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IMPERVIUS™

The Bitumen Waterproofing Conference

« The insights and knowledge that we got were impressive. A great conference in a friendly environment in which we actually get to meet other professionals and share great ideas. »

24 – 25 May 2023

Sitges | Spain

Melia Sitges

IMPERVIUS™ is a high-level conference by the industry for the industry, specially aimed at professionals in the waterproofing bituminous membranes sectors

Conference topics include:

- Market trends
- Regulatory / Recycling
- Production technologies
- Finished products
- Trends / Innovation
- Bitumen / Raw materials



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THE VOICE OF NONWOVENS

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The papers contained in this file were presented during the IMPERVIUS™ 2023 Conference (24 & 25 May 2023), organized by EDANA, the International Nonwovens Association Serving the Nonwovens and Related Industries.

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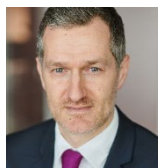
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Wednesday 24th May 2023

10:30 - 18:00 REGISTRATION DESK OPEN

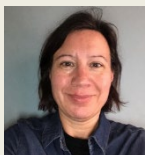
10:30 - 11:30  WELCOME COFFEE

11:30 - 11:45 **OPENING AND WELCOME ADDRESS**



Murat Dogru, General Manager – EDANA (Belgium)

11:45 - 12:30 **KEYNOTE SPEECH**



CIRCULARITY APPLIED TO THE CONSTRUCTION SECTOR

Gilli Hobbs, Associate Director – Reusefully (United Kingdom)

12:30 - 14:00  LUNCH BREAK

14:00 – 15:30 **SESSION 1: MARKET**

Moderator



Grégory Lemaire, Global Segment Manager – Construction - Valéron Strength Films

14:00 - 14:30 **Situation and forecasts of the European construction market**



Josep Fontana, Head of Market Research - ITeC and Spanish member of Euroconstruct (Spain)

14:30 - 15:00 **The European bitumen market today - Sanctions, supply, demand and pricing**



Keyvan Hedvat, Europe/Africa Editor, Argus Bitumen (United Kingdom)

15:00 - 15:30



Modified bitumen roofing membranes, a great Italian history

Massimo Schieroni, Consultant, ex-CEO of IMPER Italia, President of SITEB - Gruppo PRIMI Association (Italy)

15:30 - 16:15



COFFEE BREAK

16:15 – 17:45 SESSION 2: RAW MATERIALS

Moderator



Thomas Miowsky, Portfolio Manager – Johns Manville

16:15 - 16:45



Atactic Polypropylene (APP) Bitumen Modified Membranes deliver sustainability benefits

Anne Villard, EMEAF Senior Market Developer - Construction & Specialties Lead - ExxonMobil Chemical (France)

16:45 - 17:15



Properties and benefits of using lightweight fillers / microspheres in bitumen waterproofing membranes

David Gonzalez Amago, Director Global Business Development Lightweight Fillers - Omya (Spain)

17:15 - 17:45



New developments for sustainable roofing membranes

Erik Scholten, Sales Director Performance Products EMEA - Kraton Polymers Nederland (The Netherlands)

18:30 - 22:00



THE EDANA COCKTAIL PARTY AT THE MIRADOR DE LES CAVES

Buses depart from the Melia Hotel at 18:30 (Business Casual Dress)

Thursday 25th May 2023

08:30 - 12:00 REGISTRATION DESK OPEN

08:30 - 09:00  WELCOME COFFEE

09:00 - 09:30

KEYNOTE SPEECH



EU SINGLE MARKET FOR CONSTRUCTION PRODUCTS CURRENT RULES & FORESEEN CHANGES

Christophe Sykes, Director General - Construction Products Europe (Belgium)

09:30 – 13:00 **SESSION 3: TECHNICAL/ INNOVATION**

Moderator



Marc Beuken, Business Development Director – Brenntag - Alphamin and Chair of the EDANA Bituminous Membranes WG

09:30 - 10:00



New rheological approach to formulate bituminous compound with REOBs

Ines Antunes, R&D Director – Polyglass – Mapei Group (Italy)

10:00 - 10:30



Flame retardant bitumen membranes: the key role of the textile support in combination with mineral FR

Vanessa Matteucci, PhD in Chemistry and Material Science – IPOOL (Italy)

10:30 - 11:15  COFFEE BREAK

11:15 - 11:45



Bitumen: a building product ready for the future
Wim Teugels, Crude and Feedstock Analyst, Nynas (Belgium)

11:45 - 12:15



Biobased, a future for bitumen?
Dr Hans Aerts, Director Bitumen Technology, BMI Group / HAConsulting BV (Belgium)

12:15 - 12:45



OXIBOOST: a new versatile technology to improve bitumen
Camillo Cardelli, Chemist, MOPI (Italy)

12:45 - 13:00



Inspiration for the future from the BIS Team
Marc Beuken, Business Development Director – Brenntag - Alphamin and Chair of the EDANA Bituminous Membranes WG

13:00 - 14:00



FAREWELL LUNCH

EDANA would like to thank the members of the Bituminous Membranes WG for their help in setting-up this programme.

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The Bitumen Waterproofing Conference

reusefully

Circularity applied to the construction sector

Gilli Hobbs

Reusefully UK

24th May 2023

About Reusefully

- ▶ Reusefully is a partnership created to provide **expert circular economy advice and support within the built environment.**
- ▶ We enable the **practical implementation of circular economy thinking** throughout the construction supply chain and provide evidence-based support and advice for related policy development. We collaborate and work with others who genuinely share this objective and value our commitment to delivering effective & impactful project outcomes.
- ▶ We address **material and resource efficiency, embodied carbon and net zero, design for deconstruction, waste prevention and waste management, end markets, reuse and recycled content.** Collectively, Reusefully brings together over 45 years of experience, working across multiple parts of the value chain, from small practical projects to large scale R&D, for a wide variety of clients. **www.reusefully.co.uk**

Overview

- ▶ Introduction to Circular Economy
- ▶ Circularity and construction context
- ▶ Life cycle opportunities to apply circularity
- ▶ Circularity approaches as applied to built environment
- ▶ Case studies, R&D and other examples of circular economy in action
- ▶ Conclusions



What is circular economy?

- ▶ **So many definitions!**
- ▶ ISO TC 323 Standardization in the field of Circular Economy
- ▶ CEN/TC 350/SC1 Circular Economy in the Construction Sector

The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended.

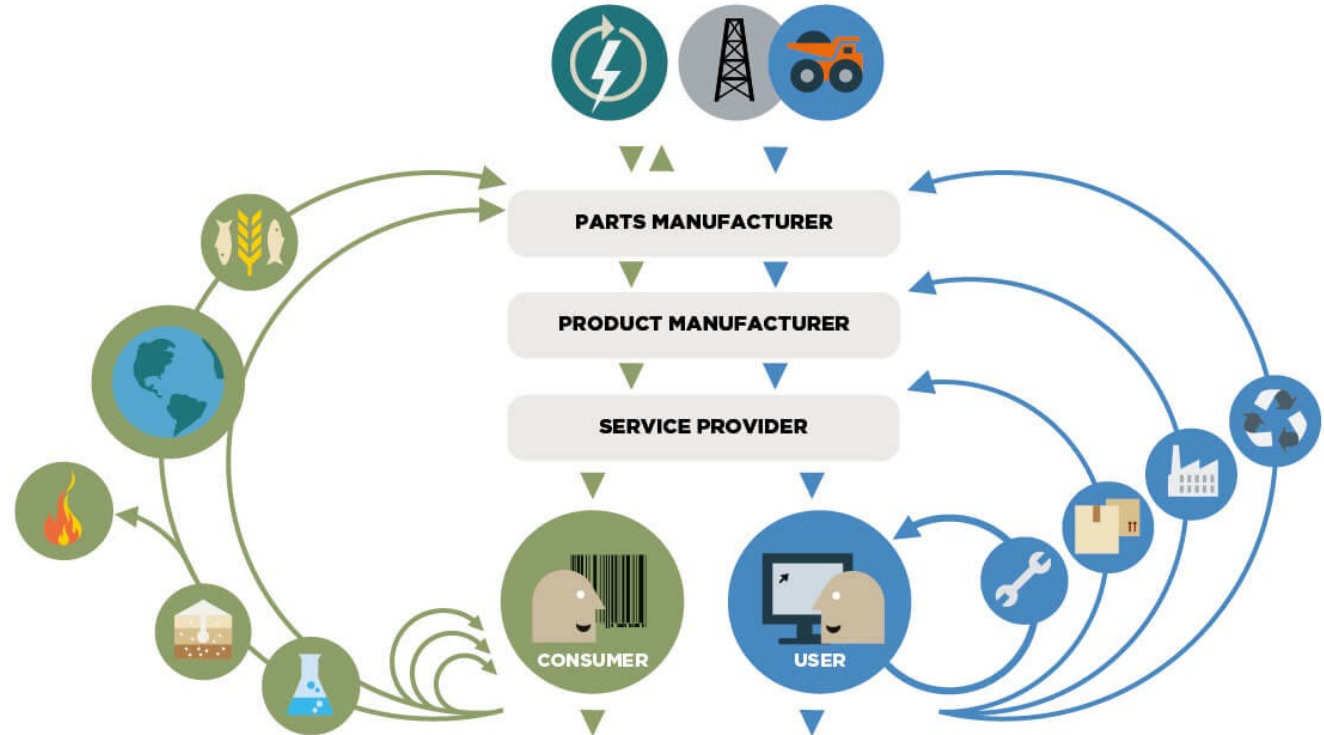
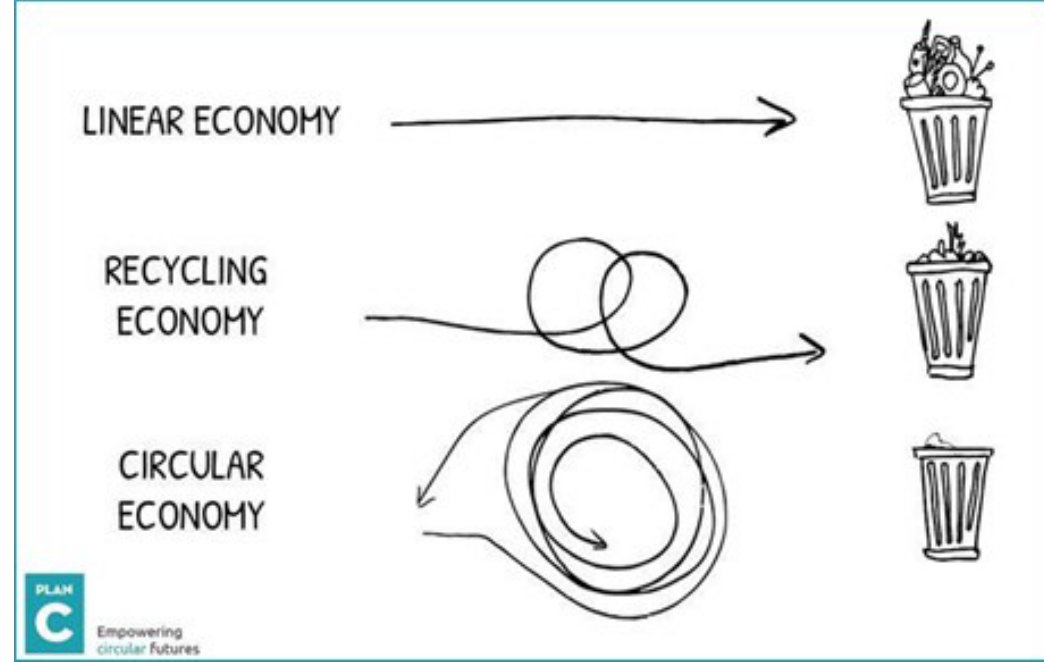
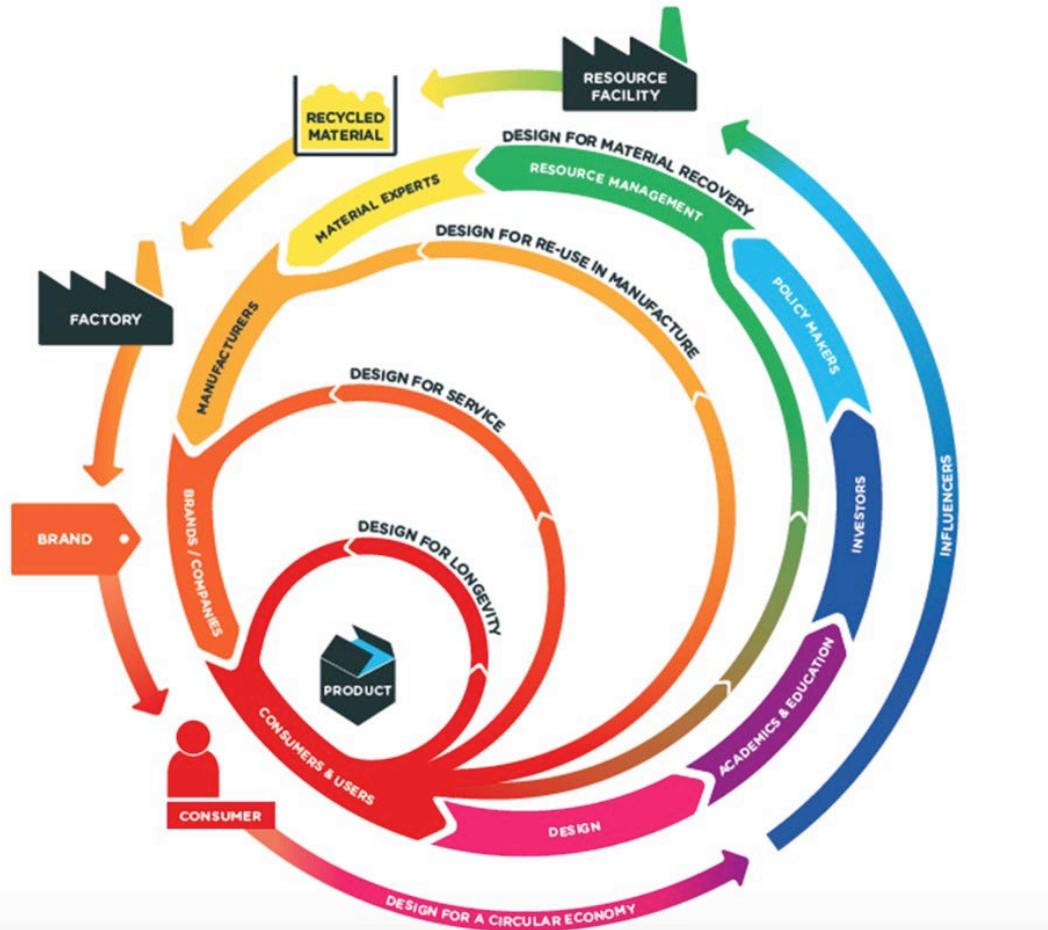
'An economic system based on the reuse and regeneration of materials or products, especially as a means of continuing production in a sustainable or environmentally friendly way' (OED)

3.1.1 circular economy

economic system (3.1.2) that uses a systemic approach to maintain a *circular flow of resources* (3.1.5), by recovering, retaining or adding to their *value* (3.1.6), while contributing to *sustainable development* (3.1.10)

[Add/View comments \(0\)](#)

What is circular economy?



EU construction overview

Construction is one of 14 industrial ecosystems identified in the updated EU Industrial Strategy (2021)

- ▶ 9.6% of EU Gross Value Added (EUR 1 158 billion)
- ▶ 25 million jobs, 5.3 million firms
- ▶ Low productivity & Low innovation uptake
- ▶ High environmental impact - half of Europe's extracted resources, over a third of total waste generated per year.
- ▶ Construction is also a major source of GHG emissions across the life cycle

Annual Single Market Report 2023:

<https://ec.europa.eu/docsroom/documents/48877>



Transition pathway: <https://europa.eu/!FcbxNr>

EU wide action plan developed for the construction ecosystem – March 2023

EU – Circular Economy Action Plan

Published March 2020...for Construction and buildings

- ▶ Greenhouse gas emissions from material extraction, manufacturing of construction products, construction and renovation of buildings are estimated at 5-12% of total national GHG emissions . Greater material efficiency could save 80% of those emissions .
- ▶ ... promote circularity principles throughout the lifecycle of buildings by:
- ▶ ... the revision of the Construction Product Regulation, including the possible introduction of recycled content requirements for certain construction products, taking into account their safety and functionality;
- ▶ promoting measures to improve the durability and adaptability of built assets in line with the circular economy principles for buildings design and developing digital logbooks for buildings;
- ▶ using Level(s) to integrate life cycle assessment in public procurement and the EU sustainable finance framework
- ▶ considering a revision of material recovery targets set in EU legislation for construction and demolition waste and its material-specific fractions... the Commission will pay special attention to insulation materials, which generate a growing waste stream.

EU activities - study on end-of-waste criteria

- “Background data collection for future EU end-of-waste criteria of construction & demolition waste”
- Ends March 2024
- JRC scoping study March 2022 already identified aggregates & mineral wool as priority CDW streams. <https://europa.eu/!t7WKdK>



EU Taxonomy for sustainable activities

- ▶ Objective: direct investments towards “sustainable” projects
- ▶ Climate Change Adaptation & Mitigation (in force since January 2022)
- ▶ Water, Biodiversity, Pollution,
- ▶ Circular Economy criteria (expected soon)

EU Taxonomy:

<https://europa.eu/!WV46yv>

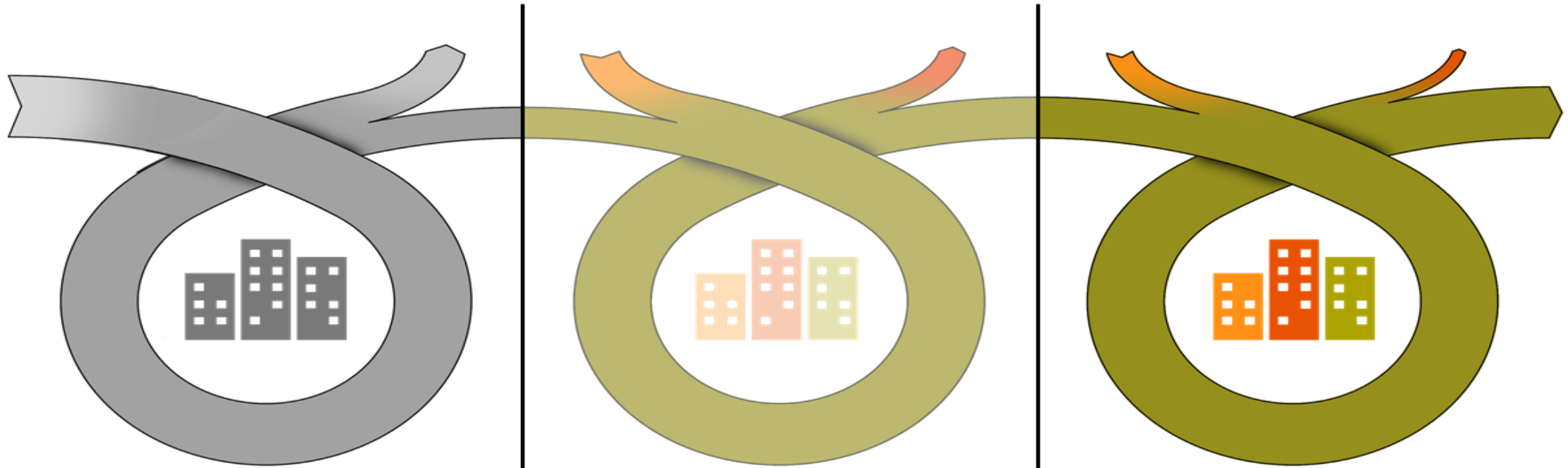


EU Guidance

- **EU Construction & Demolition Waste Management Protocol**
- Available in 15 languages
- <https://ec.europa.eu/docsroom/documents/20509/>
- Revision being planned



Life cycle approach to Circular economy – multiple!



Previous Buildings

Existing assets are **Donors** of building product and materials

Current Building

Construction projects can be **Recipients**— reducing carbon, cost and preserving heritage

Future Buildings

Designing for adaptability and **future reuse** creates longer lived assets & future bank of resources

Summary - Life cycle stages and opportunities for circular economy

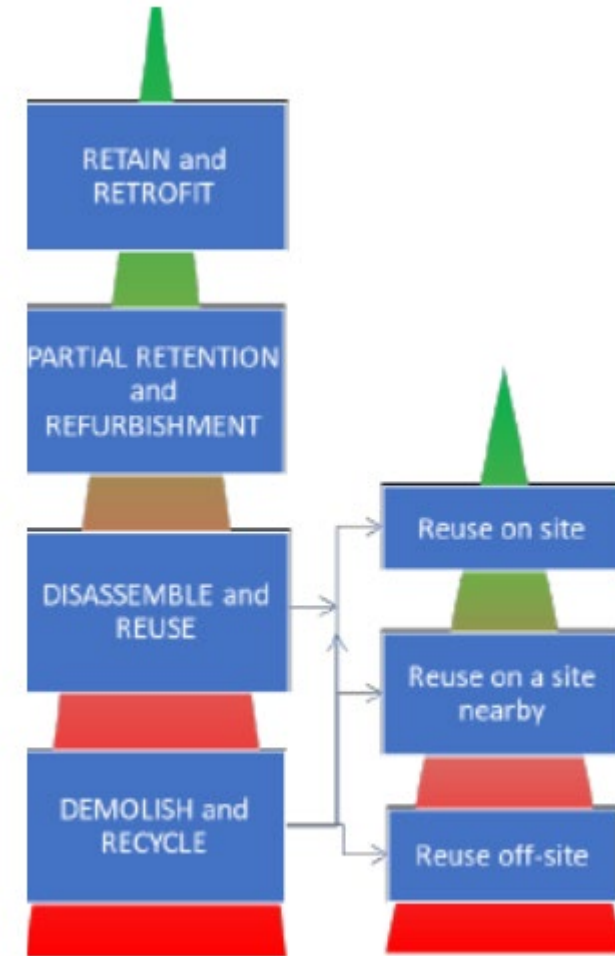
Design	Manufacture and supply	Construction	In use	End of life
Design for deconstruction Design for adaptability and flexibility Design for standardisation Designing out waste Modularity Specifying reclaimed materials Specifying recycled materials	Ecodesign principles Using less materials/ optimising material use Using less hazardous materials Increasing the life span Designing for disassembly Designing for standardisation Using more secondary materials Take back schemes Reverse logistics	Minimise construction waste Procuring reused materials Procuring recycled materials Off site construction	Minimise waste Minimal maintenance Easy repair and upgrade Adaptability Flexibility Utilising assets	Deconstruction Selective demolition Reuse of products and components Closed loop recycling Open loop recycling
Management of information including metrics and datasets				

A bit more detail on...

- ▶ Life time extension
- ▶ Increasing reuse/recycling from demolition
- ▶ Designing for future disassembly and reuse/recycling
- ▶ Designing for flexibility and adaptability
- ▶ Improving material efficiency/intensity/mass of materials used
- ▶ Increasing recycled and secondary content
- ▶ Improving durability, lifespan and repairability
- ▶ Product as a service, new business models

Lifetime extension e.g. through retaining and refurbishing

- ▶ Reusing an entire asset, or reusing a significant proportion of the existing asset, to accommodate similar or different needs and/or uses (e.g. from industrial use to mixed use) whilst exceeding current regulations and standards through restoration or significant changes.
- ▶ Ensure a presumption in favour of retaining most, if not all, of the asset (structure, facade, building services, fixtures and fittings) based on whole life cost modelling



Increasing reuse/recycling of waste from strip out and demolition works

- ▶ Carry out pre-demolition audit to develop targets for reuse & recycling
- ▶ Embed into specification for demolition and design opportunities for subsequent development i.e. what can be 'harvested'
- ▶ Can products & materials be returned to suppliers?
- ▶ A demolition contractor should be engaged early in the process to enable products to be reused where possible of higher value recycling.

