

Building investable business for plant-based ingredients

beyond the obvious



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Executive summary

Sustainability targets, health concerns and the need for more resilient food systems are currently driving the global shift towards more plant-based diets. While demand for plant-based ingredients is growing, capital has become more selective. The market increasingly values performance over novelty, pushing ingredient producers to focus on functionality, consistency, scalability and cost competitiveness.

Current processing technologies still have notable limitations for plant protein manufacturing. Wet extraction methods can achieve high purity but are often complex, costly and economically feasible only at a large industrial scale. Dry fractionation methods, on the other hand, are less costly to set up and simpler to operate but may not deliver sufficient performance for targeted food applications.

The growth of the plant-based food market depends on research, development and innovation (RDI) to deliver better production processes that are resource-efficient and improve ingredient performance in end products.

This white paper shows that moving the focus from maximal purification to optimal performance and creating value across all fractions is critical to achieving a viable business case.

The white paper identifies three key shifts that define investable plant-based ingredient value chains:

From protein-only to full-stream value

Profitability depends on creating value from every fraction, not just the protein stream. Business models must evolve towards more diversified product portfolios and multi-channel market approaches.

From purity targets to fit-for-purpose performance

Successful ingredients must be designed for real applications, validated with customers and produced using scalable, locally feasible and resource-efficient technologies.

From isolated projects to coordinated value chains

Investable growth requires genuine collaboration across growers, processors, food companies, investors and policymakers.



RETHINK co-innovation project

In the Business Finland co-innovation project RETHINK, VTT and the Finnish ingredient and food industry worked to develop the plant-based ingredient sector. This included evaluating different raw materials and processing methods, developing new ingredient technologies, analysing factors that drive feasibility and validating functionality to demonstrate their applicability in foods. Particular attention was given to what is viable in a smaller ecosystem like Finland, where industry scale, infrastructure and resources differ from those of larger global players.

Key drivers for improving the investment case for plant-based ingredients

Value chain design

A shift towards more decentralised, local and modular production is emerging as companies seek resilience, flexibility and better alignment with regional raw materials. The key challenge is how these models can remain cost-competitive with centralised, large-scale production factories.

