



SCIENCE AND
EDUCATION **FOR**
SUSTAINABLE
LIFE

Moving from scientific results to implementation – Examples from the BioBIGG project

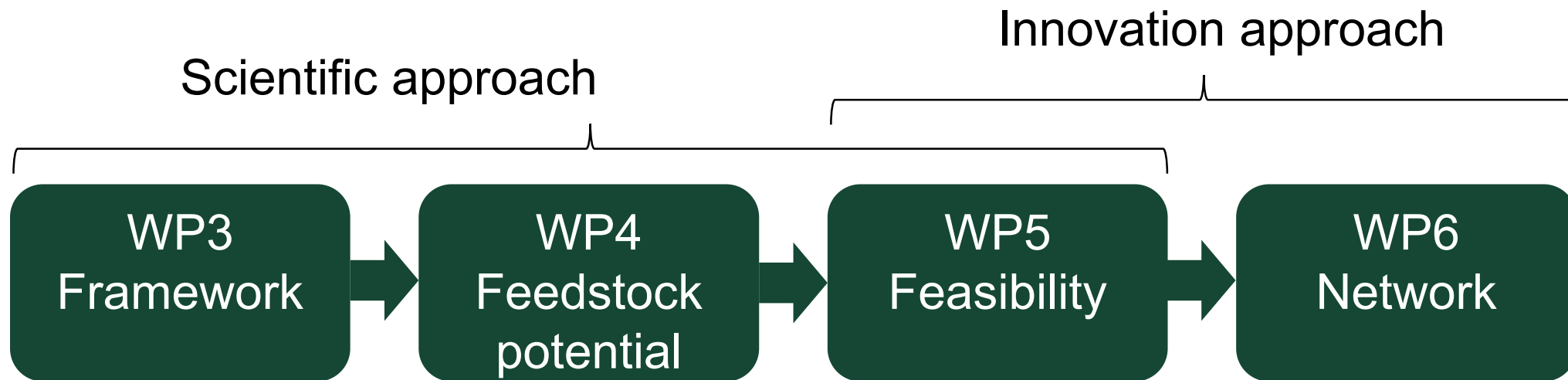
Thomas Prade, Dept. Of Biosystems and Technology, Swedish University of Agricultural Sciences (SLU)

Biomass-based Innovation and Green Growth

The BioBIGG project aims at unlocking the innovation potentials related to underutilised biomass resources along the agro-industrial value chains

- residuals and by-products from grain production, sugar production, vegetable production, forestry and wood manufacturing, new crops production etc.

Project scope

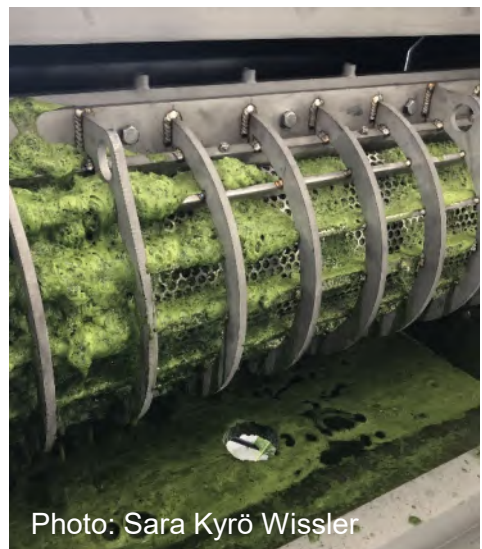
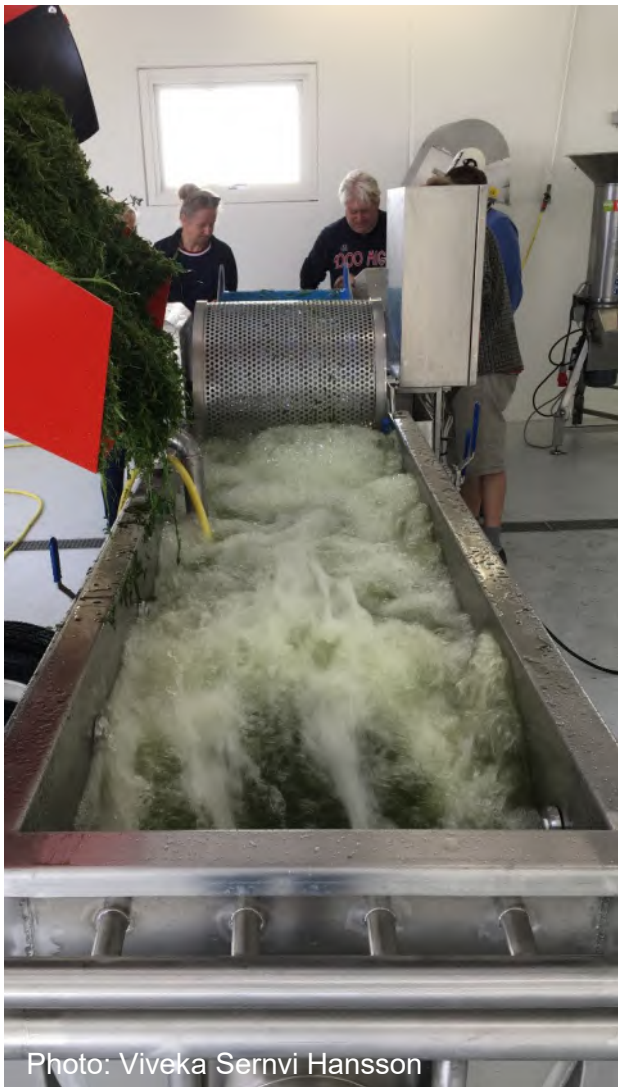


Plant protein from intermediate crops



White mustard; picture: Sven-Erik Svensson





Fractions and their application



White protein

- For human consumption
- Functional value (lower yield)
- Nutritional value (high yield)
- Dry powder



Green protein

- For animal consumption
- Monogastric animals
- Nutritional value
- Dry powder/pellet



Fiber pulp

- For animal consumption
- For ruminants
- Nutritional value
- Ensiled

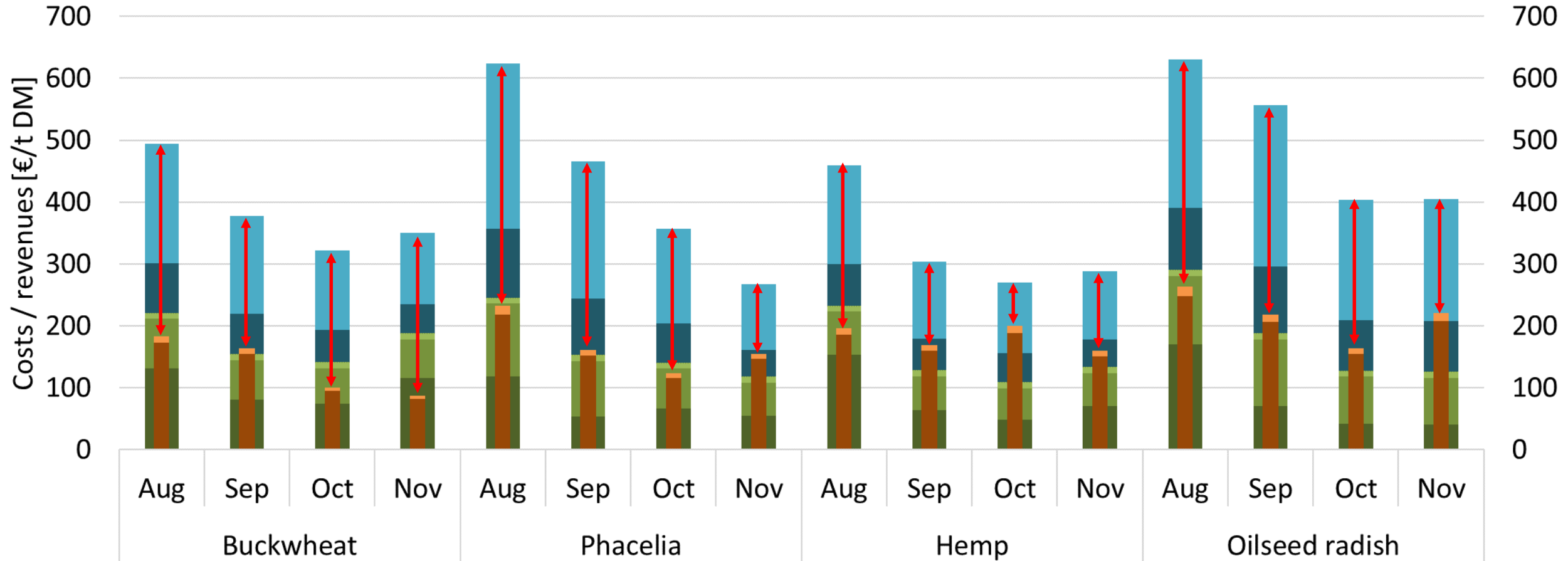


Brown juice

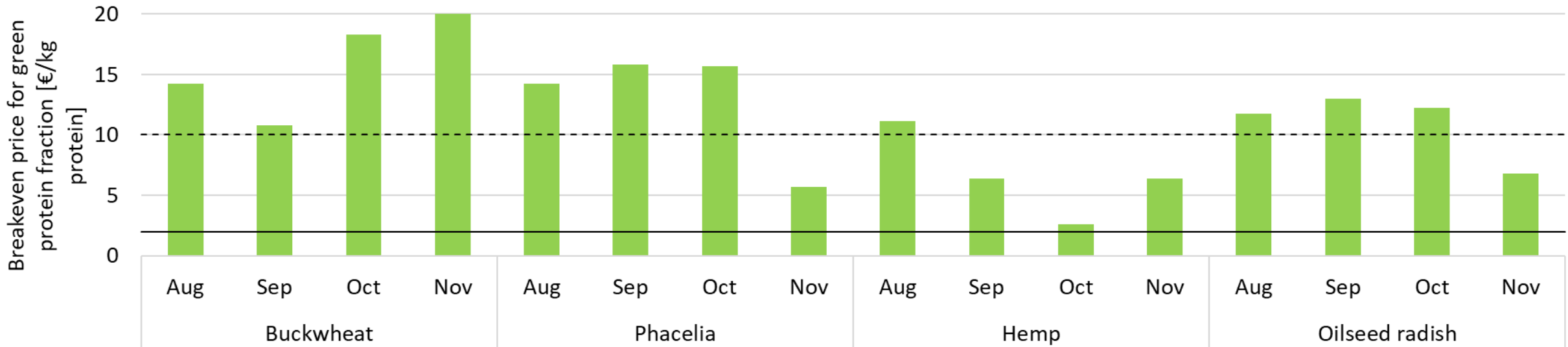
- High sugar content
- Fermentation medium
- Biogas feedstock
- High water content

