

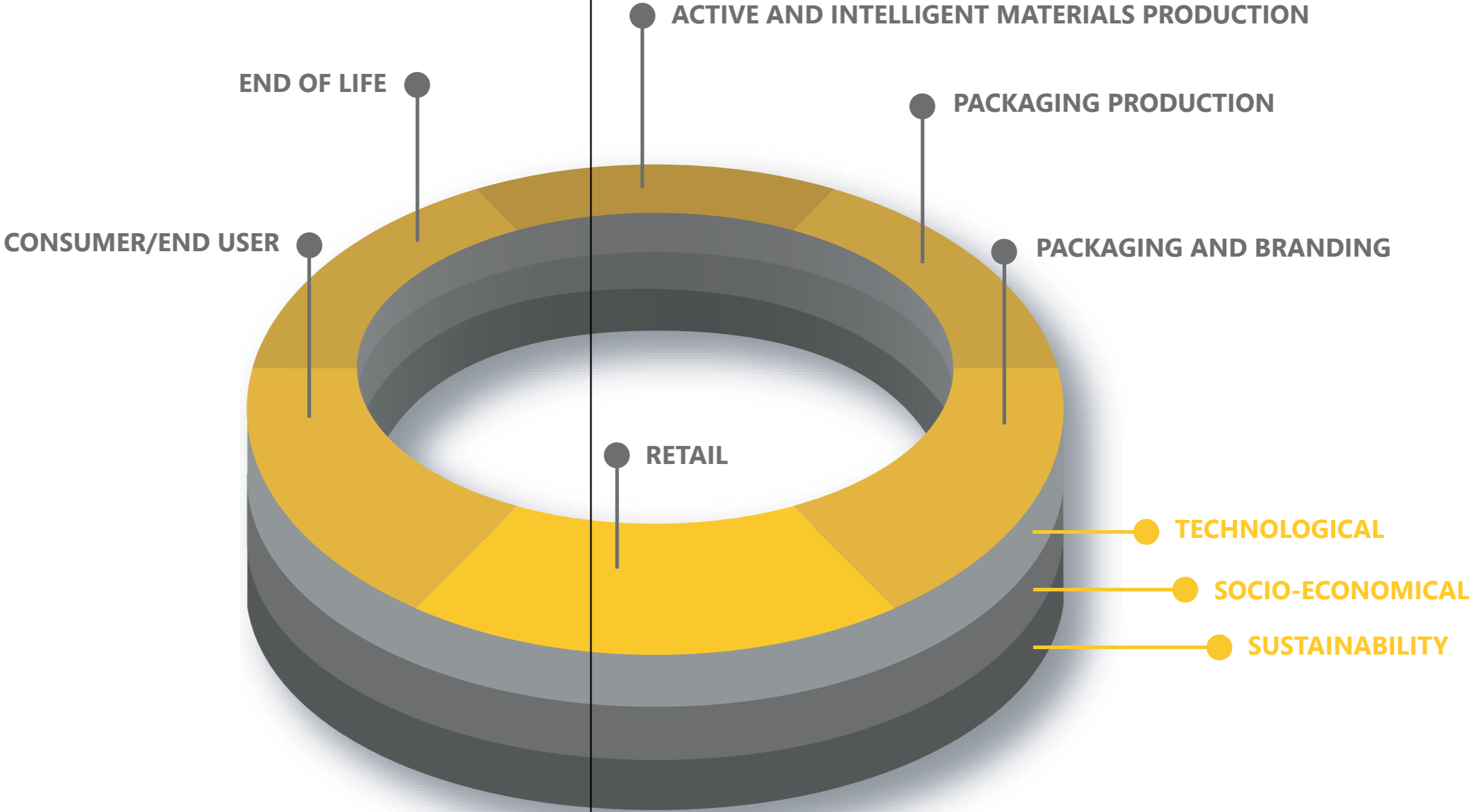
ROADMAPS SOCIO-ECONOMIC



Groups of researchers concentrated on developing roadmaps for three different levels of active and intelligent packaging development: Socio-economical, Technological and Sustainability.