Make products and materials easier to recycle e.g.

- ▶ Rewind, a 100% polyolefin-based recyclable event carpet by Beaulieu International Group

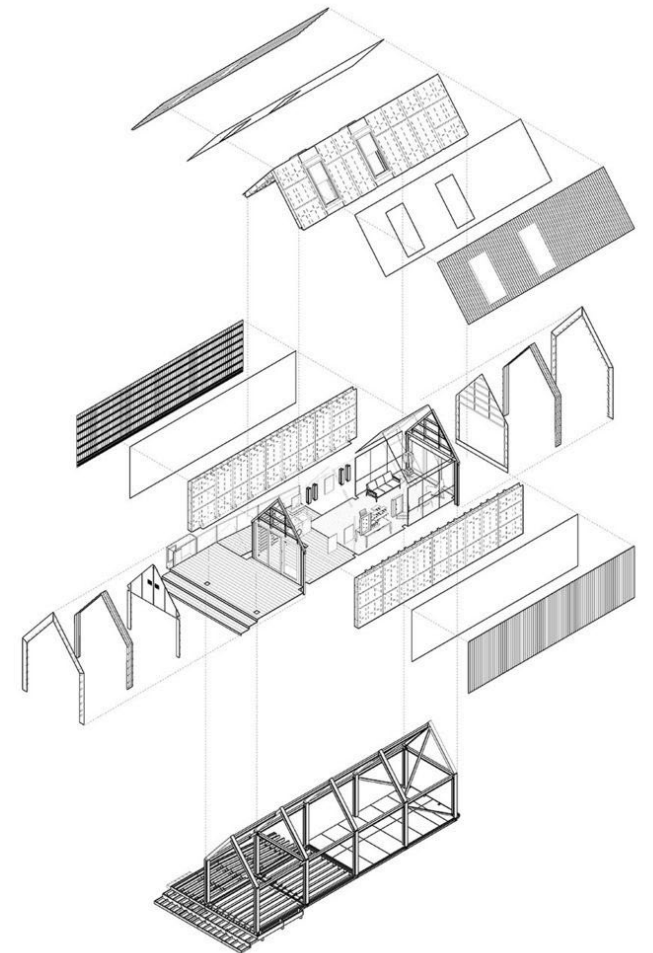


760 m² cold flat roof (33 tonnes)



Designing for future disassembly and reuse


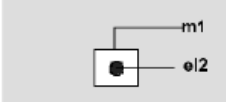
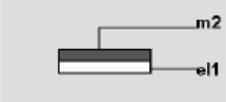

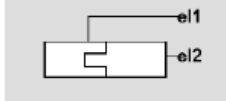
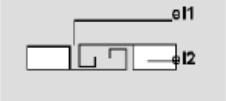

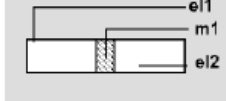
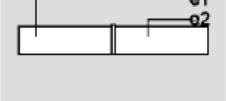
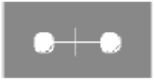
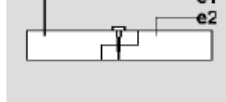
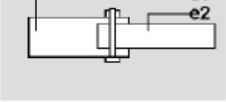

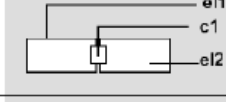
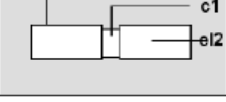

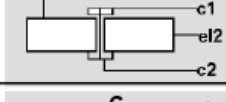
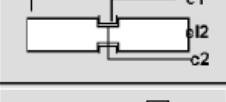

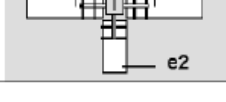

- ▶ Products and services are designed to be assembled, deconstructed and reused or recycled
- ▶ Ensure that the asset has been designed to allow for easy assembly and reconfiguration for alternative future uses for example, design of interior systems for disassembly.
- ▶ The material and product manufacturer should provide EoL scenarios to develop End of life plan
- ▶ Ensure that the materials have the option to be taken apart through mechanical and reversible fixings to allow for future reuse.
- ▶ Ensure layer independence: the design of building systems and components in layers
- ▶ Ensure unnecessary toxic treatments and finishes are avoided.
- ▶ Investigate products with a planned short life span if they can have an agreement with the manufacturer to take back or that they are procured through a service agreement.



Designing in layers

	Short life components		Long life components	
Lifespan	0-5 years	5-10 years	20-30 years	30-300 years
Example components	Internal finishes, furniture	Internal partitions, ceilings, floors, local services	Building services	Sub-structure, structure, floors, fabric
Overall strategy	Match material to lifespan, design for disassembly and return to manufacturer	Design for reconfiguration, use modular systems	Design for maintenance, replaceability, remanufacture	Long life, loose fit Adaptable to different uses Temporary buildings designed to be relocatable
Designing in layers	Ensure finishes allow access to services	Non-structural partitions	Services to be accessible and replaceable	Avoid interdependency of structural frame and facade

Fixings

		type of connection	graphic representation		dependence in assembly
fixed		I Direct chemical connection two elements are permanently fixed (no reuse, no recycling)			$m1 \text{---} e2$
		II direct connections between two pre-made components two elements are dependent in assembly/ disassembly (no component reuse)			$e1 \rightarrow e2$
		III indirect connection with third chemical material two elements are connected permanently with third material (no reuse, no recycling)			$m1$ $e1 \text{---} e2$
		IV direct connections with additional fixing devices two elements are connected with accessory which can be replaced. If one element has to be removed than whole connection needs to be dismantled			$c1$ $e1 \text{---} e2$
		V indirect connection via dependent third component two elements/components are separated with third element/component, but they have dependence in assembly (reuse is restricted)			$e1 \rightarrow c1 \rightarrow e2$
		VI indirect connection via independent third component there is dependence in assembly/disassembly but all elements could be reused or recycled			$c1$ $e1 \rightarrow c1 \rightarrow e2$ $c2$
		VII indirect with additional fixing device with change of one element another stays untouched all elements could be reused or recycled			$e3 \rightarrow c \leftarrow e1$ $e2$



Designing for flexibility and adaptability

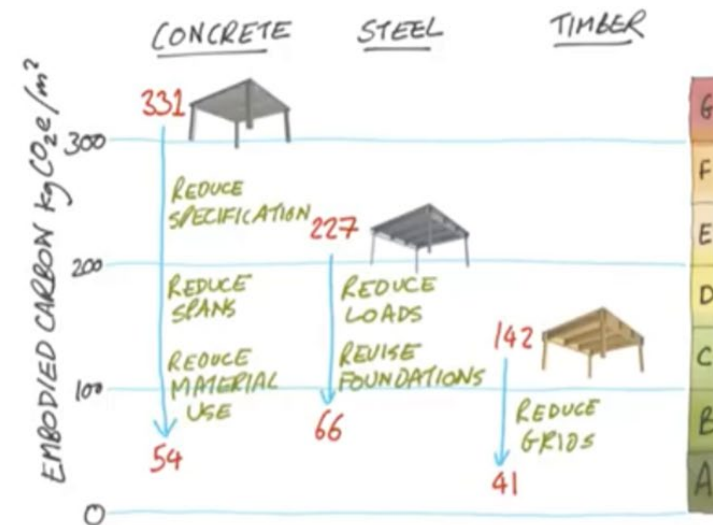
- ▶ Balance the needs of the present with how those needs will change in the future and to enable change through frequent reconfiguring including reconfiguration of non-structural parts
- ▶ Ensure the built asset allows for flexibility to cope with a diversity of scenarios, e.g. flexible space planning.
- ▶ Develop a 'meanwhile' strategy for more efficient use of the built asset in operation to ensure full utilization of the space.
- ▶ Ensure that the built asset allows for adaptability to cope with a diversity of future scenarios. For example, flexible space planning, location of cores, and generous floor to ceiling heights.
- ▶ Floor plate depth, floor plate shape, window sizes and locations, internal partition layouts, plant room sizes, riser sizes and space for horizontal distribution all play a role in determining whether a building can accommodate an adapted or wholly-new MEP system.



Green Transformable
Building Lab – Heerlen NL

Improving material efficiency/intensity/mass of materials used

- ▶ Meets the project requirements with minimal material consumption.
- ▶ Simple design approaches, considering the real need of components and materials.
- ▶ Questions if certain components can be refused without compromising the desired performance level.
- ▶ Prioritise passive and simple servicing strategies over overly complex ones
- ▶ Refuse finishes where possible
- ▶ Key link with embodied/whole life carbon



Based on **Embodied carbon: structural sensitivity study**
By Buro Happold
<https://www.istructe.org/resources/case-study/embodied-carbon-structural-sensitivity-study/>

Increasing recycled and secondary content

- ▶ To recognize and encourage the use of recycled content and secondary aggregates, thereby reducing the demand for virgin material and optimizing material efficiency in construction.
- ▶ Carry out research to determine the best approach to recycled content and secondary materials based on the location of the site.
- ▶ Specify recycled content targets – some information available from manufacturers (limited)
- ▶ A lot of focus on concrete and steel
- ▶ PVC has had recycling scheme for many years – recovinyl, recofloor and roofcollect



Built in 1997, [BRE's Environmental Building](#) incorporated 100% recycled aggregates and GGBS in all in situ concrete, alongside 80,000 reclaimed bricks and reclaimed flooring.





Example – Roofcollect recycling scheme

European level, post-consumer thermoplastic roofing membranes led by ESWA (European Single ply Waterproofing Association). Thermoplastic roofing membranes can be recycled after many years service by:

- ▶ Removal - old roof is prepared and cleaned with a broom, cut on site in 1 m large strips and mechanical removed. Membranes are rolled as tight as possible and placed in big bags containing up to 400m² (1 tonne) or larger containers for bigger sites
- ▶ Acceptance – Need to be supplied in a cleaned state and not contain remaining particles of glue or bitumen. Fleece-backed and adhered roofing membranes can also be collected.
- ▶ Collection - The end-of-life material will be collected once it has been correctly prepared and registered.

Improving durability, lifespan and repairability

- ▶ Requires little modification/no replacement of parts, due to its 'loose fit', generous proportions and readiness for alternative technologies
- ▶ Ensure the long term durability of building elements and services and effective recoverability during maintenance, refurbishment and disassembly.
- ▶ Ensure that the built asset allows for changing climatic conditions. For example, to protect materials from degradation due to environmental conditions, adopt passive design strategies to provide resilience, size systems to cope with future climate scenarios
- ▶ Plan for an appropriate and simple maintenance strategy from the design stage, including using condition-based monitoring for equipment
- ▶ Select materials from manufacturers offering take-back schemes and leasing



Circular Asphalt hierarchy – from Big Buyers for Climate & Environment working group on Circular Construction

Product as a service, new business models

- ▶ A few leasing examples/product as service (not many)
- ▶ A few reuse/remanufacture examples e.g. lighting, social enterprise
- ▶ Quite a few take back schemes e.g.
 - ▶ Ceiling tiles
 - ▶ Carpet tiles
 - ▶ Plasterboard
 - ▶ Insulation
 - ▶ Packaging and temporary materials
 - ▶ PVC
- ▶ Quite a few material exchange platforms



Case study: RIC A12 School, Netherlands

- ▶ Installation of a new carpet tiles (850 m²) supplied by Desso
- ▶ Airmaster carpet (C2C)
- ▶ Lease of 5 or 7 years
- ▶ Financial flexibility
- ▶ Control of monthly costs
- ▶ End of lease, it is removed taken back, disassembled and recycled into new carpet
- ▶ Regular maintenance checks
- ▶ Loose lay to avoid being part of the building (and therefore not the owner)




Drivers and activities are increasing, some example...

- ▶ Product Circularity Datasheet – Luxembourg
- ▶ Citumen – Circular Bitumen - Netherlands
- ▶ Embodied carbon savings through circularity – BAMB Brussels
- ▶ GLA circular economy statement/ Enfield Excess Materials Exchange– London
- ▶ France - Demolition products and waste audit (PEMD)
- ▶ Level (s) – European Framework for Sustainable Buildings
- ▶ Netherlands - Sustainable procurement of infrastructure in the Netherlands
- ▶ CEN TC 350 SC1 Gap analysis



Product Circularity Dataset - Luxembourg

identical, but the chemical composition differs and impacts some PCDS statements. Therefore, two distinct PCDS shall be created in such case.

SECTIONS			STATEMENTS (EXAMPLES)
1		GENERAL INFORMATION	
2		COMPOSITION	THE PRODUCT CONTAINS > 75-95 % POST-CONSUMER RECYCLED CONTENT BY WEIGHT THE PRODUCT DOES NOT CONTAIN SUBSTANCES OF VERY HIGH CONCERN FROM THE REACH CANDIDATE LIST IN CONCENTRATION ABOVE 0.1% BY WEIGHT
3		DESIGNED FOR BETTER USE	THE PRODUCT CAN BE MAINTAINED & REPAIRED BY UNTRAINED PERSONNEL AT THE LOCATION OF THE PRODUCT USE
4		DESIGNED FOR DISSASSEMBLY	THE PRODUCT IS DESIGNED TO BE INSTALLED AND DEMOUNTED USING REVERSIBLE CONNECTORS
5		DESIGNED FOR RE-USE	THE PRODUCT IS DESIGNED FOR RE-USE AS-IS OR WITH MINIMAL MODIFICATION THE PRODUCT IS DESIGNED FOR COMPOSTING IN A HOME COMPOSTER

Citumen - NL

Circular Bitumen Roofing by Icopal, New Horizon and ZND Nedicom in 5 steps:

- ▶ Separate layers of bitumen roofing membrane and other roof materials such as insulation are separated from each other.
- ▶ Shred the aged bitumen in specialist shredder. This is the base material for the recycling process.
- ▶ BiELSo recycling machine heats gradually and uniformly to make the bitumen liquid. The base product will detach from the bitumen. All solid particles are removed from the bitumen using a sieve.
- ▶ Liquid pure bitumen is added to the production process of the new roofing membrane product.
- ▶ The end product is Citumen, a new circular roofing membrane that can be recycled again and again after a long service life via the BiELSo process.




1 000 000 m²
Citumen

= 
400 tonnes
CO₂ savings

*Estimated 1.5 tonnes of savings in
CO₂ per tonne of roof waste*

BAMB – Brussels BRIC Embodied carbon cumulative results

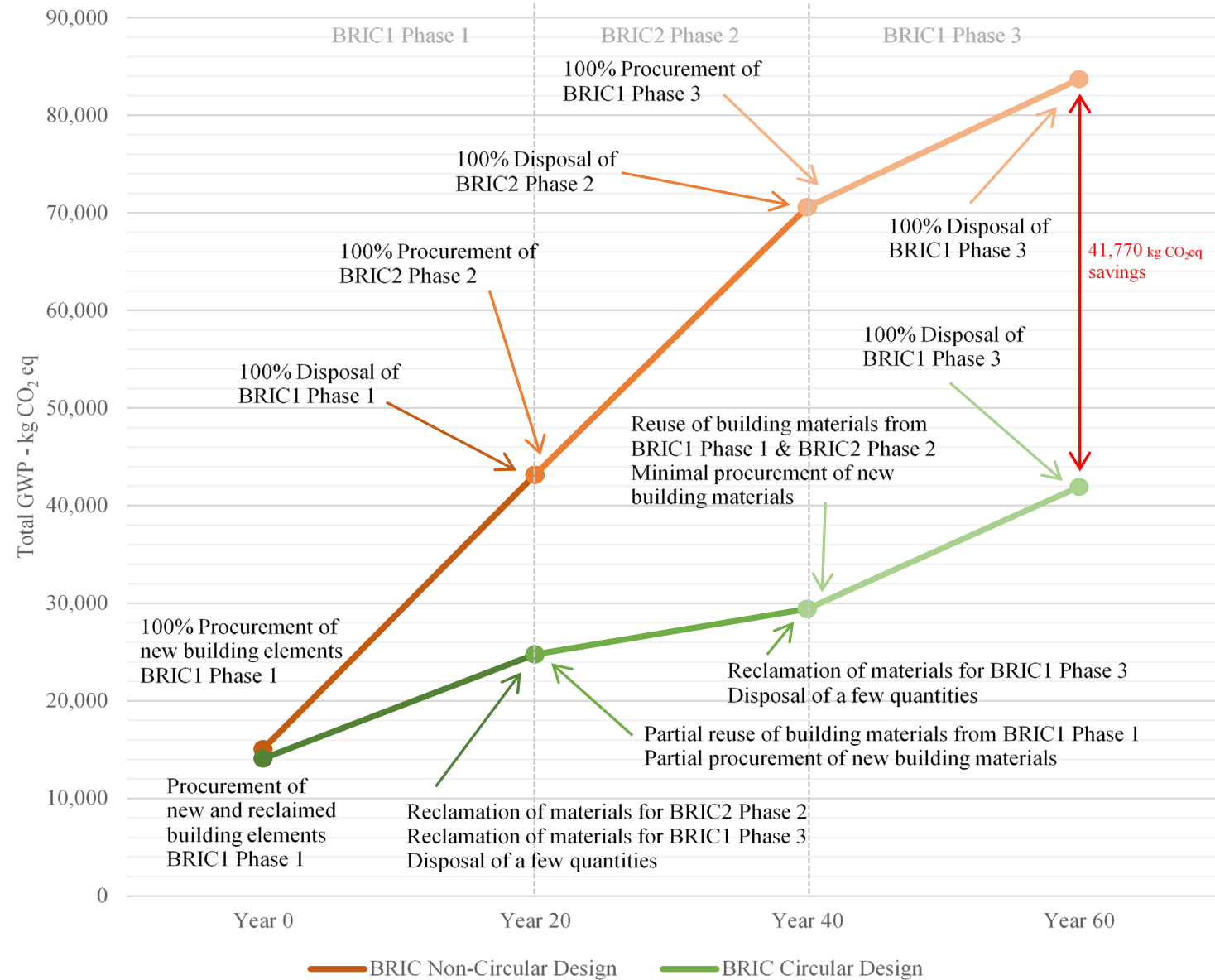
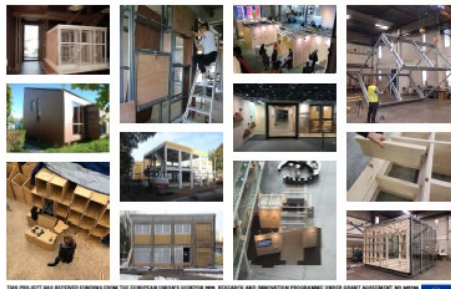
- ▶ Cumulative impact over a 60-year achieved approximately 41,770 kg CO₂eq saving by adopting Circular Design instead of Non-Circular.
- ▶ Find out more at: bamb2020.eu



BUILDINGS AS MATERIAL BANKS

TESTING BAMB RESULTS THROUGH
PROTOTYPING AND PILOT PROJECTS

D14 – 4 pilots built + Feedback report 28.02.2019



London Circular Economy Statement - UK

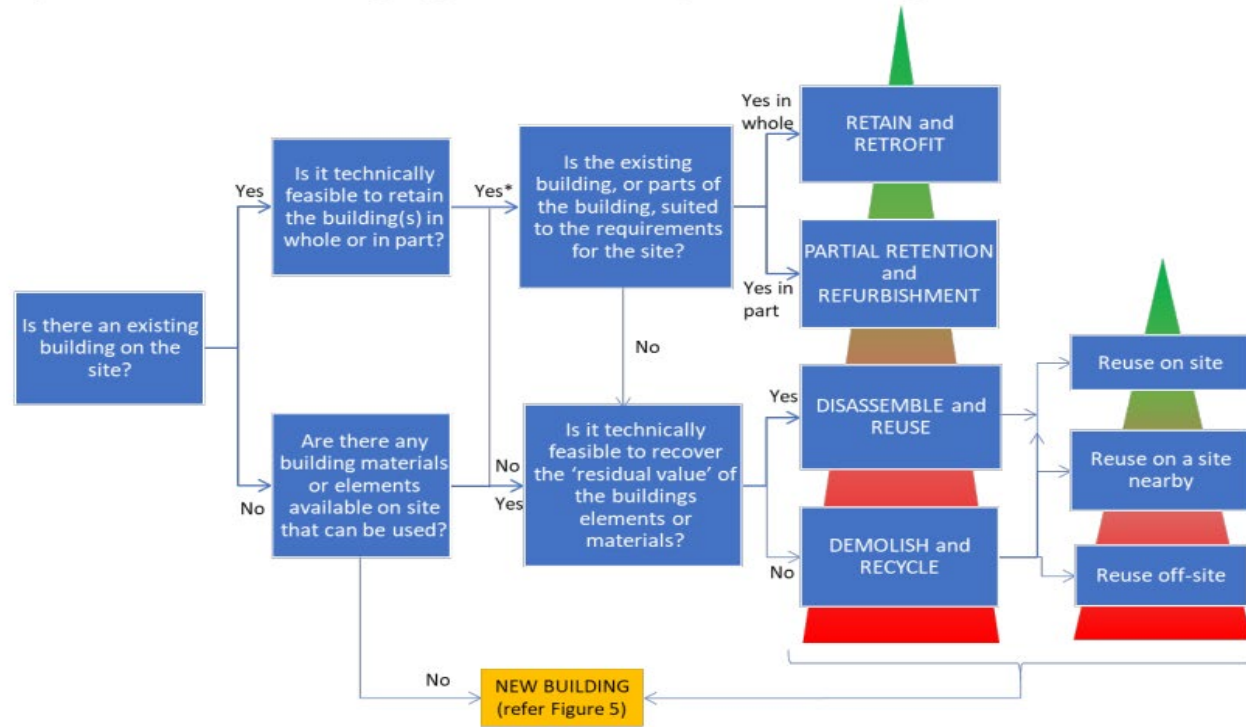
MAYOR OF LONDON

London Plan Guidance

Circular Economy
Statements

March 2022

Figure 4: Decision tree for design approaches for existing structures/buildings



<https://www.london.gov.uk/programmes-strategies/planning/implementing-london-plan/london-plan-guidance/circular-economy-statement-guidance>

France - Demolition products and waste audit (PEMD)

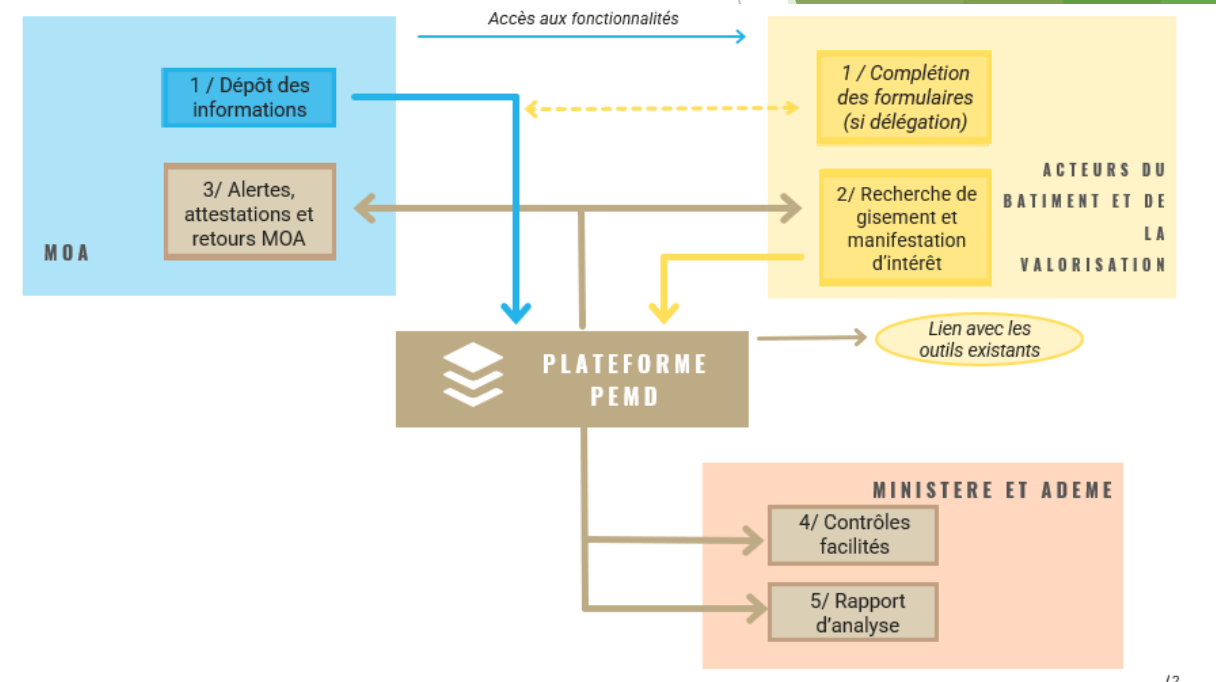
Overview:

- CSTB (Centre Scientifique et Technique du Bâtiment) is developing a digital platform at the request of the French Ministry of Ecological Transition to **enable project owners to comply with 'PEMD diagnosis' obligations** (an audit of demolition products, equipment, materials and waste). The platform will be finalised in July 2023
- In addition to compliance, the platform aims to **boost collaboration between stakeholders** and **improve accessibility of data on products and materials** that can be used for further developments. To support this, the platform will aggregate and link demolition-related data
- Key stakeholders include: Project owners, construction companies, and project managers working on major demolition and rehabilitation operations, and national authorities to verify compliance.

