



財團法人
食品工業發展研究所
Food Industry Research and Development Institute

Global Trend and Opportunity on Carbon Reduction and High-Value Development of Food Industry



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Global food industry face **five** challenges in environmental aspect

overcome

to find solutions

- ① Satisfy **Various Diet** demands (Population growth & elder...)
- ② Focus on **Nutritious Diet**
- ③ Overcome **Reduce Carbon and Sustainability**
- ④ **Reduce Food Waste**
- ⑤ **Flexible** and **Safe** food supply chain

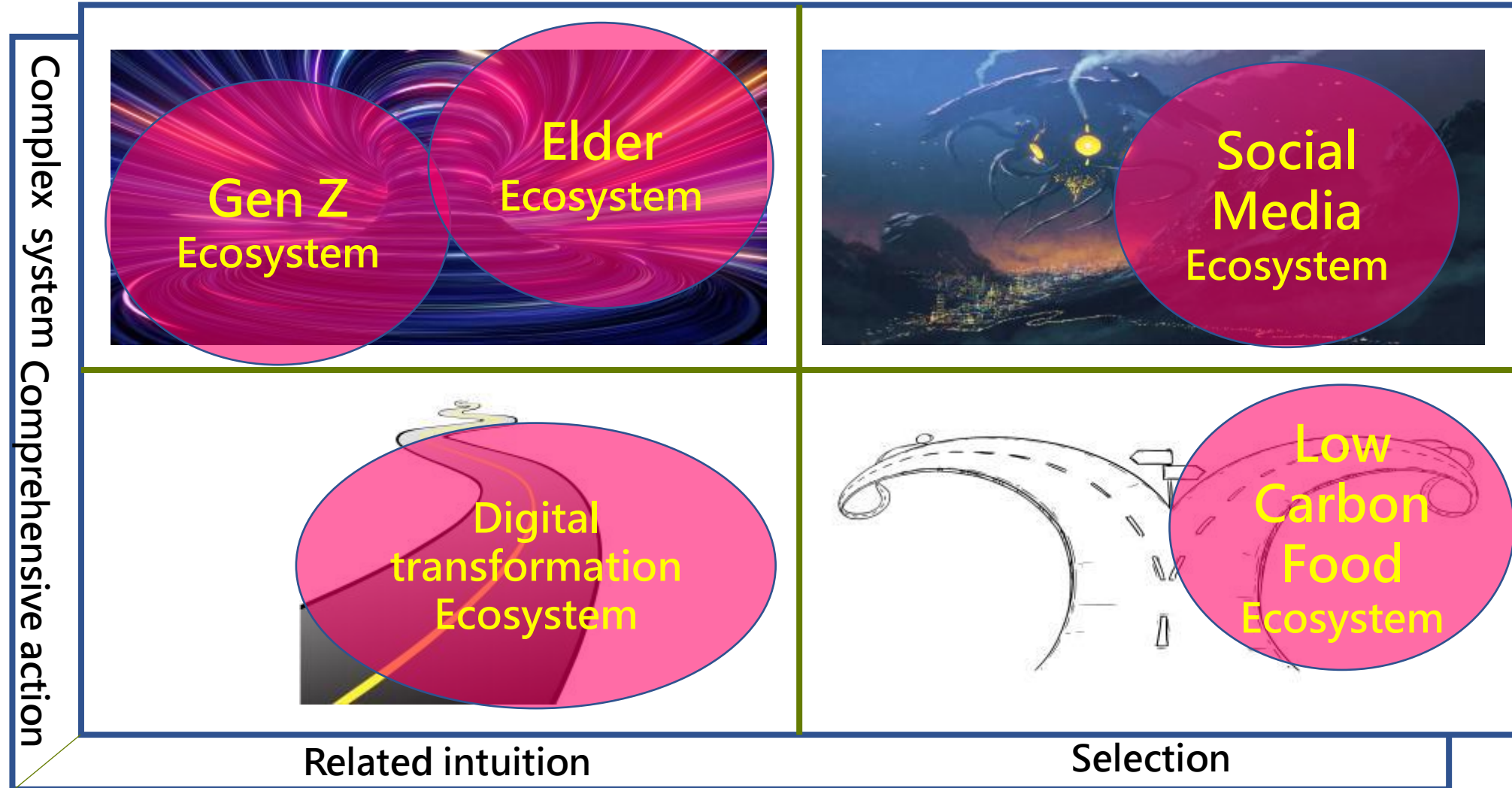
Overcome Challenges to find a new way for food sustainability



