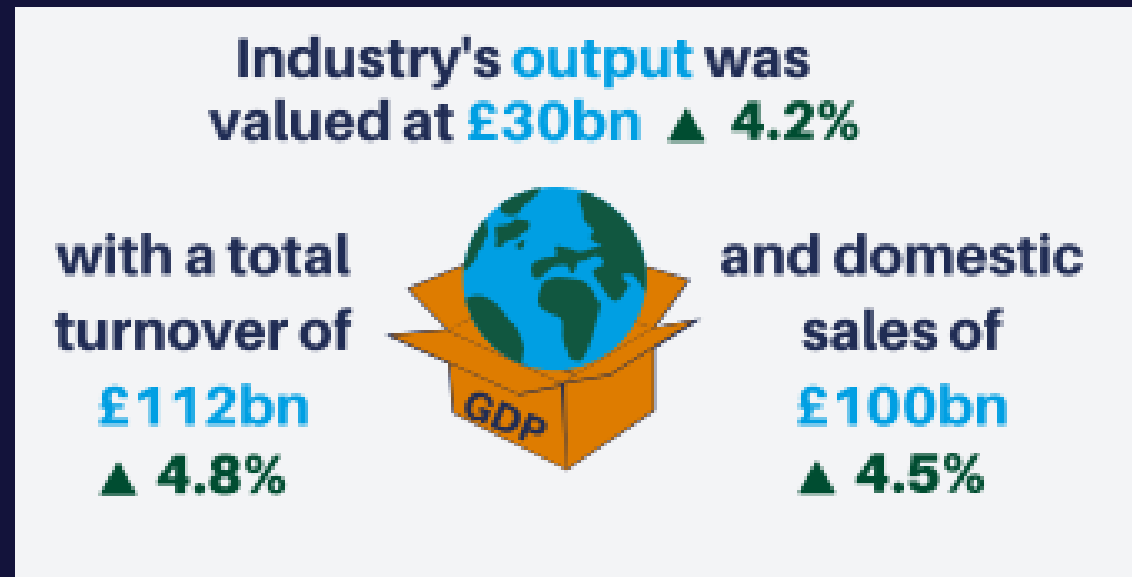
UK's food processing sector is the largest manufacturer in the UK;

Contributes > £100 bn. to the economy

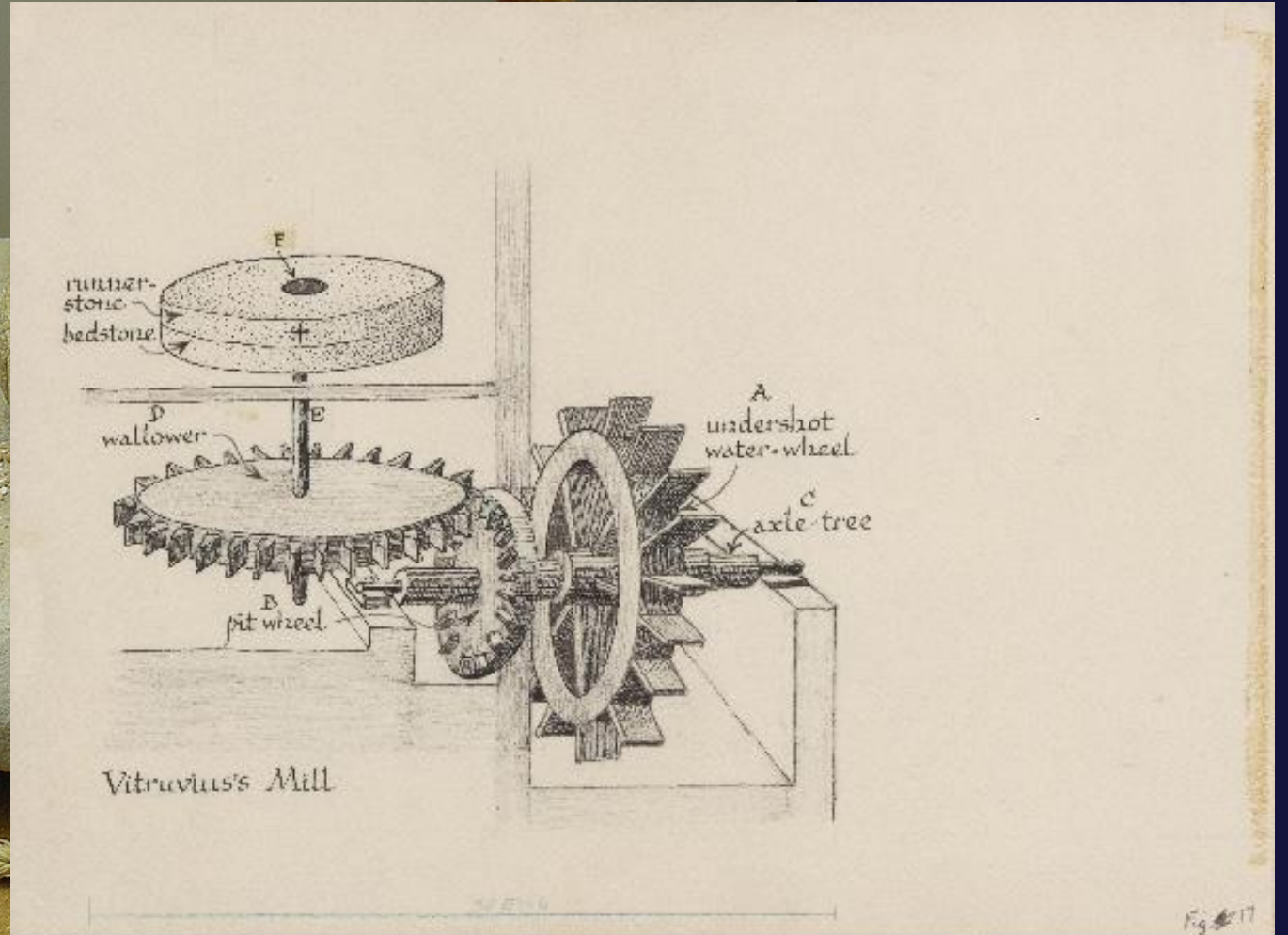
Employs 440,000 people;

8.4% Highly skilled (NVQ level 7)

24.1% Skilled (Degree and experience NVQ Level 5-6)



Grain Milling; Vitruvius!



The World's first Food Process Engineer!

19th Century; 1st Industrial Revolution

Think steam !

- George Stevenson; The first steam locomotive
- Richard Arkwright; Cromford Mill (Cotton spinning)
- 1809, Nicolas Appert, the father of food preservation, came up with the concept of preserving food by way of a heat process and hermetically sealing the preserved product in a glass jar.
- 1813, Bryan Donkin, a Northumberland engineer, set up the world's first canning factory in the UK

W. VERNON & SONS' NEW FLOUR MILLS, BIRKENHEAD DOCK. SOUTH VIEW.

1878 Henry Simon of Manchester built his first "steam" flour mill based on the 'Gradual Reduction' process of milling wheat