Data and indicators

Data collected:

- Areas (ground surface, premises, etc.)
- Construction year
- Main building use
- Main structural material
- Items suitable for Reuse
- Information on recycling, recovery, disposal
- Quantities of standardised product and material categories.



Overview of the PEMD platform and its functionalities

Level(s) - EU

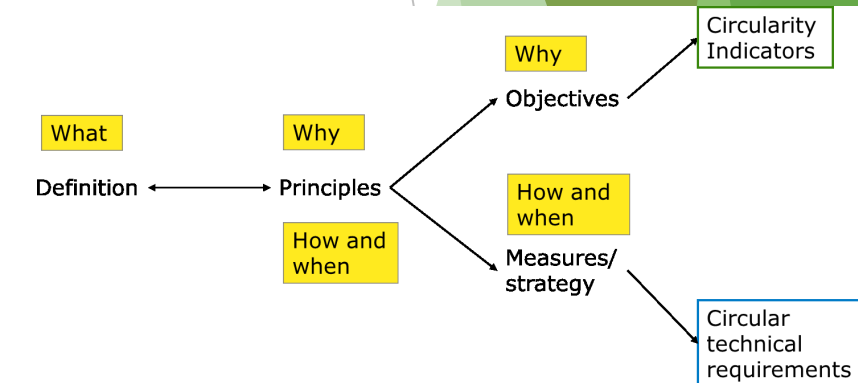
3 themes	6 macro-objectives	16 indicators	L1	L2	L3	
Resource use and environmental performance	1. Greenhouse gas emissions	1.1. Energy performance in the use phase	●	●	●	
		1.2. Life cycle global warming power (GWP)	●	→	●	
	2. Life cycles of energy-efficient materials resources and circulars	2.1 Bill of quantities, bill of materials and lifetimes	●	→	●	
		2.2 Construction and demolition materials and waste	●	→	●	
		2.3 Design for adaptability and renovation	●	→	●	
		2.4 Design for deconstruction, reuse and recycling	●	→	●	
	3. Effective use water resources	3.1 Water consumption during the use phase	●	●	●	
	Health and comfort	4. Healthy and safe spaces comfortable	4.1 Indoor air quality	●	●	●
			4.2 Time outside the thermal comfort range	●	●	●
4.3 Lighting and visual comfort			●	N/A	N/A	
4.4 Acoustics and noise protection			●	N/A	N/A	
Cost, value and risk	5. Adaptation to climate change and resilience	5.1 Protection of health and thermal comfort of the occupants	●	●	N/A	
		5.2 Increased risk of extreme weather events	●	N/A	N/A	
		5.3 Sustainable drainage	●	N/A	N/A	
	6. Value and cost of optimised life cycle	6.1 Life cycle costs	●	●	●	
		6.2 Value creation and risk exposure	●	N/A	N/A	

Sustainable procurement infrastructure - NL

2008 Rijkswaterstaat started awarding sustainability using MEAT criteria (Most Economically Advantageous Tender) and DuboCalc: LCA based design instrument

Methodology:

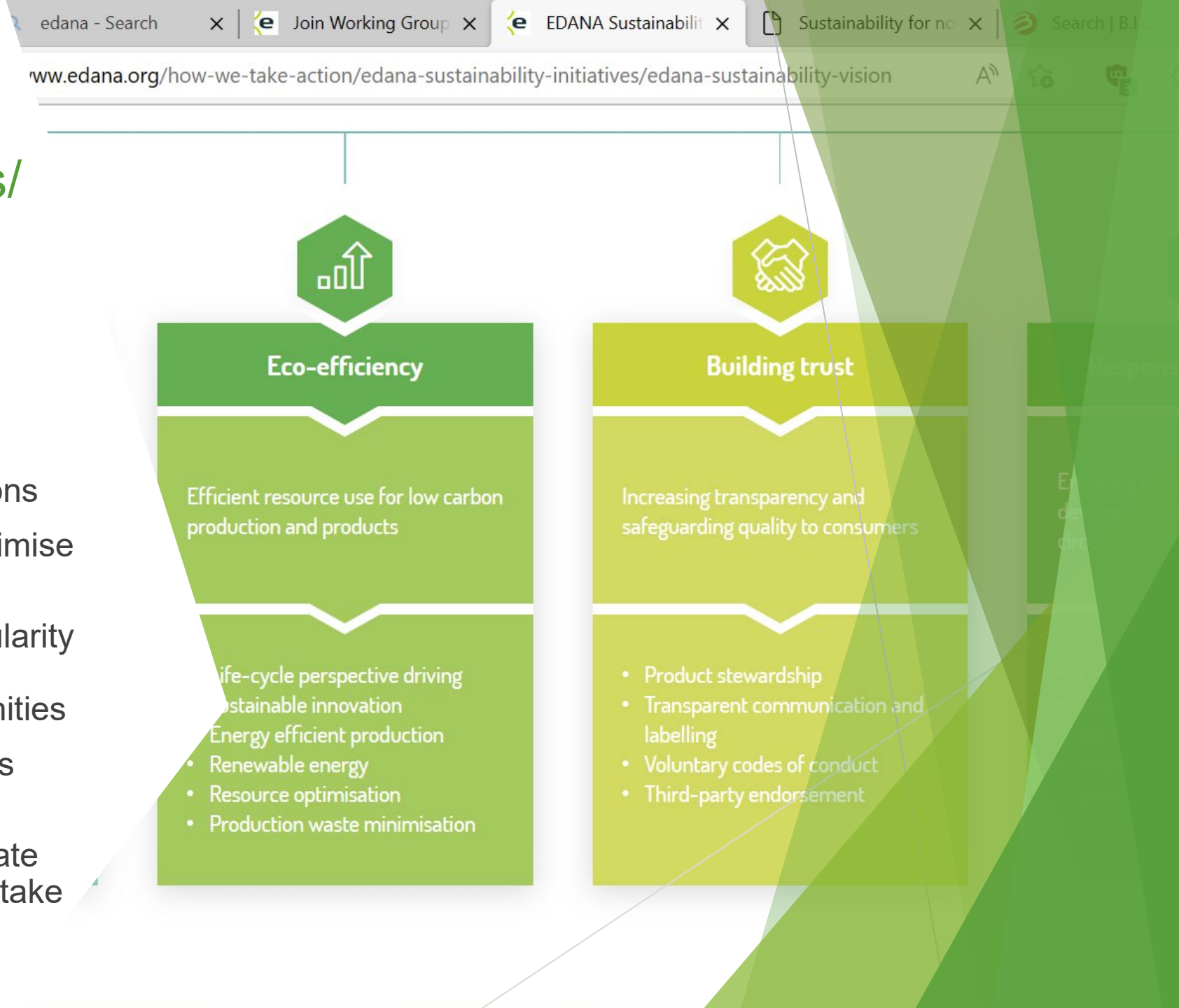
- Bidder required to assess the environmental impact of their design using Dubocalc (or other allowed LCA software)
 - The result is an aggregated indicator for the environmental costs *in Euros*.
 - These costs are added to the price of the bid, and the project is awarded to the bid with the lowest price (including the environmental costs).
- In 2016 Rijkswaterstaat adopted the ambition to “work in a fully circular manner by 2030”, but what does this mean?
 - Initiative to start Platform CB'23 (circular construction 2023), together with national Standardisation Institute NEN, objectives are to
 - Protect the environment (including climate change)
 - Protect resource availability
 - Protect value
 - Now need to find measurable indicators for each of these



CEN TC350 SC1 'Standards gap analysis' – current recommendations - Europe

- ▶ Establish the following new working groups:
 1. Data, measurement and assessment linked to circular economy (products and asset(infrastructure)/building level)
 2. Reused: Quality assurance, testing, requalification, traceability of reused products and materials (including pre-development & pre-demolition audits)
 3. Recycled: Quality assurance, testing and certification of products containing recycled content (including end of waste criteria)
 4. Design for circularity (including reused/recycled content, adaptability, disassembly)





Conclusions... Priorities for suppliers/ manufacturers

- ▶ Product information to support circularity
- ▶ Take back/ extended producer responsibility
- ▶ Design for circularity considerations
- ▶ Guidance to supply chain to maximise circularity outcomes
- ▶ Learn by doing – implement circularity approaches with projects to understand barriers and opportunities
- ▶ Invest/ participate in R&D projects with the supply chain
- ▶ Celebrate success and disseminate widely to promote widespread uptake of better practices



Thanks for listening
gilli@reusefully.co.uk

reusefully

European construction market outlook

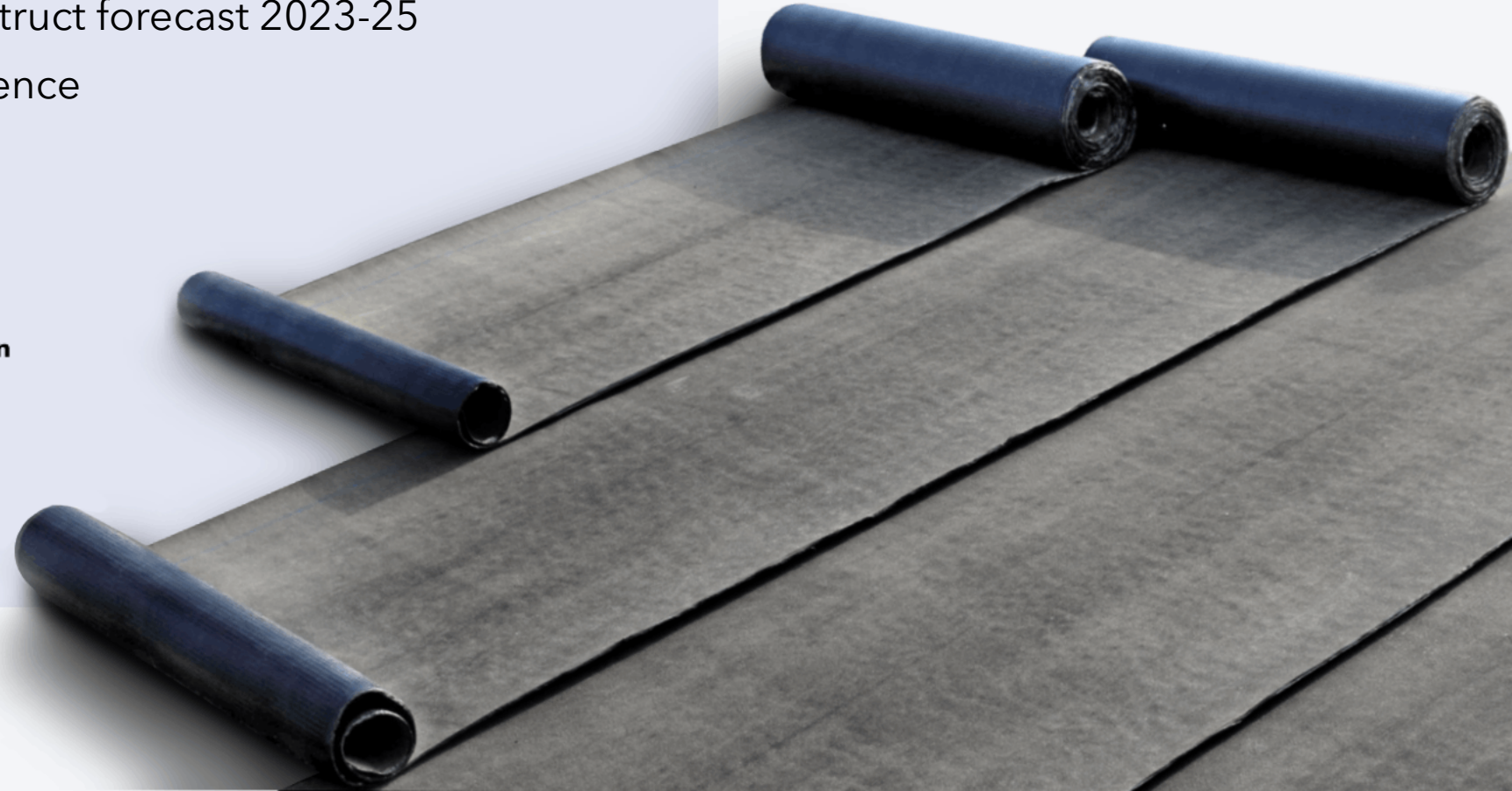
Summary of the Euroconstruct forecast 2023-25
for the IMPERVIUS conference

Josep R Fontana



**The Catalonia
Institute of Construction
Technology**

Sitges, 24th May 2023



Macroeconomic background: what the gurus are telling us



What is the difference between the 1990-91 recession, or the financial crisis of 2008, and the present chaos?
There is no doubt that it will weigh down the economy, but how much?
Should the economic policy be revised?

The answer is easy...

...nobody knows

Paul Krugman Nobel Prize in Economics

**Insolvent firms
and
industries past their primes**

**Weak banks,
de facto renationalised
after the 2008 bailout**

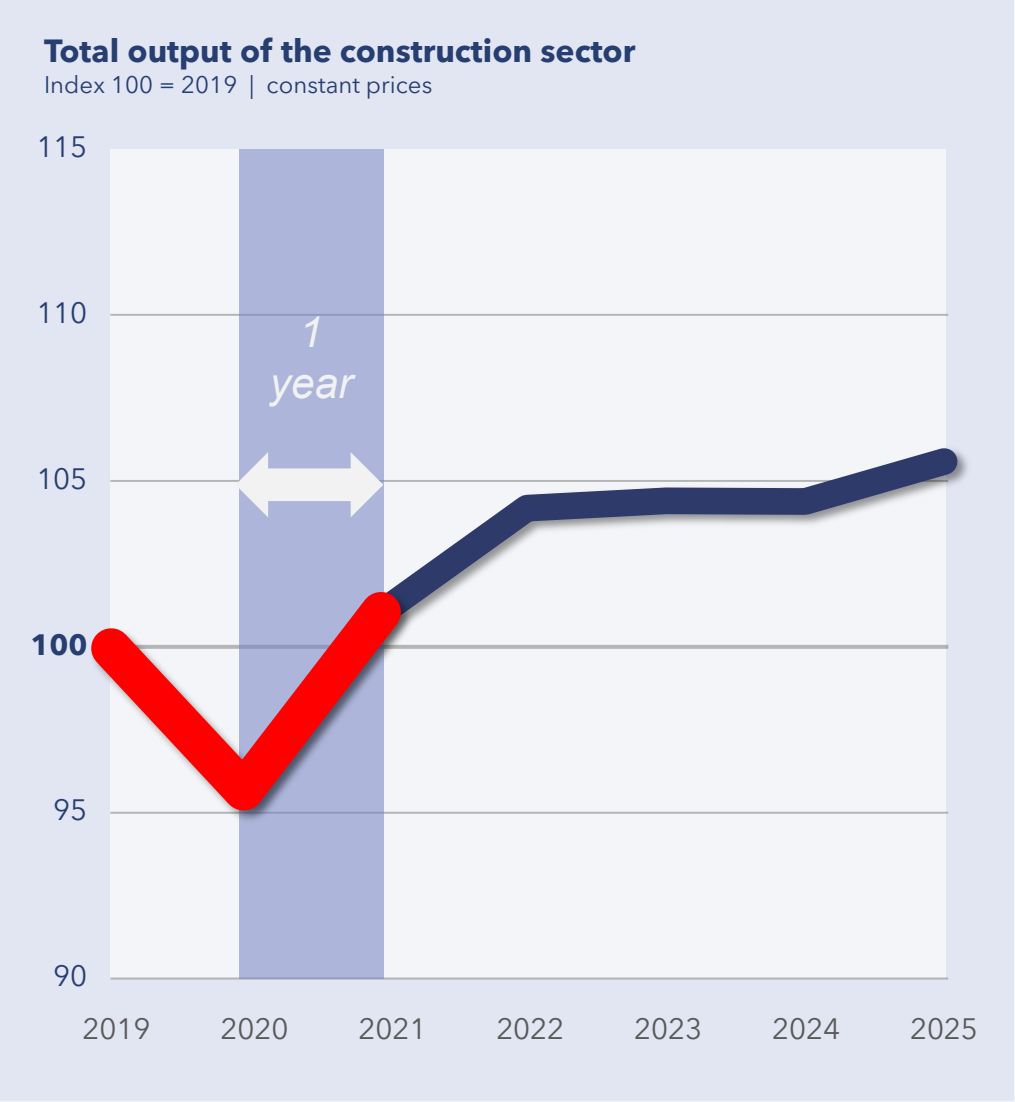
**Governments desperate to
protect their economic
model**



European construction: it gets difficult to keep growing



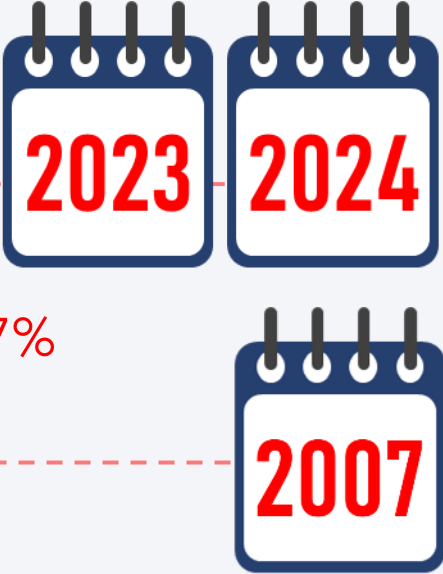
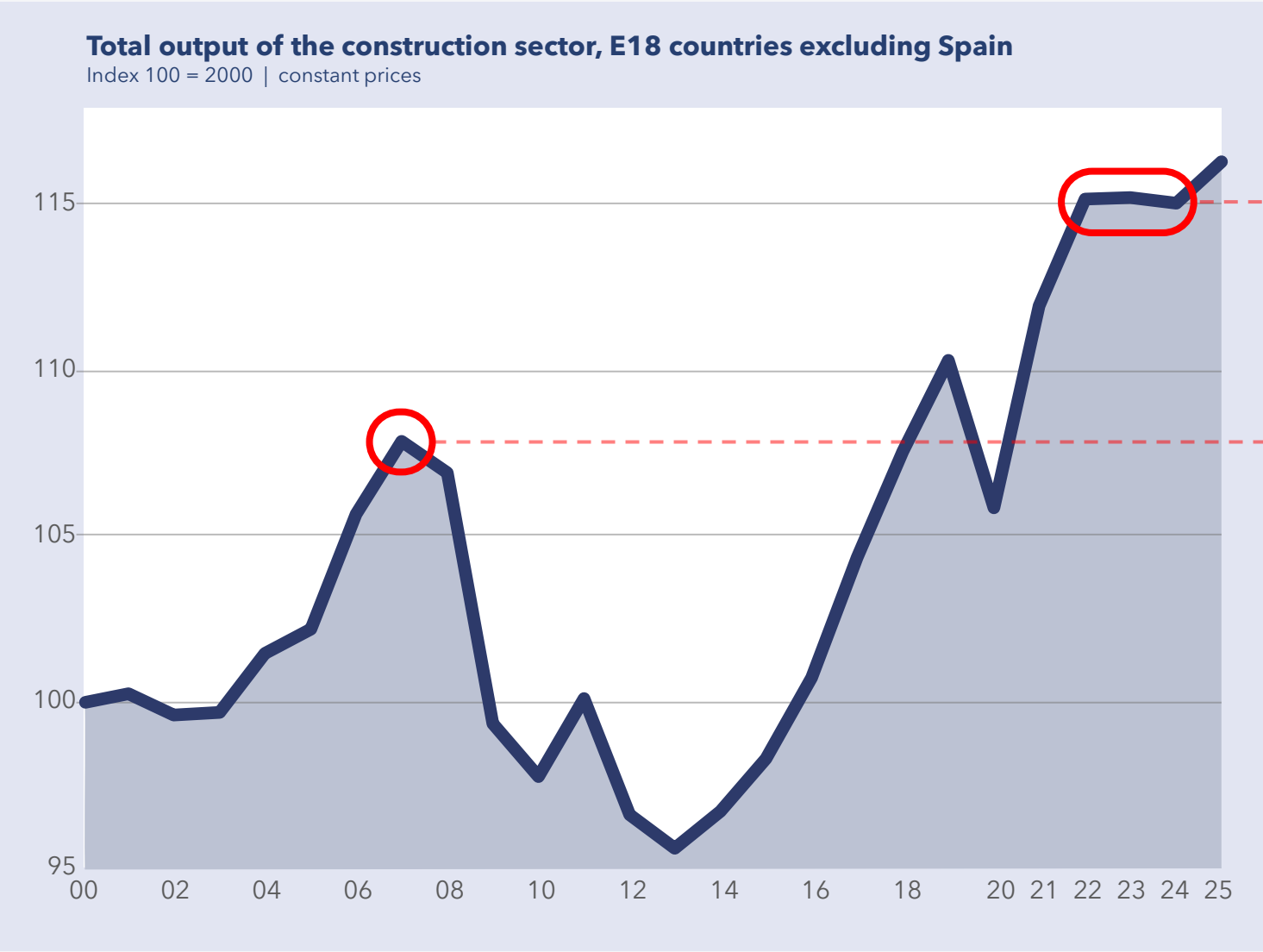
Swift recovery from the COVID disruptions