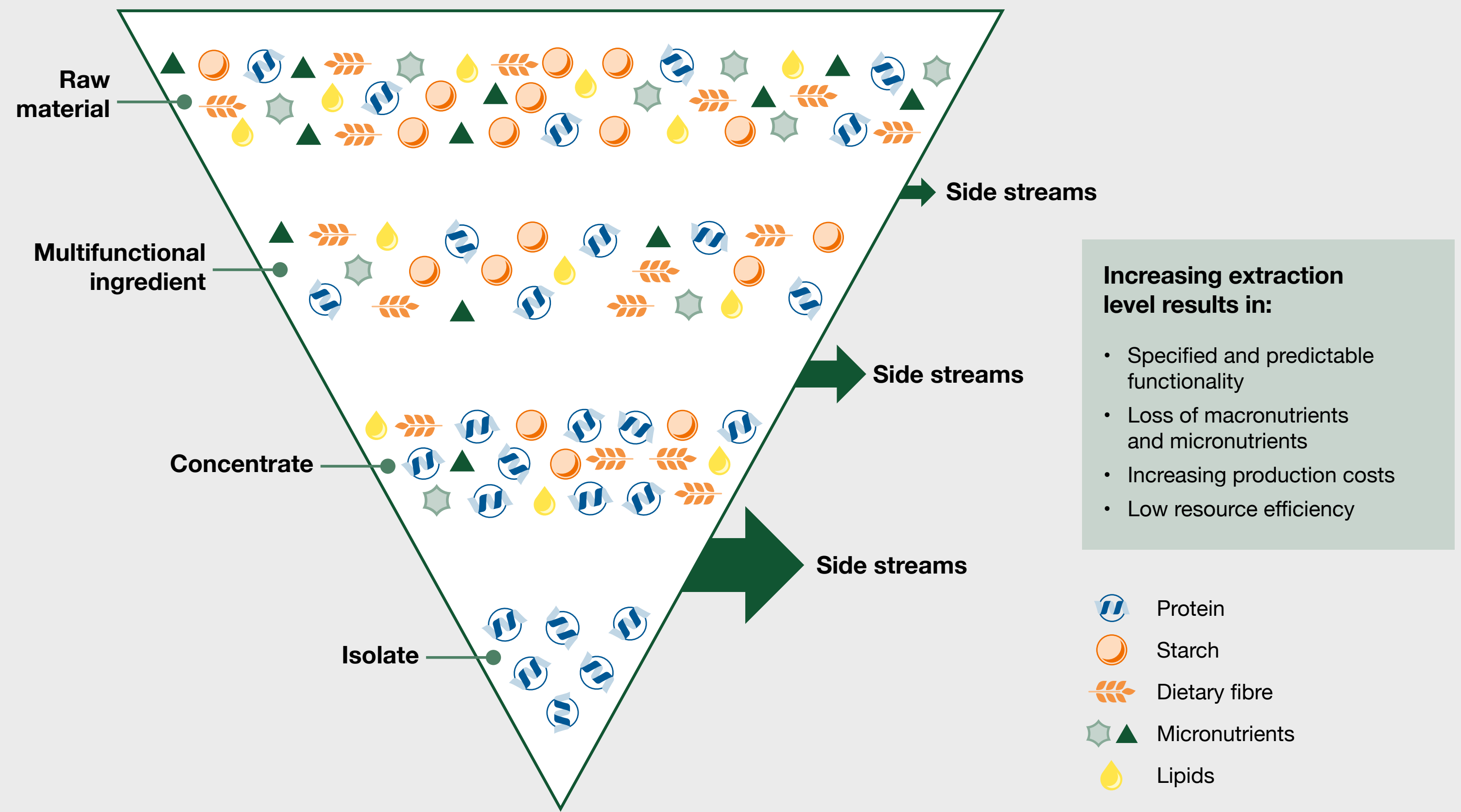
Processing strategies

Moving from maximal purification towards optimal ingredient performance is emerging as a promising direction that improves resource efficiency and aligns with current consumer preferences. For protein ingredients in particular, it may also enhance nutritional value through higher fibre content. This aligns with emerging dietary patterns, as protein- and fibre-rich plant ingredients can support GLP-1-related weight management by enhancing satiety and helping to maintain diet quality during reduced food intake.

Full-stream utilisation

Full-stream valorisation and diversified product portfolios are becoming increasingly important. Carbohydrate-rich side streams can determine profitability, meaning producers cannot focus solely on protein.

Target is to move from maximal purification to production of high-performance, high-quality ingredients



Turning raw materials into market success

Plant-based ingredient value chains span multiple stages: primary production, trading and logistics, ingredient processing, end-product manufacturing, retail, food service and consumers.

The greatest value is typically created during ingredient conversion, where raw materials are transformed into application-ready fractions. This stage is technology-driven and capital-intensive, and its economics depend on utilisation rates, energy and water efficiency and the ability to commercialise multiple co-products.

Plant raw materials, however, are inherently local: availability, quality and cost vary by geography. These factors influence facility location, logistics, storage needs and seasonal supply risks. This leads to a strategic choice between centralised and decentralised production models.

Large, centralised plants benefit from lower unit costs but increase dependence on single sites and longer logistic chains. Regional or distributed plants can improve resilience and reduce logistic risks. To avoid higher unit costs and remain competitive, regional production requires modular designs, high utilisation and effective valorisation.

Value chains can also combine centralised and decentralised steps or scale capacity in phases. These hybrid models can offer an attractive balance between cost, flexibility and investment risk.



Case example

Finland is a great example of a European country where hybrid value chain models could be applied to scale the plant based ingredient industry. The country has strong capabilities in regional crop production and a food industry with a strong plant-based agenda. Co-innovation within the RETHINK consortium has explored potential process routes and partnerships, while the broader Finnish food ecosystem is actively looking for models for industrial-scale deployment.