2nd Industrial Revolution; Mass Food Production & Iconic brands

1887 Milk chocolate ;
Condensed milk; 1930 Coffee



1847 Cadbury's moved to first factory in Birmingham



1865 Cargill set up their first grain silo in Iowa, USA



1871 Tomato Ketchup;
1920 Baked beans



1877 Quaker Oats registered the first breakfast cereal brand.



1929 Lever Bros, makers of



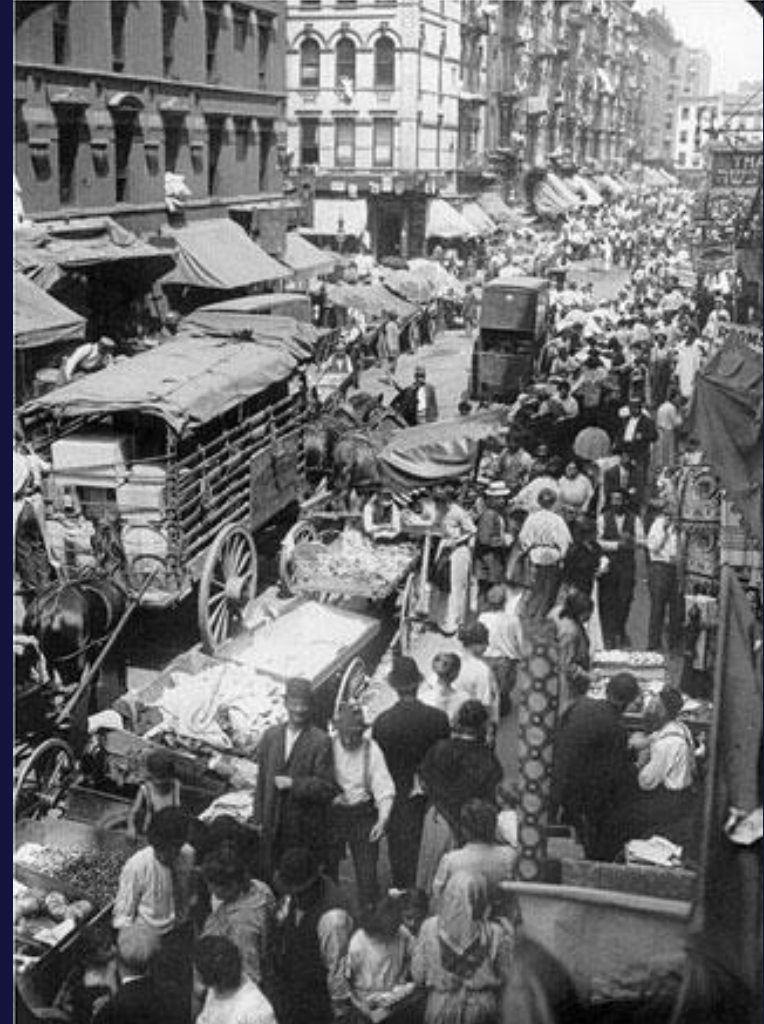
Merged with Margarine Uni to become



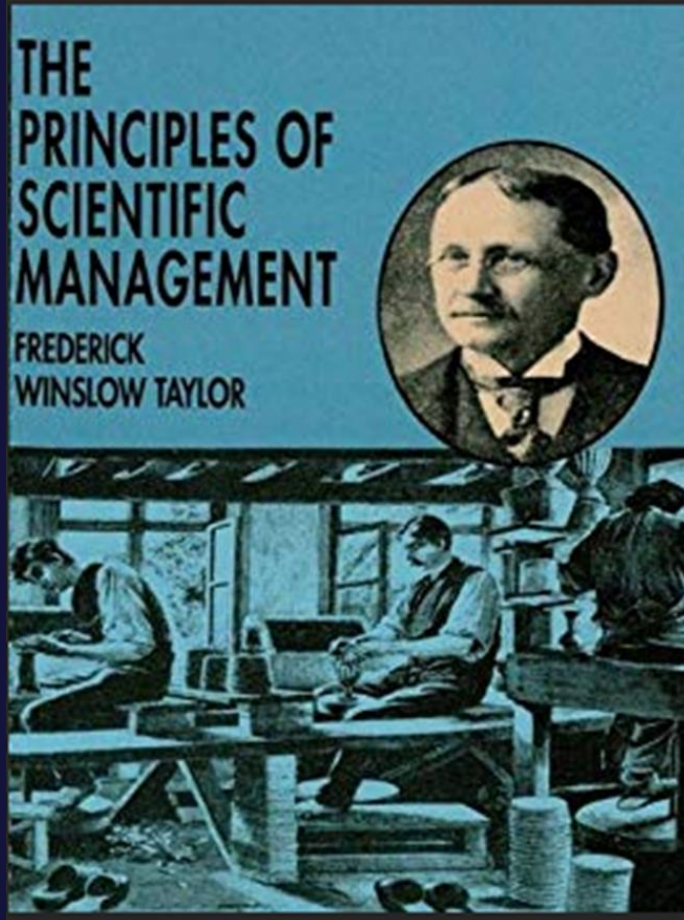
Early 20th Century; The beginning of Urbanisation & the Production line



The birth of the process line, factory management, mass production and factory automation



20th Century; The Birth of the Management Century



Taylor set off a century-long quest for the right balance between the “things of production” and the “humanity of production”.

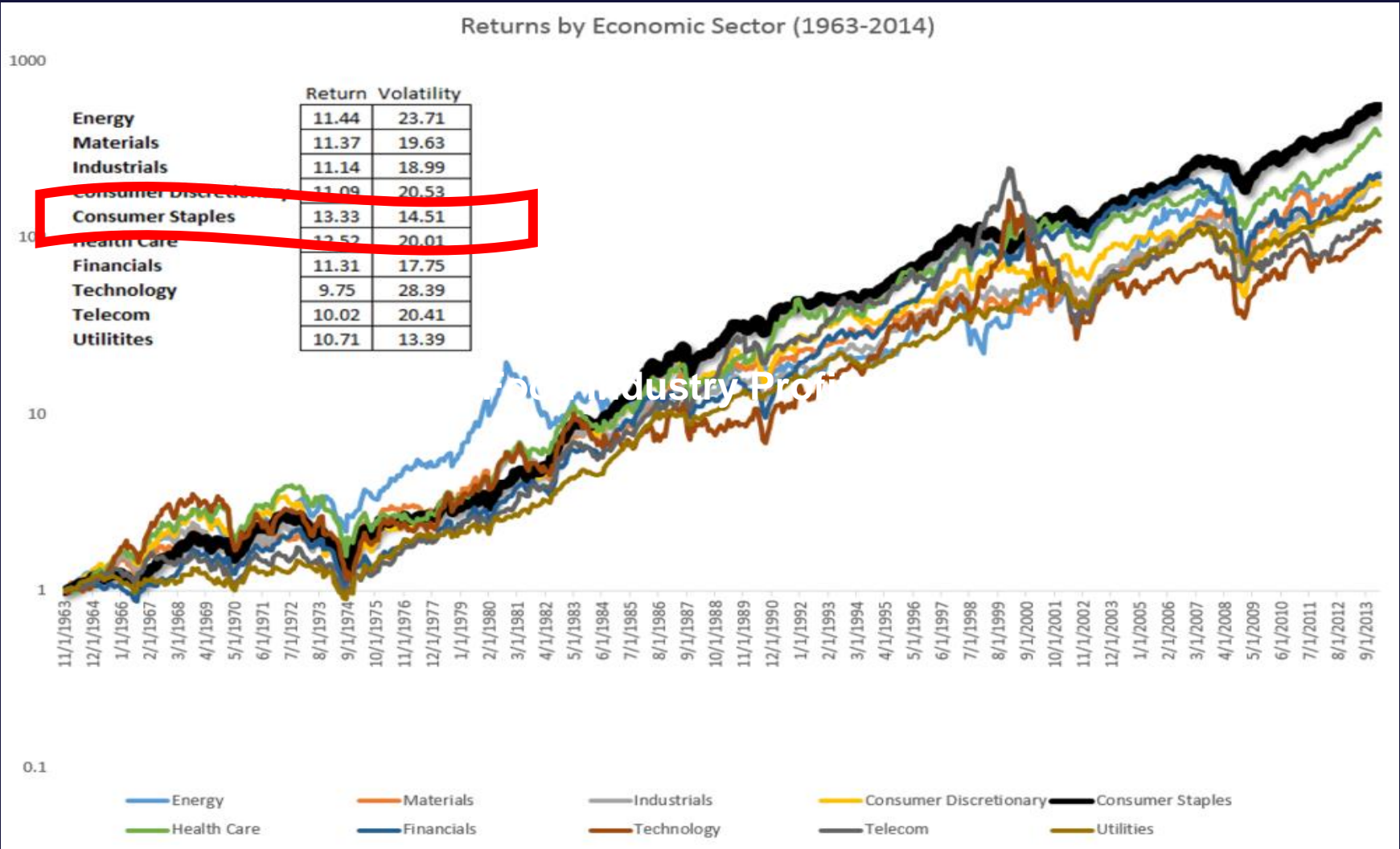
(Kiechel,2012)