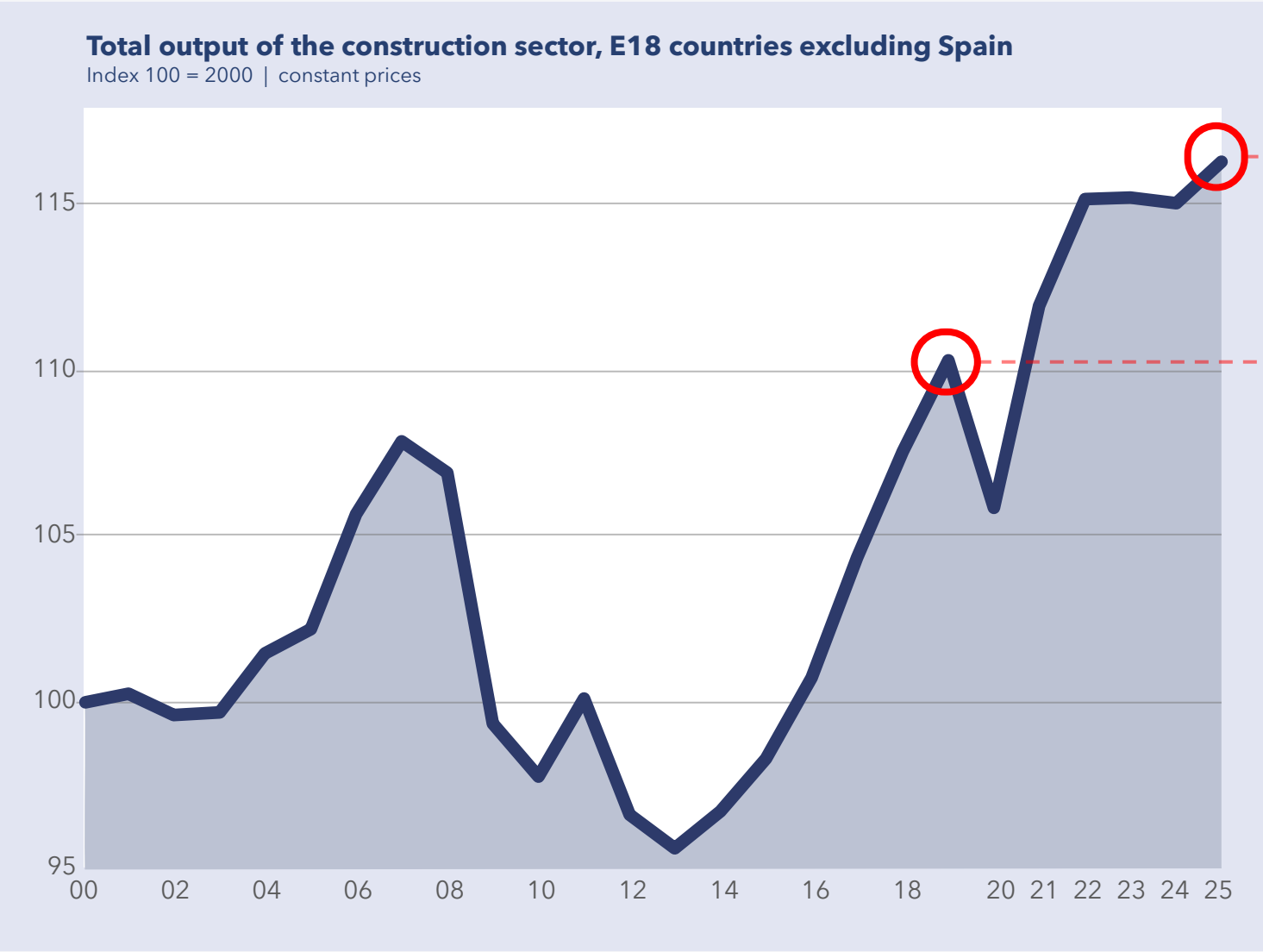
Two years of **stagnation**



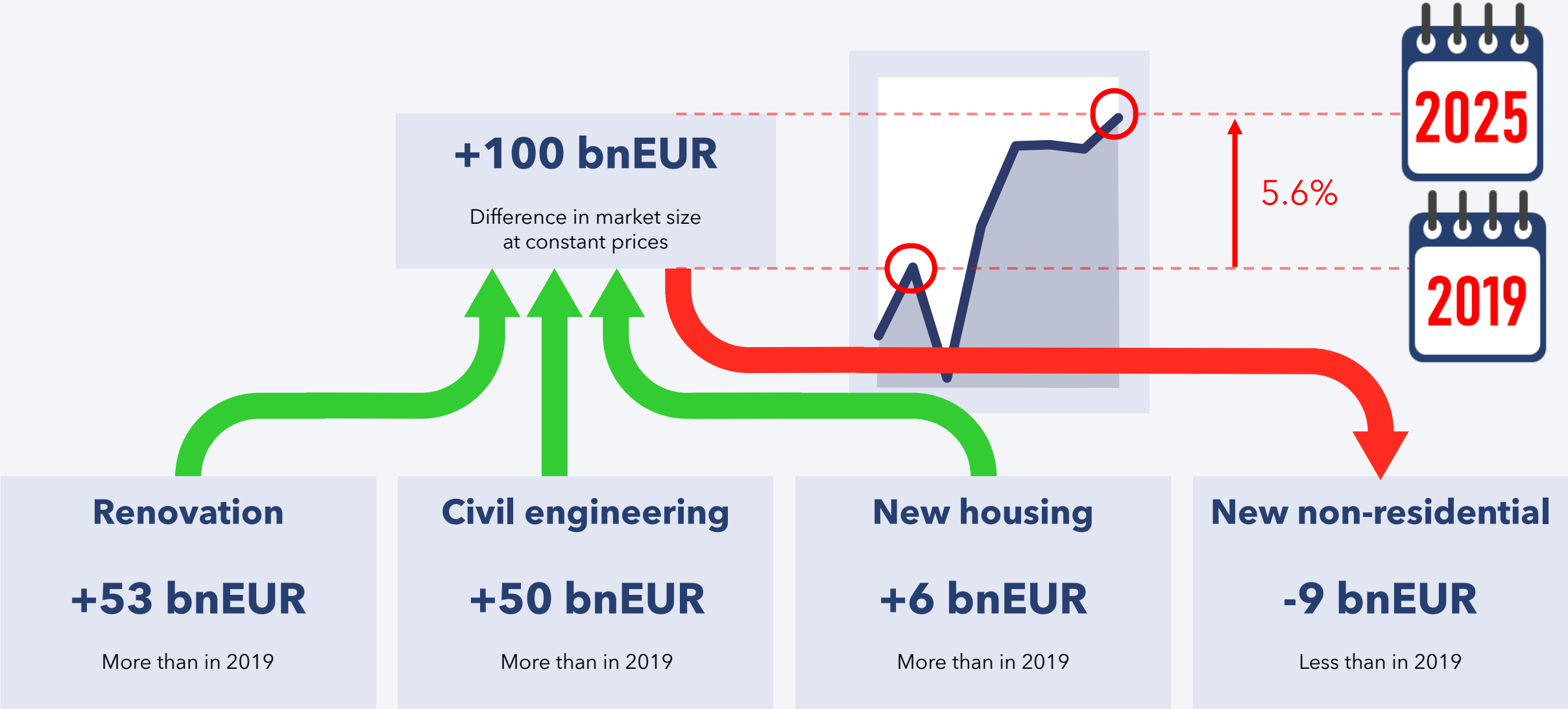
Stagnation at a high level above than expected in pre-pandemic forecasts



Stagnation at a high level above than expected in pre-pandemic forecasts



Growth drivers: the construction subsector dynamics



Forecast by subsectors: the abridged summary

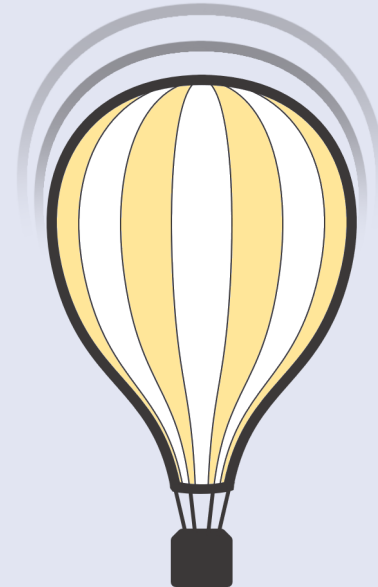
Renovation



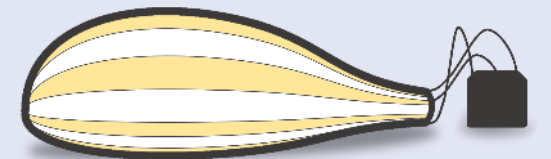
Civil engineering



New housing



New non-residential



Building renovation: the ceiling may not be where it seems

The figures say...



Building renovation: the ceiling may not be where it seems

The figures say...



The reality is...

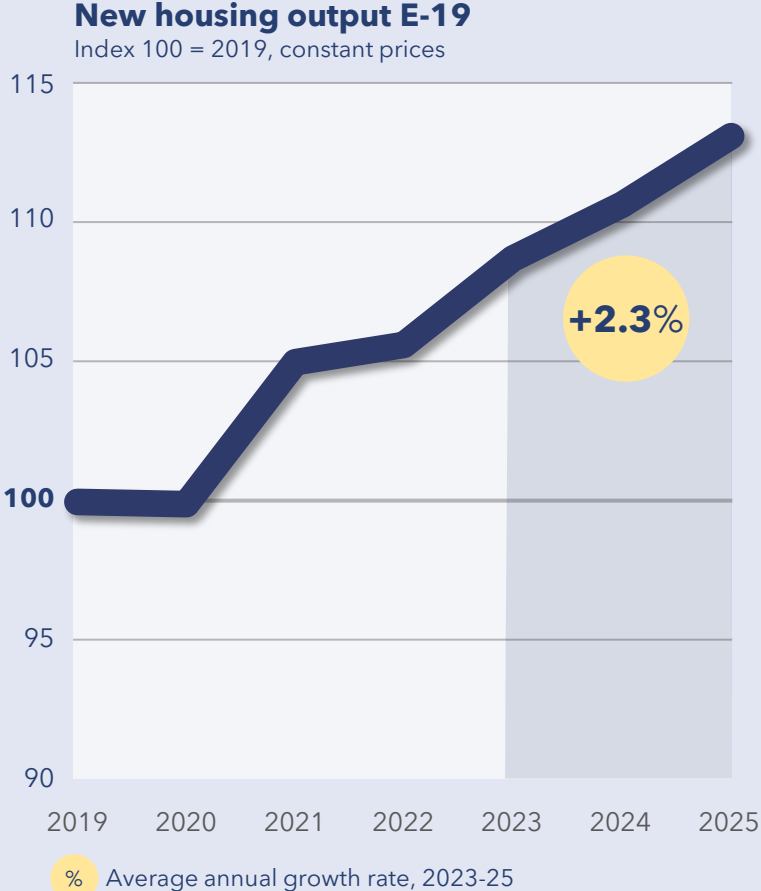


Renovating like never before in recent history

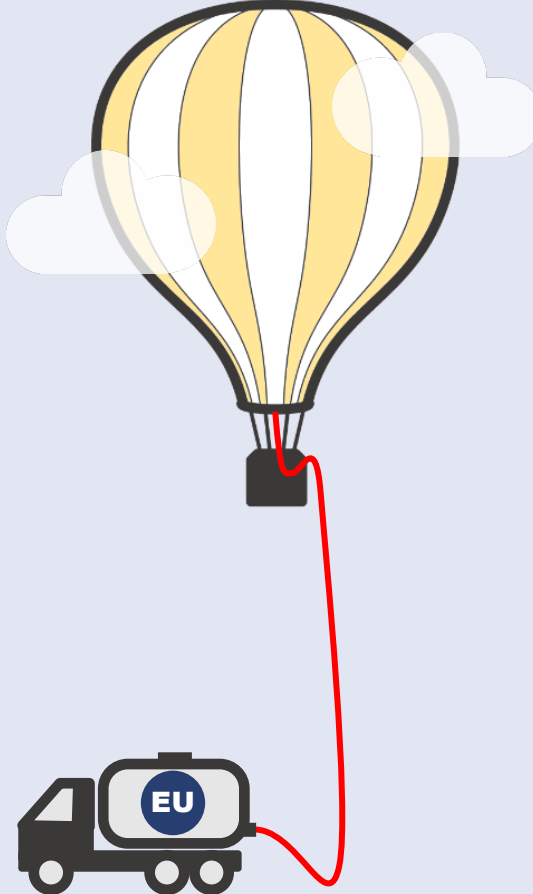


Civil engineering: the best growth prospects within the sector

The figures say...

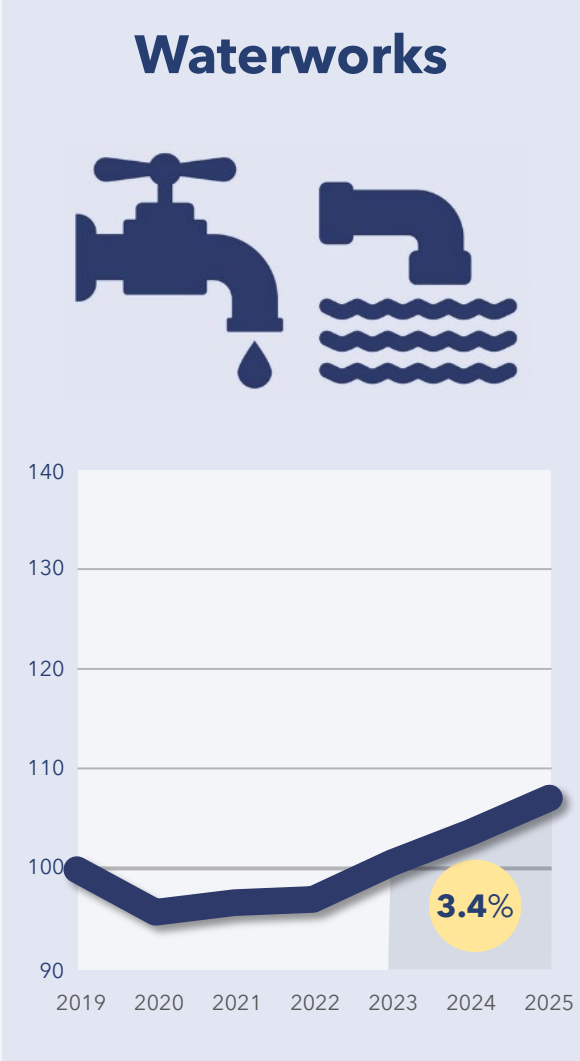
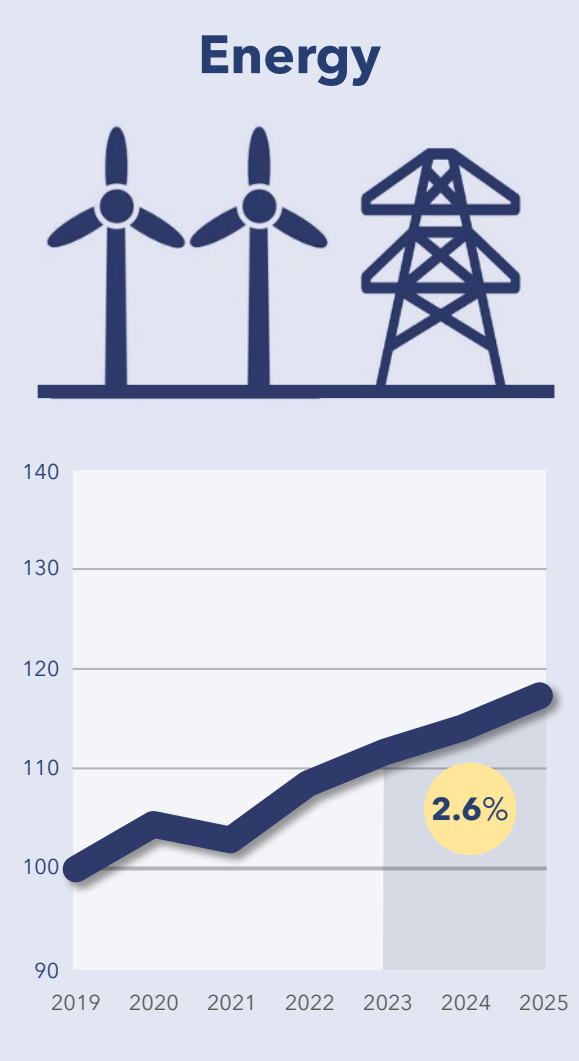
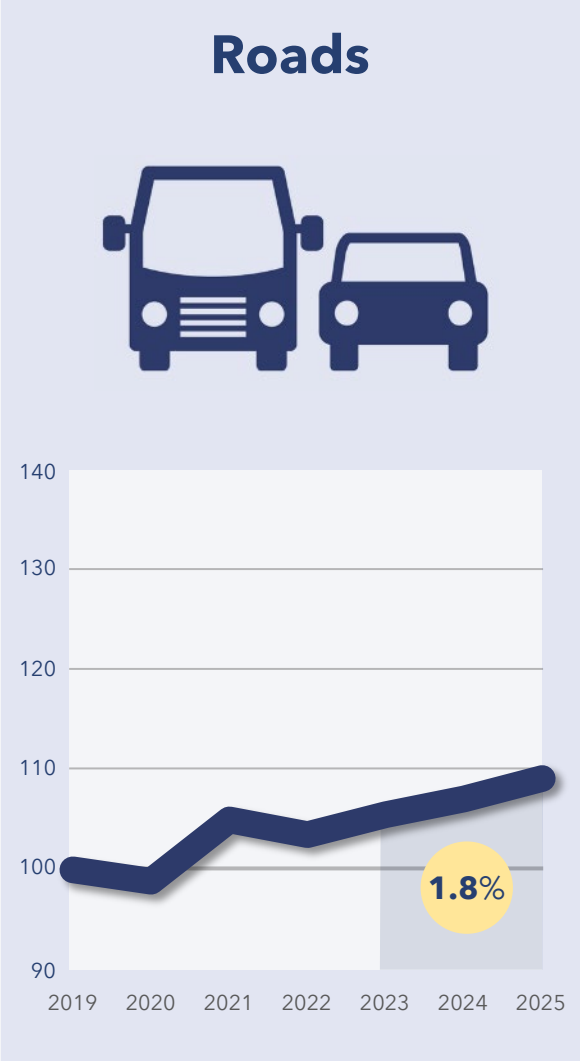


The reality is...



Civil engineering: pro-environment investment gets an extra push

Output E-19 Index 100 = 2019, constant prices % Average annual growth rate, 2023-25



New non-residential: not yet recovered from the 2020 blow

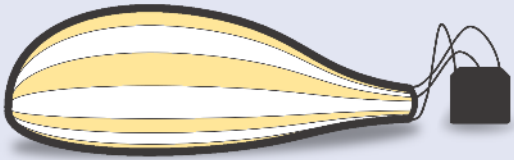
The figures say...

New non-residential output E-19
Index 100 = 2018, constant prices

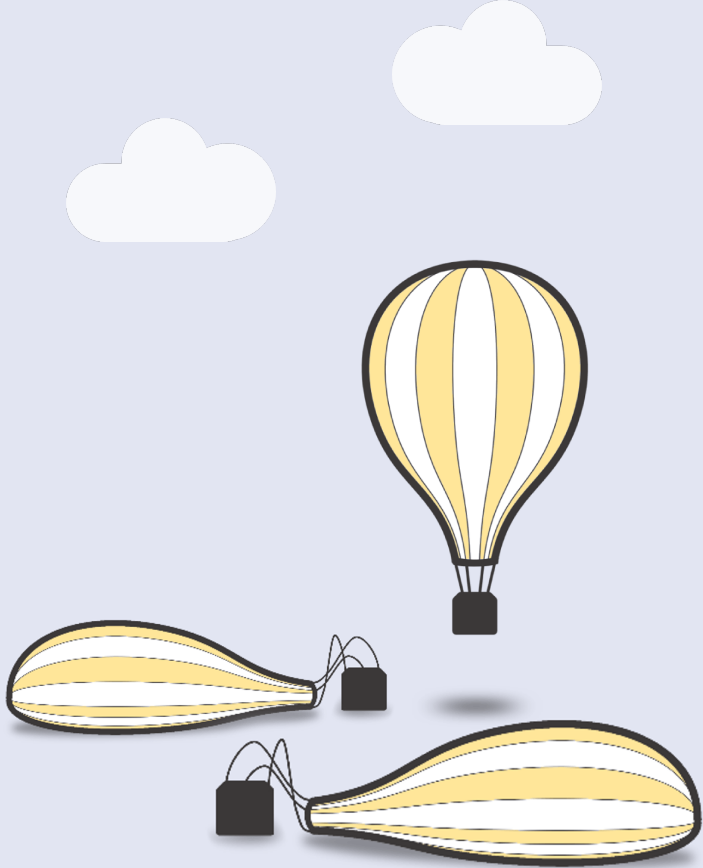


0.9%

% Average annual growth rate, 2023-25

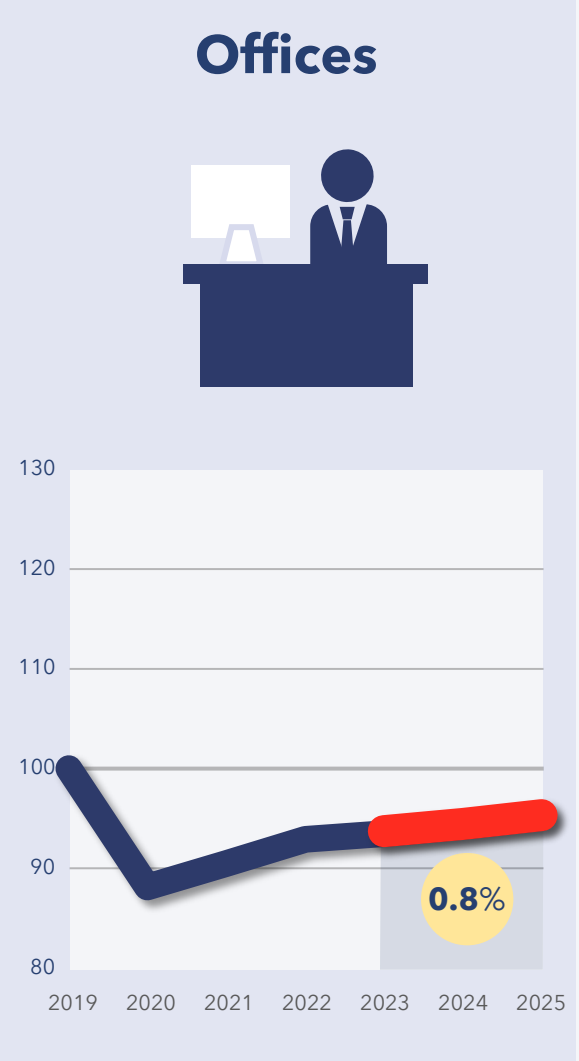
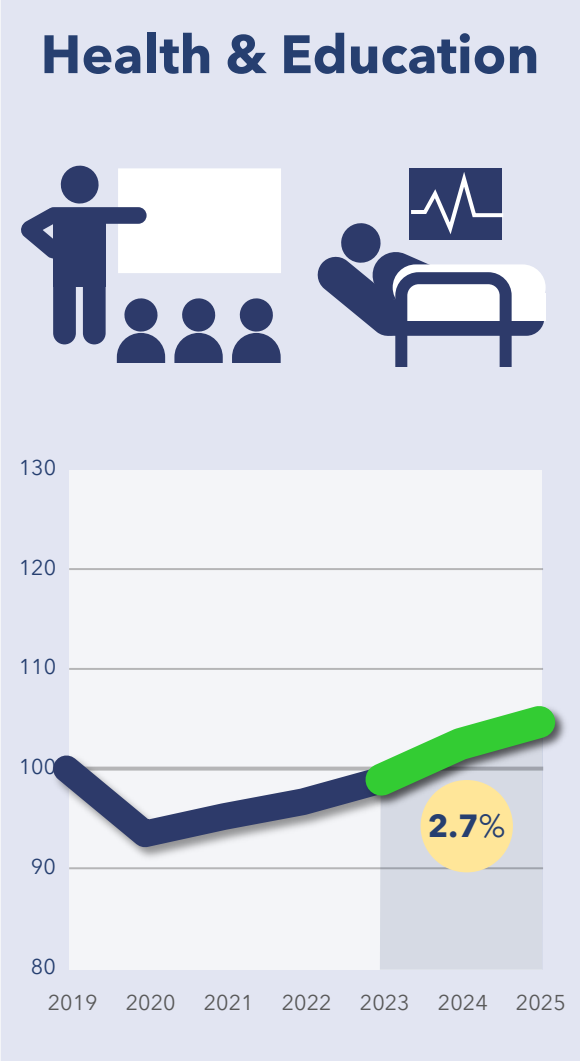


The reality is...