Diets for a Better Future

Friendly Environment

Future ECOSystems → Change & Response



Adopt **Technology**
Create Friendly Environment

Creating Triple-Wins Win-Win-Win

The future of Diet

**Friendly
Environment**

**Delicious
Eat better
Continuous Eating**

**Better for People
Better for Food Ecosystem
Better for sustainability**

Innovate and Win Together

Problem Solving

(Upstream)

Develop alternative food
By-product application

The future of Diet

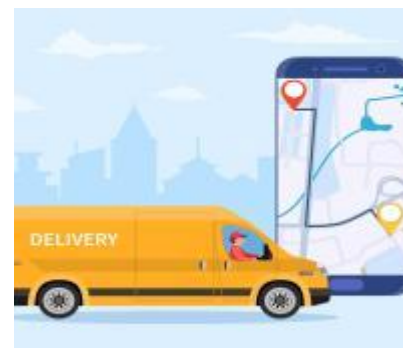
Friendly Environment

(Downstream)

Extend shelf-life
Waste reduction

Green Production

Food Industry Carbon Emission Inventory (UK as an example)



Material
(66%)

Packaging
(3%)

Manufacturing
(6%)

Transporting & Storage
(5%)

Consumption
(20%)



Content

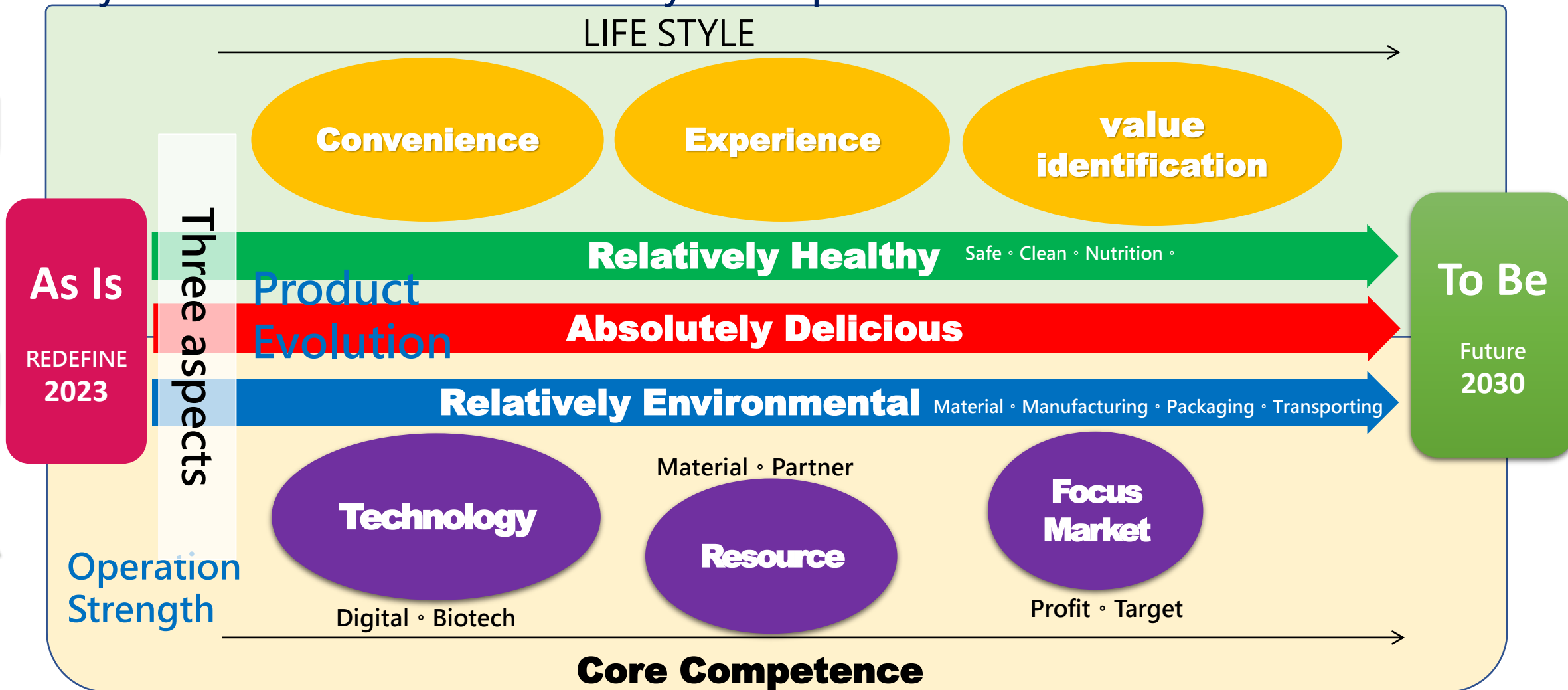
- WHY Actions for Sustainability
- WHAT Key Points towards sustainability
- HOW Net Zero Emissions Step by Step