The growth of 20th century food industry

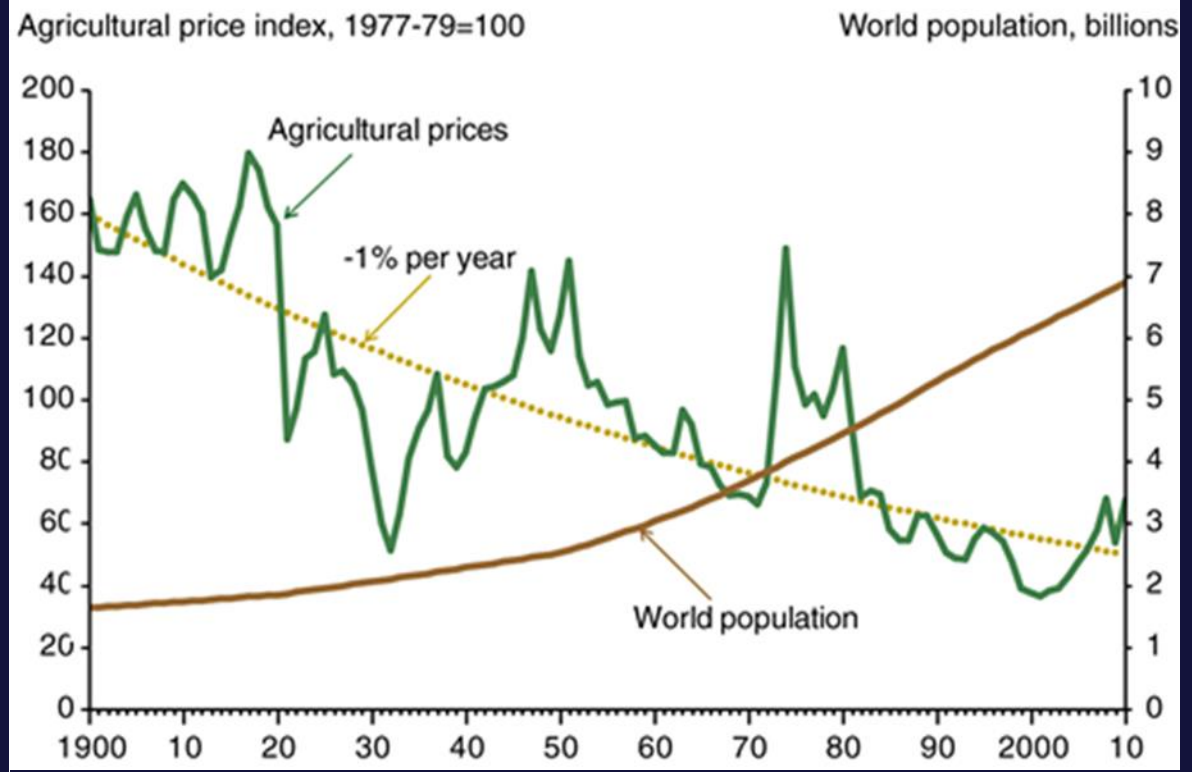
Thus began the nascent Food industry's conflict with business management theories rooted in economics, which also evolved during the 20th century.

- The rise of capitalism, and service-linked industries, marketing & advertising, the big four accountancy firms, asset investment agencies, and management consultancy.
- Globalisation, market and trade liberalisation, capital flow, discount retail and urbanisation.
- A shift in the purpose of food processing, transitioning beyond just food safety and preservation methods to the mass production of branded convenience foods.

Food Industry Profitability



Real agricultural prices and world population, 1900-2010



Given the many achievements the food industry has achieved in recent times in terms of scalability, food safety, price, taste, convenience; and an abundance of food supply with obvious profitable success, why would we need to change it?

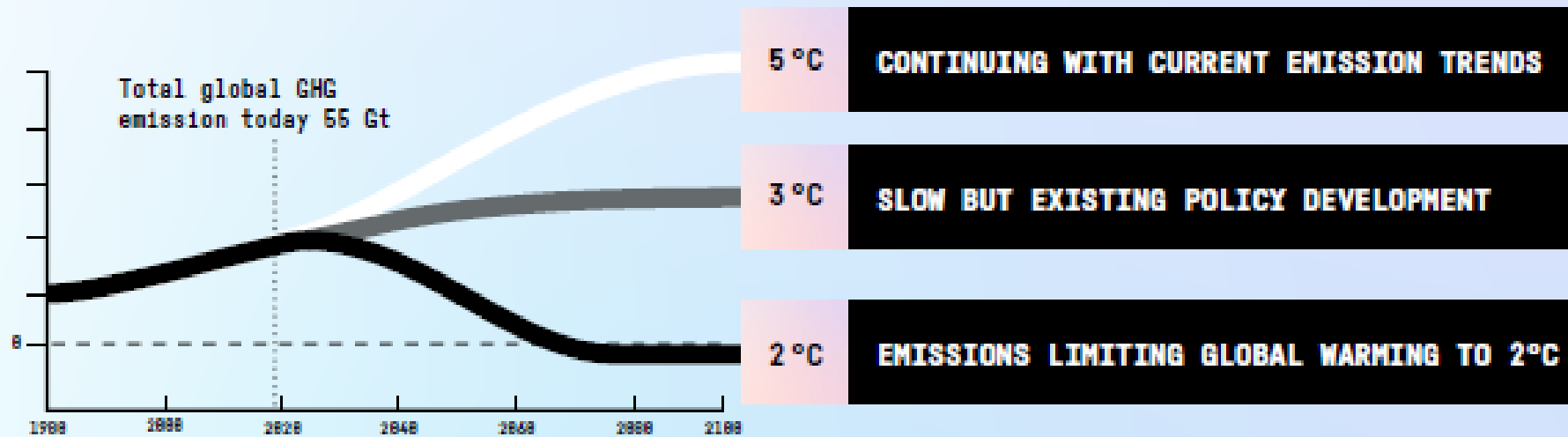
The cost of our current food model



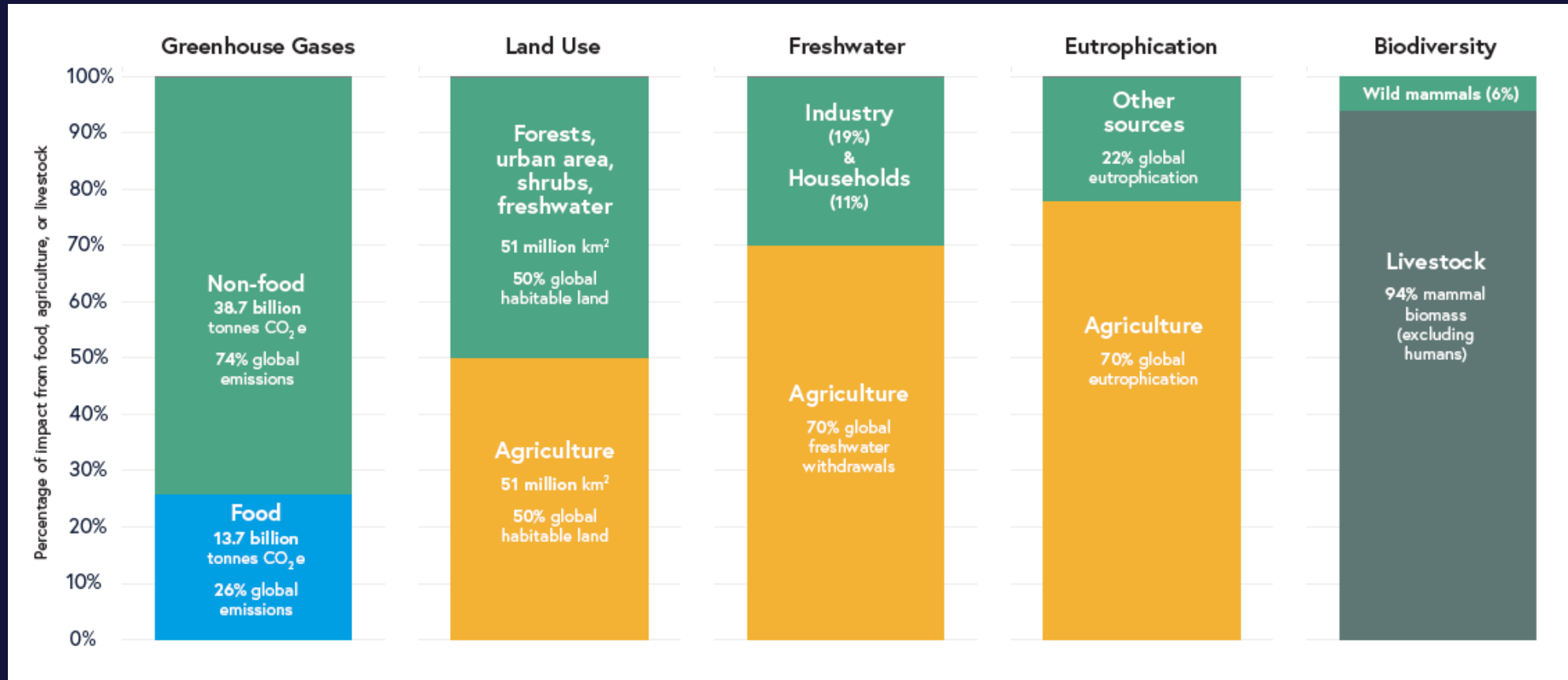
The FAO calculates the global cost of hidden health and environmental costs of our present agrifood systems to be at least \$10 trillion annually.

Greenhouse Gas Emissions from the Agrifood System Are higher than you might think!