White protein & fibre pulp value

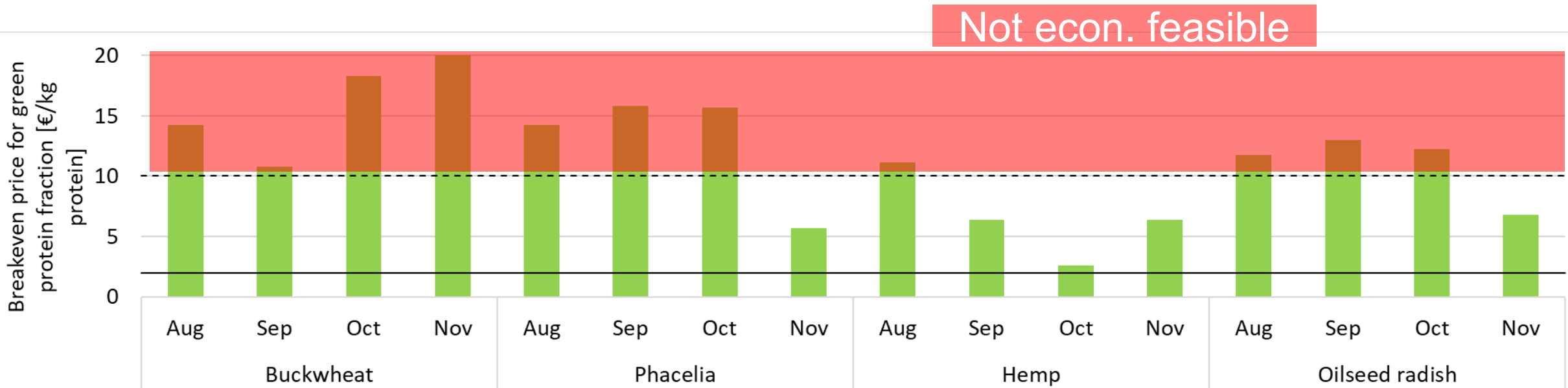
- Cultivation costs
- Harvest and transport costs
- Ensiling of fiber pulp
- Process - capital costs
- Process - operating costs
- White protein fraction value
- Fibre pulp value