Requirements for feasible value chains

Investable plant-based ingredient businesses require an integrated crop-to-market model: reliable raw material supply, consistent quality, fit-for-purpose processing, validated end-use applications and credible routes to market. Supply risk can be reduced through contract farming, grower cooperation and shared quality management. At the same time, demand should not be seen as fixed: new product formats, use cases and application-led innovation can create higher-value markets for new ingredient streams.

Integrated model from crop to market

Successful ingredient businesses align customer demand, technology choices and commercial execution. The strongest models integrate crop supply, processing, application validation and routes to market, while being adapted to local conditions and flexible to scale.

Reliable volumes and consistent quality

Mechanisms such as contract farming, grower cooperatives and shared quality management can reduce supply risk and support scale-up.

End-use development

Current product formats or customer needs are not fixed. Innovation in new products and use cases often drives stronger demand and higher-value markets for new ingredient streams. Encouraging application-led innovation alongside upstream processing investments is essential.

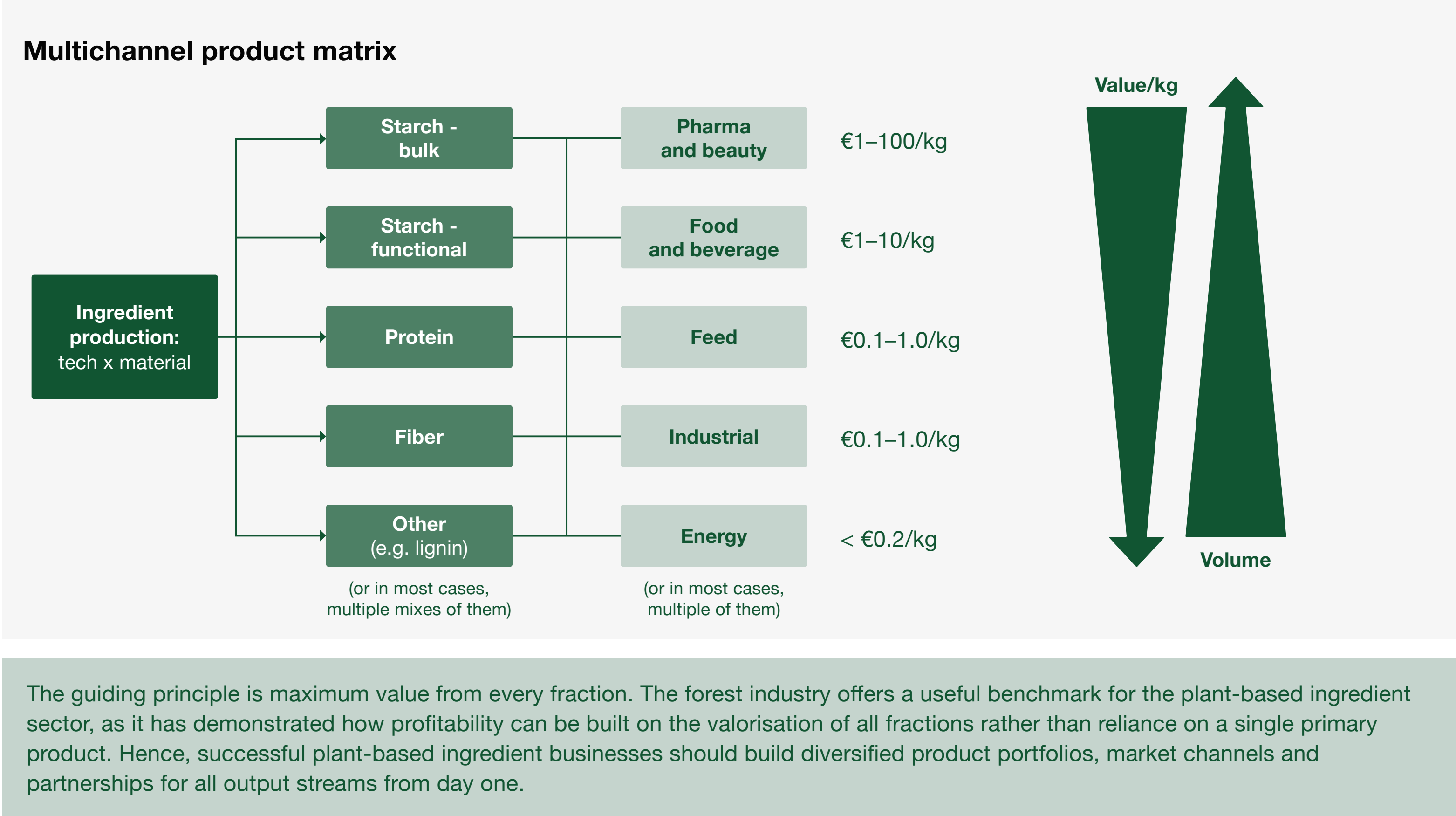
Make every fraction count: multichannel strategies and new ingredient technologies