CO₂ EMISSIONS MUST BE CUT FAST

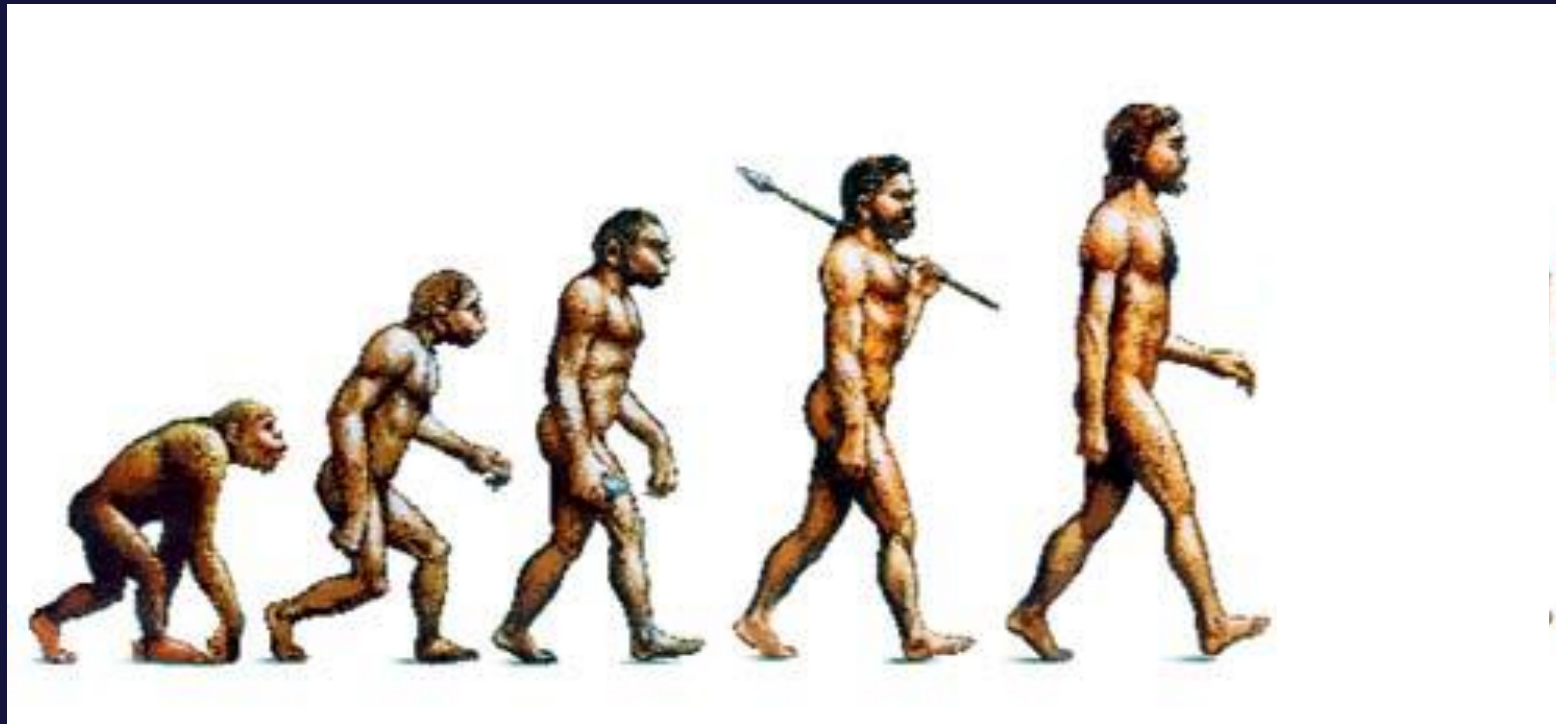


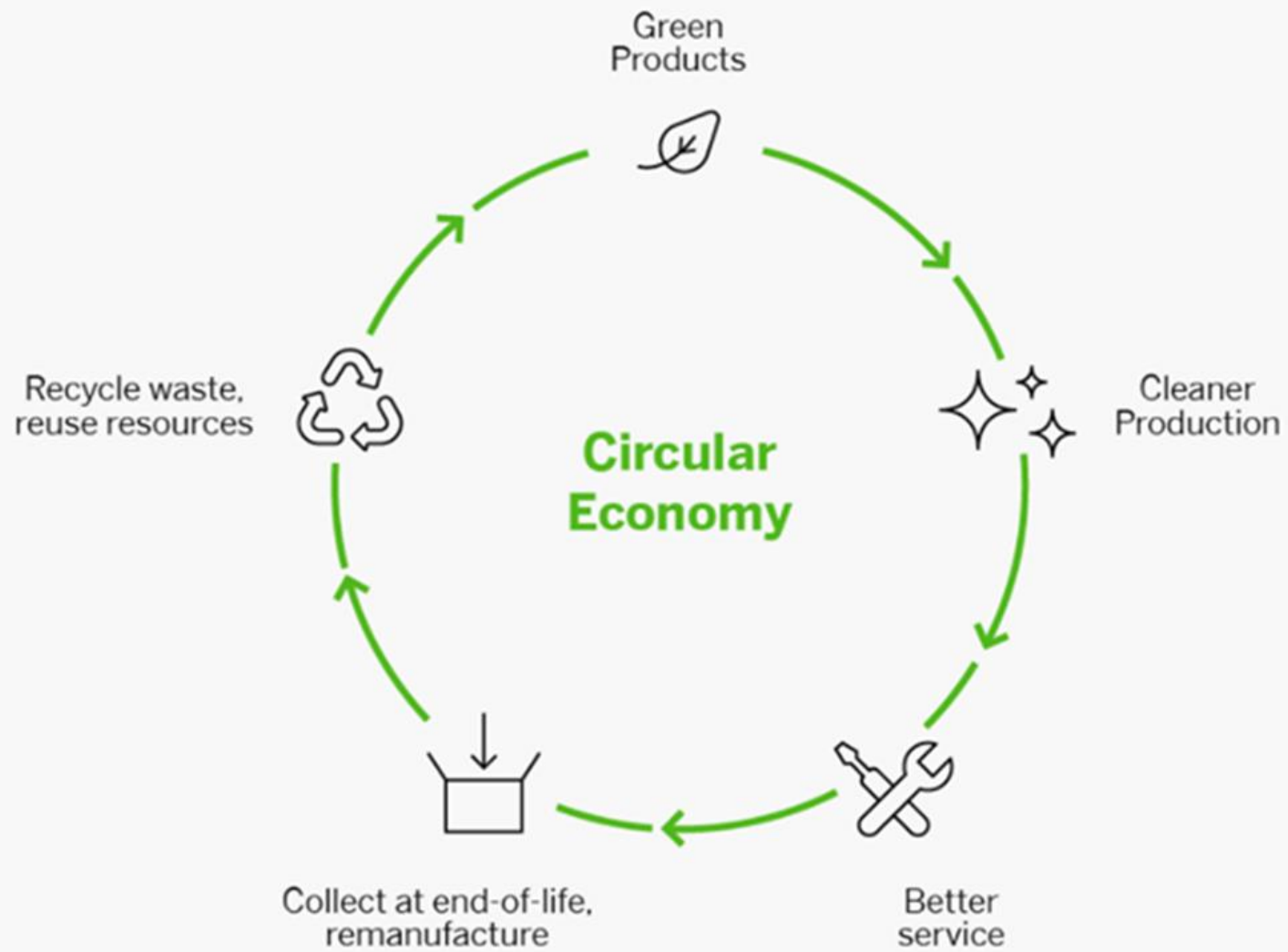
Other environmental problems



21st Century Food & rising lifestyle disease

The rise in over-nutrition from food is leading to obesity and other diet related metabolic disease in many developing countries.





FOOD PRODUCTION DEFINES OUR SOCIETIES



100 000-10 000

**HUNTER-
GATHERER
SOCIETIES**



10 000-1700

**THE
AGRICULTURAL
SOCIETIES**




1700-2000

**THE
INDUSTRIAL
SOCIETIES**





The world needs more engineers!

 University of Nottingham
UK | CHINA | MALAYSIA

Re-engineering the food industry:

where do we go from here?