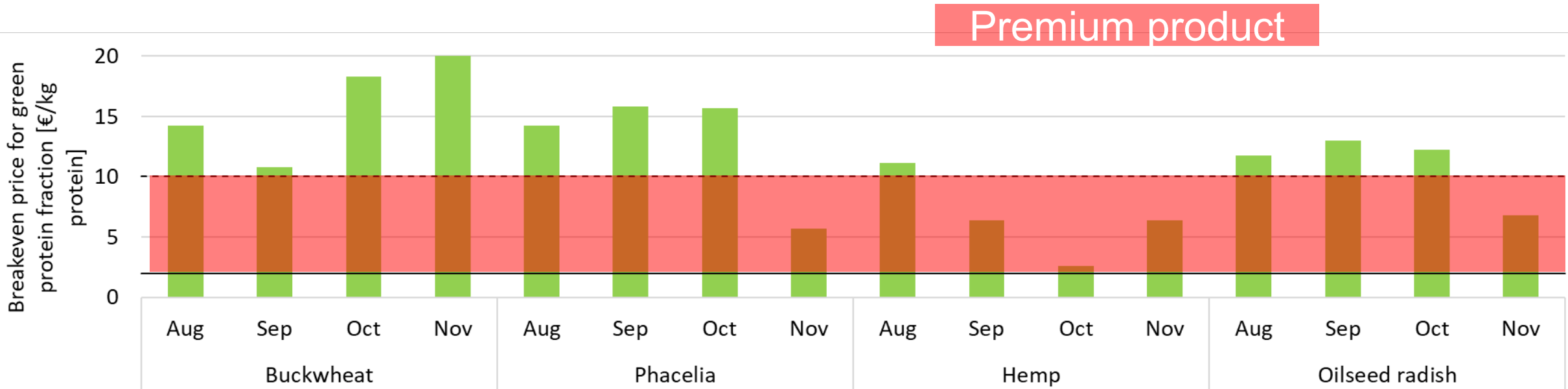
Green protein price*



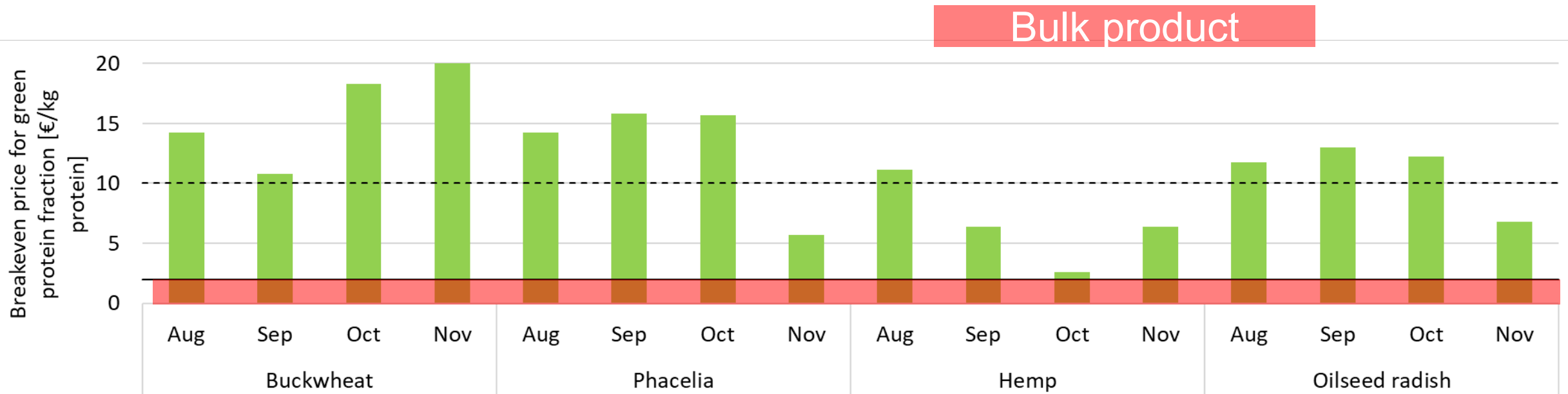
Green protein price*



Green protein price*

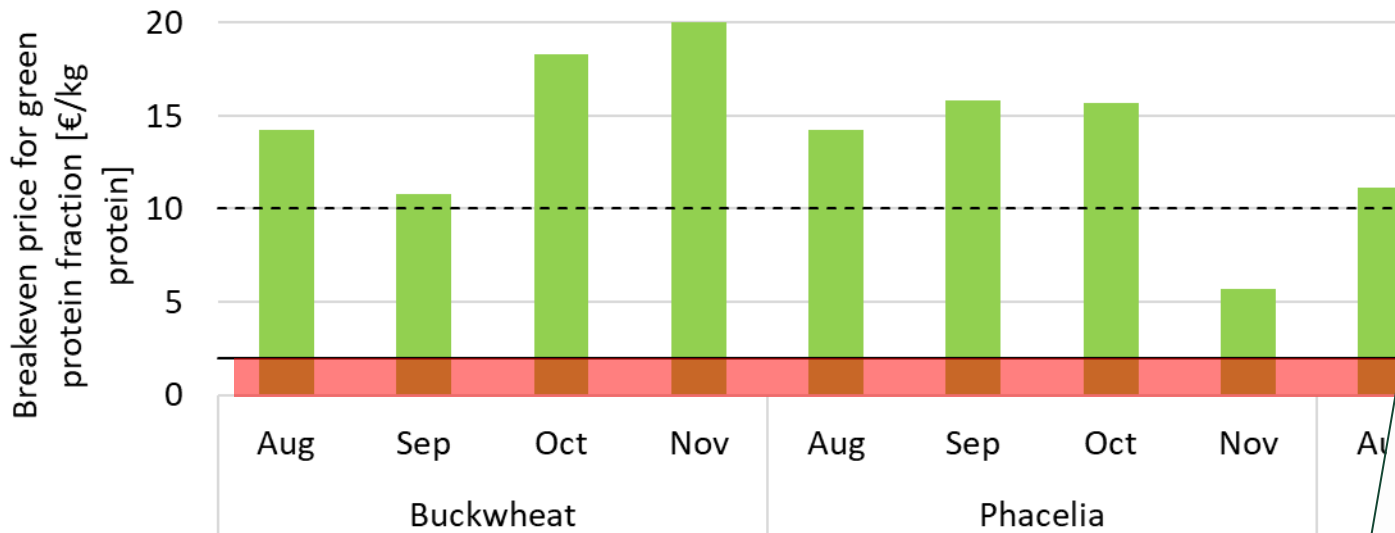


Green protein price*



Green protein price*

* To cover the cost/revenue difference



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Economic viability of protein concentrate production from green biomass of intermediate crops: A pre-feasibility study
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ABSTRACT
 Green biomass is a major potential source of proteins for food and feed. This pre-feasibility study evaluates the use of green biomass of buckwheat, phacelia, hemp and oilseed radish grown as intermediate crops (IC) as a feedstock for production of protein concentrates to produce recovery-rich food and feed products. We investigated the biomass yield, protein concentration and protein recovery potential of non-fertilized IC, nitrogen-fertilized IC and IC intercropped with legumes, harvested in late summer to autumn during 2017 and 2018 in southern Sweden. The results showed that IC fertilized with 40 kg ha⁻¹ N and intercropping with legumes contributed to a higher biomass dry matter (DM) yield of 4.9–5.8 t ha⁻¹ as compared to buckwheat. Higher DM yield was obtained when IC were harvested in October and November than in August and September. Economic assessment showed that hemp, phacelia and oilseed radish showed up to ca. 25% higher DM yield and up to ca. 70% higher protein concentration as compared to buckwheat. Nitrogen concentration was the main factor determining the size of revenues. Protein production pathways; (A) Green and white proteins and (B) total recoverable combined protein fraction (CPF). For all IC, cost per t DM was higher in August and therefore resulted in higher revenues in that year. Inter cropping resulted in higher protein content and therefore contributed to lower breakeven prices of recovered green proteins for all IC. Breakeven price analyses showed that nitrogen concentration was 34% higher in 2018 compared to 2017 and therefore resulted in higher revenues in that year. Inter cropping resulted in higher protein content and therefore contributed to lower breakeven prices of recovered green proteins for all IC. Breakeven price analyses showed that depending on lower (<2 € kg⁻¹) or higher (2–10 € kg⁻¹) price ranges, respectively. The results demonstrate that use of IC biomass could be a feasible option to produce high value protein-rich products, which can contribute extra income from IC for farmers.

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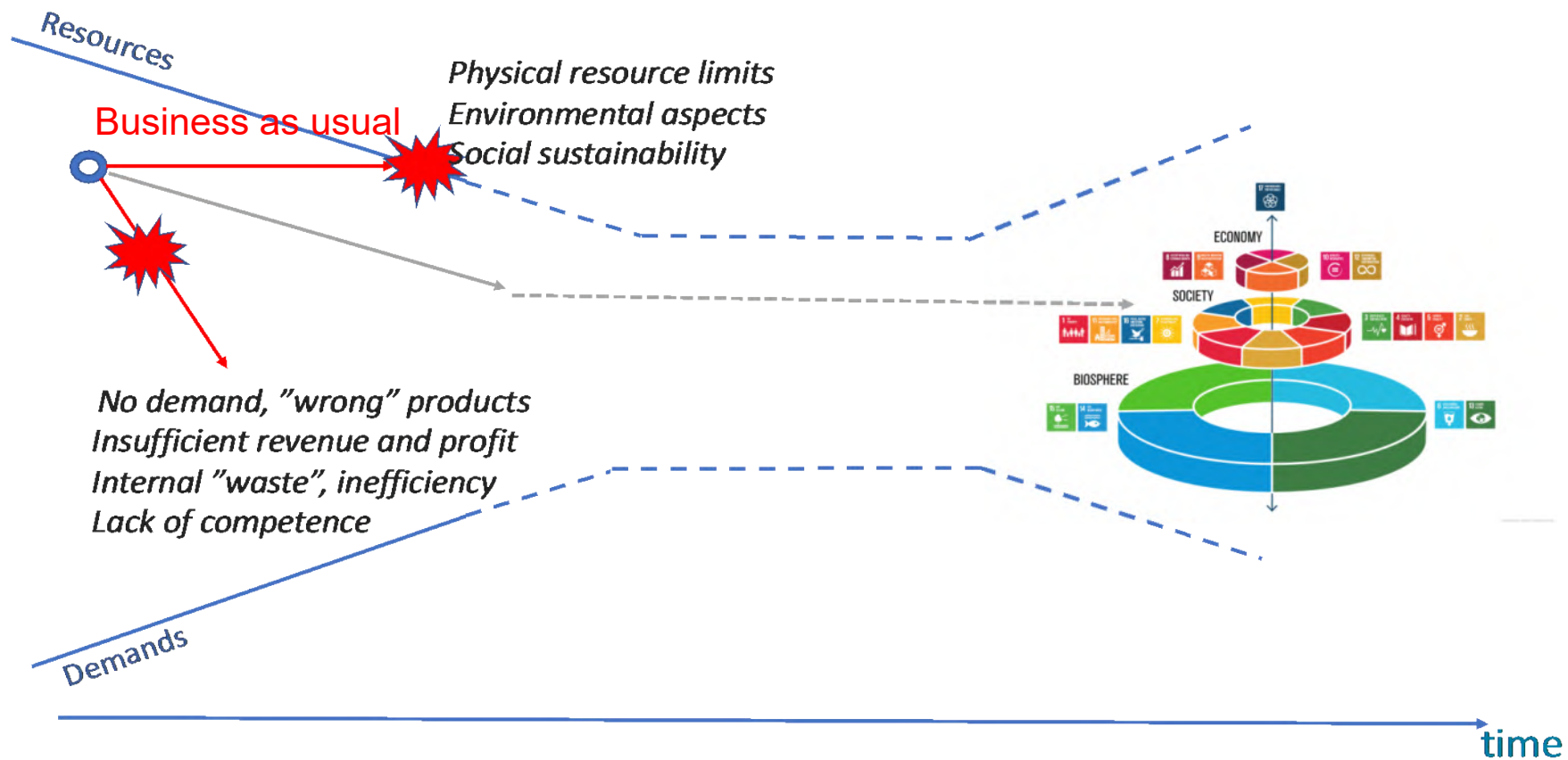
1. Introduction
 Currently, the diet patterns of modern society are rapidly changing. Plant-sourced protein-rich diets are increasingly replacing meat, and modern food alternatives with a balanced content of nutrients are gaining increasing attention (Kumar et al., 2017; Rosenfield and Burrow, 2017). The changes in diet patterns are largely related to i) a perception that food consumption choices influence public health, ii) a desire to manage body weight (Rosenfield and Burrow, 2017) and iii) ethical and environmental concerns regarding meat production (Schösler et al., 2012). This change in food choices may require an altered or increased production of crops containing suitable protein for human consumption. In addition, the increased desire of locally produced protein sources for feed purposes, results in an increased requirement of plant-based protein products (de Visser et al., 2014). Increased plant-based protein production requires either an increased yield per hectare or an increased use of agricultural biomass that is currently not used to produce plant protein-rich products. In this context, opportunities to use already available biomass, currently

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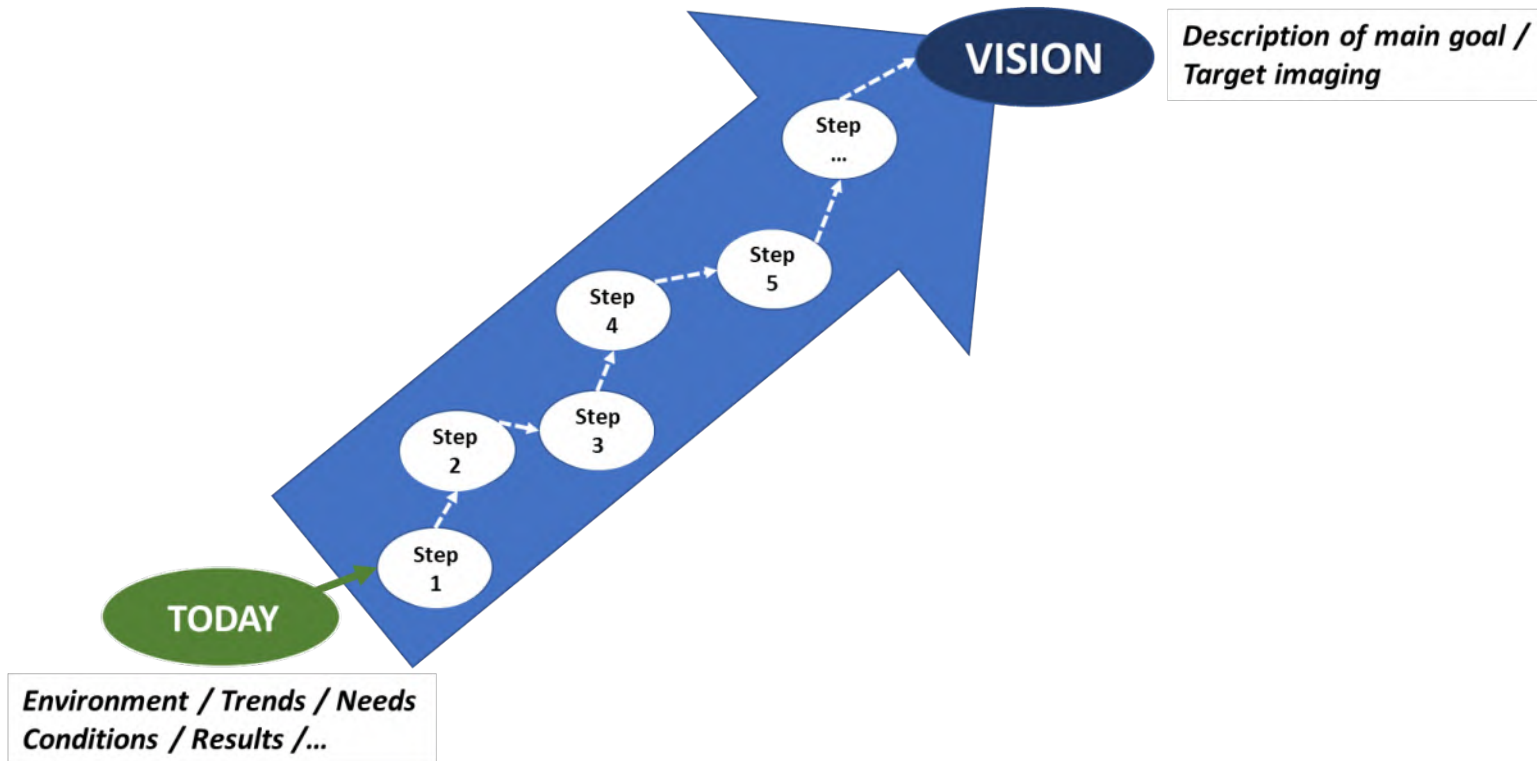
Transition to implementation