Sustainable Food Evolution

Major Trends of Global Food Industry Development



TA

Climavores

SHOW UP



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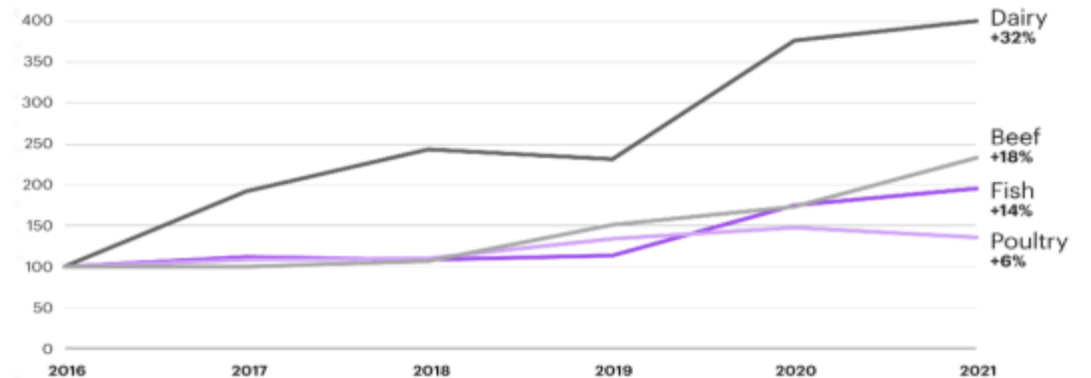
- **Vegan:** Choose food defined by food ingredients
- **Climavores:** choose foods less defined by ingredients and more in line with climate impacts.

Consumers Increasingly seeking answers for food climate Impacts on Google



Consumers increasingly seek answers for food climate impacts

Number of Google searches on "carbon dioxide keywords" for food categories, United States, Indexed 100=2016; indicated % is 2016-2021 CAGR



Source: Euromonitor, Green queen, Kearney and etc (2022/04), ITIS Group of FIRDI (2023/09)

Problem Solving Key in Alternative Food

Key raw material (Protein)

Commodities : Plant raw material...
 New material : Seaweed / Insect...
 Potential material : animal cell/Fungus...

- (1) Alternative Object
- (2) Raw Material
- (3) Technology

(4) Core Value

Type of alternative meat

Beef : Hamburger/Ground meat
 Pork : Meat Ball/Ground meat
 Chicken : Nugget/Shredded chicken
 Fish : Fish steak/Fish meat
 Seafood : Shrimp

Type of alternative milk

Liquid milk : Plant based milk / breast milk
 Solid milk : Yogurt / Cheese
 Dairy product