Seamus Higgins
Associate Professor of Food Process Engineering

Daniel I Hefft
Research Fellow, Food Process Engineering

The word Engineer is derived from two Latin words;

Ingeniare;

"to create, generate, contrive, devise"

Ingenium

"cleverness"

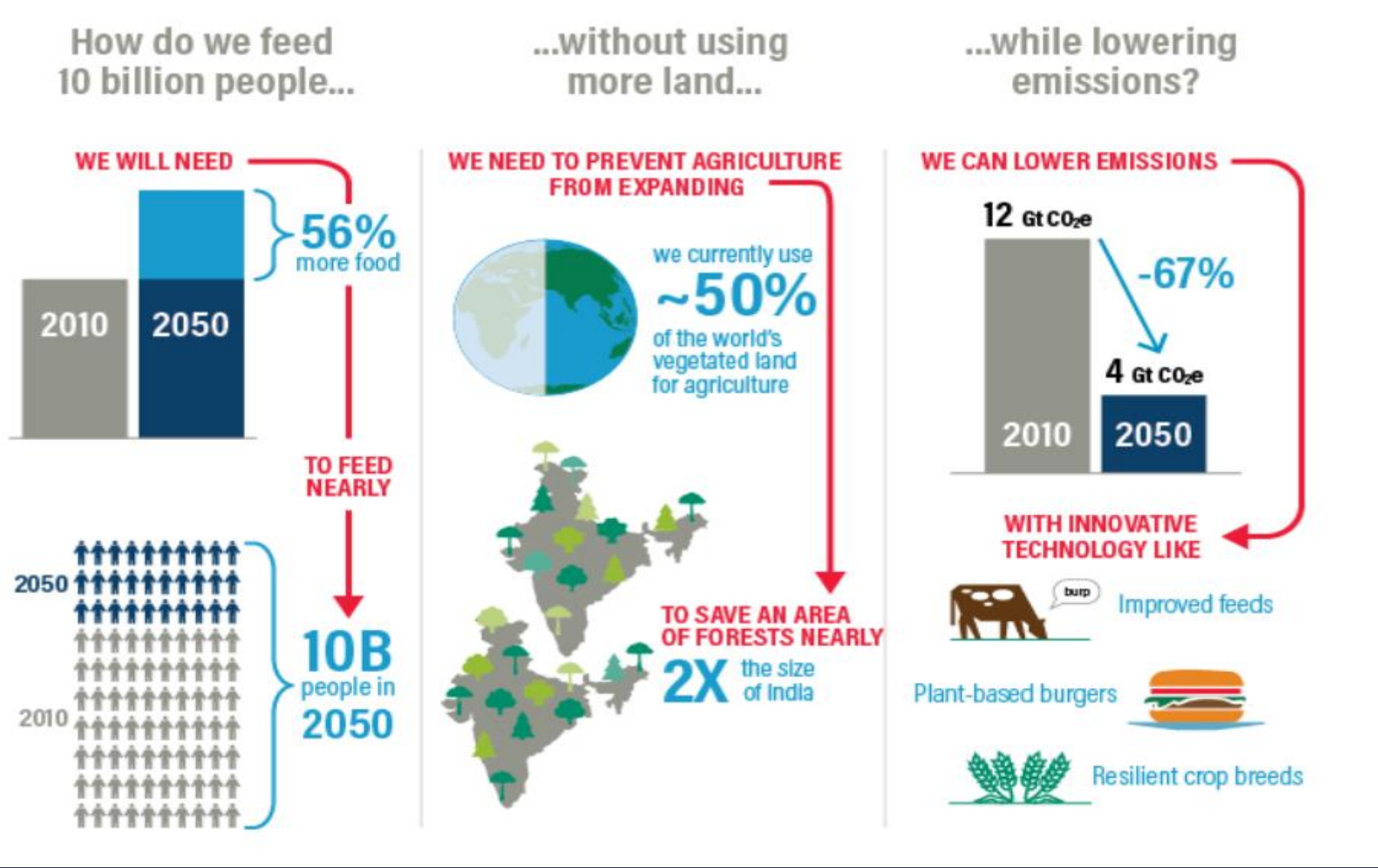
Engineering; simply defined as; "the ability to make things or to make things better";

...becomes a vital profession for solving global Food challenges!.

SUSTAINABLE DEVELOPMENT GOALS



The future food sustainability challenge



Changing the status quo!

- Define why and what you need to change in order to attain your sustainability goals.
- Identify barriers.
- Set realistic, measurable short- and long-term goals.
- Set up your team and involve all stakeholders.



Changing Preservation Processes

More modern techniques have evolved, such as high-pressure food preservation, Pulsed electric field treatment, Plasma technology, and natural preservatives such as Ozone, and Ionisation.

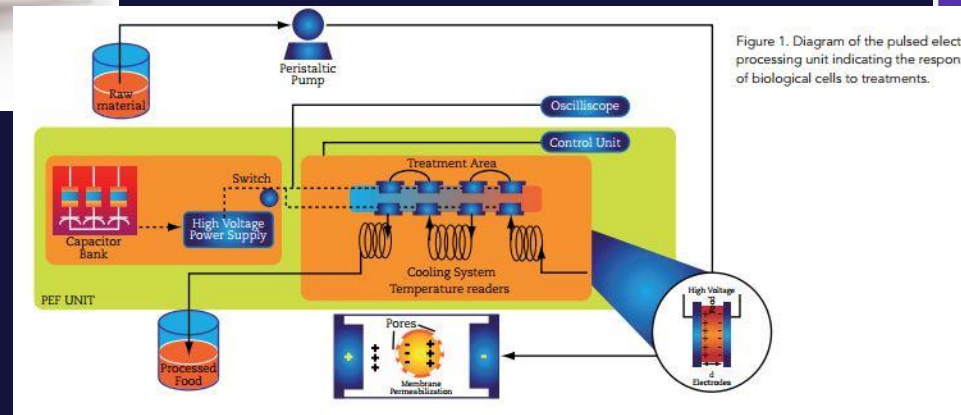
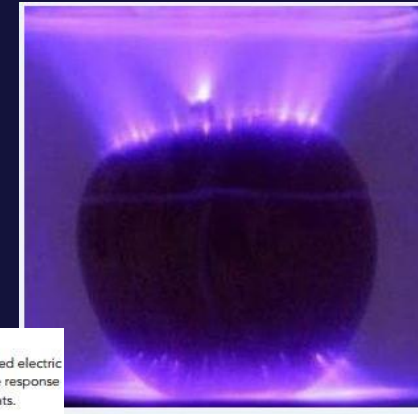
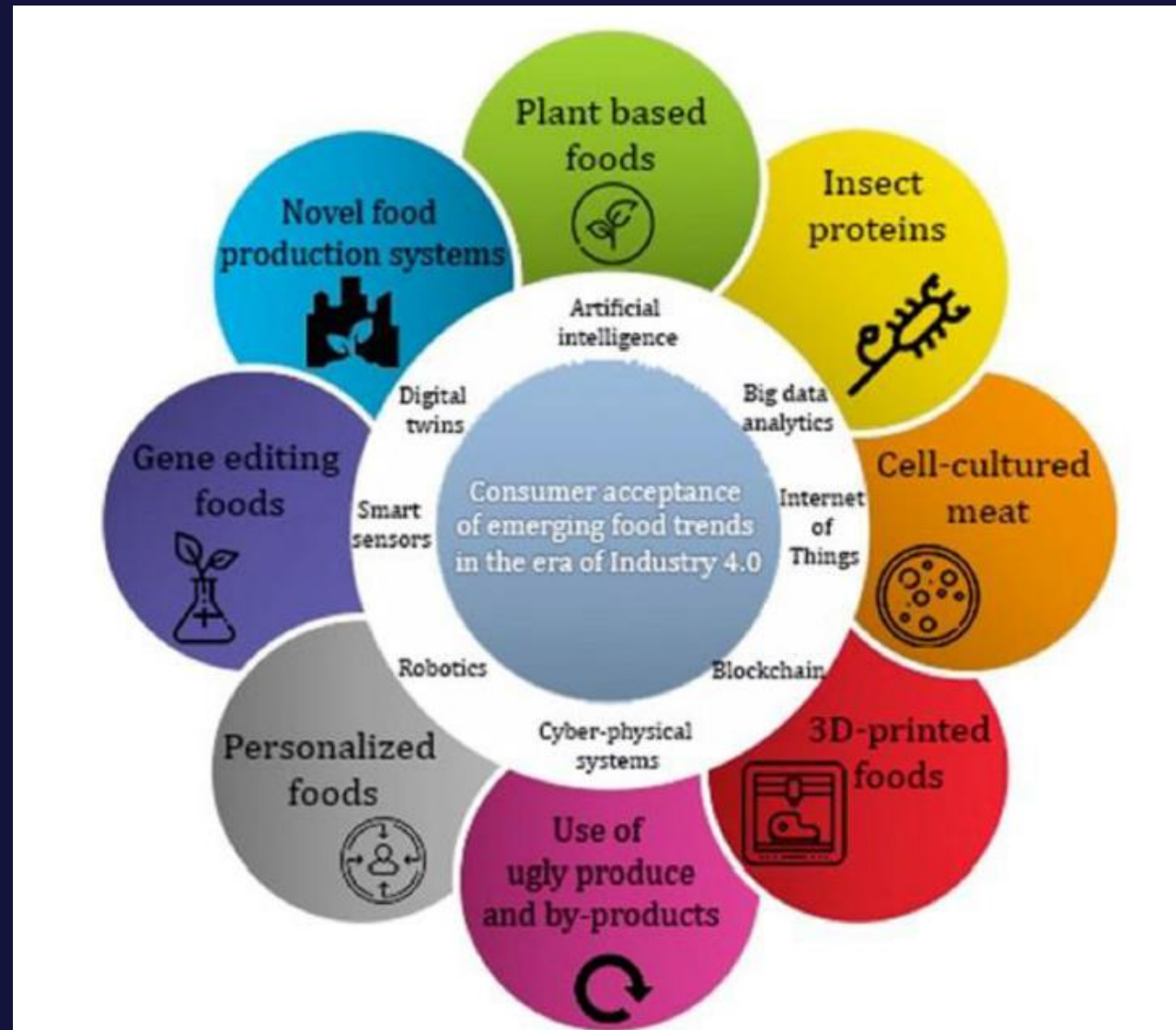


Figure 1. Diagram of the pulsed electric processing unit indicating the response of biological cells to treatments.