From a linear chain to a multichannel ingredient production

Ingredient production always produces multiple streams. Commercial success requires moving beyond a simple “protein in, protein out” model towards a multichannel approach, in which protein, carbohydrate and other fractions are directed to food, feed and other industrial markets. This is often what makes a production plant profitable.

Viable business models are preferably regionally designed. Product portfolios should align with nearby demand, existing industrial ecosystems and practical logistics. There is also a trade-off between value and scale: higher-value products typically serve smaller markets and require tighter specifications. Simpler processes can lower investment needs but may limit performance and market access. More advanced technologies can unlock higher-value applications but require stronger commercial capabilities to develop and sell products supporting multiple markets.

A common bottleneck in the plant protein business is the carbohydrate-rich side streams. If they lack clear value pathways, the economics of the protein fraction also weaken. A key RDI priority is to increase the value of carbohydrate streams, for example, through improved separation, functionalisation or bioconversion, as well as application development, including uses beyond food.



A simplified example shows why full-stream valorisation matters

From one tonne of peas priced at ~€300, a dry fractionation route might yield:

- a protein concentrate stream suited, for example, for meat alternatives (e.g. ~200 kg at ~€5/kg);
- substantial carbohydrate-rich fractions (e.g. ~600 kg that may default to low-value feed at ~€0.2/kg); and
- hulls (e.g. ~200 kg that can end up in near-zero-value energy use).

Improving profitability, therefore, depends both on enhancing fractionation performance through raw material preparation and process tuning. It also depends on upgrading side streams, for example, by tailoring carbohydrate taste and functionality for non-dairy applications or identifying higher-value technical uses for hull fractions.



Beyond traditional plant protein production technologies

Beyond conventional wet and dry processing routes, innovation is increasingly driven by two commercial imperatives: achieving high performance with reduced purification and enabling cascading use of plant biomass to maximise value across all fractions.

New approaches aim to integrate processing steps, reduce the use of utilities and chemicals and tailor fraction functionality to specific applications. Across these concepts, one techno-economic takeaway stands out: technology choices must be linked to full-stream valorisation plans and fit-for-purpose product functionality. Value is driven not by protein fraction alone. Smaller, modular and integrated production concepts can improve feasibility in regions with limited raw material volumes, provided that utilisation and markets for all fractions are secured.

Mild enrichment can strengthen the investment case by producing ingredients that match or outperform highly purified alternatives, with less capital. This can improve resource efficiency, simplify operations and create stronger unit economics. It also shifts the focus of value creation from purity alone to application performance, faster scale-up and better returns. In addition, milder enrichment can preserve nutritionally beneficial components such as dietary fibre and bioactive compounds that resonate with consumer needs.



Future ingredient technologies building plant-based value chains



Emerging technologies

Clean-label wet fractionation

- Uses enzymes and recyclable solvents to reduce chemical inputs.
- Improved nutritional value compared to conventional wet routes and better functionality and sensory quality compared to dry-processing methods.
- May add process complexity and is most attractive where added customer value is clearly demonstrated in target applications.