Type of alternative egg

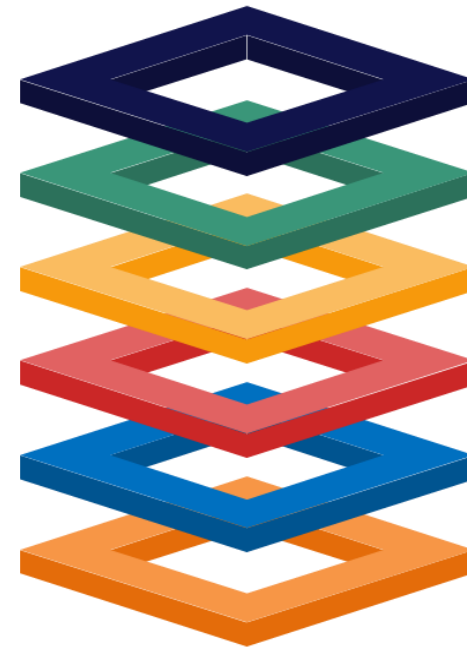
Solid/Liquid/Powder

Alternative Food

Color
 Color will change while cooking

Aroma
 Imitate different aroma of various meat

Flavor
 Juicy & less bean flavor



Texture
 The relationship between protein ingredient and texture

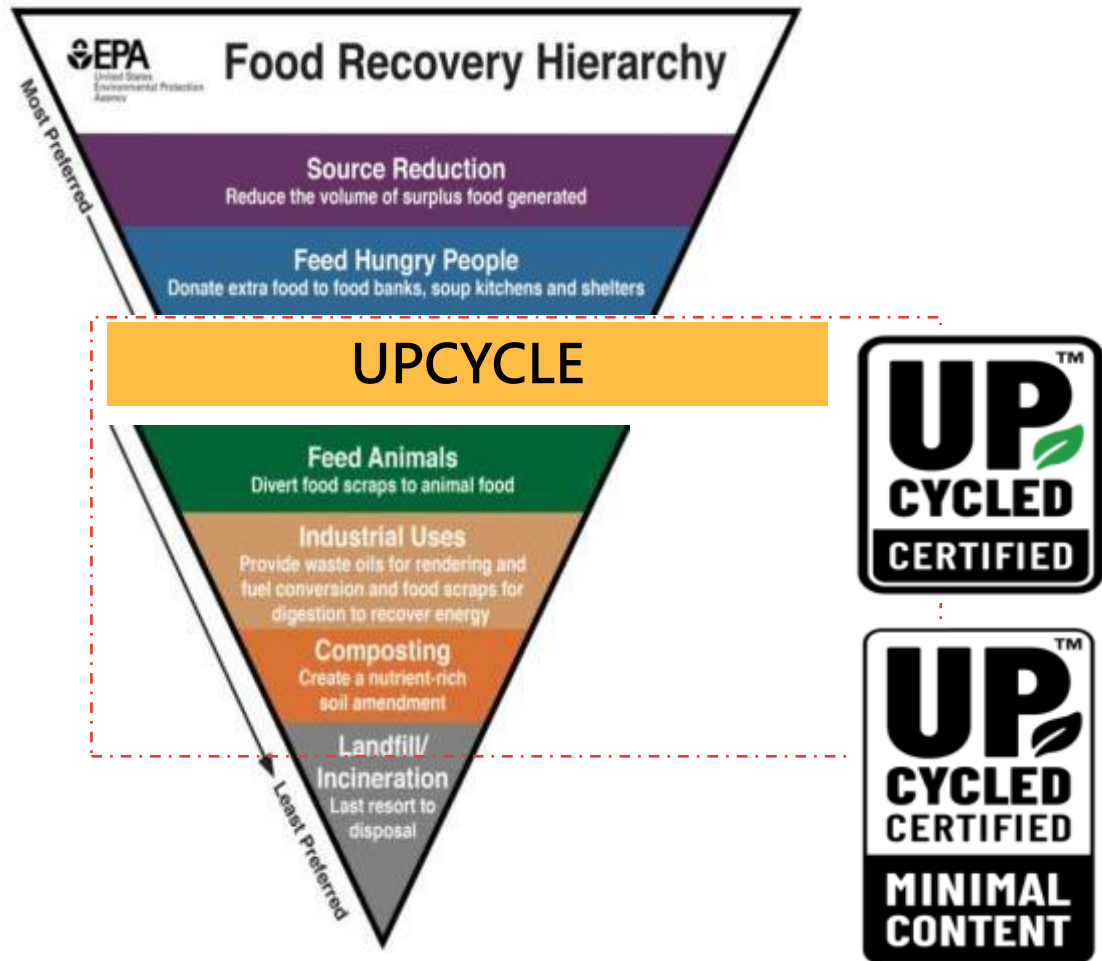
Conservation
 Prevent oxidation through packaging and food additive