Each of the three levels has multiple stages and concerns, tips and solutions are presented for everyone of the following: Active and Intelligent Materials, Packaging, Packaging and Branding, Retail, Consumer Behaviour, End of life.

You are currently in the Socio-economic roadmap. Please visit www.actinpak.eu/roadmaps for more info.



SOCIO-ECONOMIC

CURRENT SITUATION

A&I COMPONENT PRODUCER

Dependency

- Packaging machines dictate properties
- Behaviour of components in combination with up scaled production not yet known

Costs versus revenues

- Customer willingness to pay unknown
- ROI unclear

Availability

- Willingness and flexibility to produce not yet established
- Batch / production size not matching demand
- Market readiness not sufficient

Legislation

- Complex and unclear matter
- Potential migration issues

PACKER/BRAND OWNER

Awareness

- Possibilities unknown/unclear
- Potential benefits unknown/unclear

Costs versus revenues

- Willingness to pay for A&I packaging and to what extent uncertain
- ROI unclear
- Less food loss/waste = lower production/sales = lower profits

Availability

- Willingness and flexibility to produce not yet established
- Batch / production size not matching demand
- Market readiness not sufficient
- Existing infrastructure not flexible enough

Trust in technology

- Fear of consumer rejection
- Fear of failures affecting reputation

Legislation

- Complex and unclear matter
- Potential migration issues

RETAILER

- Awareness

Possibilities unknown/unclear

- Potential benefits unknown/unclear

Costs versus revenues

- Willingness to pay for A&I packaging and to what extent uncertain
- ROI unclear
- Indicators might cause product losses

Transparency

- Desire to control freshness without showing the consumer

Trust in technology

- Fear of consumer rejection
- Fear of failures affecting reputation
- Reliability
- Unknown who is liable?

Legislation

- Complex and unclear matter
- Potential migration issues

PACKAGING PRODUCER

Awareness

- Possibilities unknown/unclear
- Potential benefits unknown/unclear

Costs versus revenues

- Willingness to pay for A&I components uncertain
- Customer willingness to pay uncertain
- ROI unclear
- Lower food loss & waste = lower production = lower profits

Availability

- Willingness and flexibility to produce not yet established
- Batch / production size not matching demand
- Market readiness not sufficient
- Production machines dictate which AIP technologies are possible to use

Legislation

- Complex and unclear matter
- Potential migration issues

CONSUMER/END USER

Awareness

- Unknown makes suspicious
- Possibilities unknown/unclear
- Benefits unknown/unclear
- Costs versus revenues
- Willingness to pay and to what extent uncertain

Trust in technology

- Safety and healthiness doubted
- Visible versus invisible technology/info
- Blind faith in technology versus use of senses

Perception

- Freshness-perception vs extended shelf-life
- Active parts considered 'additives' =undesired
- Way of communication
- Negative communication affects acceptance
- Different consumer groups (geography, age, education) have different concerns = different way of addressing them

SOCIO-ECONOMIC

VISIONARY SITUATION

A&I COMPONENT PRODUCER

Dependency

- Industry is closely cooperating and the interdependency between components and packaging machines is rather an opportunity than a challenge
- Packaging machines are more flexible
- Components are flexible and adaptable to different packaging production systems

Costs versus revenues

- Optimal relation cost vs benefit: minimal cost, maximal benefit while being sustainable

Availability

- 50% of packaging is active and/or intelligent

Legislation

- Clear legislation is in place

PACKER/BRAND OWNER

Awareness

- Social impact is regained
- Companies are well-informed about the possibilities, potential benefits and challenges
- Companies actively search cooperation with other stakeholders