Extrusion-based fractionation

- Integrates fractionation into the extrusion process, enabling one-step protein and carbohydrate separation.
- Reduces processing stages, leverages existing industrial infrastructure and creates differentiated functionality, including production of texturised structures.
- May improve capital efficiency and support the use of local raw materials

Hybrid fractionation models

- Combines different approaches, such as dry fractionation followed by selective wet processing steps to improve purity and/or functionality.
- Can be attractive when integrated to validated, higher-value applications.
- May add complexity and capital requirements, making early techno-economic validation essential.

Conventional technologies

Isoelectric precipitation

- The dominant wet-processing method for producing high-purity protein isolates (typically >80–90% protein). Proteins are extracted into water under alkaline conditions, separated from insoluble material, precipitated by lowering pH and then recovered and dried into an isolate powder.
- Relatively complex, water- and energy-intensive and usually requiring large-scale continuous production to achieve competitive costs, but typically delivering high and predictable functionality.
- Generates carbohydrate-rich side streams used as food ingredients, animal feed or industrial applications.

Air classification

- The dominant dry-processing method in which milled grains or seeds are separated using air classification equipment. Produces protein concentrates (typically ~50–65% protein), which can perform well in selected applications and may offer nutritional benefits due to higher fibre content.
- Requires lower upfront investment, uses no process water and is operationally simpler than wet extraction.
- Sensory and functionality limitations, as well as the presence of anti-nutrients, can reduce suitability for more demanding uses.
- Generates starch-rich fractions that require commercial outlets.

From research to business: case examples

In the co-innovation project RETHINK, Finnish ingredient and food companies and VTT developed new, scalable plant-protein ingredient technologies. These technologies enable the use of local crops, such as oats, peas and faba beans, in high-value food ingredients. The project strengthens resilient, decentralised food systems by building new local value chains that benefit industry, farmers and rural regions. Examples of the project outputs are presented on this page.

CASE 1:

New emerging technologies for the plant ingredient business

Proprietary enzyme technologies and know-how for protein- and fibre-rich ingredients

VTT developed new enzyme-enabled processing concepts that reduce chemical use while ensuring the performance of ingredients. The technologies enable the production of new protein- and fibre-rich ingredients while facilitating their incorporation into a wide range of foods, including liquid foods, with fewer technological challenges. These solutions support the production of nutritionally valuable, clean-label ingredients and end products without the need for complex processing.

Improved flavour in legume-based ingredients

VTT developed a new process for dry fractionation of legume protein production without off-flavour formation. The unique pre-treatment prior to dry fractionation improves the sensory quality of mildly enriched ingredients and expands their potential in food applications.



CASE 2:

Startup company – Happy Plant Protein

Happy Plant Protein, a VTT spinout, commercialises an extrusion-based, market-disruptive process that separates protein and carbohydrates and texturises protein in a single step. RETHINK supported the technology's development towards commercial readiness. The approach minimises processing steps, leverages existing food industry infrastructure and supports the use of local raw materials and may lower capital requirements.

CASE 3:

Successful innovation ecosystem

RETHINK demonstrated how industrial co-innovation can accelerate value-chain development. By combining public research with industry collaboration, the project strengthened partnerships, aligned RDI with commercial needs and supported the creation of investable ingredient production concepts. This also illustrates how national funding instruments can facilitate building competitive plant-based ingredient ecosystems.

Viking Malt x Valio – a tastier and healthier plant protein ingredient

Germination is a natural process that activates plant seeds to achieve their full potential. Under the brand of Sprau, Viking Malt has germinated faba beans to improve the flavour profile and digestive tolerance, which are the major challenges for plant-based ingredients. Partnered with Gold&Green expertise from Valio, germinated faba bean granule can serve the alternative meat and hybrid meat market. The collaboration is based on a common desire to maximise the value of Finnish plant-based ingredients. It integrates domestic best practice and know-how and drives innovations in plant-based ingredients.