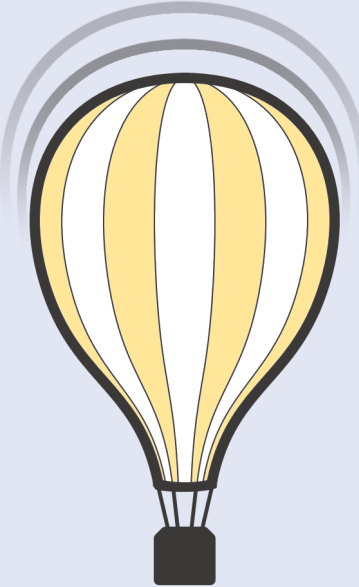
New non-residential : some key niches still below pre-covid levels

Output E-19 Index 100 = 2019, constant prices % Average annual growth rate, 2023-25

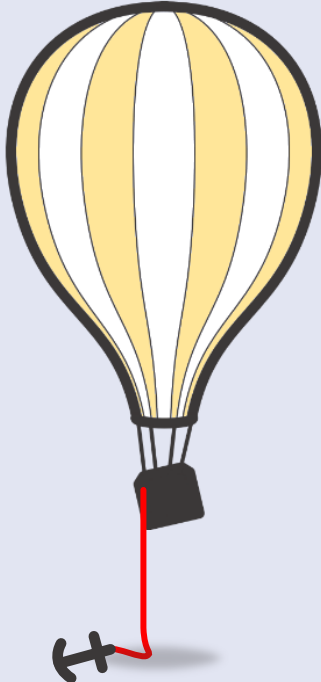


New housing: not a problem of demand

The figures say...



The reality is...



Housing prices: how big a problem?



BAU 2023



   
Ausgang Ost
Exit East

Gastkarte/Werkzeug
Tickets

THE LONG NIGHT OF ARCHITECTURE

THE LONG NIGHT OF ARCHITECTURE

THE LONG NIGHT OF ARCHITECTURE

THE LONG NIGHT OF ARCHITECTURE

THE LONG NIGHT OF ARCHITECTURE

BAU 2023: five challenges for the construction market

CLIMATE CHANGE



DIGITAL TRANSFORMATION



CIRCULAR ECONOMY



MODULAR OFF-SITE



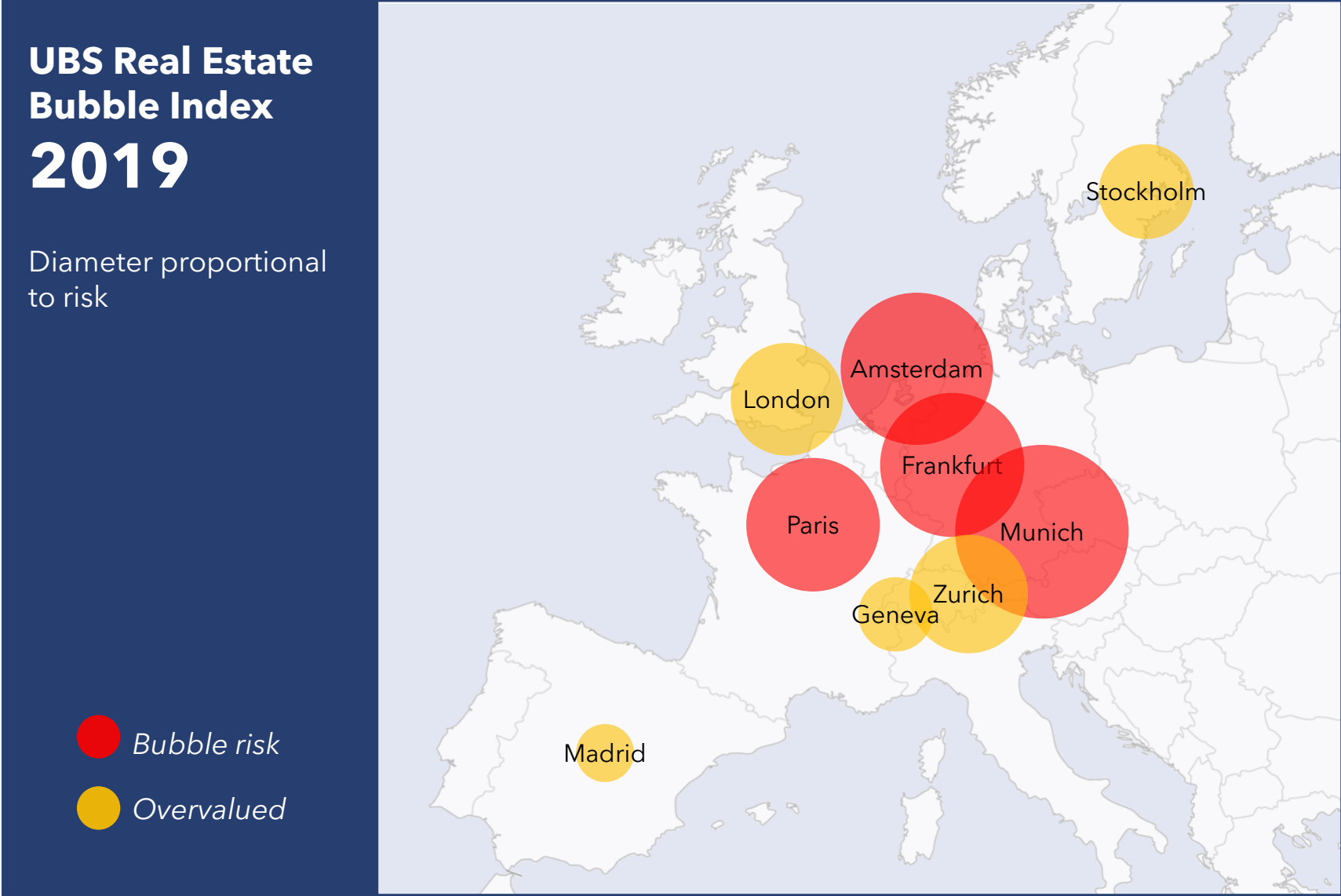
OFFER / DEMAND MISMATCH



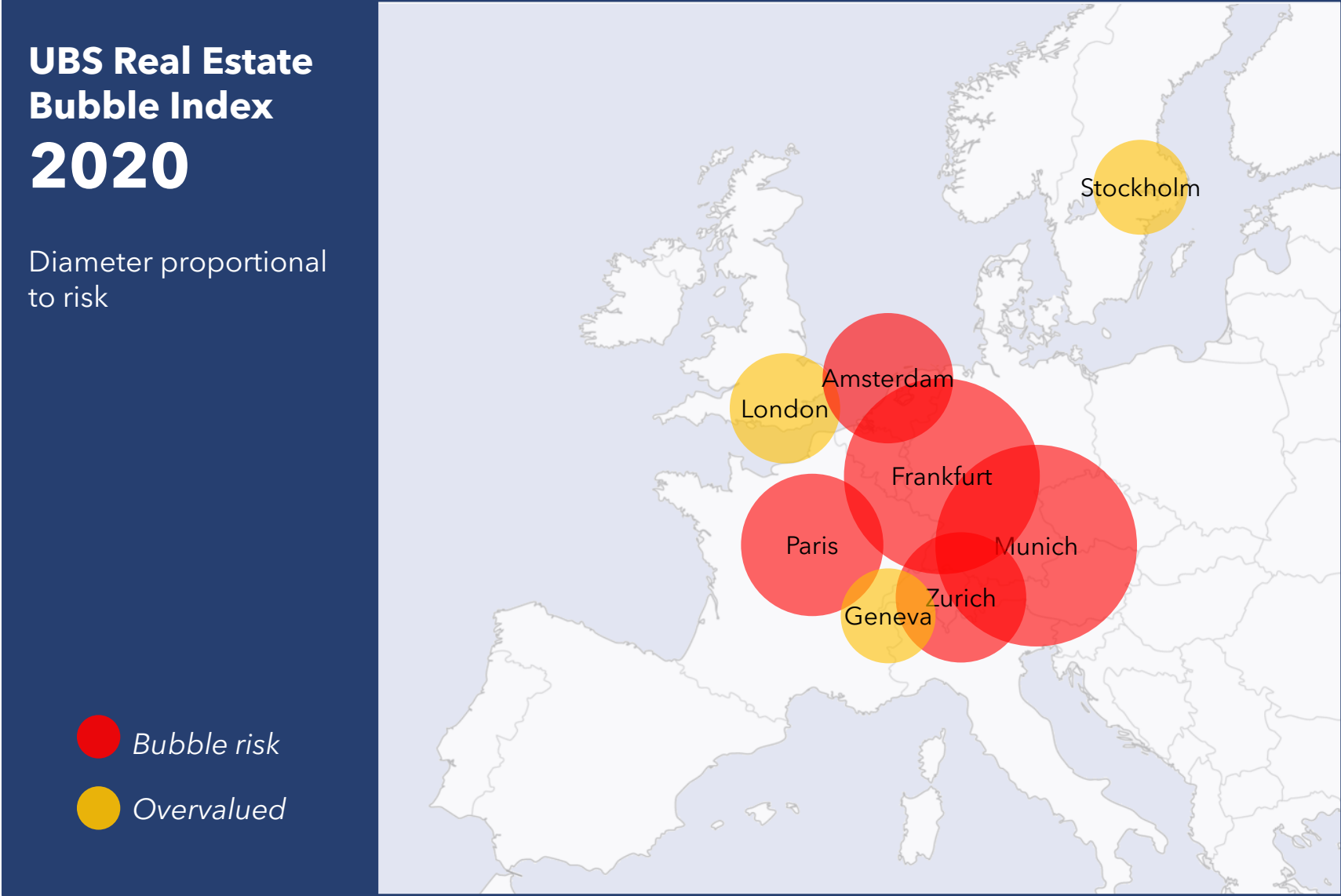
Housing prices: getting any respite?



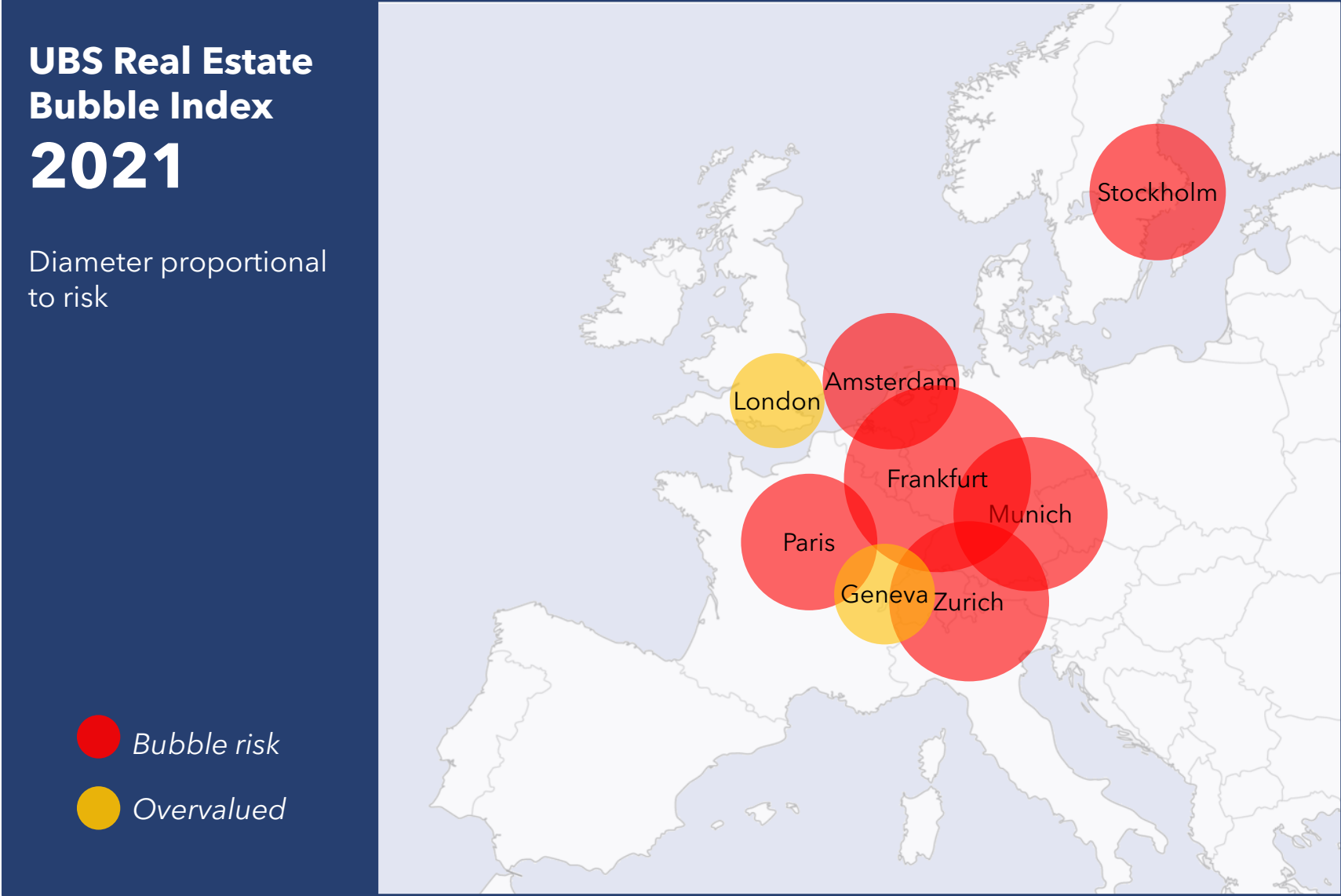
Housing prices: heat map of European capitals in 2019



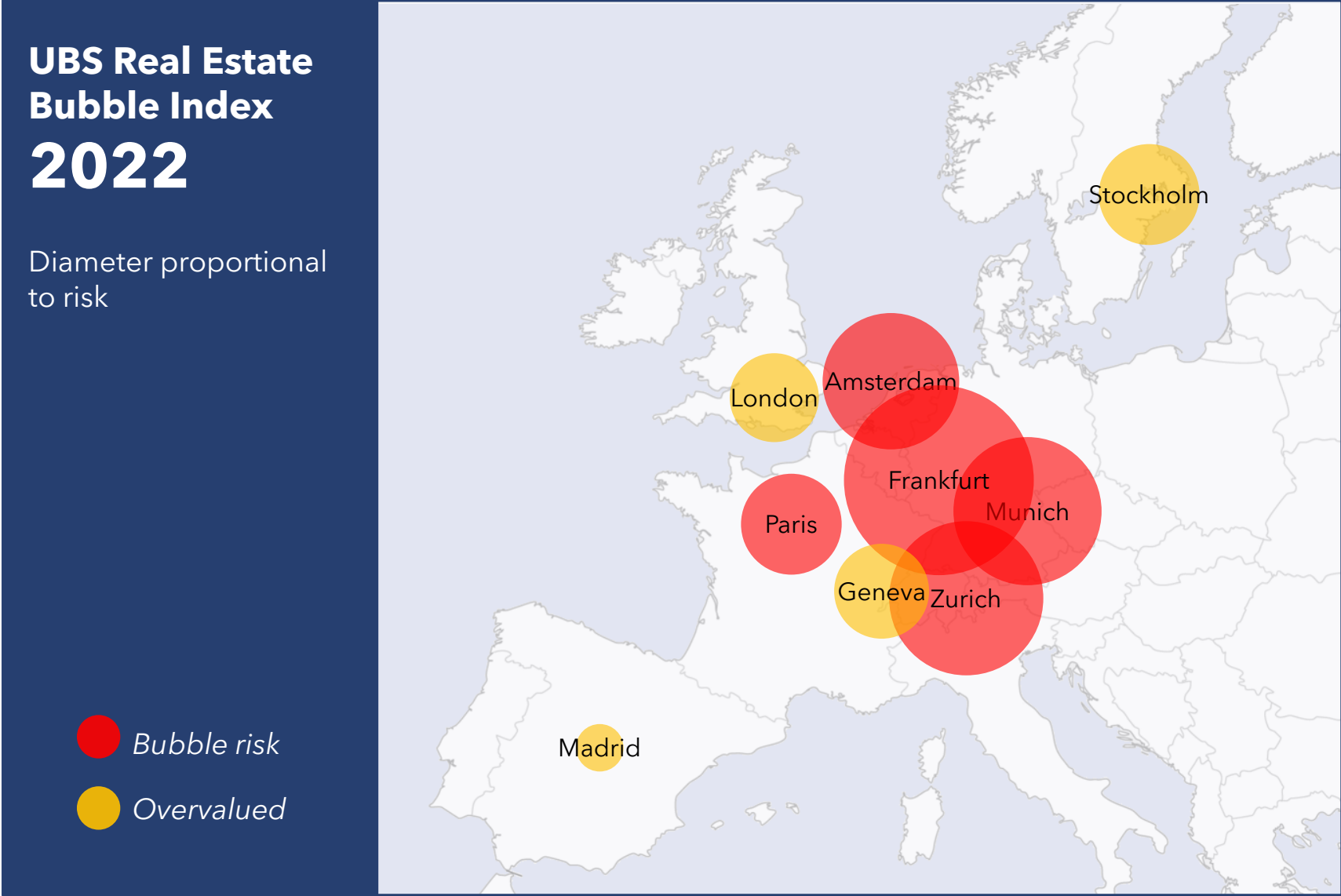
Housing prices: some extra heat, even during the pandemic



Housing prices: risk redistribution, but not true reduction



Housing prices: risk relaxation, but not everywhere



Summary: plenty of caveats that could spoil the modest positives



Overall sector

The sector will keep **producing at objectively high levels**: 6.7% over the past 2008 record

...but it cannot escape from **stagnation**, at least in 2023-2024

Civil Engineering

The subsectors with a **more expansive forecast**

...but they are quite **dependent from public investment**, so we must watch if the governments can keep their policies or not

Building Renovation

New housing

Gentle brake, consistent with the weakening demand

...but a **price bubble burst** may become the next "zombie" to arise

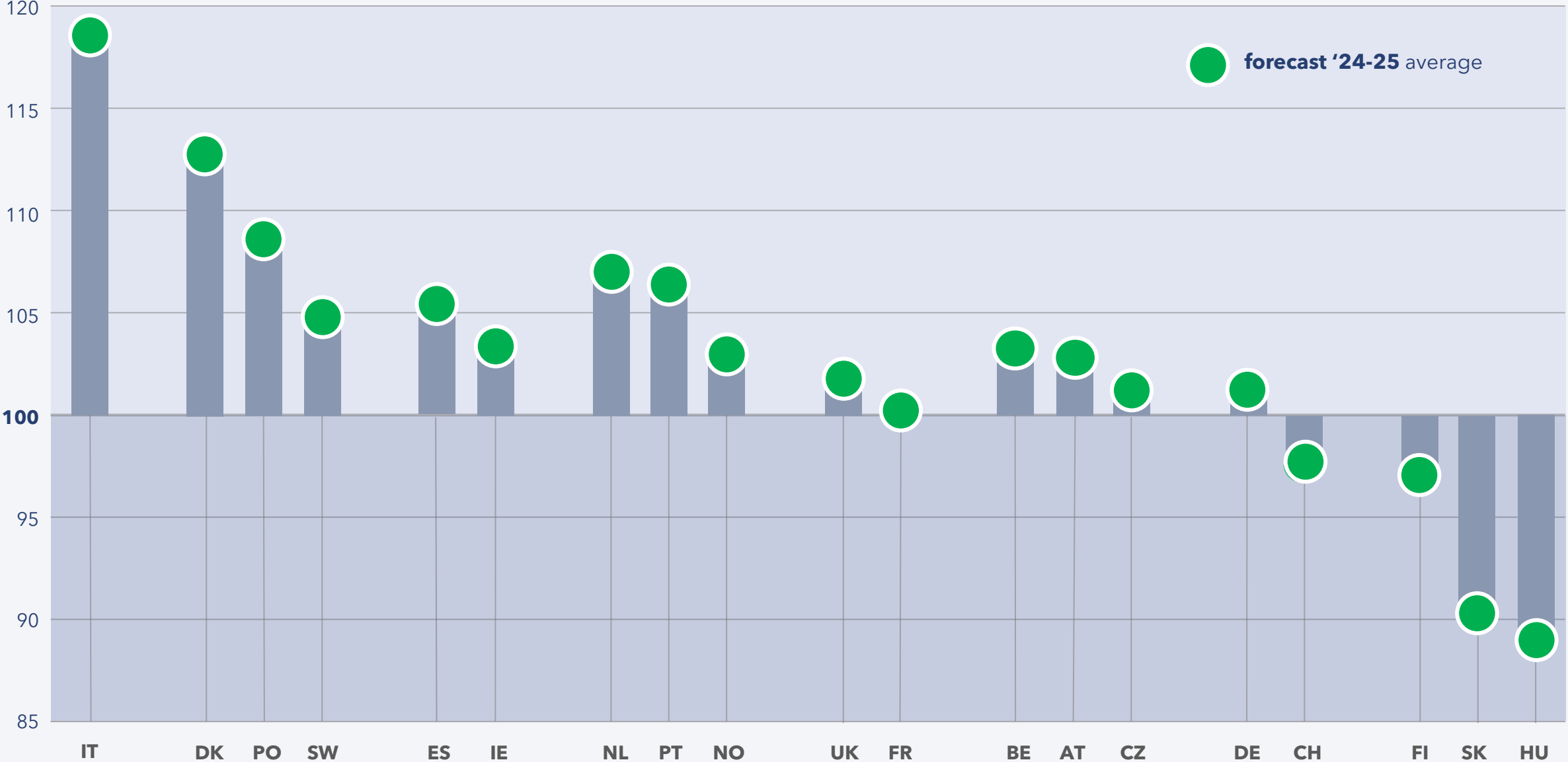
New non-residential

...