Nutrition
 Protein Digestibility
 Nutritious ingredient

Market Demand

Cost
 Consumer Demand

Value-Added for By-Product



Upcycling Food Association

- Non-profit organizations
- Prevent food waste by coordinating hundreds of companies around the world and empowering millions of consumers to prevent climate change with the products they buy. °
- Promote **Up cycled certification**
- Types of Up cycled certification
 - $\geq 95\%$ Upcycled input(s) by weight.
 - $\geq 10\%$ Upcycled input(s) by weight or threshold met for total tonnage diverted.
 - $< 10\%$ Upcycled input(s) by weight or content less than threshold for total tonnage diverted.

Food Material Carbon Emission

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New Food Ecosystem

Measure	Content
Sustainable agriculture	<ul style="list-style-type: none"> Improving livestock health and productivity Low-methane diets and feed additives for ruminants Slurry acidification Anaerobic digestion Nitrogen use efficiency (NUE) and controlled-release fertilisers Low-till and no-till farming Onsite renewables such as solar and wind turbines can provide zero carbon electricity supply Planting trees, focusing on broadleaf woodland
LOW-CARBON Material	<ul style="list-style-type: none"> Switching to lower carbon ingredients Tracking material carbon footprint
Food waste reduction	<ul style="list-style-type: none"> Inventory carbon emission of production roadmap Control food supply and demand By-Production application

Packaging Carbon Reduction

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New
Food
Ecosystem

Measure	Content
Reduce	<ul style="list-style-type: none"> Reduce packaging volume by minimizing material use Use the right amount of packaging - where possible reducing its material weight through redesigning the packaging or the product
Reuse	<ul style="list-style-type: none"> Reuse packaging items in their current form
Recycle & Compost	<ul style="list-style-type: none"> Ensure recyclability by using materials that are easy to recycle in the UK, and single material packaging where possible Work with suppliers to find lower-carbon sources of individual packaging materials such as glass and aluminium
Recover	<ul style="list-style-type: none"> Recover energy through waste treatment processes
Dispose	<ul style="list-style-type: none"> Dispose of any residual packaging safely via landfill

Manufacturing Carbon Reduction

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New Food Ecosystem

Measure	Content
ENERGY EFFICIENCY & MANAGEMENT	<ul style="list-style-type: none"> Develop a corporate energy efficiency policy Implement an Energy Management System to monitor and optimise energy use Staff training on energy management principles and practices Install sub-meters to measure energy use of individual processes Plan a programme of regular maintenance and cleaning of motors, boilers, pipework, ovens etc Install automatic process control and switch off equipment when not required
DECARBONISING ELECTRICITY	<ul style="list-style-type: none"> Procuring renewable electricity Review your site(s) for suitable for renewable electricity Identify trusted sources of advice on renewable electricity Design renewable electricity procurement strategy compatible with corporate decarbonisation targets Switch to 100% renewable electricity by 2030
DECARBONISING PROCESS HEAT	<ul style="list-style-type: none"> Learn more about technological options for decarbonising process heat Explore electrical alternatives for hot water and steam Investigate government incentives for fuel switching Develop a long-term plan for decarbonisation of process heat Implement energy efficiency measures compatible with long-term plan for decarbonisation Decarbonise heat processes by commissioning alternative systems powered by renewable energy

Logistics and Transportation Carbon Reduction

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New Food Ecosystem

Measure	Content
Vehicle improvements	<ul style="list-style-type: none"> ■ Regular maintenance, including refrigeration ■ Vehicle procurement (e.g. hybrid drivetrains; electric LGVs) ■ Advanced tyres to reduce rolling resistance ■ Aerodynamic body designs ■ Systems to reduce engine idling.
Operational efficiency (reducing fuel per ton-kilometre)	<ul style="list-style-type: none"> ■ Reduce distance travelled per unit of product ■ Increasing size of average payload / Shorter supply chains/ Optimised vehicle routing and timing ■ Modal shift to rail or barge
Driving	<ul style="list-style-type: none"> ■ Driver training and incentives ■ Reducing running speeds and idling ■ Monitoring and auditing data on fuel use, routes & speed
Storage	<ul style="list-style-type: none"> ■ Optimised refrigeration plant ■ Switch to low-GWP refrigerants ■ Smart temperature monitoring and energy management
Cold chain Improvement	<ul style="list-style-type: none"> ■ Power fridge directly from main engine ■ Move to electric mobile refrigeration ■ Improve trailer insulation ■ Implement better loading/unloading procedures to minimise heat gain