Costs versus revenues

- Optimal relation cost vs benefit: minimal cost, maximal benefit while being sustainable
- AIP costs the same as conventional packages
- Benefits outweigh costs, proven by successful business cases
- Reduction of food loss & waste outweigh lower production/profits and companies have embraced this different business approach
- Companies gain alternative benefits from lower food waste/loss through government funding

Availability

- 50% of packaging is active and/or intelligent
- AIP is produced at industrial level

Legislation

- Clear legislation is in place
- Legislation makes AIP the standard: all products should be packed in AIP

PACKAGING PRODUCER

Awareness

- AIP widespread for packaged goods and benefits are well-known
- Large companies have invested in communication to and education of the consumer to raise the awareness and acceptance

Costs versus revenues

- AIP costs the same as conventional packages
- Benefits outweigh costs, proven by successful business cases
- Benefits in other areas (such as food loss reduction or consumer loyalty) outweigh production costs and companies have embraced this different business approach
- Companies gain alternative benefits from lower food waste/loss through government funding

Availability

- AIP is produced at industrial level
- Small companies started and proved the potential, but large companies have followed and made it the standard

Acceptance

- Brands see AIP as a useful tool in their kit to make their business profitable and enhance their reputation
- Large companies have invested in communication to and education of the consumer to raise the awareness and acceptance
- Trust in technology
- AIP enables new food supply chain and business models

Legislation

- Legislation makes AIP the standard: all products should be packed in AIP

RETAILER

Awareness

- AIP widespread for packaged goods and benefits are well-known
- Consumers are used to buy discounted (closer to expiry date) products and trust its quality through AIP
- Only AIP products are available in supermarkets

Costs versus revenues

- AIP costs the same as conventional packages
- Benefits outweigh costs, proven by successful business cases
- Benefits in other areas (such as food loss reduction or consumer loyalty) outweigh production costs and companies have embraced this different business approach

Transparency

- AIP is widely used to transparently inform stakeholders about the product
- It is common and without consequence to transparently communicate to the consumer

Trust in technology

- Retailers completely accept AIP in their stores and know that a failure will not affect their reputation if they are transparent.

Reliability

- The value chain as a whole is liable and made agreements about this.

Legislation

- Legislation makes AIP the standard: all products should be packed in AIP

CONSUMER/END USER

Awareness

- Consumers are aware of the benefits and demand AIP from companies (they don't buy conventional packaging anymore)

Costs versus revenues

- Benefits are well-known to consumers on different levels (shelf-life extension, second shelf life, reduction of food losses, more natural food)
- Consumers are willing to pay 10% more for AIP, but in practice the products costs the same as conventional packaging due to availability

Trust in technology

- Consumers only trust and buy sensitive food equipped with AIP
- Consumers are well-educated in this field but also educated to trust their own senses
- AIP is transparent towards consumer

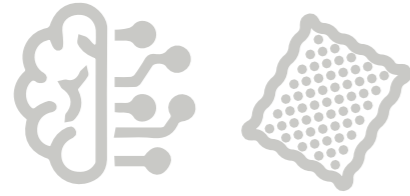
Perception

- No wasted food is the most important to the consumer, therefore second shelf life is guaranteed by AIP
- Education of consumers has proven that extended shelf life does not equal lower freshness but equals more natural food

Way of communication

- Honest and positive communication, also information about benefits and why food waste is a problem
- Government supports it with official statements and advertising

SOCIO-ECONOMIC CHALLENGES



A&I COMPONENT PRODUCER

- Dependency
- Costs versus revenues
- Availability
- Legislation



PACKAGING PRODUCER

- Awareness
- Costs versus revenues
- Availability
- Legislation



PACKER/BRAND OWNER

- Awareness
- Costs versus revenues
- Availability
- Trust in technology
- Legislation



RETAILER

- Awareness
- Costs versus revenues
- Transparency
- Trust in technology
- Reliability
- Legislation



CONSUMER/END USER

- Awareness
- Costs versus revenues
- Trust in technology
- Perception
- Way of communication