The niches performing marginally better are also **dependent from public investment**

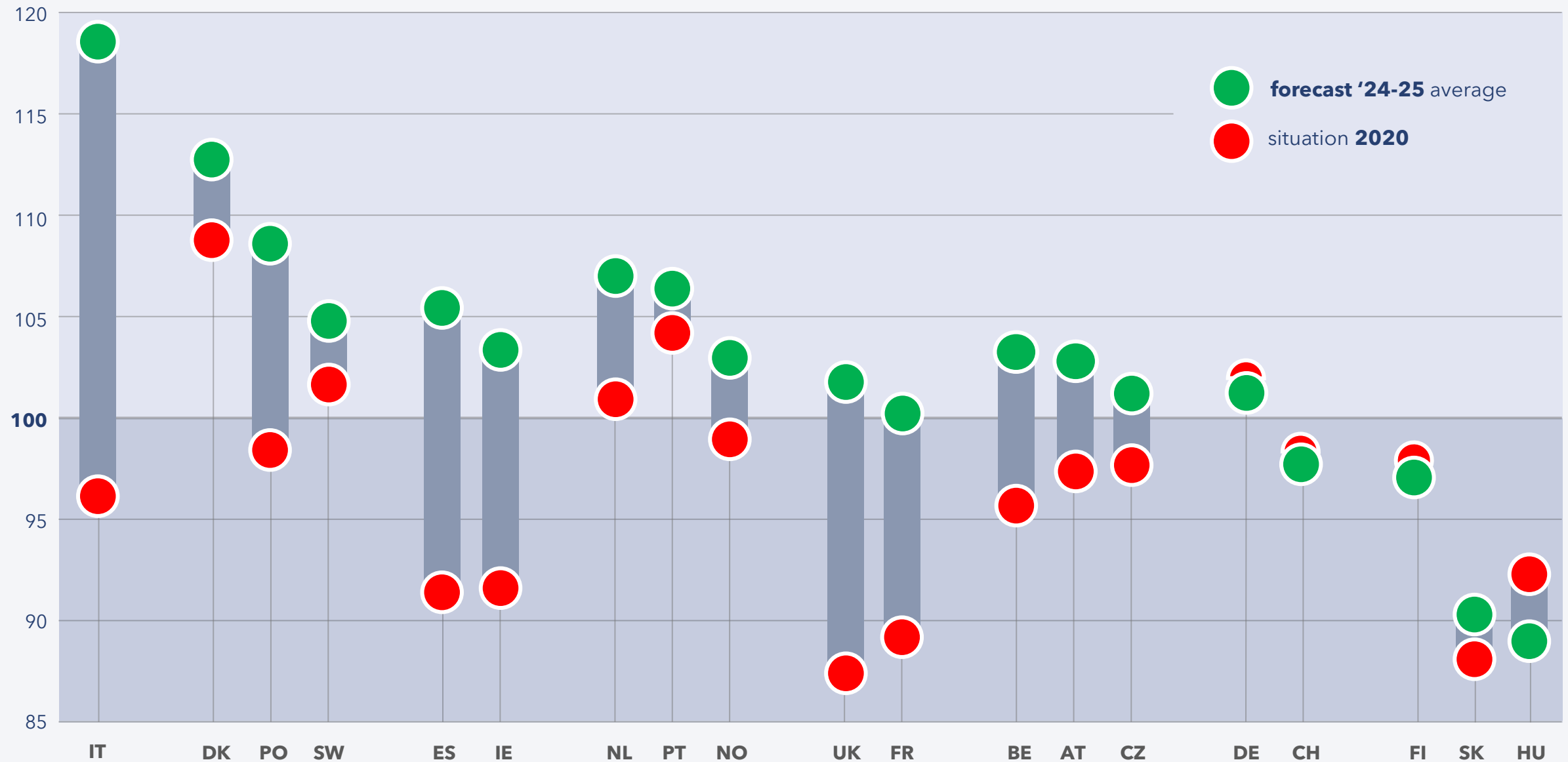
Country analysis: not all markets have recovered pre-covid levels

Construction sector output index 100 = 2019 | constant prices

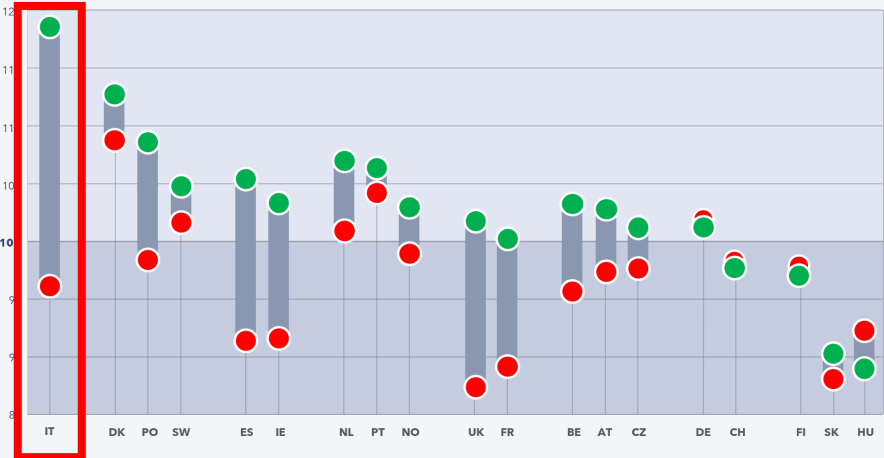


Country analysis: long and short roads to recovery

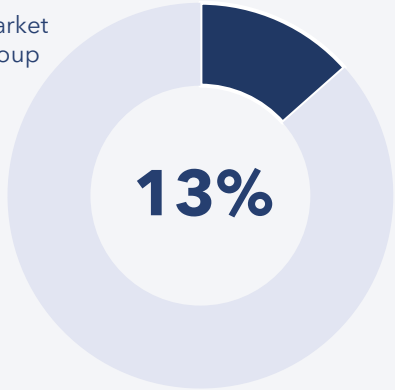
Construction sector output index 100 = 2019 | constant prices



Group 1: growth* >20% even after the hit taken in 2020



Aggregated market quota of the group (2022)

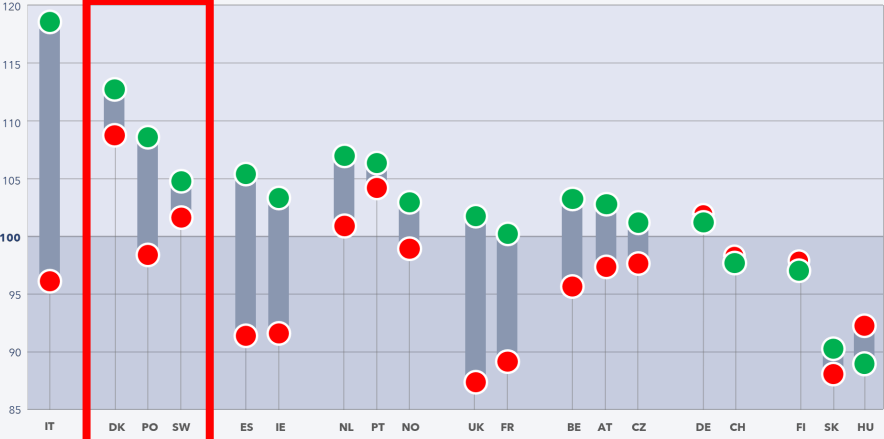


Construction sector output
index 100 = 2019 | constant prices

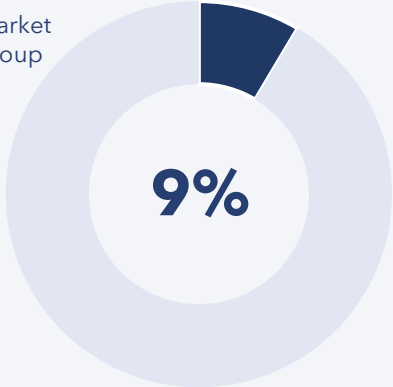


*over 2019

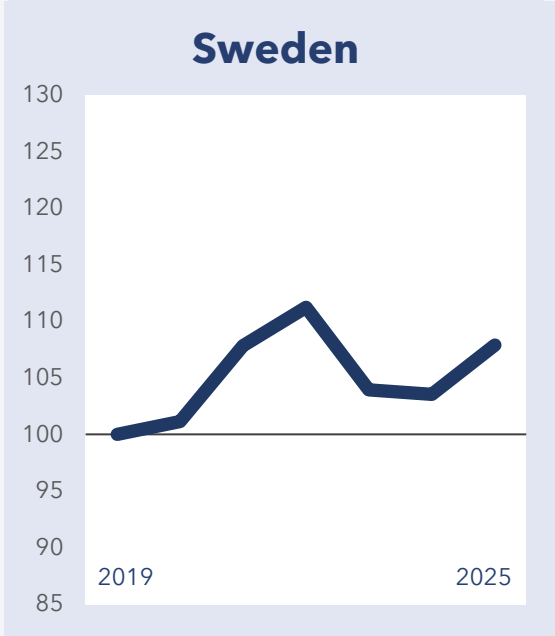
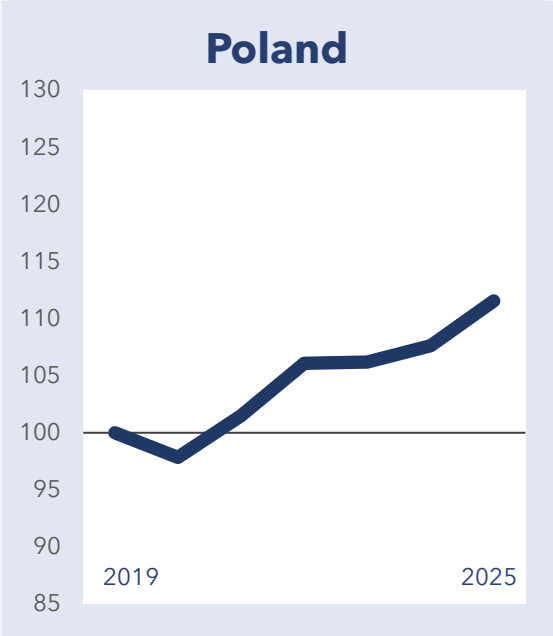
Group 2: growth* >10% after a noneventful 2020



Aggregated market quota of the group (2022)

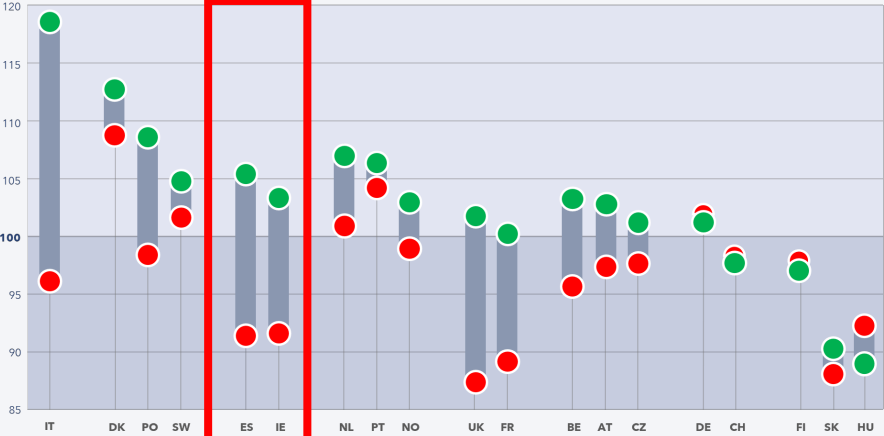


Construction sector output index 100 = 2019 | constant prices

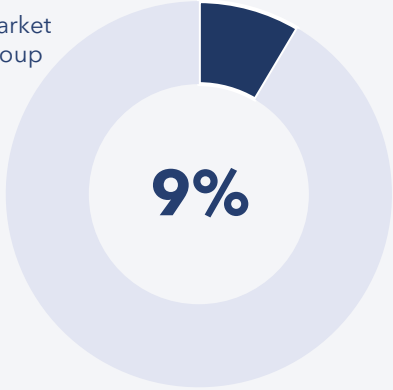


*over 2019

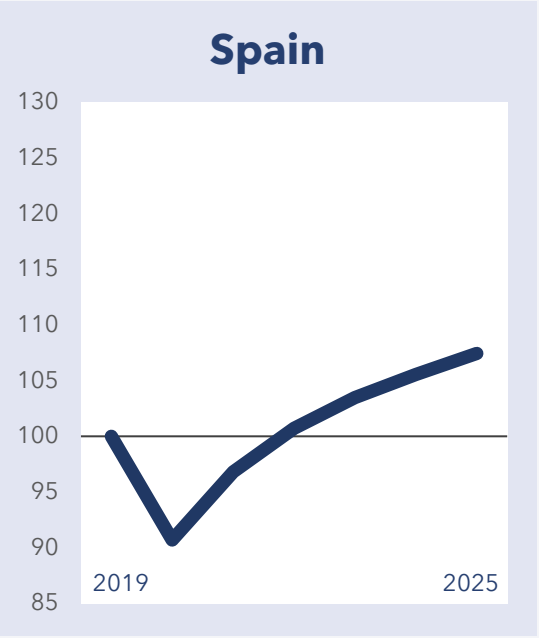
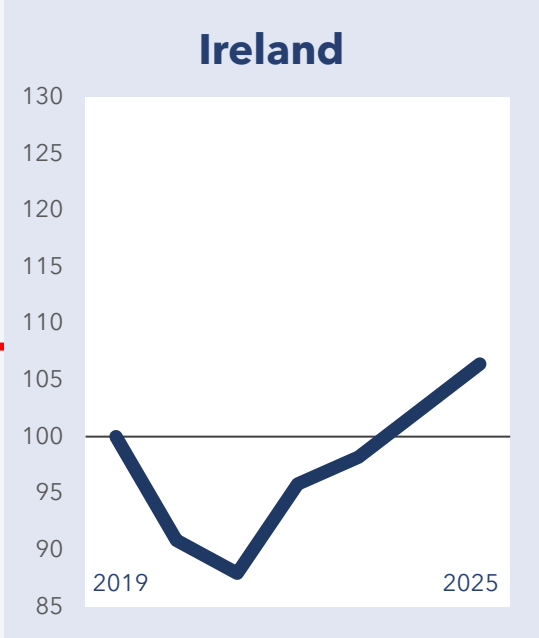
Group 3: growth * >5% after a rough pandemic & post-pandemic



Aggregated market quota of the group (2022)

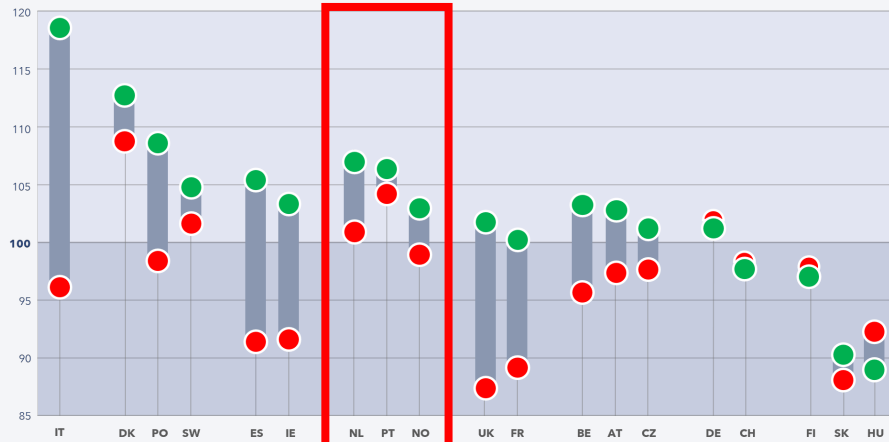


Construction sector output
index 100 = 2019 | constant prices

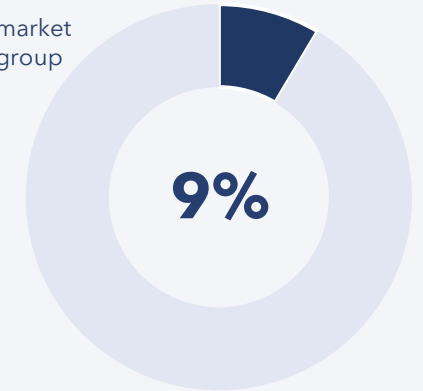


*over 2019

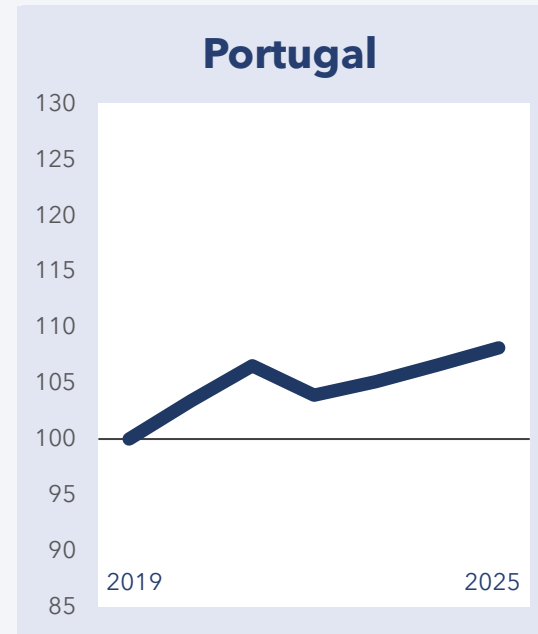
Group 4: growth * >5% after a noneventful 2020



Aggregated market quota of the group (2022)

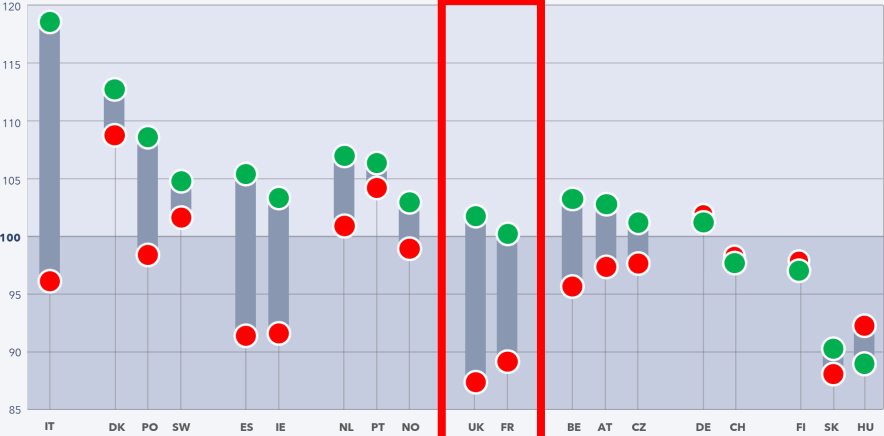


Construction sector output index 100 = 2019 | constant prices

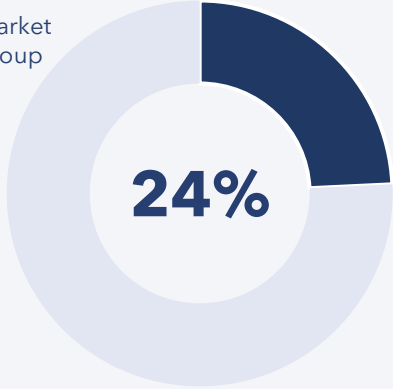


*over 2019

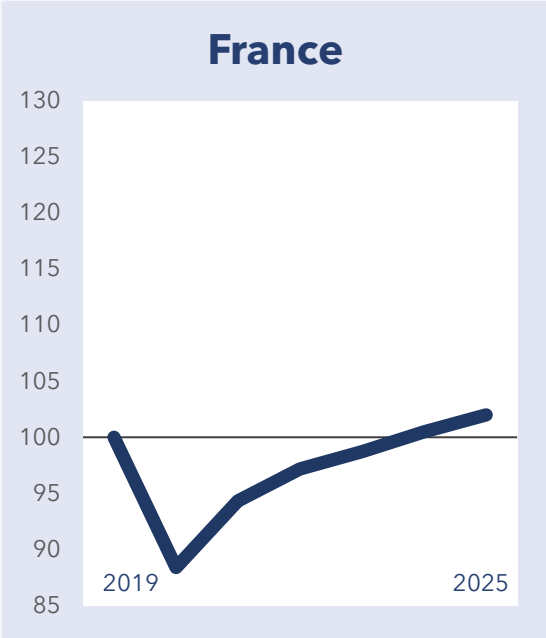
Group 5: growth * <3% after a rough pandemic



Aggregated market quota of the group (2022)

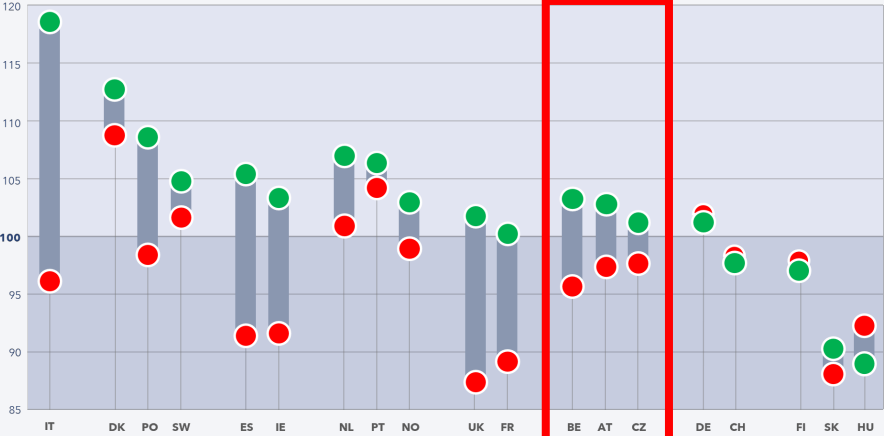


Construction sector output
index 100 = 2019 | constant prices

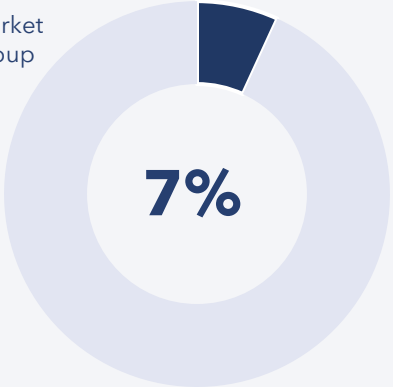


*over 2019

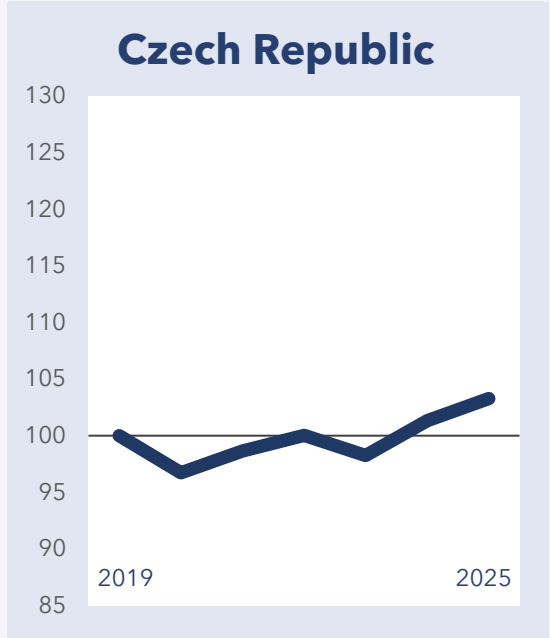
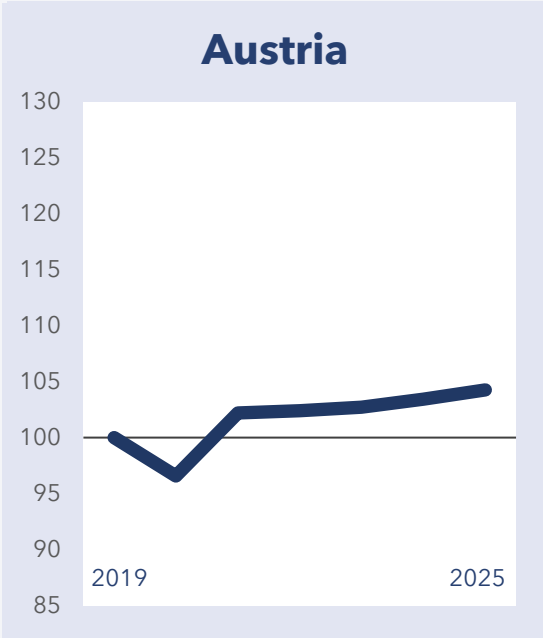
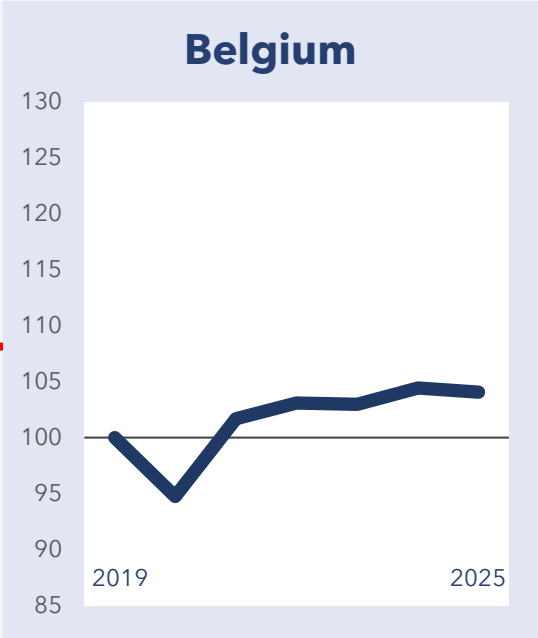
Group 6: expansion* <3% after a smooth(ish) 2020



Aggregated market quota of the group (2022)