Consumption Carbon Reduction

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New Food Ecosystem

Measure	Content
Understand customer expectations on climate	<ul style="list-style-type: none"> Retail and hospitality is coming under increasing pressure to act on climate. Demands will flow up the supply chain. Build understanding of present and upcoming customer expectations on climate.
Lower carbon diets	<ul style="list-style-type: none"> Demand for plant-based foods is one of the key trends in the UK. And product carbon labels look set to arrive imminently.
Engage consumers on climate issues and waste reduction	<ul style="list-style-type: none"> Help consumers to lower their carbon footprints. Promote sustainable, healthy diets and provide guidance to store, prepare and cook food as eco-efficiently as possible.
Net zero Carbon reduction	<ul style="list-style-type: none"> Retailers are tackling their Scope 1 & 2 emissions, through actions such as sourcing renewable energy and improving efficiency of heating and lighting. Work with customers to develop lower-carbon products and help consumers reduce their emissions through initiatives such as clear carbon labelling schemes.
WASTE REDUCTION	<ul style="list-style-type: none"> Targeted public campaigns such as Love Food Hate Waste, Food Waste Action Week which promote actions to reduce waste from the most wasted foods. Improved labelling

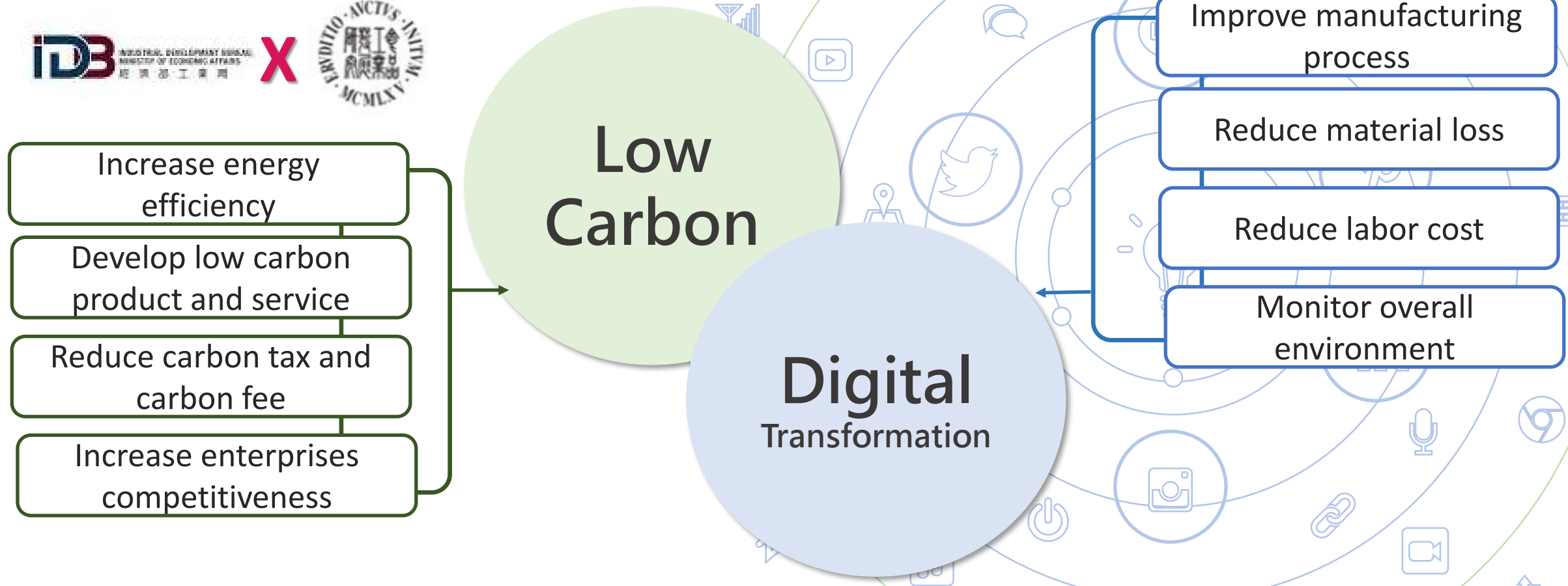
International Food companies are going to Carbon Neutrality