A&I COMPONENT PRODUCER

MARKET DRIVERS

Sustainable goes mainstream

- Transition towards bio-based and 100% recyclable
- Extending shelf life = less food loss/waste
- Lightweight: optimisation of material

E-commerce

- Enable the merge offline with online

Technological development

- Lower costs due to technological development
- Public investment and technology transfer

Legislation

- Legislation under development

SOLUTIONS

SHORT-TERM

- Increase shelf-life to reduce food waste
- Packaging improvement
- Raise awareness of packaging producers
- Educational strategies for packaging producers

MID-TERM

- Lower costs due to increased production and technological development
- List of approved active compounds in packaging
- Collect more data to get compounds to be approved

LONG-TERM

- Continuous development of new and safe A&I components for specific purposes
- High throughput testing technologies
- Shorter time from application to approval of safety of compounds

ENABLING TECHNOLOGIES

SHORT-TERM

- Market-ready technologies as currently developed
- New, green processes to obtain A&I components

MID-TERM

- New (green) materials
- New (green) processes

LONG-TERM

- Move industry production from SMEs (low batch sizes) to large companies (large production runs) increasing availability

RESOURCES

SHORT-TERM

- Production facility
- Process knowledge
- Green chemistry knowledge
- Legislation

MID-TERM

- Knowledge and Technology transfer from science to industry

LONG-TERM

- Knowledge and Technology transfer from small industry to large industry

PACKAGING PRODUCER

MARKET DRIVERS

- Sustainable goes mainstream*
- Replacement of aluminium
 - Transition towards bio-based and 100% recyclable
 - Bio-degradability
 - Natural (health, responsible living)
 - Extending shelf life = less food loss/waste
 - Lightweight: optimisation of material
- E-commerce*
- Online food suppliers
 - Technological development
 - Integration of A&I components in roll-to-roll processes, e.g. embedding electronics, sensors, actuators and software during or after the production process.
- Legislation*
- Legislation under development
- The internet-of-things*
- On request of the packer to follow up the condition of his products;
 - On request of the brand owner who wants to interact with the consumer via the packaging, etc.

SOLUTIONS

SHORT-TERM

- Increase shelf life to reduce food waste
- Packaging improvement
- Packaging interaction with the consumers
- Raise awareness of packers/brand owners
- Educational strategies for packers/brand owners

MID-TERM

- Tax food waste
- Simplify legislation

LONG-TERM

- More strict legislation about food and packaging safety

ENABLING TECHNOLOGIES

SHORT-TERM

- Market-ready technologies as currently developed
- New, green processes to integrate A&I

MID-TERM

- New (green) materials
- Flexible processes

LONG-TERM

- Optimised and flexible production processes capable to match all ranges of needs (also lower batch sizes)

RESOURCES

SHORT-TERM

- Multidisciplinary approach
- LCA
- Specific treatment after-life packaging
- Legislation

MID-TERM

- Knowledge and Technology transfer from science to industry

LONG-TERM

- Knowledge and Technology transfer from small industry to large industry

PACKER / BRAND OWNER

MARKET DRIVERS

- Sustainable goes mainstream*
- Enter the circular economy
 - Extending shelf life = less food loss/waste
 - Lightweight: optimisation of material
 - Reuse of packaging or recycling possibilities
 - Food without artificial preservatives (cosmetics, pharma)
- Competitive value*
- Emerging of new products
 - Higher value products
 - Trademark
 - Customer demands certain packaging solutions (regarding safety) which gives additional value to the product, decreasing cost and food waste
- Production*
- Lower costs = higher volume
 - Profit
 - Increasing demand on AIP decreases costs
- E-commerce / the internet-of-things*
- Online food suppliers
 - Sustained growth upcoming years gives opportunities
- Personalisation*
- Personal connections
 - Use of big data for connection with customer

SOLUTIONS

SHORT-TERM

- Create awareness
- Identification of market-ready technologies
- Build business cases to identify market opportunities
- Flexible risk assessment methods for compliance