Industry 4.0 driving New food technologies

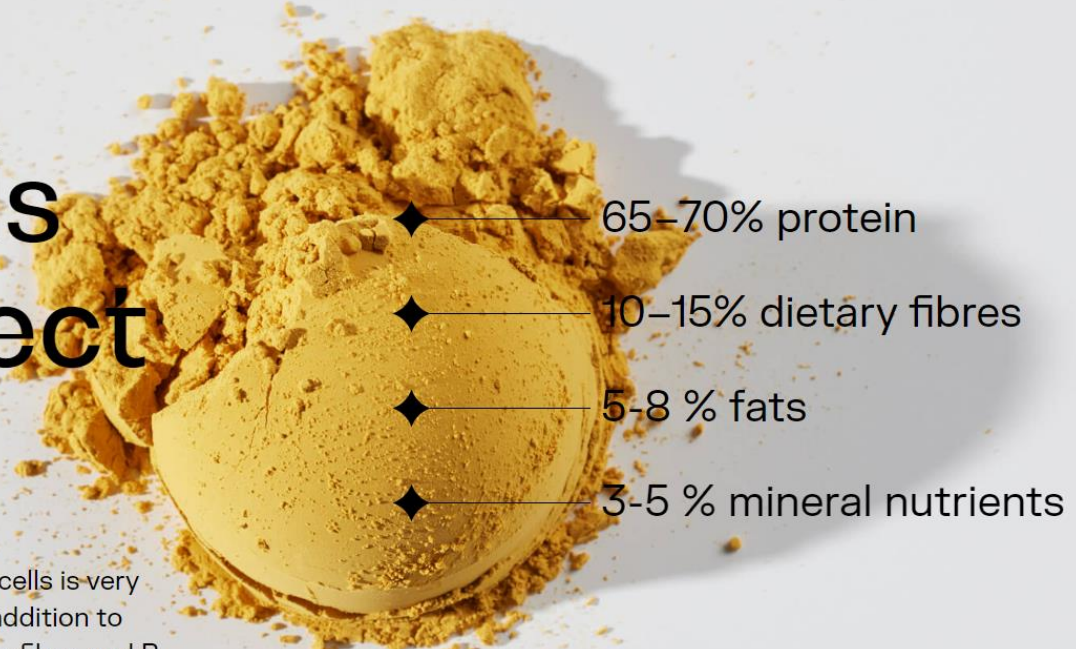


“Food from Air” Solar Foods Finland

solein

All the
essentials
of a perfect
protein.

The macronutrient composition of the cells is very similar to that of dried soy or algae. In addition to protein, Solein provides a source of iron, fibre, and B vitamins.



65-70% protein

10-15% dietary fibres

5-8 % fats

3-5 % mineral nutrients

All the benefits of a perfect protein without the use of animal or land resources

Exploring Waste Management Technologies

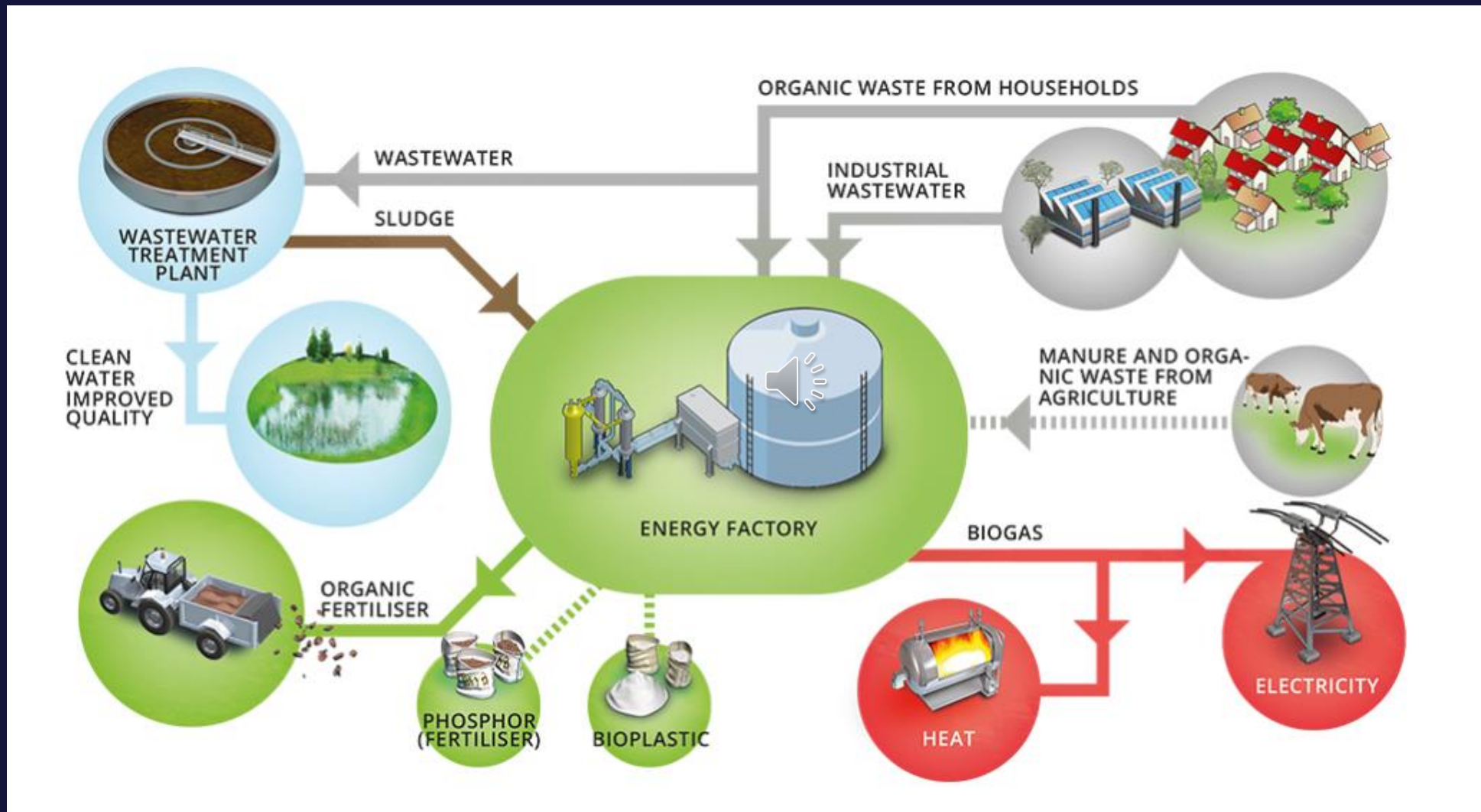
The central teal box is titled "The First Law of Thermodynamics" and "Energy transformation". It contains a diagram of a balance scale. On the left pan is a blue box labeled "Energy Before". On the right pan is a red oval labeled "Energy After". A white arrow points from the "Energy Before" box to the "Energy After" oval. The scale is balanced on a yellow beam, with a red needle pointing to a scale marked "0".

The left white box features an icon of a power plant and a list of waste management technologies:

- Immobilization:
- Carbon absorption
- Distillation
- Filtration
- Evaporation/volatilization
- Grinding, Shredding
- Compacting
- etc

The right white box features an icon of a flask with green liquid and a circular label that says "Biological".