Carbon Reduction Aspect	Company Name	Carbon Neutrality Target	Carbon Reduction Dynamics
Develop low carbon product	Premier	2040	Plan to have a threefold increase in sale performance of plant-based product.
	Quorn	2030	Improving plant-based product packaging with carbon footprint labeling
	General Mills	2050	Invest Gathered Foods which is plant-based seafood to expand plant-based marketing share.
Integrating with upstream	Nestlé	2050	Developing low carbon coffee– two new Robusta varieties with up to 50% higher yields per tree versus standard varieties.
	Pepsi	2040	Using innovative carbon-capture technology, potato peelings leftover from making crisps will be transformed into low-carbon fertiliser and returned to farms where potatoes for Walkers crisps are grown across the UK.
	McCain Foods	2050	implementing regenerative agricultural practices across 100% of its potato acres worldwide by 2030, and has committed to reducing emissions related to potato farming, storage and freight by 25% by 2030.
Toward sustainability in packaging	Coca-Cola	2040	Significantly increased the recycled plastic (rPET) content of its packaging.
	PG Tips	2030	remove the plastic film from boxes of tea in 2021. •
	Macphie	2050	Working with Tetra Pak, the food manufacturer is packing its ready-to-use dessert and sauce ranges into cartons made from 87% renewable materials, reducing the packs' carbon footprint by 11%.
Minimise manufacturing carbon emission	Britvic	2050	Sourced 100% renewable electricity for all its UK manufacturing sites since 2018, achieved through a power purchase agreement for wind energy.
	Mondelēz	2050	Switched to purchasing 100% renewable electricity for all six of its production sites in the UK.
	Unilever	2039	only buys freezers that use natural refrigerants with low global warming potential.
Storage and transportation Carbon Reduction	Mars	2050	Cooperated with DHL to the opening of a new state of the art warehousing facility that will deliver an annual logistics CO2 reduction of 7.7% for Mars UK.
	AB InBev' s	2040	investigate the roll-out of hydrogen trucks and filling stations on a large scale.
	Crown AmbA	2050	Develop a new transport corridor to achieve climate-neutral food transports from Denmark to the UK (net zero) by 2030

2050 Net-Zero Pathway Promotion Process



TAIWAN ACTION: Twin Green & Digital Transformation



Hundreds of Taiwan industrial associations support Net Zero Action



Low Carbon

Carbon Emission Reduction

- Reduce industrial carbon emission
- Increase carbon management

Adopt Low Carbon Technology

- Adopt new technology to reduce carbon emission in manufacturing sector



Assist the company in managing, developing and retaining TOP Talents

Low Carbon

Build industrial sustainable development
Cultivate talents with carbon reduction skill



Course Target

- Carbon management trend and practice
- FIRDI carbon reduction skill
- Carbon fee and enterprise's net zero strategy

- Food industrial greenhouse gases inventory
- Food product roadmap
- Carbon footprint calculation
- Tool induction of calculating carbon footprint





CLEAN

新味
食潮
FUN FOOD
TAIWAN



Less additives

Re-examine the additives used in products and avoid using them unless necessary or replace them with ingredients to make product labels cleaner while without compromising food safety.

Advance processing

Reduce or optimize processing procedures to avoid damaging nutritional components or other food quality factors.

Fine ingredients

Improve raw material quality through testing or certification, and use natural ingredients.

Clear labeling

Clearly convey product information and make it easy for consumers to read and understand.

Transparent information

Fully disclose product information such as raw materials, manufacturers, and product quality, and make it searchable.

DESIGN



Visual aesthetics

Design products and packaging with aesthetics and unique concepts.