- Scientific work usually ends here
- More and more research funders want to integrate the first parts of this transition
- Many innovation projects require a good plan for that transition

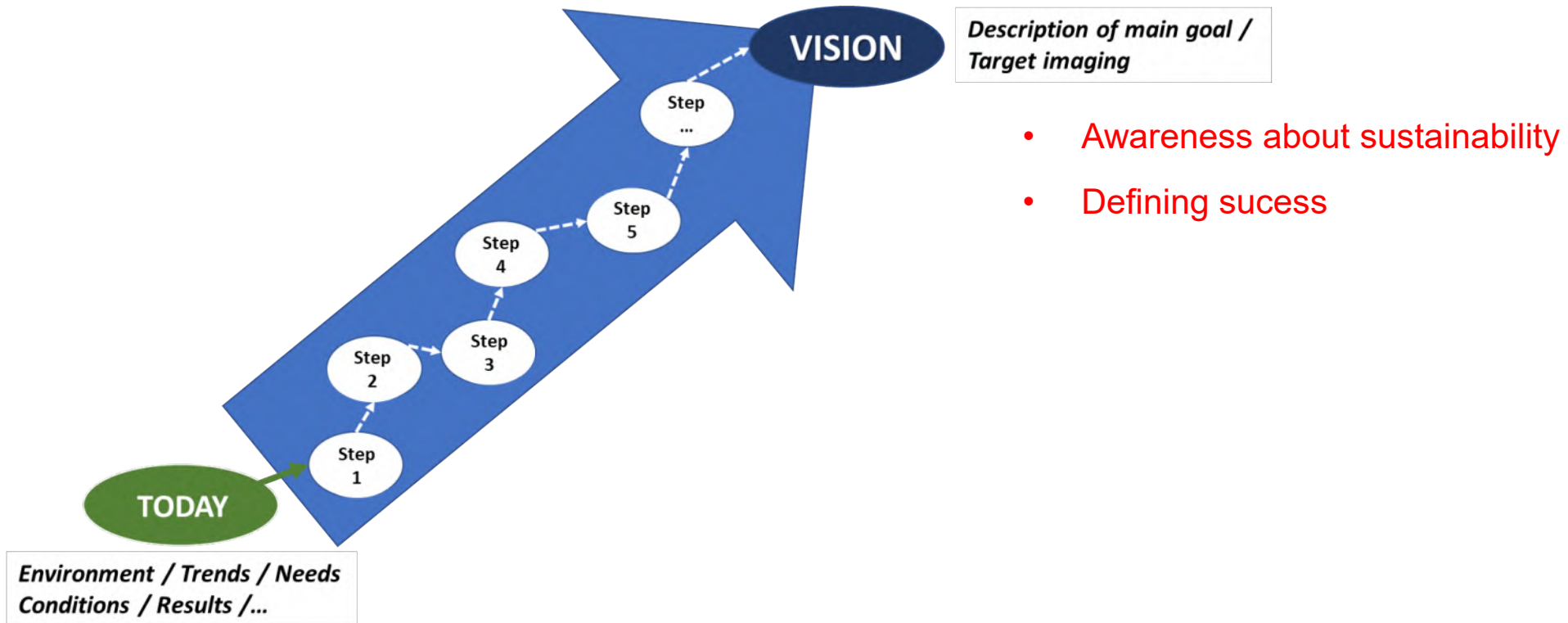
Sustainability is not just an opportunity