The Billund Bio-refinery process



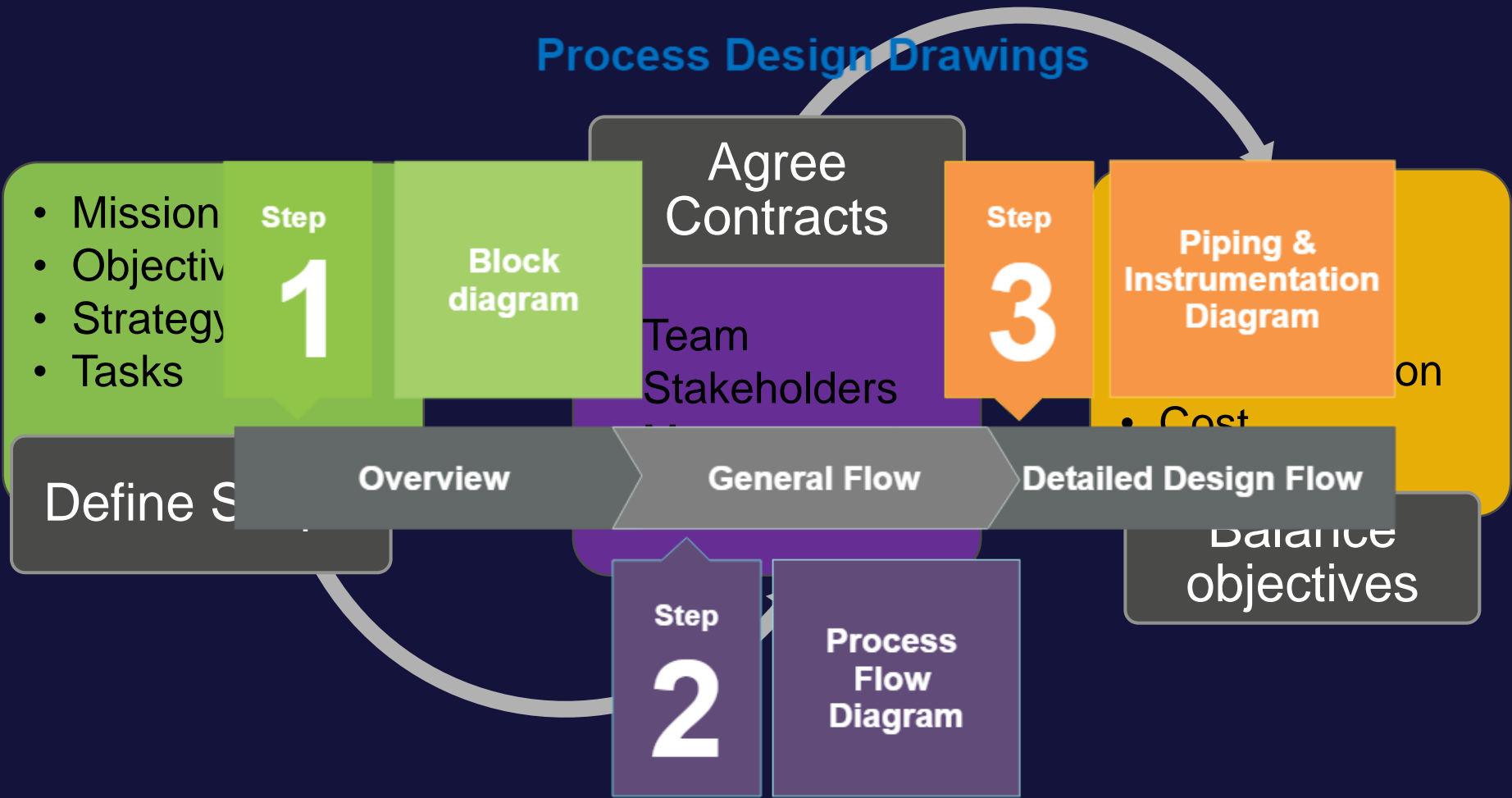
Reducing Energy Consumption

- Automate, monitor and control.
- Improve the efficiency of refrigeration and temperature-controlled systems.
- Use variable speed drives (VSD) and motors.
- Employ energy-efficient lighting systems.
- Use alternative energy systems and sources where possible.
- Implement a culture of energy efficiency.

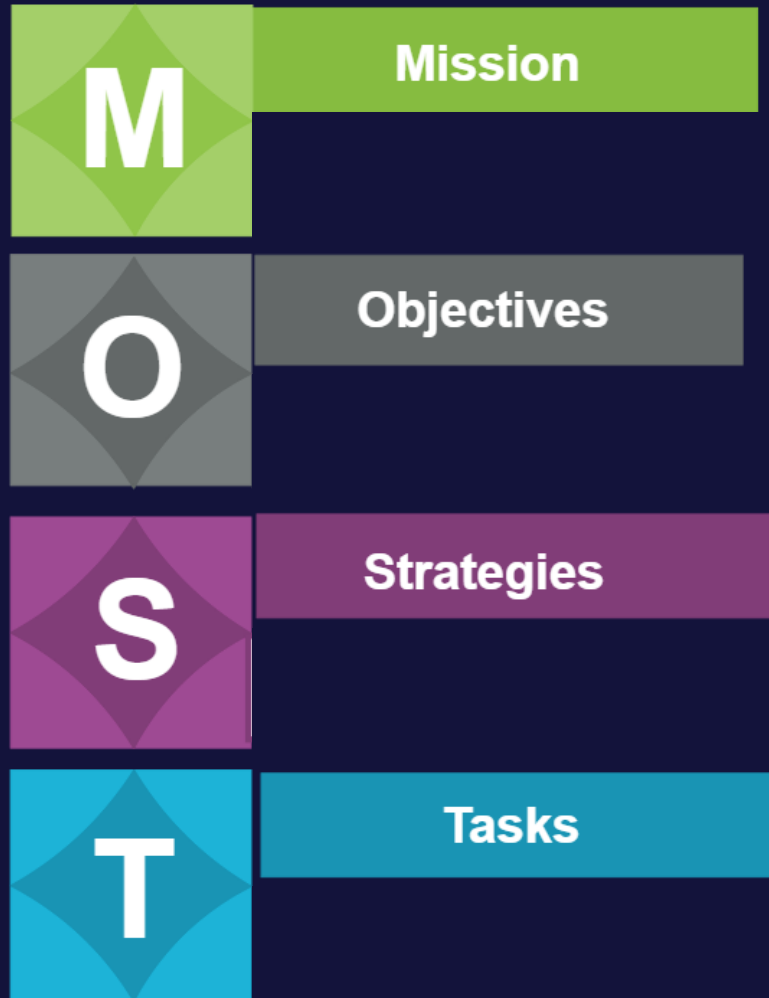


Ingraining a culture of conservancy among employees and stakeholders is perhaps one of the most important steps any food and beverage company can take to reduce their overall carbon footprint and achieve aggressive energy-conservation goals

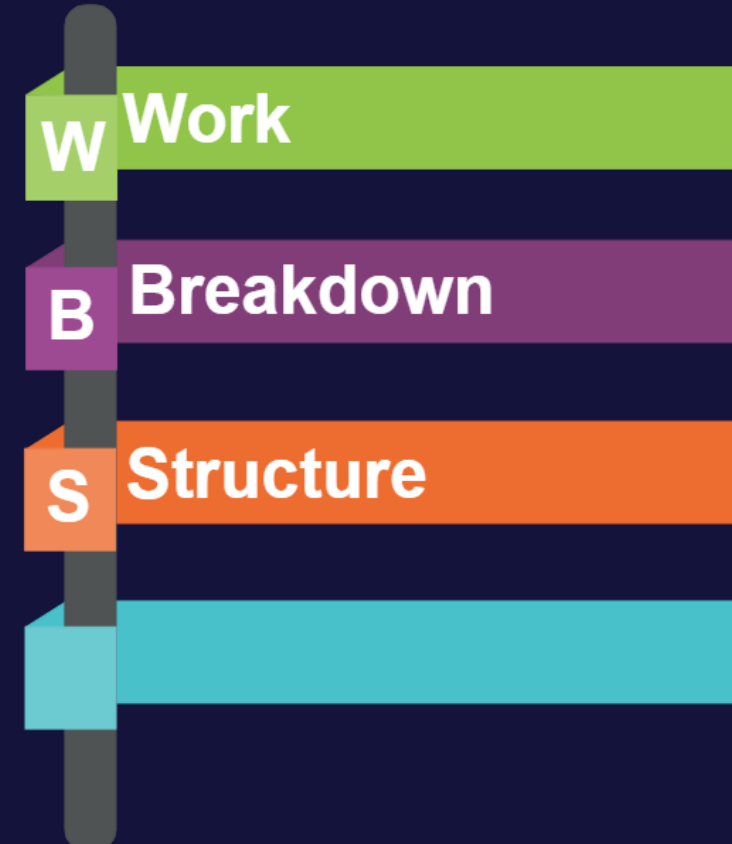
Developing a systems approach to setting targets