MID-TERM

- Cooperation with academic society
- Government funding
- Database of market ready technologies
- media promotion of AIP

LONG-TERM

- Cooperation with academic society
- Government funding
- Database of market ready technologies
- Media promotion of AIP
- More strict legislation about food and packaging safety

ENABLING TECHNOLOGIES

SHORT-TERM

- Market-ready technologies as currently developed
- New, green processes to integrate A&I

MID-TERM

- Upgraded sensors
- Smart shops
- Smart household equipment

LONG-TERM

- Smart houses and household devices
- Digitalisation
- Technologies for IoT and resources

RESOURCES

SHORT-TERM

- Investments to modify the existing production process
- Raise awareness to resolve investment decisions
- Raise awareness of the technologies in the whole value chain
- Raise awareness of the food waste issue and find strategic partners

MID-TERM

- Social media promotions

LONG-TERM

- Integration with other industries and services to create Smart Homes

RETAILER

MARKET DRIVERS

Benefits

- Awareness of increased profit
- Motivate retailers (big players) to adapt AIP to their own advantage, not focusing on consumers
- Reduce AIP costs
- Reduce waste of food/perishable items

Retail spaces become brand experience spaces

- Online and real-world shopping ecosystems are merging

Consumer behaviour

- Assumption: no change in consumer behaviour or regulation in next 5-10 years

E-commerce / the internet-of-things

- Online food suppliers
- Sustained growth upcoming years gives opportunities

ENABLING TECHNOLOGIES

SHORT-TERM

- Integration with new non-packaging technologies (AR, smart fridges, shopping via Alexa, ...)
- Determine the need for staff >> training plan

MID-TERM

- Specific packaging for different consumers i.e. disabled people
- Communication / dissemination activities

LONG-TERM

- Integration of smart houses and smart packaging: the house works for you; food scanned, app telling when your food is spoiled (continuous tracking) or when perfect to eat

SOLUTIONS

SHORT-TERM

- Communication to customers in-store
- Get feedback from consumers
- Train employees
- Prove practical application through usefulness
- Make strategies specific for target groups
- Create trends in AIP
- Lobby for support from related industry groups

MID-TERM

- Willingness to pay for AIP by the consumer
- Easy and clear communication
- Consumer perception
- Consumer interaction
- Keep up with consumer trends

LONG-TERM

- Reduce food waste and food spoilage
- ensure storage conditions cold chain
- ensure quality and safety of food product and package

RESOURCES

SHORT-TERM

- Trained staff
- Prepared stores (shelving, special space and place)
- Communication measures
- ROI matrix to explain the change in sales

MID-TERM

- New electronics to support AIP retail

LONG-TERM

- Integration with other industries and services to create Smart Homes

CONSUMER / END USER

MARKET DRIVERS

Sustainable goes mainstream

- Consumers become more aware of the environmental cost of modern conveniences like one-time use packaging
- Driven by convenience, cost, availability (most consumers)

Gen-Z

- This generation (1995-2018) are considered digital natives and are now getting jobs and income creating a new market and generation of consumer

Changing consumer needs

- Different consumer needs of gen-X and gen-Z
- Early adopters of AIP technologies
- Ageing population needs

Engagement

- Micro-influencers
- Videos
- Social media = transparency, always connected
- Activism: food waste prevention, health and nutrition sustainability

Hi-tech

- Consumers embrace virtual entertainment industry, now trend moves on to other areas

Adversity

- There will always be consumers against technology

SOLUTIONS

SHORT-TERM

- Educate customers about AIP
- Latest concern or food scare does not stay in consciousness for long
- Inform via advertising / social media
- Start using AIP in common products and with big brands

MID-TERM

- Engage early adopters in educational campaigns
- Tailoring AIP for packaging and consumer needs

LONG-TERM

- Discounts for pre/early shopping online (better planning >> better prices)
- Rewards for sustainable buyer behaviour (food and material waste reduction)