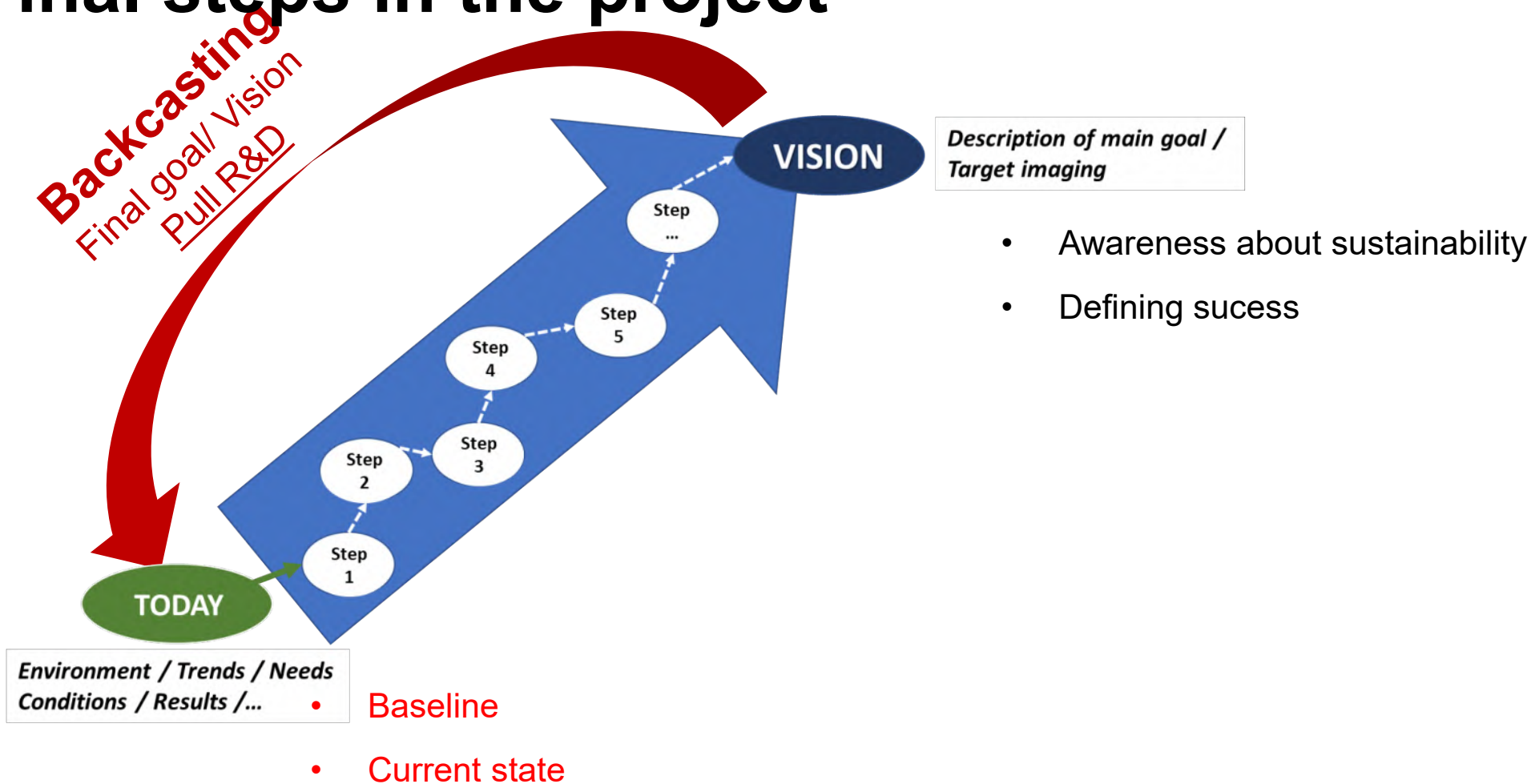
Final steps in the project



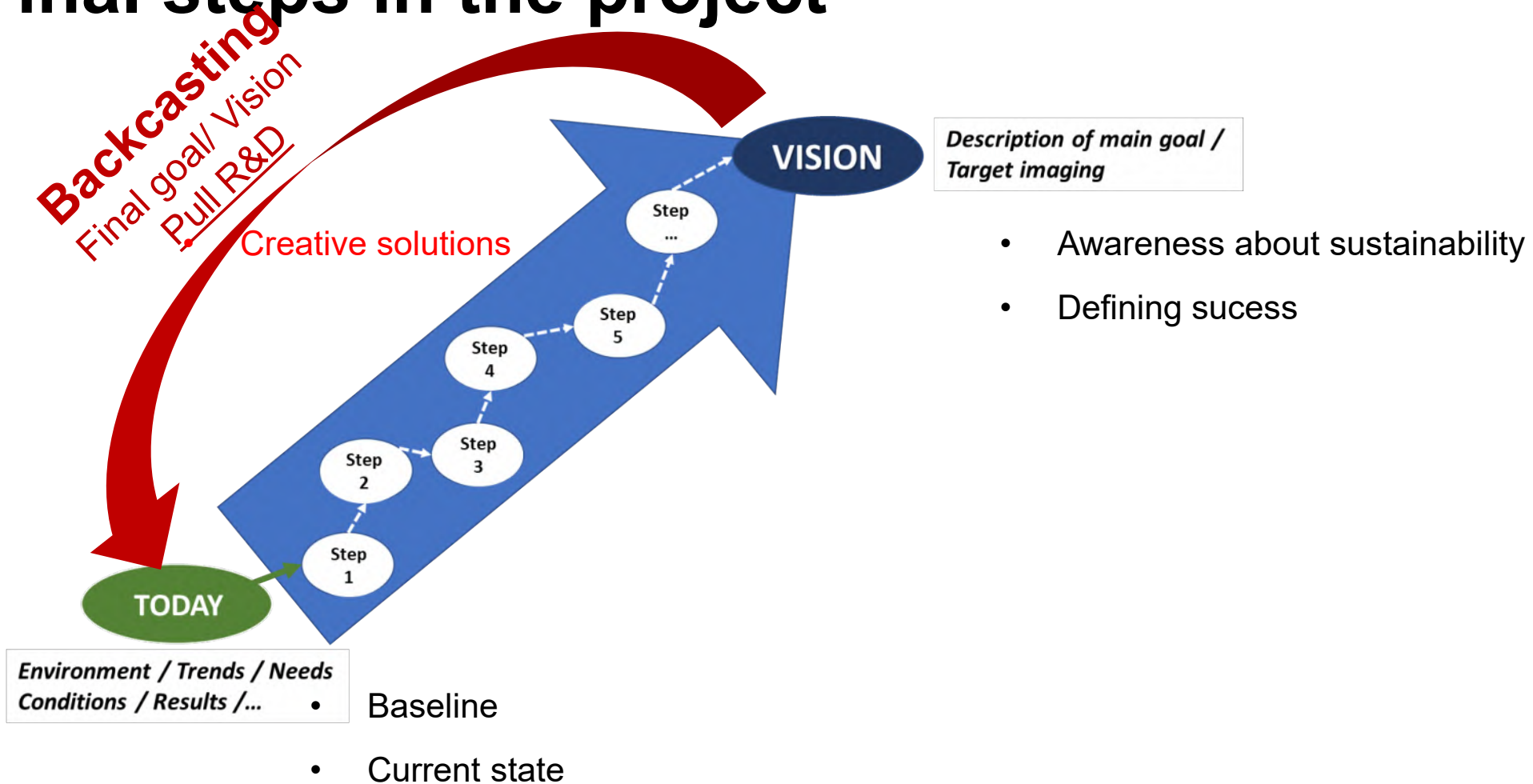
Final steps in the project



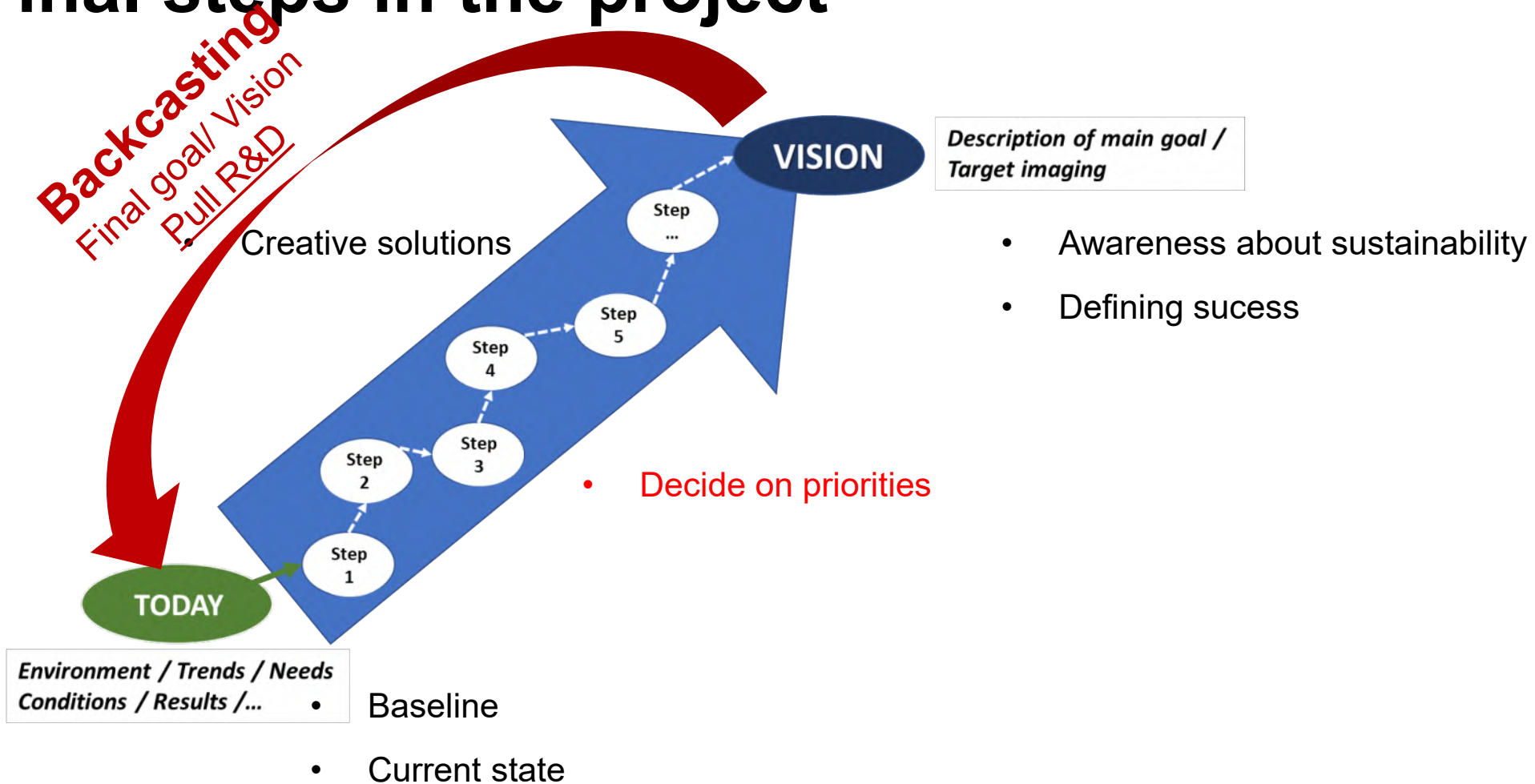
Final steps in the project



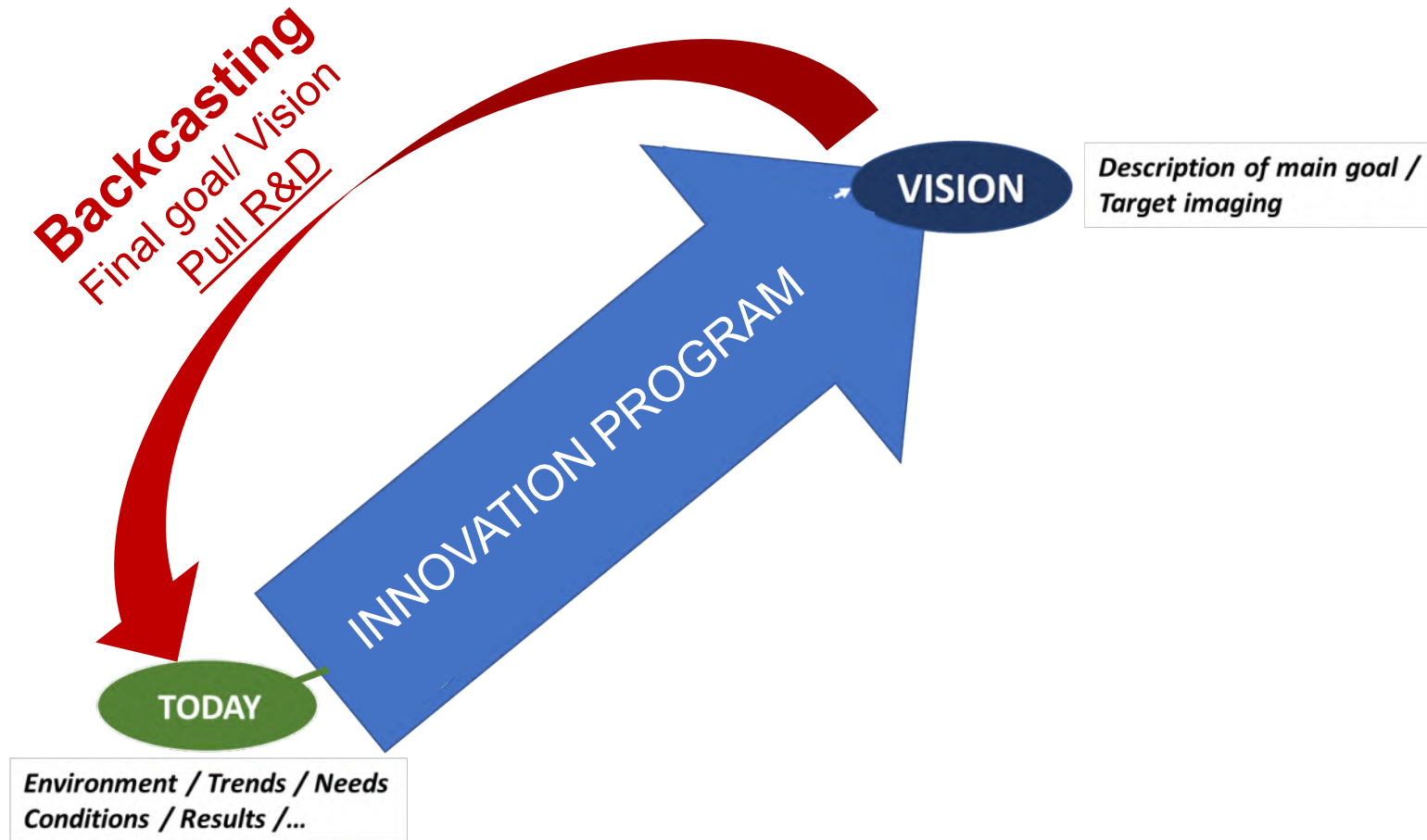