Defining your Sustainability Statement and ESG goals



Use a work breakdown structure



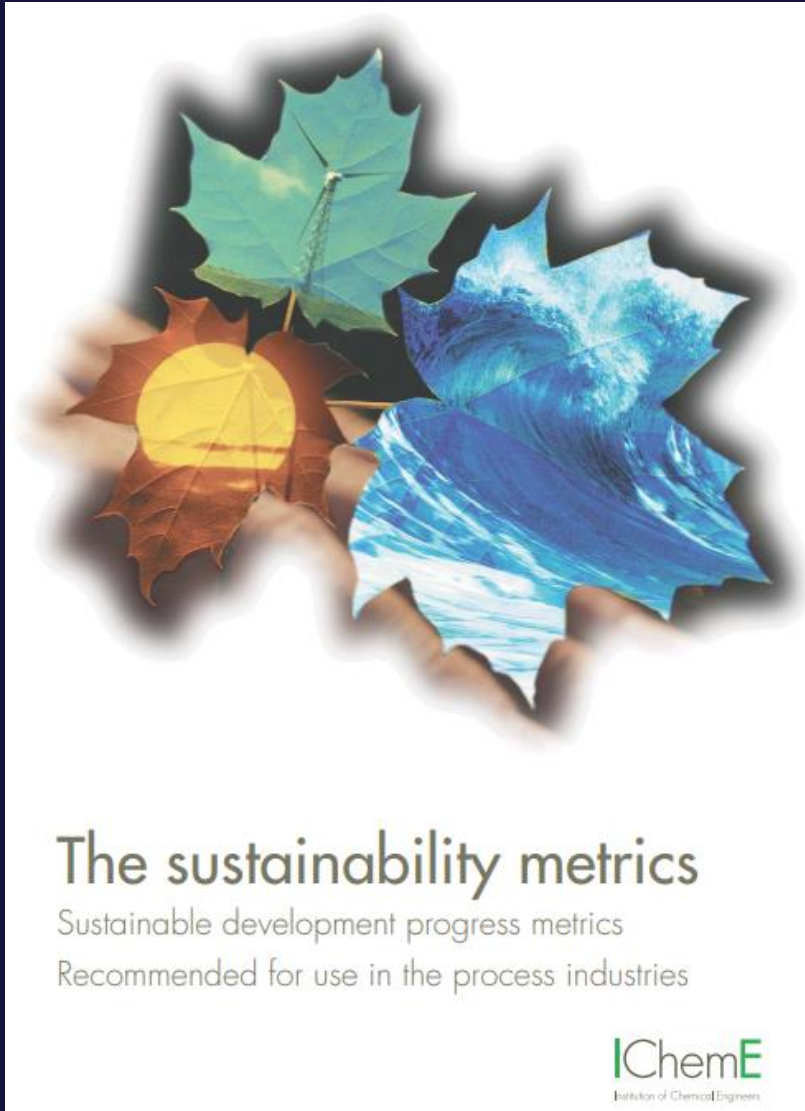
Selecting a global Environmental & Sustainability standard agency



The global reporting initiative

Is used by more than 10,000 organisations in over 100 countries, their Standards are advancing the practice of sustainability reporting and enabling organisations and their stakeholders to take action that creates economic, environmental and social benefits for everyone.

As confirmed by 2022 research from KPMG, the GRI Standards remain the most widely used sustainability reporting standards globally.



The IChemE format as also recommended here is in the spirit of the GRI. Global Reporting Initiative; (Sustainability Reporting Guidelines, www.globalreporting.org).

Download Link;

<https://www.icheme.org/media/16021/sustainability-metrics.pdf>

Tasks ; Evaluating your sustainability index from an economic perspective

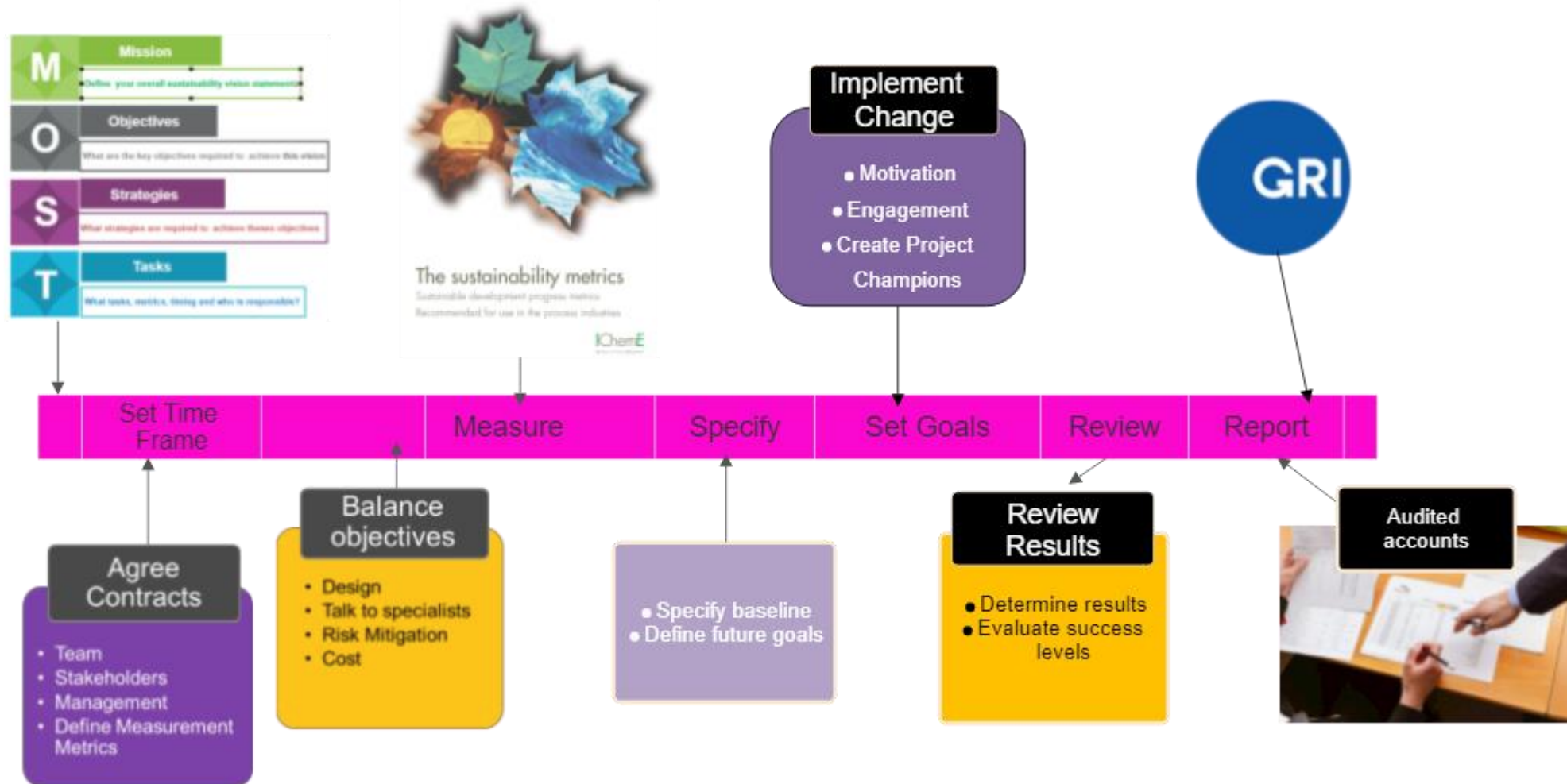
Speak to the experts

- Carbon Neutrality
- Waste management
- Water management
- Energy management
- Supply Chain
- Sourcing local
- Packaging
- Transport
- Human wellbeing



worldfavor

Implementing Your Plan



- ✓ **Manage through a Structured Work or Product Breakdown.**
(Use a breakdown structure)
- ✓ **Focus on Results.**
(Focus on what to achieve, not how to do it)
- ✓ **Balance Objectives through the Breakdown Structure.**
(Achieve a balance)
- ✓ **Negotiate a Contract between the Parties Involved.**
(All planning is a process of negotiation!)
- ✓ **Give and receive appropriate feedback**
(People need attention, especially on what they do best).
- ✓ **Adopt Clear and Simple Management Reporting Structures.**
Please keep it simple! Use single-page reporting

Beyond the Horizon



For Further Study!



**IChemE on-demand-course/
food-structures-for-a-sustainable-
world**



MSc programme in Food Process Engineering



University of
Nottingham

UK | CHINA | MALAYSIA

Thank you for
listening to me today!

(LinkedIn profile)



Seamus Higgins Food Enginee...

Associate Professor Food
Process Engineering, Uni...

Questions?