ENABLING TECHNOLOGIES

SHORT-TERM

- Social media advertising
- Mobile phone interaction with labelling

MID-TERM

- New communication channels

LONG-TERM

- Target next generation (instead of traditional) in shops and innovation
- Price of AIP comparable to conventional products
- Good recyclability of AIP
- Afraid of being manipulated by producers or retailers

RESOURCES

SHORT-TERM

- Home deliveries with amazon
- Kids are nowadays decision makers regarding what to buy
- Information campaign about products, food waste, new technologies
- Social media, videos to spread information

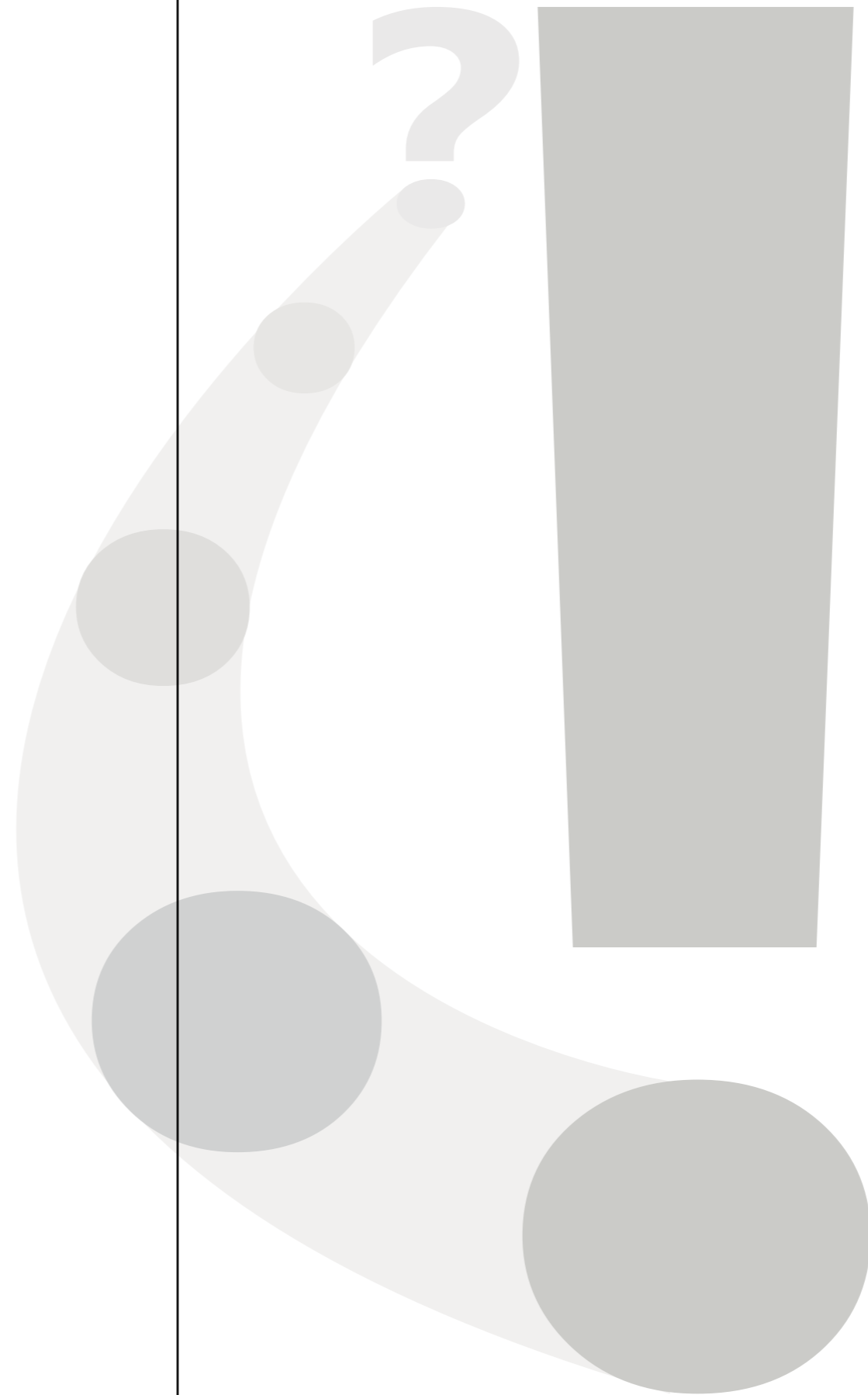
MID-TERM

- Influencers, e.g. bloggers

LONG-TERM

- Strategic partnerships

ROADMAPS OVERVIEW



SOCIO-ECONOMIC

	A&I COMPONENT PRODUCER	PACKAGING PRODUCER	PACKER / BRAND OWNER	RETAILER	CONSUMER / END USER
CHALLENGES	<p>Dependency Costs versus revenues Availability Legislation</p>	<p>Awareness Costs versus revenues Availability Legislation</p>	<p>Awareness Costs versus revenues Availability Trust in technology Legislation</p>	<p>Awareness Costs versus revenues Transparency Trust in technology Reliability Legislation</p>	<p>Awareness Costs versus revenues Trust in technology Perception Way of communication</p>
MARKET DRIVERS	<p>Sustainable goes mainstream E-commerce Technological development Legislation</p>	<p>Sustainable goes mainstream E-commerce Technological development Legislation The internet-of-things</p>	<p>Sustainable goes mainstream Competitive value Production E-commerce / the internet-of-things Personalisation</p>	<p>Benefits Retail spaces become brand experience spaces Consumer behaviour E-commerce / the internet-of-things</p>	<p>Sustainable goes mainstream Gen-Z Changing consumer needs Engagement Hi-tech Adversity</p>
SHORT TERM (NOW - 2020)	<p>SOLUTIONS Increase shelf-life to reduce food waste Packaging improvement Raise awareness of packaging producers Educational strategies for packaging producers</p> <p>ENABLING TECHNOLOGIES Market-ready technologies as currently developed New, green processes to obtain A&I components</p> <p>RESOURCES Production facility Process knowledge Green chemistry knowledge Legislation</p>	<p>SOLUTIONS Increase shelf life to reduce food waste Packaging improvement Packaging interaction with the consumers Raise awareness of packers/brand owners Educational strategies for packers/brand owners</p> <p>ENABLING TECHNOLOGIES Market-ready technologies as currently developed New, green processes to integrate A&I</p> <p>RESOURCES Multidisciplinary approach LCA Specific treatment after-life packaging Legislation</p>	<p>SOLUTIONS Create awareness Identification of market-ready technologies Build business cases to identify market opportunities Flexible risk assessment methods for compliance</p> <p>ENABLING