Final steps in the project



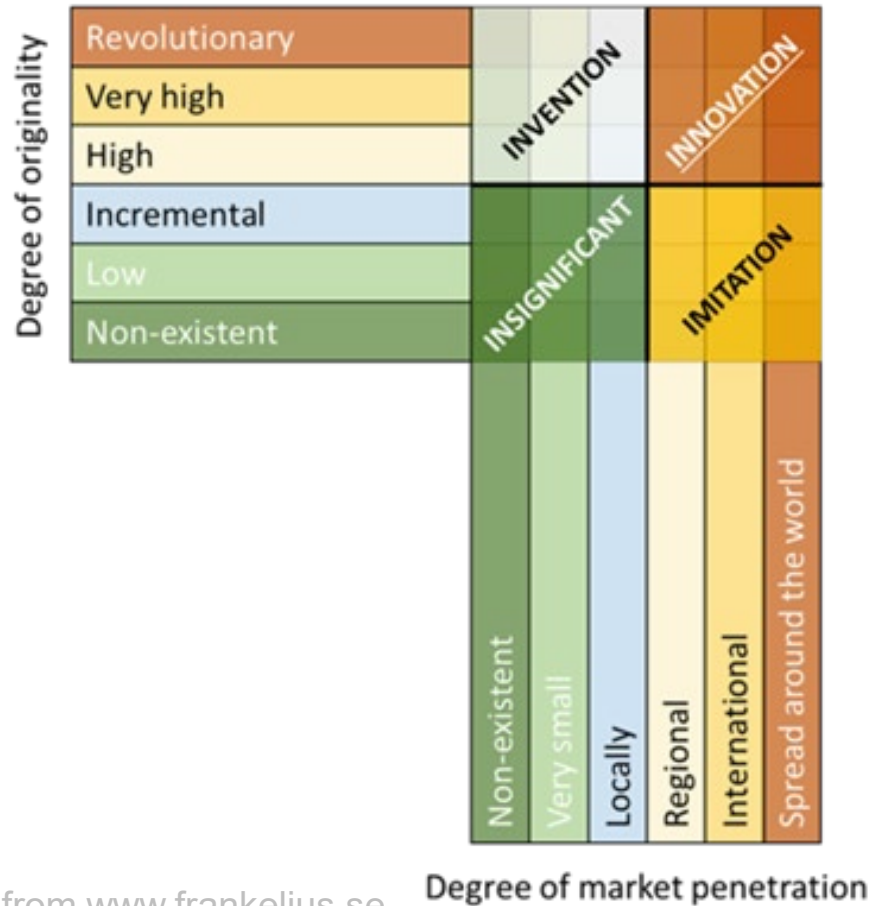
Final steps in the project



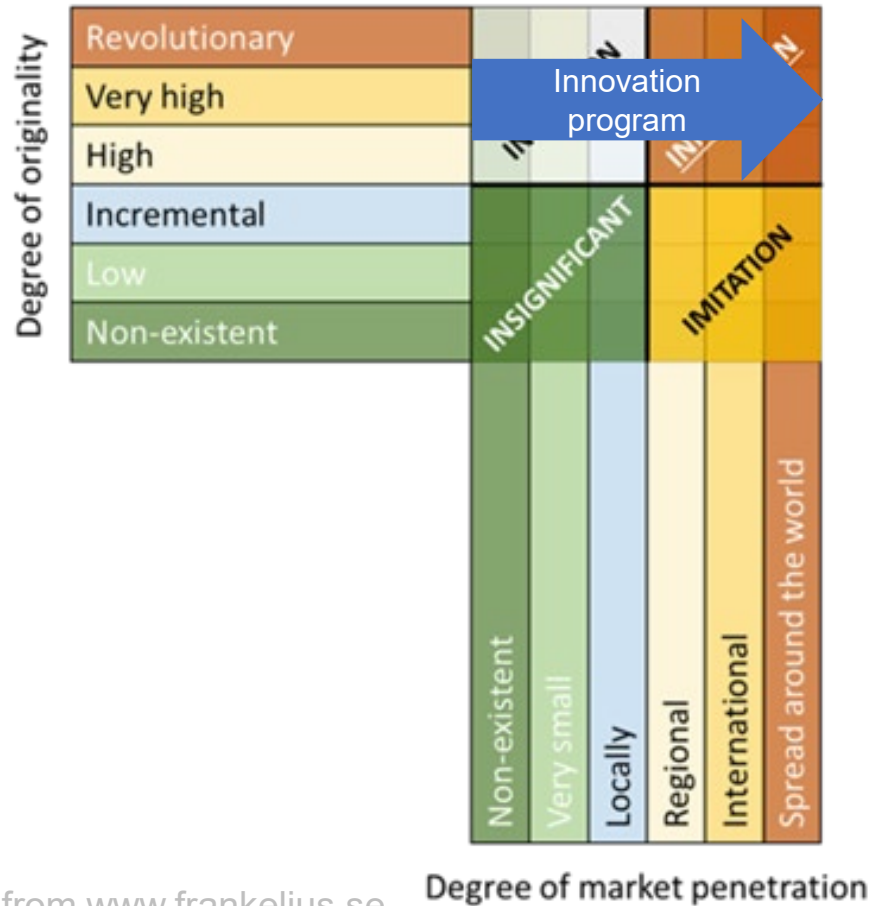
Final steps in the project



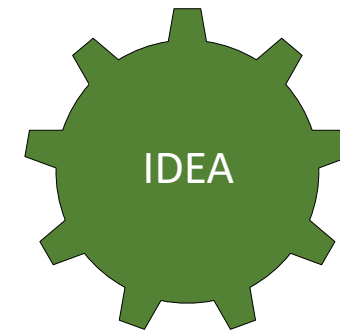
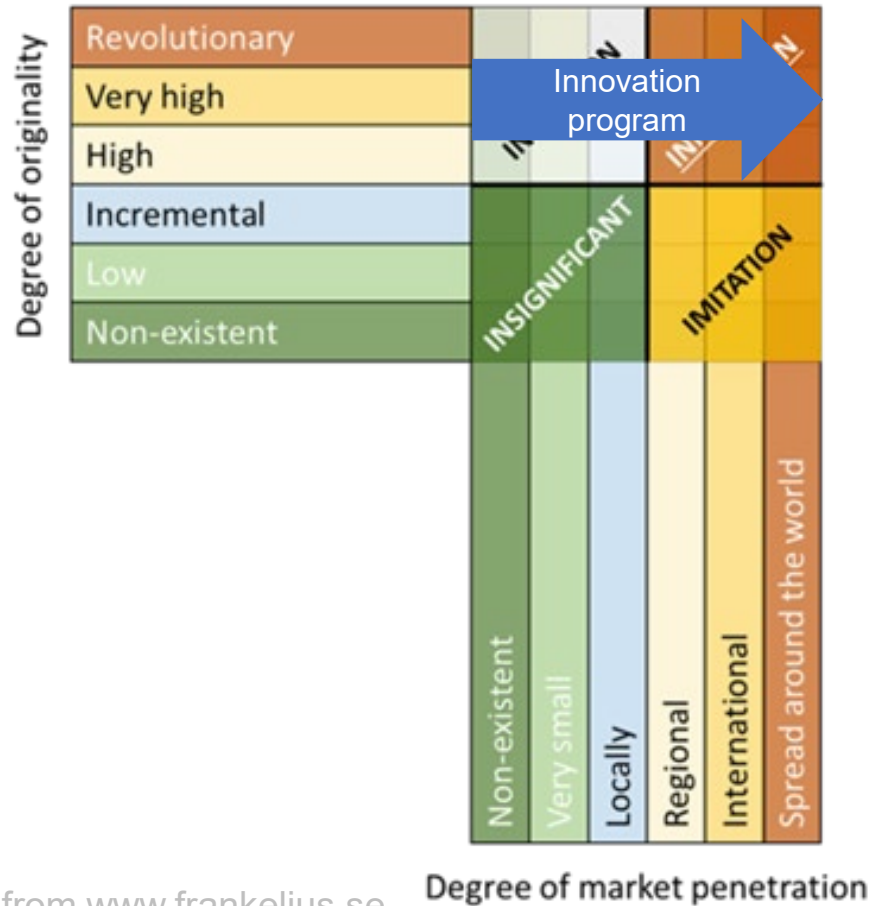
Innovation models