Steps to de-risk and scale plant-based ingredient businesses

Industry and investors: de-risk the investment

An investable case for plant-based ingredient production starts with clear positioning. Companies can operate across a range of business models, from commodity ingredients and functional ingredients to application-specific or multi-industry platforms, contract manufacturing and R&D and IRP driven approaches. Each of them has different capital requirements, risk profiles and routes to competitive advantage. In practice, these models are often combined, and the chosen configuration has a direct impact on scalability, resilience and investment needs.

Clear market pull is essential for an investable case. The first step is to identify two to three applications that pay for functionality and define a clear price-in-use target. Differentiation is also of great importance: competitive advantage may come from raw materials, process integration, proprietary technology or proven application performance.

A credible business case also requires credible unit economics, including key cost drivers (raw materials, utilities, labour, drying and logistics) and their sensitivity to scale. Equally important is the viability of the multichannel portfolio: specify markets, specifications and volumes for protein, carbohydrate and other fractions.

De-risking checklist for industry and investors

1. Pilot production with repeatable quality
2. Validation in target applications
3. Techno-economic assessment (TEA) with sensitivity analysis
4. Customer interest through paid trials or letters of intent
5. A defined pathway to a demo and the first commercial factory

The investment strategy should reduce first-of-a-kind risk by leveraging existing infrastructure, using contract manufacturing, implementing phased capacity expansion or adopting hybrid production models. Combining centralised and decentralised production can often be the most attractive model, considering the required investments and included risks.

For industry and investors, a pragmatic next step is a joint RDI-to-investment pipeline:

Evaluate raw material ×
technology combinations

Select concepts
based on TEA

Validate
performance
rapidly

Build staged plans toward a first
plant, including fraction outlets and
early customer engagement



Policymakers: ensure favourable conditions

Effective tools for policymakers to accelerate private investment include co-investment, guarantees and blended finance to bridge the “valley of death” from pilot to first commercial facilities.

Provide targeted support

for infrastructure and logistics, such as storage and preprocessing hubs near raw material sources. Shared-use facilities and support for hybrid production models can lower capital expenditure, reduce risk and accelerate ecosystem learning.

Strengthen supply stability

by creating guidance and incentives for contract farming, long-term offtake agreements and shared quality standards. This can reduce volatility and improve confidence for processors and investors.

Keep regulation and permitting predictable

especially for water, energy and sustainability requirements. This helps shorten development cycles and lower execution risk.

Generate demand for new plant-based ingredients

through public procurement and innovation programmes. This can help first production plants secure anchor customers and de-risk market entry. Incentives for application-led innovation, including pilot and demonstration projects, can further accelerate market uptake.

Enable a competitive local raw material base

through breeding, agronomy support and quality standards. This improves cost efficiency and supply consistency, reinforcing the business case for downstream processing.

Next step for policymakers is to co-fund value-chain development initiatives that:

- 1 Accelerate grower–industry collaboration
- 2 Advance technology readiness of new ingredient concepts
- 3 Enable collaborative RDI and shared pilot/demo infrastructure and testing facilities to facilitate scale-up
- 4 Deploy risk-sharing instruments that attract private investment into new ingredient capacity



Key takeaways

Fit-for-purpose – develop processes for targeted performance and markets

Technology choices should prioritise efficient, clean-label solutions that fit regional scale, deliver high performance and are flexible for market uptake. Validation of ingredient performance in real applications throughout the development pipeline is essential.

Optimise the multichannel ingredient portfolio to ensure economic feasibility

Successful plant ingredient businesses are built on value creation across all fractions – not protein alone. Bankable factories require multi-channel go-to-market strategy and full-stream monetisation plans from the start.

Build value chains through collaboration among all stakeholders

Successful concepts must be co-developed to local crops, infrastructure, logistics and market conditions. Sustained collaborative RDI, as well as shared business models and infrastructure, can generate investable outcomes and deliver value chains that benefit resilience and growth.



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RETHINK co-innovation project

Project type:

A co-innovation project consisting of a public project combined with various parallel company-driven projects by the Finnish food industry

Research partner of the public project:
VTT

Industry partners:
Anora, Appetit, Fazer, Helsinki Mills, Raisio, Valio, Viking Malt

Duration:
June 2023 - August 2026

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