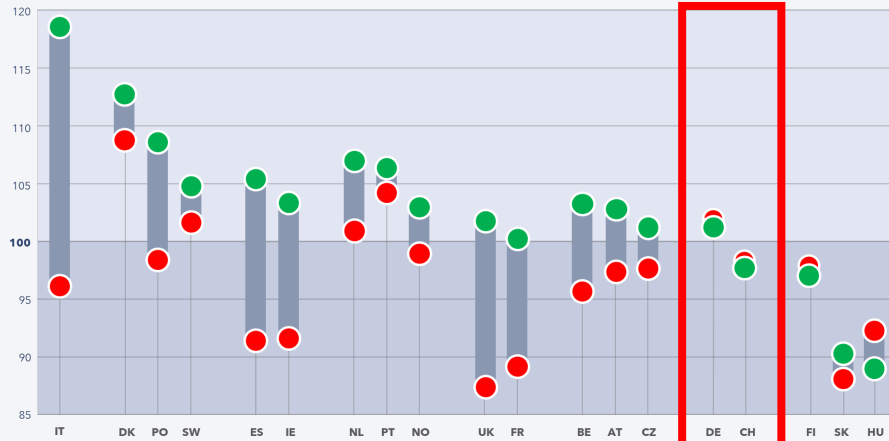


Construction sector output index 100 = 2019 | constant prices

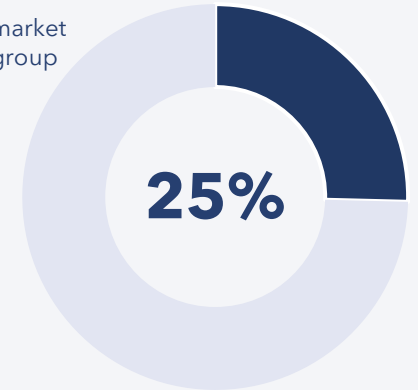


*over 2019

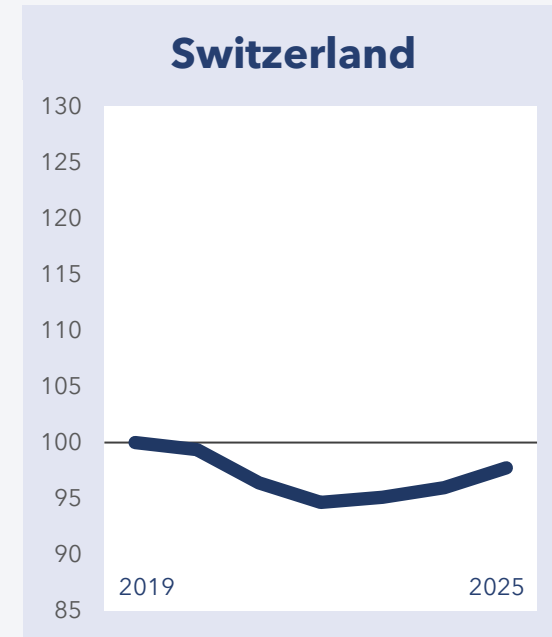
Group 7: stagnation, after a noneventful 2020



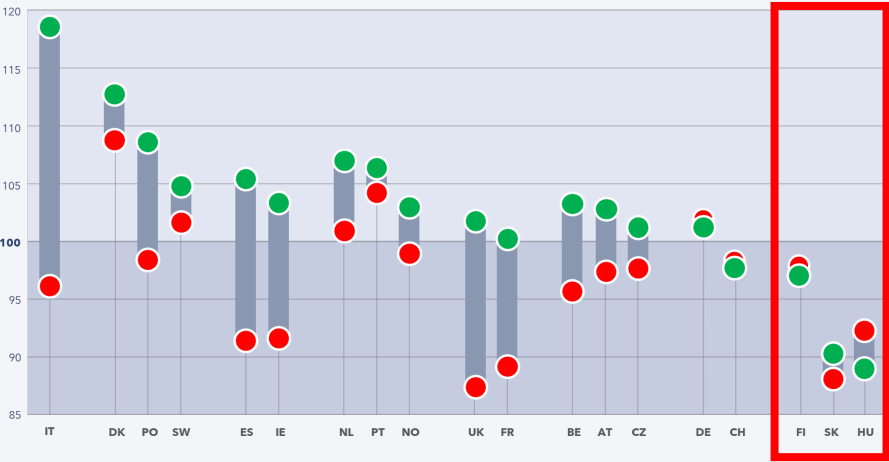
Aggregated market quota of the group (2022)



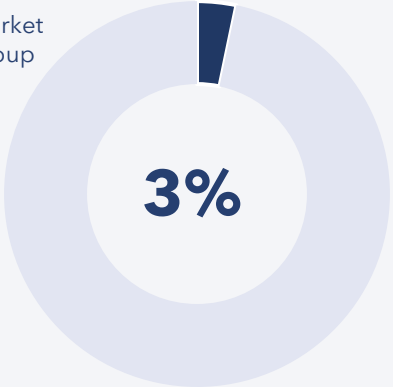
Construction sector output
index 100 = 2019 | constant prices



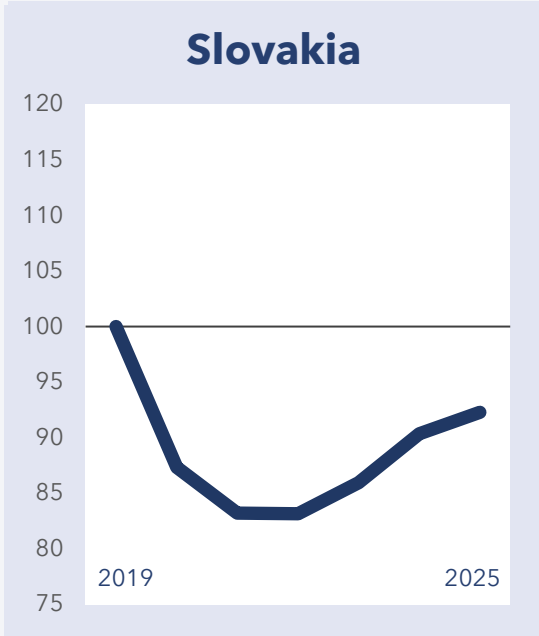
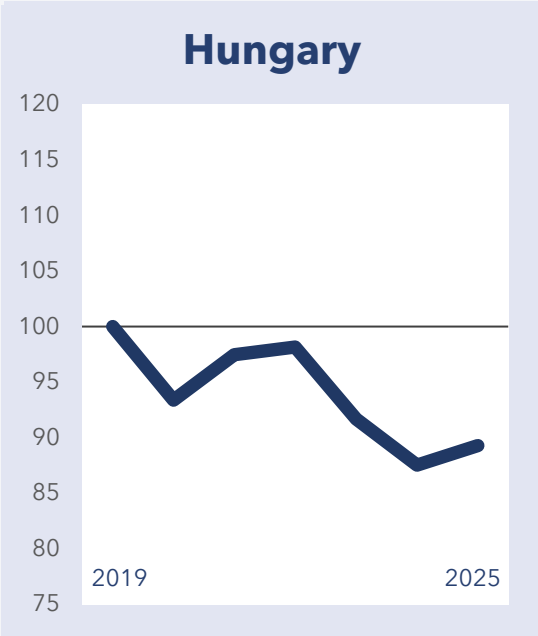
Group 8: recession



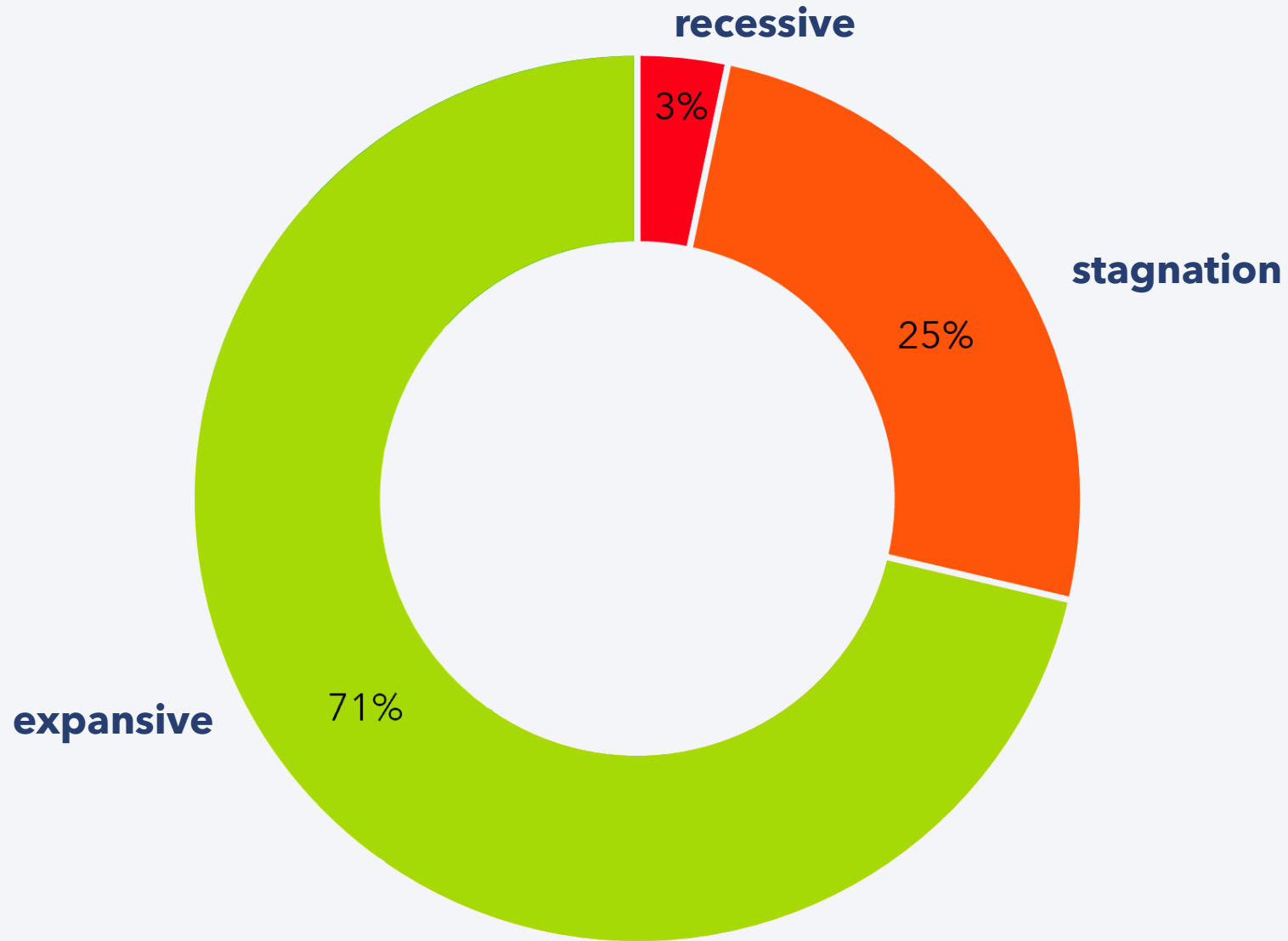
Aggregated market quota of the group (2022)



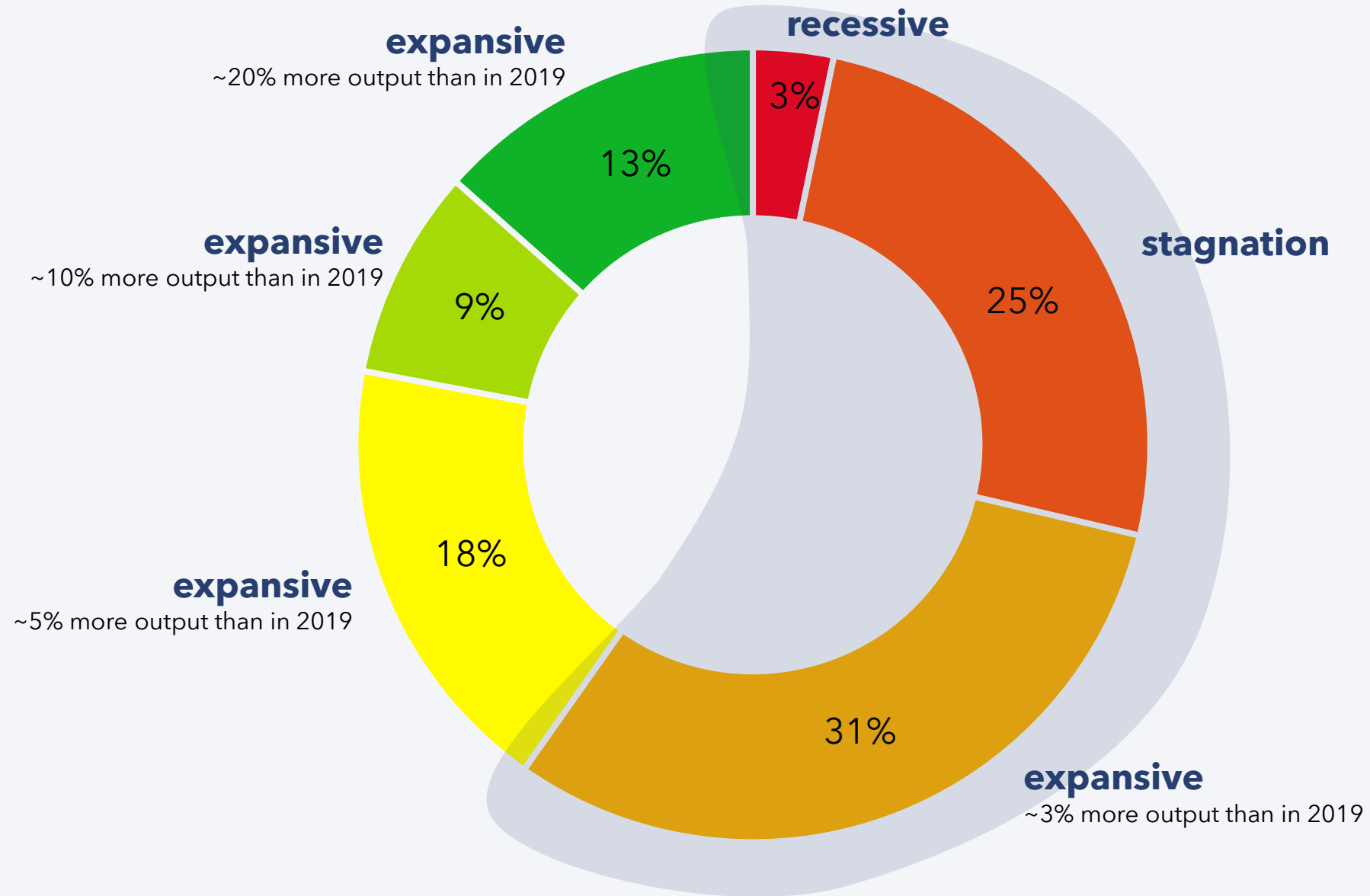
Construction sector output index 100 = 2019 | constant prices



Europe: **mixture of trends...**



Europa: mixture of trends...



Thank you for your attention

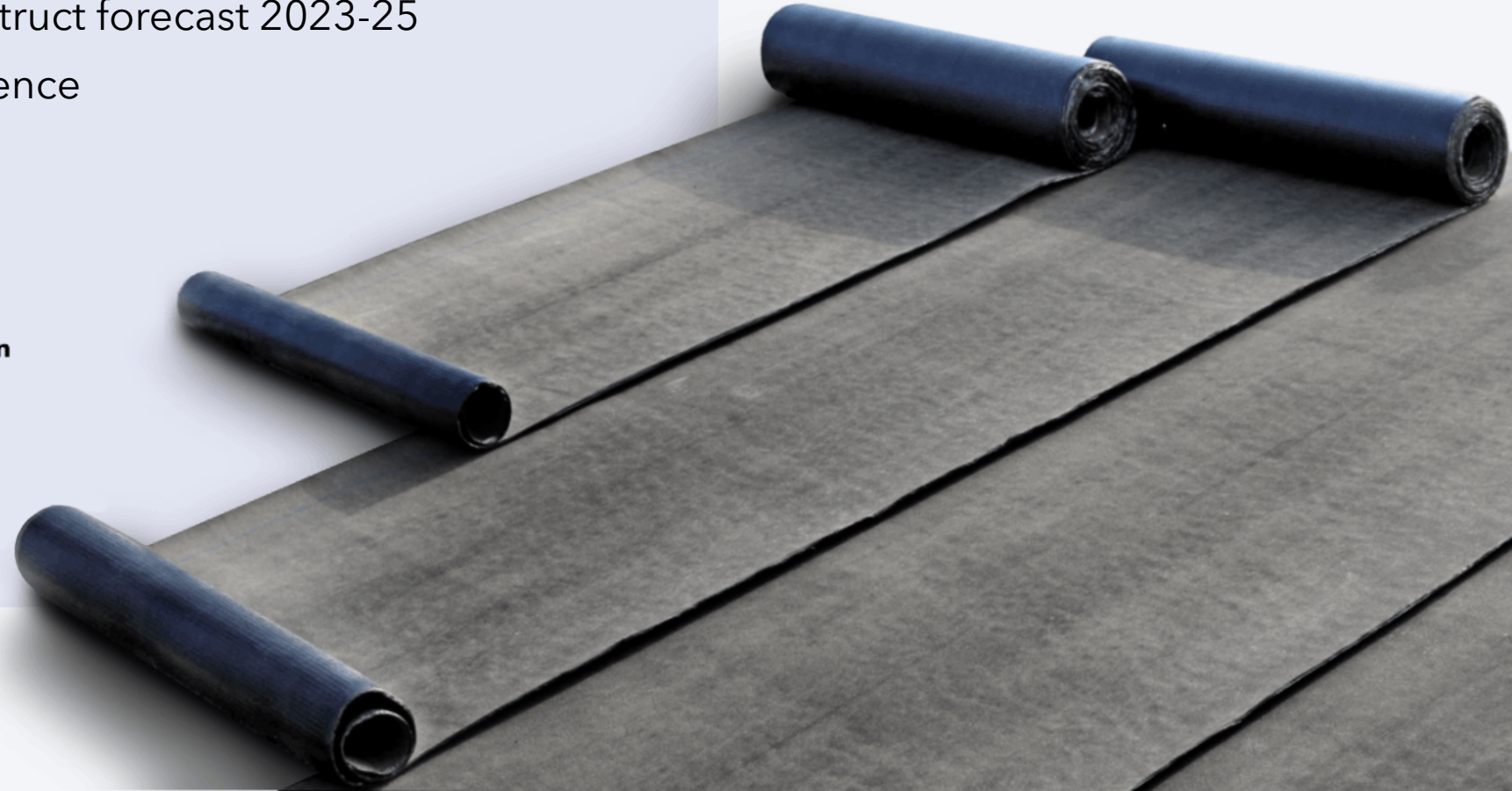
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**The Catalonia
Institute of Construction
Technology**

Sitges, 24th May 2023





argusmedia.com

The European bitumen market today

Sanctions, supply, demand and pricing

IMPERVIUS 2023

Keyvan Hedvat, Europe/Africa Editor, Argus Bitumen

Sitges, Spain - 24 May 2023



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Agenda

- About Argus
- Crude, products and bitumen price trends in Europe and related markets.
- Bitumen production/supply impact of sanctions on Russian crude and oil products – including bitumen.
- How supply gaps are being filled.
- The state of Europe/Africa bitumen demand.
- Evolving cargo flow patterns.
- Concluding thoughts.

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Argus Bitumen report



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Argus Bitumen

Europe, Africa, Middle East and Asia-Pacific prices and commentary
Incorporating Argus Asphalt Report

Issue 23-15 | Friday 14 April 2023

- The *Argus* Bitumen report includes in-depth market coverage and prices for northwest Europe, the Mediterranean, sub-Saharan Africa, Mideast Gulf and Asia-Pacific.
- Recently launched Central Europe Bitumen Index, alongside established price markers in Rotterdam and the Mediterranean. Baltic assessment also launched last year.
- Tanker freight rates, covering the major routes, together with vessel tracking information.
- *Argus* bitumen consulting. Bespoke projects and the Asphalt Annual covers forecasts and supply and demand for every country in the world.
- Outright pricing at key hubs best way to price bitumen as bitumen becomes a global commodity driven by own fundamentals.
- Robust methodology and price discovery process with extensive market survey each week across market participants.

SUMMARY

Summary

Bitumen cargo price trends were mixed, with some gains in northern Europe and the Mideast while Asia-Pacific, Mediterranean and sub-Saharan African values were generally stable.

Road paving activity continued to pick up in Europe and market participants expect activity to show more significant gains after the Easter break, although Ramadan and the Eid holiday period following it were seen dampening demand in some Mediterranean, Asia-Pacific and Mideast markets through to late April.

Strike action across the French refining sector subsided, with the country's refineries and most ports resuming operations.

Cargo differentials to fob Mediterranean high-sulphur fuel oil (HSFO) cargoes were unchanged in Italy, Spain and Turkey but were assessed \$2-3/t firmer in Greece at around flat to premiums of \$5/t. A HSFO price swing caused fob Mediterranean HSFO cargo prices to fall below fob Rotterdam barges by as much as \$10-11/t. Numerous cargoes were seen transporting Mediterranean bitumen to northwest Europe.

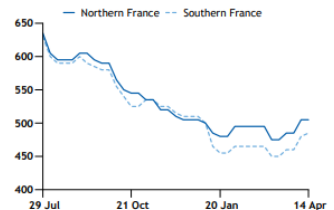
South Africa continues to import significantly higher volumes of bitumen, with some of those cargoes heading there from Bahrain.

Bitumen prices in Singapore were steady with deals and discussions taking place at a wider range than the previous week. Poor weather in parts of the Asia-Pacific region hampered demand from regional buyers.