Five-sense experience

Enhance product visual/auditory/olfactory/taste/touch experiences and create pleasant and novel experiences for consumers.

Food texture

Create distinct texture or food structure which differentiates the products from similar products.

Cultural stories

Design unique product images by integrating such as local Taiwanese ingredients, historical culture, art, or modern coolness.

Target customer

Clear product position with precise and systematic marketing strategies to target customer.

SUSTAINABLE



Universal design

Design convenient features that meet different consumers need for products.

● Whole food utilization

Reduce the amount of waste generated during product manufacturing.

● Carbon footprint Reduction

Increase use of local ingredients and shorten food transportation distances.

● Preserve freshness

Extend shelf life by using methods such as formula adjustment, process improvement, sterilization, packaging, etc..

● Environmental-friendly packaging

No excessive package, incorporate environmentally friendly packaging materials, and recycle packaging materials.



Taiwan & Thailand Collaboration Opportunities in Food & Biotechnology industries

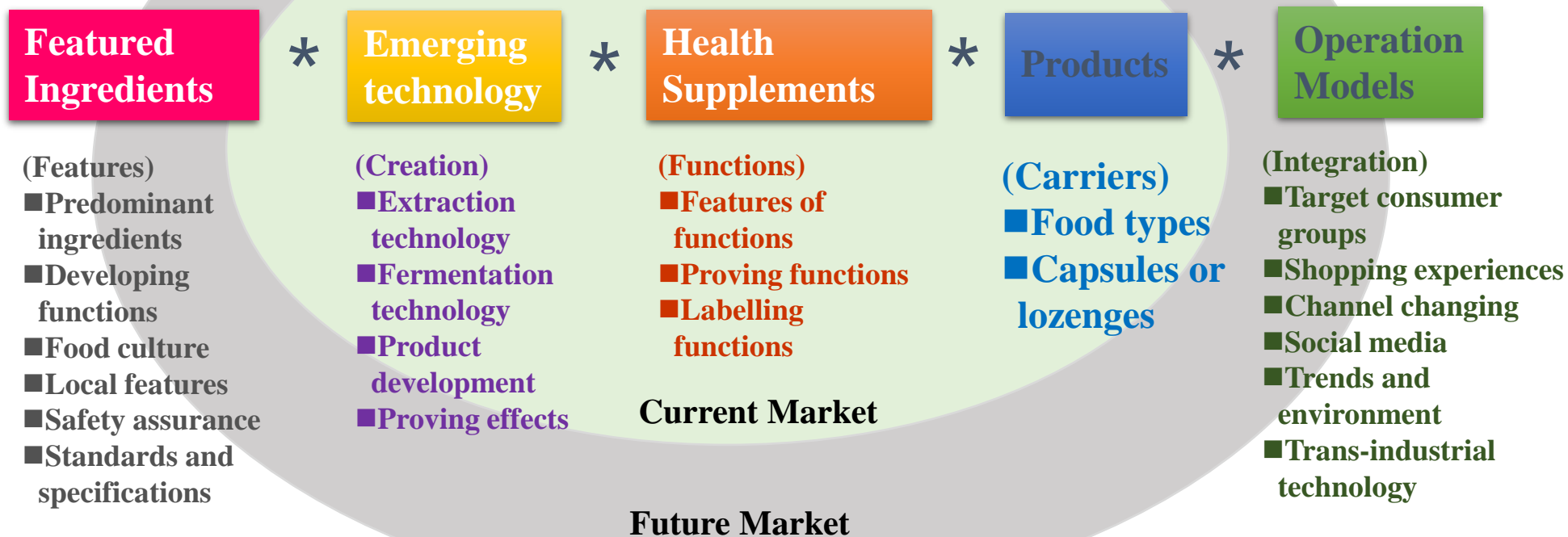


High-Fiber Foods	Probiotic Foods	Prebiotic Foods	Synbiotic Foods	Anti-Inflammatory Foods
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Discovering & Creating New Collaboration Opportunities in ASEAN and Global Markets



Source : FIRDI (2023/09)



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***Food Industry Research and Development Institute (FIRDI) Hsinchu, Taiwan.
Since 1965***



Thank you for your attention!