TECHNOLOGIES Market-ready technologies as currently developed New, green processes to integrate A&I</p> <p>RESOURCES Investments to modify the existing production process Raise awareness to resolve investment decisions Raise awareness of the technologies in the whole value chain Raise awareness of the food waste issue and find strategic partners</p>	<p>SOLUTIONS Communication to customers in-store Get feedback from consumers Train employees Prove practical application through usefulness Make strategies specific for target groups Create trends in AIP Lobby for support from related industry groups</p> <p>ENABLING TECHNOLOGIES Integration with new non-packaging technologies (AR, smart fridges, shopping via Alexa, ...) Determine the need for staff >> training plan</p> <p>RESOURCES Trained staff Prepared stores (shelving, special space and place) Communication measures ROI matrix to explain the change in sales</p>	<p>SOLUTIONS Educate customers about AIP Latest concern or food scare does not stay in consciousness for long Inform via advertising / social media Start using AIP in common products and with big brands</p> <p>ENABLING TECHNOLOGIES Social media advertising Mobile phone interaction with labelling</p> <p>RESOURCES Home deliveries with amazon Kids are nowadays decision makers regarding what to buy Information campaign about products, food waste, new technologies Social media, videos to spread information</p>
MID TERM (2020 - 2025)	<p>SOLUTIONS Lower costs due to increased production and technological development List of approved active compounds in packaging Collect more data to get compounds to be approved</p> <p>ENABLING TECHNOLOGIES New (green) materials New (green) processes</p> <p>RESOURCES Knowledge and Technology transfer from science to industry</p>	<p>SOLUTIONS Tax food waste Simplify legislation</p> <p>ENABLING TECHNOLOGIES New (green) materials Flexible processes</p> <p>RESOURCES Knowledge and Technology transfer from science to industry</p>	<p>SOLUTIONS Cooperation with academic society Government funding Database of market ready technologies media promotion of AIP</p> <p>ENABLING TECHNOLOGIES Upgraded sensors Smart shops Smart household equipment</p> <p>RESOURCES Social media promotions</p>	<p>SOLUTIONS Willingness to pay for AIP by the consumer Easy and clear communication Consumer perception Consumer interaction Keep up with consumer trends</p> <p>ENABLING TECHNOLOGIES Specific packaging for different consumers i.e. disabled people Communication / dissemination activities</p> <p>RESOURCES New electronics to support AIP retail</p>	<p>SOLUTIONS Engage early adopters in educational campaigns Tailoring AIP for packaging and consumer needs</p> <p>ENABLING TECHNOLOGIES New communication channels</p> <p>RESOURCES Influencers, e.g. bloggers</p>