Innovation models



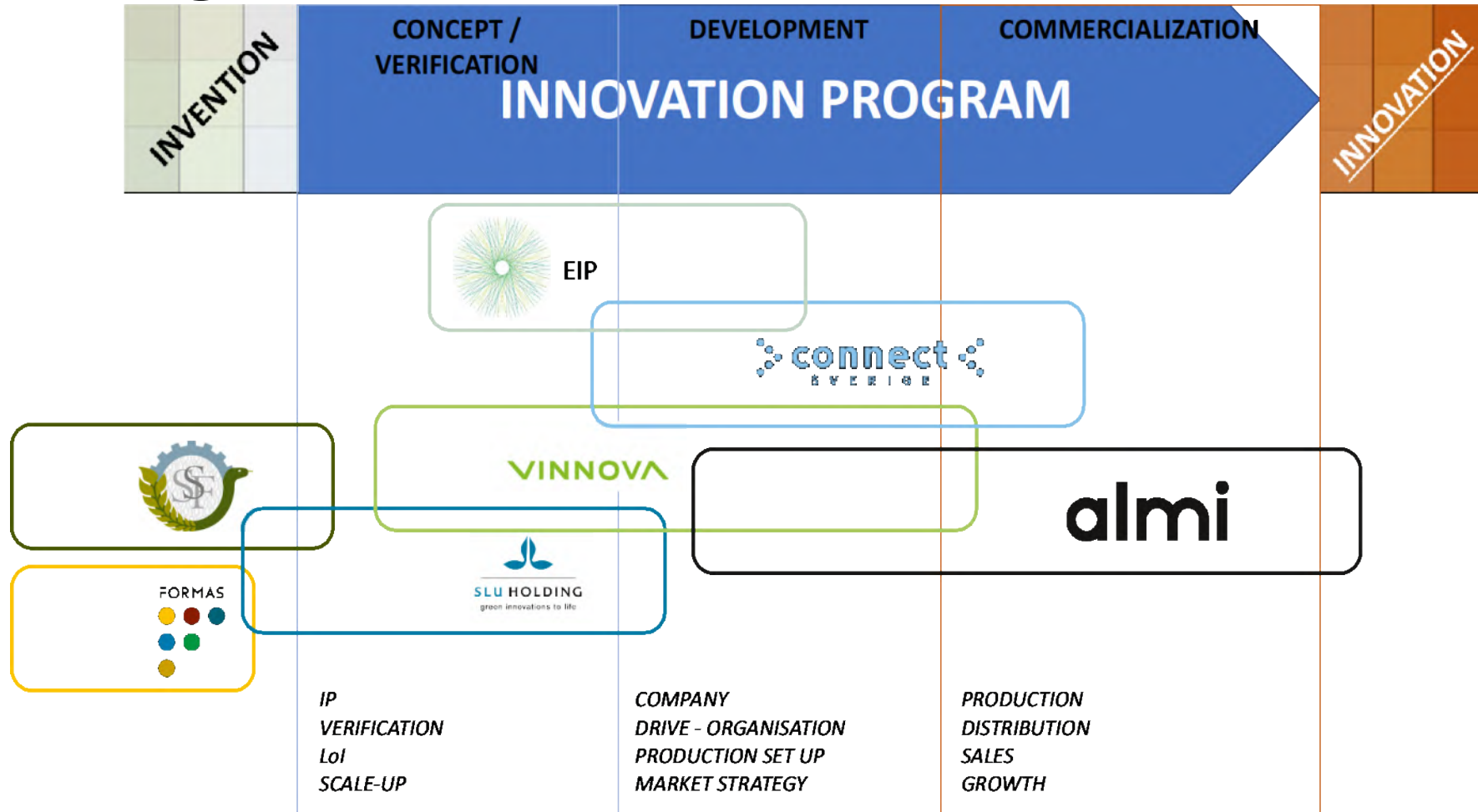
Innovation models



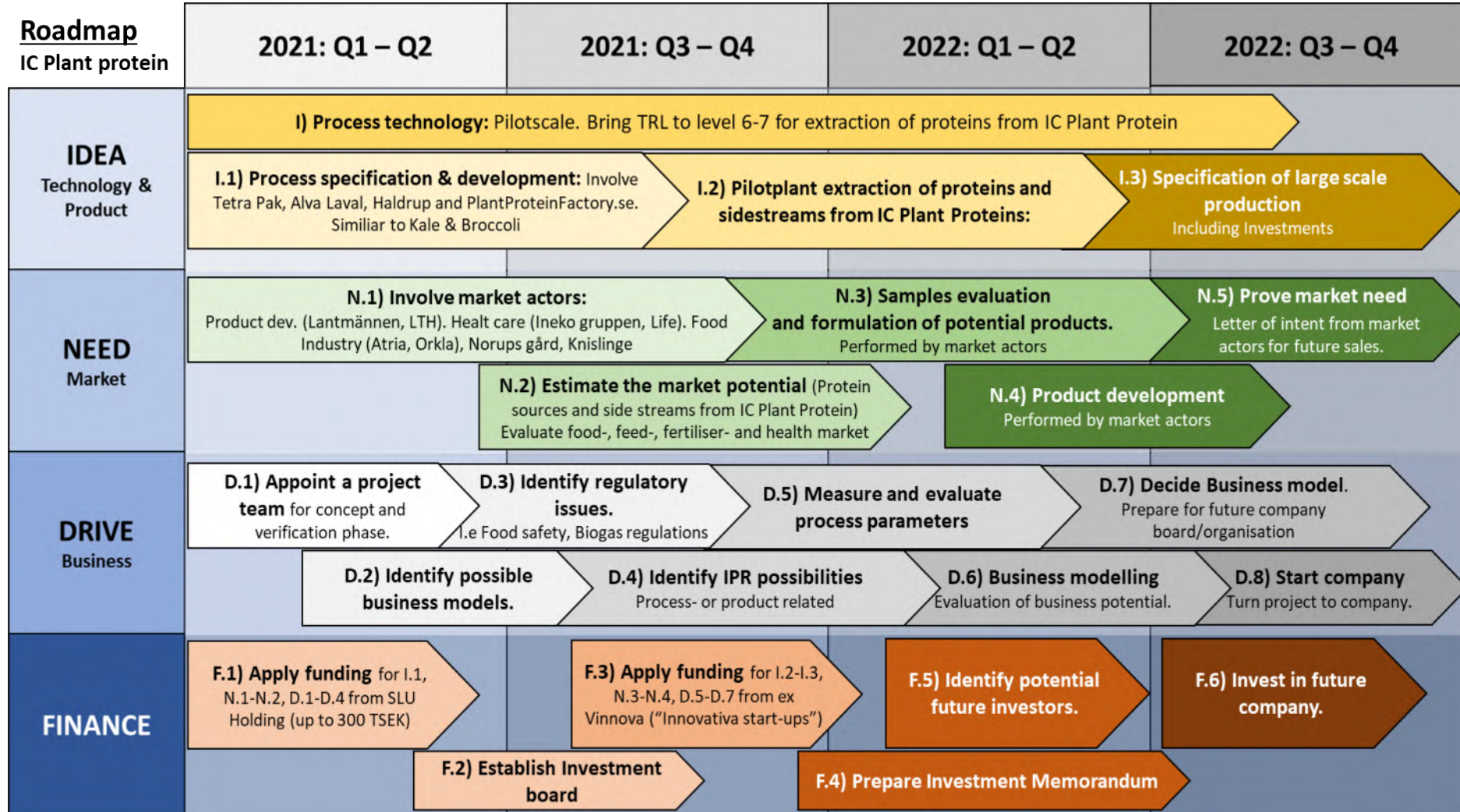
How to structure the innovation program



Funding the transition

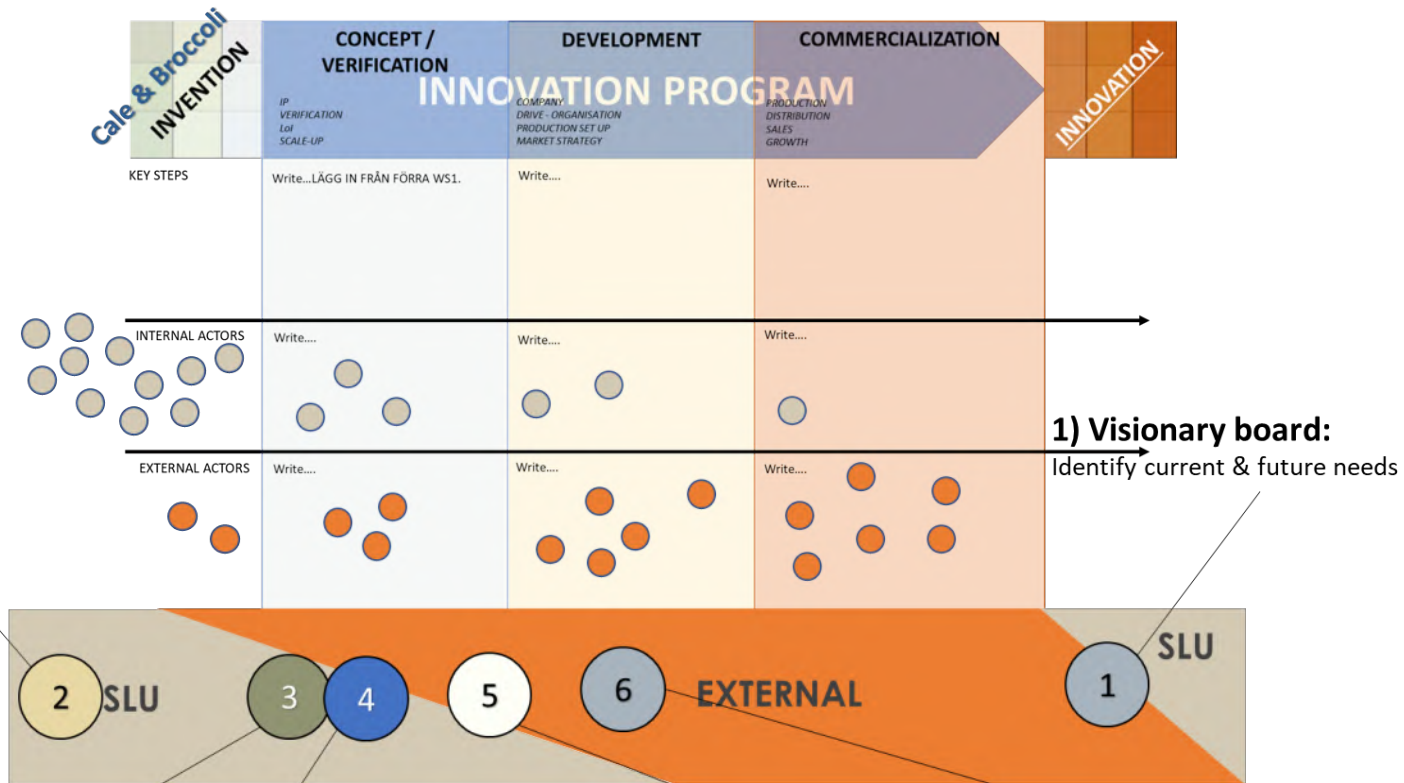


Road map



Finding the right partners

- = Internal actors
- = External actors



3) Innovation board:
Screen results according to need and potential.

4) Project team:
Implementation of initial steps

5) Investment board:
Judge potential, verify market and technology, find investment capital, company?, Business model?