LONG TERM (2025 - 2030)	<p>SOLUTIONS Continuous development of new and safe A&I components for specific purposes High throughput testing technologies Shorter time from application to approval of safety of compounds</p> <p>ENABLING TECHNOLOGIES Move industry production from SMEs (low batch sizes) to large companies (large production runs) increasing availability</p> <p>RESOURCES Knowledge and Technology transfer from small industry to large industry</p>	<p>SOLUTIONS More strict legislation about food and packaging safety</p> <p>ENABLING TECHNOLOGIES Optimised and flexible production processes capable to match all ranges of needs (also lower batch sizes)</p> <p>RESOURCES Knowledge and Technology transfer from small industry to large industry</p>	<p>SOLUTIONS Cooperation with academic society Government funding Database of market ready technologies Media promotion of AIP More strict legislation about food and packaging safety</p> <p>ENABLING TECHNOLOGIES Smart houses and household devices Digitalisation Technologies for IoT and resources</p> <p>RESOURCES Integration with other industries and services to create Smart Homes</p>	<p>SOLUTIONS Reduce food waste and food spoilage ensure storage conditions cold chain ensure quality and safety of food product and package</p> <p>ENABLING TECHNOLOGIES Integration of smart houses and smart packaging: the house works for you; food scanned, app telling when your food is spoiled (continuous tracking) or when perfect to eat</p> <p>RESOURCES Integration with other industries and services to create Smart Homes</p>	<p>SOLUTIONS Discounts for pre/early shopping online (better planning >> better prices) Rewards for sustainable buyer behaviour (food and material waste reduction)</p> <p>ENABLING TECHNOLOGIES Target next generation (instead of traditional) in shops and innovation Price of AIP comparable to conventional products Good recyclability of AIP Afraid of being manipulated by producers or retailers</p> <p>RESOURCES Strategic partnerships</p>

Socio-economic roadmap was done with contribution of the WG2 members of the Cost Action "ActInpak" and with major contributions from the following members:

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COST FP1405 ActInPak aims to identify and overcome the key technical, social, economic and legislative barriers to a successful deployment of renewable fibre-based functional packaging solutions such as active and intelligent packaging. Currently, 43 countries are involved in the network, with participants representing 209 academic institutions, 35 technical centers, and 83 industrial partners.

For more information, please visit the ActInPak website: www.actinpak.eu

COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.

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