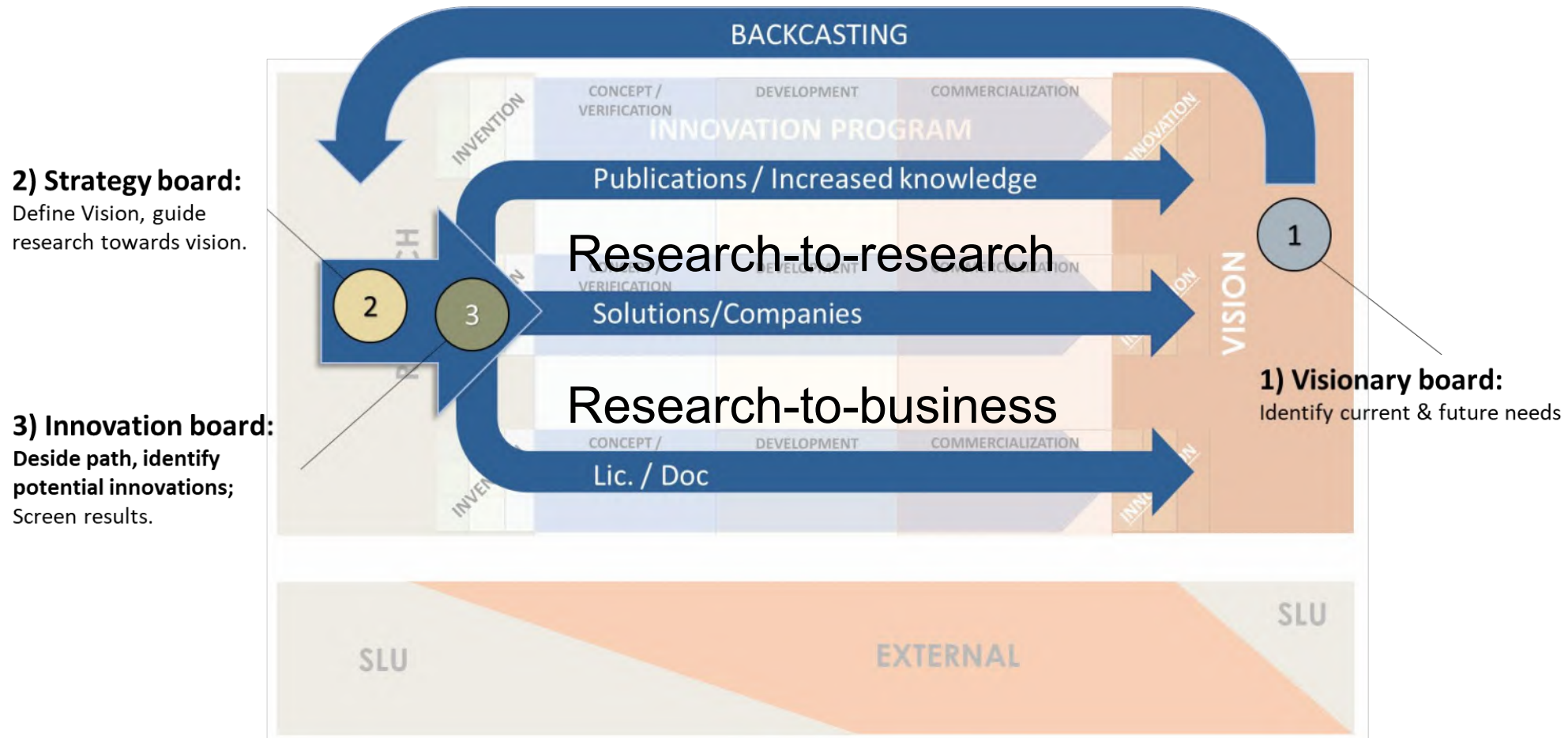
6) Company board:
Development & commercialization



INTERNAL ACTORS SLU	CONCEPT / VERIFICATION IP VERIFICATION Loi SCALE-UP	DEVELOPMENT COMPANY DRIVE - ORGANISATION PRODUCTION SET UP MARKET STRATEGY	COMMERCIALIZATION PRODUCTION DISTRIBUTION SALES GROWTH	INNOVATION
	<p>SLU Holding AB Plant Protein Factory Product quality group Harvesting & collecting broccoli/kale Project management</p>	<p>SLU Holding AB Board member: Process development / Quality assurance: Gun FoodLab</p>	<p>Board member:</p>	
EXTERNAL ACTORS (Roles & Companies)	<p>Farmers: Sydgrönt, Grönsaksmästarna</p> <p>Process equipment: Tetra Pak, Alfa Laval,</p> <p>Transportation/Logistics: Food Hill</p> <p>Scale-up/testbed companies: RISE, Biobased Europé, Norups gård, Knisslinge, RME-companies</p> <p>Product development: Lantmännen, Svenska foder, Gasum, Gaia, LTH Foodtech</p> <p>Health care stores: Life, Inekogruppen</p> <p>Food industry: Orkla, Findus, Atria</p> <p>Financing actors: Vinnova,</p> <p>Harvesting tech: Haldrup, RJ-maskinerBjuv</p> <p>Licencing knowledge:</p> <p>Market analyzing companies:</p>	<p>Financing: Almi, Connect, VentureCap companies</p> <p>Market development/strategy: Marketing agencies, life style coaches (tareq effect),</p> <p>Company management:</p> <p>Process installation & service companies:</p> <p>Legal issues: Novelfood, IP, agreements</p> <p>Technical consulting firms:</p> <p>Process companies: Food hills</p> <p>Packaging companies:</p>	<p>Sale/distribution organization:</p> <p>Purchase organization:</p>	

Finding the right partners

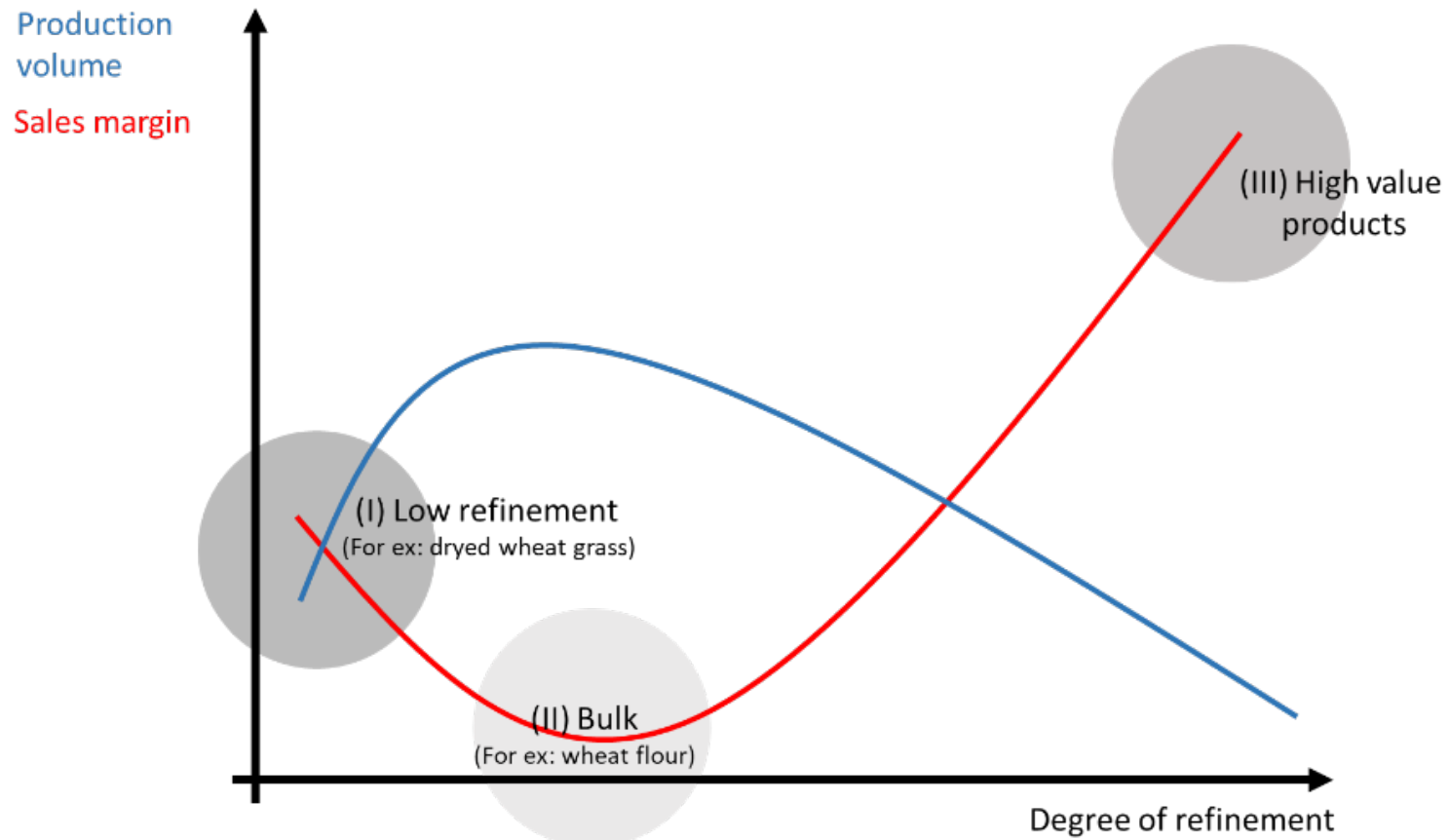
Innovation as motor for research



Business models

- Identify value-creating products and services
- In research, or when in the invention phase, involve external partners and together identify potential products

Valuable products



Types of business models

(A) IPR: patents and trademarks

(B)
Raw material
supply

(C)
Manufacturing

(D)
Distribution and
retail

(E)
Sales to final
customers

Summary

To move research forward to implementation

- ... R: involve external actors early, e.g. when you can imagine a final product
- ... C: support and accompany research and get involved early
- ... do a market analysis for potential products
- ... investigate what funding could be obtained to make the idea an innovation
- ... design an innovation program (together with other actors)
- ... actors may change over the course of an innovation program

Thank you for your attention

Thomas Prade

A warm thanks to
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Helena Tillborg, Greengap

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