PRICES

Bitumen prices at key locations, 7-14 Apr		Low	High	\$/t
				£
Export cargo prices fob				
Mediterranean		434.69	439.35	-1.36
Rotterdam		495.19	499.19	+15.31
Baltic		480.19	484.19	+15.31
Singapore		459.00	475.00	-0.50
South Korea		432.00	441.00	-7.75
Mideast Gulf		362.00	370.00	+9.00
Delivered cargo prices cfr				
North Africa	Alexandria, bulk	500.00	510.00	+1.00
East Africa	Mombasa, drum	496.00	506.00	-3.00
West Africa	Lagos, bulk	650.00	660.00	-2.00
East China coast		485.00	495.00	+20.00
Domestic prices				
Antwerp	ex-works	547	558	+8.00
Southern Germany	ex-works	525	536	+2.00
Hungary	ex-works	525	536	+13.00
Italy	ex-works inc tax	531	542	+5.50
Indonesia	ex-works	683.00	683.00	+4.00
Mumbai	bulk	594.00	597.00	-1.50

France: North vs South \$/t



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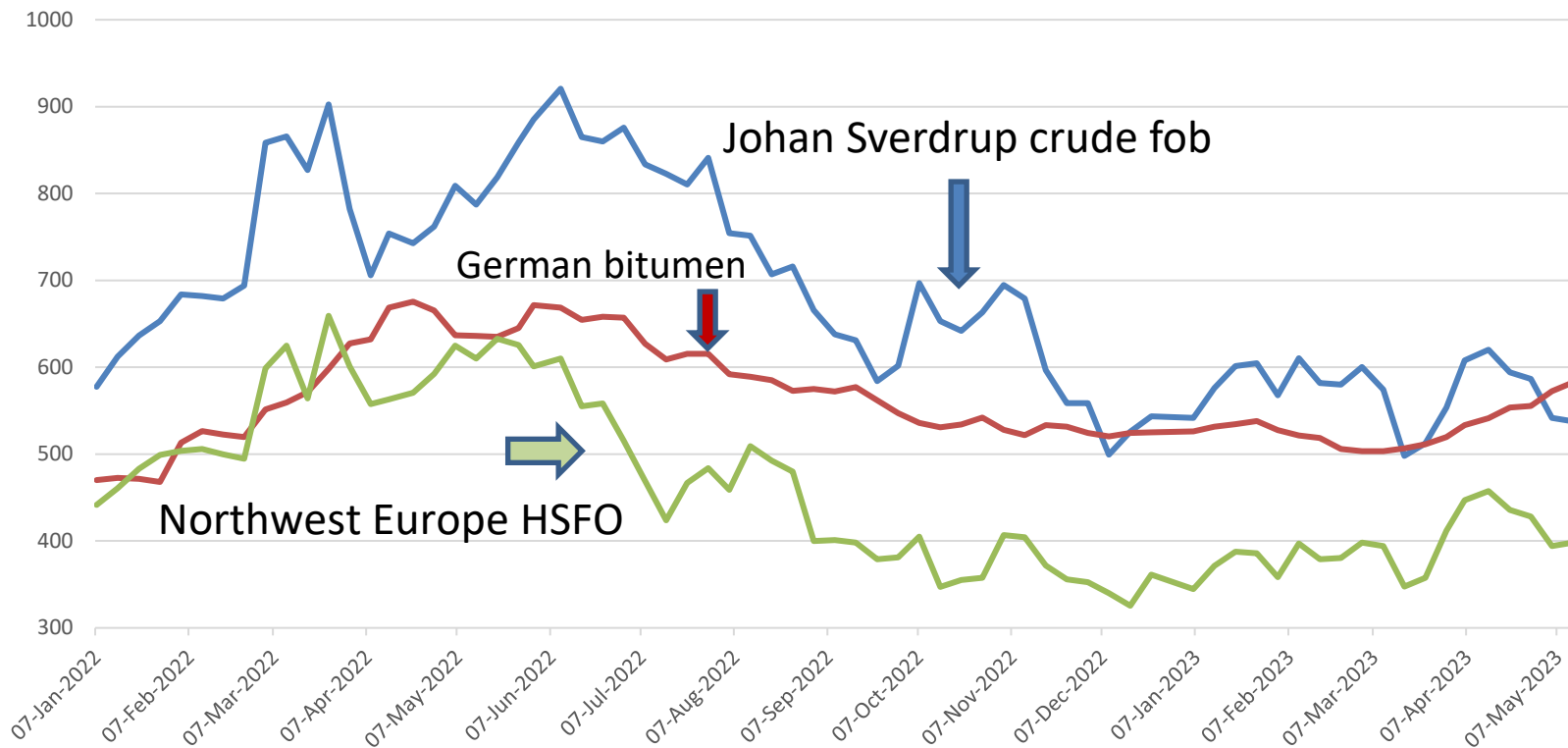
Key bitumen prices	1
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Northwest and central Europe	3-4
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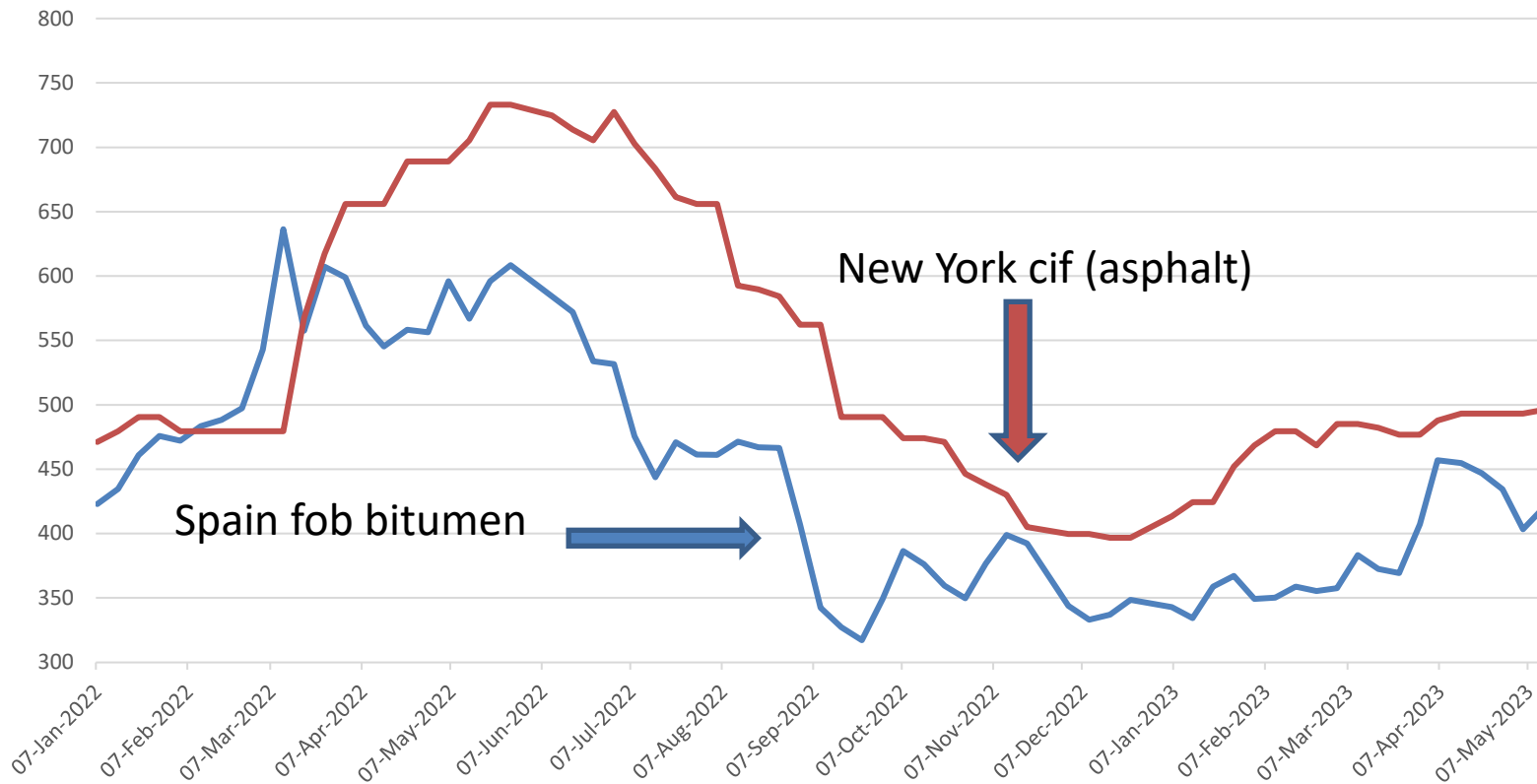


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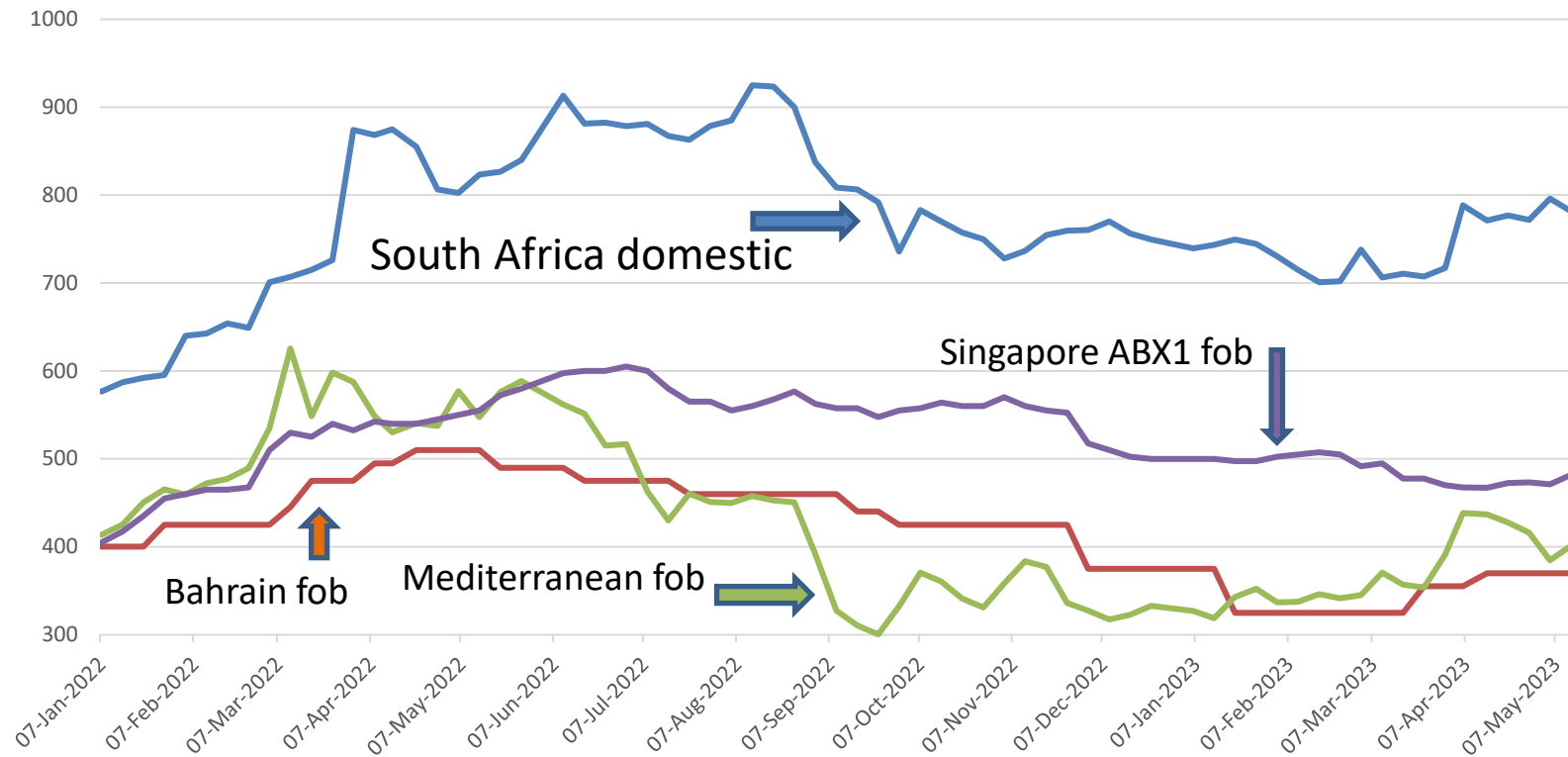
Bitumen's link with crude and HSFO more volatile (\$/t)



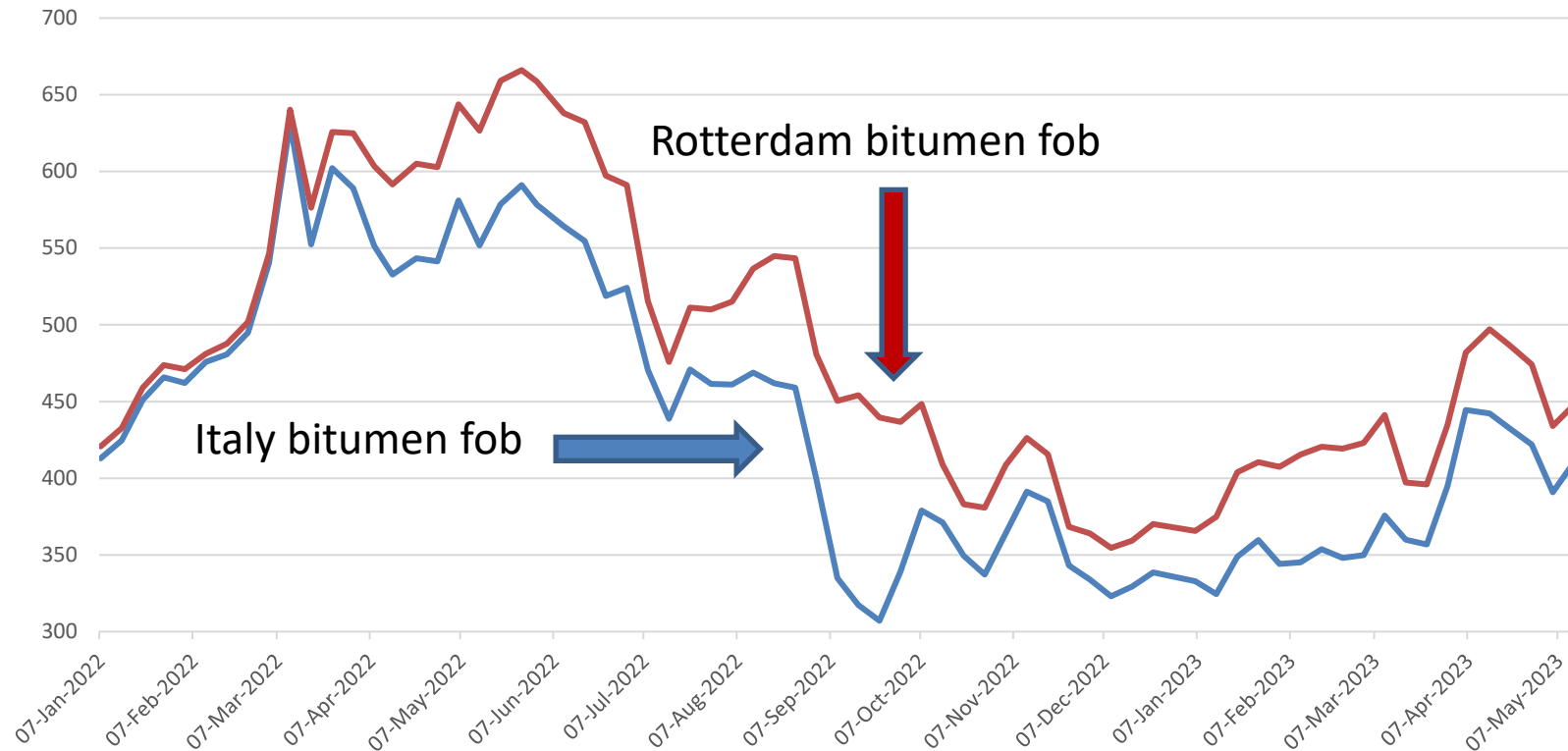
Med to US arb open last summer, now marginal (\$/t)



South African prices rise, eyes import options (\$/t)



Italy v Rotterdam bitumen (\$/t)



The state of play

- Ukraine war: bitumen market impacts so far – esp after EU/UK sanctions on Russian exports kicked in;
- Northern/central Europe far more impacted by EU sanctions than the Med;
- European bitumen demand trends in 2022 and how 2023 is looking;
- How 2023 supply/demand balances are shaping up;
- Med-North Europe flows re-ignited;
- So far quiet on the western (arb) front!;
- West and southern Africa-bound flows gaining prominence.

Bitumen impacts so far since Feb 2022 invasion

- Major hit on Ukraine bitumen imports that totalled around 900kt in 2021 – with a halt to cargo flows into its Black Sea terminals (estimated 175kt in 2021);
- Ukraine bitumen (truck) demand/imports slowly rising this year – volumes still very low;
- Halving of Russian Baltic bitumen exports from 350-400kt in 2021 to less than 200kt last year – negligible volumes this year after EU brought bitumen into sanctions regime in Feb (with 3-month wind-down period to 27 May);
- Self-sanctioning by European buyers of Russian crude, feedstocks and bitumen replaced by outlawing of such flows.
- Switch to alternative crudes/feedstocks has been expensive and impacted bitumen quality;
- After last wave of Covid-inspired refinery bitumen closures in 2021 – TotalEnergies Grandpuits, Neste Naantali, Galp Porto – Prax Group looks to have ceased UK Lindsey refinery bitumen production;
- Eni Livorno may well shut some time this year ahead of biofuels switch;
- Other simple refineries also vulnerable.

What now as EU/UK sanctions take effect?

- North/Central Europe:
 - No more Russian Baltic bitumen cargo flow to Nordics/UK;
 - Switch away from Urals to alternative crudes, carrying additional costs and bitumen spec issues;
 - Overall switch away from Urals has been to slightly sweeter crude slates;
 - Bitumen-producing refineries now taking heavier Mideast (eg Iraqi Kirkuk, Basrah Medium Heavy, KRG; Saudi and other grades) & other crudes like Norwegian N.Sea Johan Sverdrup, or US, Canadian, LatAm crudes;
 - Bitumen production at German refineries – esp PCK Schwedt (taking Kazakh) – hit hard by halt to Russian crude flows; others with sanctions-related issues to overcome – like Lukoil Burgas (Bulgaria);
 - Halt to Russian feedstock (mainly SRFO) supply also an issue: seen as factor in Prax closure, while potentially creating quality/production issues for other refineries that were fed – at least in part - by Russian SRFO – including Nynas, TotalEnergies, H&R;
 - French strikes & planned maintenance shutdowns: eg Shell (Pernis, Godorf) tightening supply as seasonal activity rises.
- Mediterranean:
 - No significant sanctions impact so far/expected due to far less dependence on Urals/Russian feedstocks, and none on Russian bitumen cargoes;
 - Mideast/Med crudes close to hand;
 - Med (esp Turkish/Iraqi) bitumen cargo exports surging:
 - Large and small bitumen cargo sizes this year out of Dordyol, southeast Turkey (origin Iraqi Kurdistan);
 - Similar flow set to emerge from nearby Torosport Ceyhan (ex-Tupras/Iraqi/Azeri);
 - A brief flurry of Livorno cargo exports seems to have come to abrupt halt amidst uncertainty over the Eni refinery's future.

The state of European/N.African demand

- What happened in 2022:
- “Demand destruction” took its toll in 1H 2022 as bitumen prices surged as war raged, while natural gas spike forced up road paving/asphalt plant costs;
- Improved picture since mid-year but overall demand in 2022 v 2021 fell in several key markets like UK, Italy, Spain, Romania, France, Algeria – while German consumption was stable.
- What’s 2023 looking like:
- A mixed bag.
- EU and UK facing twin pressures of inflation and economic slowdown;
- Government budgets already hit hard by Covid and related costs;
- Budgetary priorities in many countries look not to be to invest in new and upgraded roads and highways;
- Volatile/surging oil/bitumen prices won’t help encourage buying;
- Romania and Algeria amongst key importing markets with indications of rebound;
- Egypt in doldrums this year: no cargo imports so far in 2023 after EGPC tenders suspended due to financing/dollar issues;
- Many sub-Saharan African countries also facing such issues.

European bitumen consumption, tonnes

Country	2019	2020	2021	2022
United Kingdom	1,661,000	1,568,000	1,838,000	1,564,000
Germany	2,025,000	2,019,000	2,011,000	2,010,000
France	2,699,000	2,494,000	2,556,000	2,379,000
Romania	650,000	786,000	648,000	547,000
Italy	1,606,000	1,644,000	1,857,000	1,541,000
Spain	965,000	925,000	869,000	844,000

- Official, industry sources

Med suppliers swing into action – again!

- Now seeing (belated) resumption of Med-North Europe bitumen flows – a key feature of 2022;
- Two major new Turkish export terminals adding to east Med supply;
- Dortyol (ex-Rubis) terminal near Ceyhan already loading 5kt up to 30-35kt cargoes – and can go up to 40kt (after capacity upped to 40kt) - - all Iraqi Kurdistan (Lanaz refinery) flows;
- Guven Asphalt to export via Torosport Ceyhan terminal (capacity raised to 45,500t) from end-April/early May;
- Now Saudi Aramco (Luberef) about to emerge as a major new exporter from Red Sea refinery/terminal at Yanbu.
- Turkish bitumen exports already surged to 1.14mn t (2022) from 828kt (2021) and 707kt (2020);
- Greek exports hit 923kt ('22) from 828kt ('21), still well below 1.29mn t ('20);
- Italian exports: 918kt ('22), down from 982kt ('21) (when Livorno down and out!), 1.04mn t ('20);
- Spain flows: 819kt ('22), down from 1.15mn t ('21); 959kt ('20).

Arbs to west, east and sub-Saharan Africa

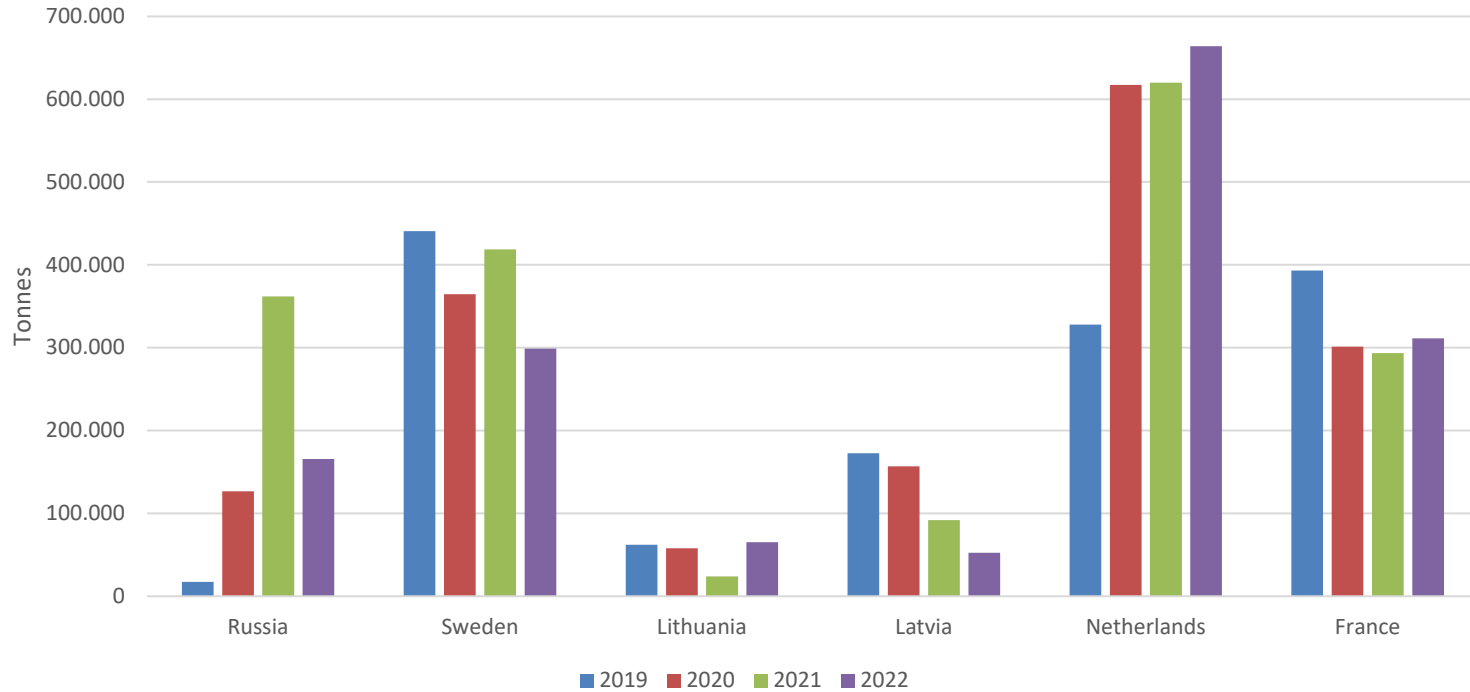
- After falling westbound TA flows in 2020 and 2021, a sizeable Europe export flurry to US last year;
- Only sporadic on/off flow so far this year – flat price volatility not helping;
- Canada, Colombia remain preferred “local” supply sources;
- Med to south America flows on the up: Estimated 177kt ('22); 58kt ('21); negligible ('20).
- Med to Mideast Gulf/Asia remains limited/occasional into Qatar/Malaysia;
- Changing China Covid picture could boost eastbound openings;
- S.Africa now rising cargo importer – flows from Spain, Greece, Singapore, Bahrain & Pakistan rose sharply in '22 – and being stepped up another gear in 2023!;
- Cautious optimism on west Africa demand/import prospects but dollar and govt financing concerns persist – east Africa with more mixed/uncertain outlook.

European bitumen export points

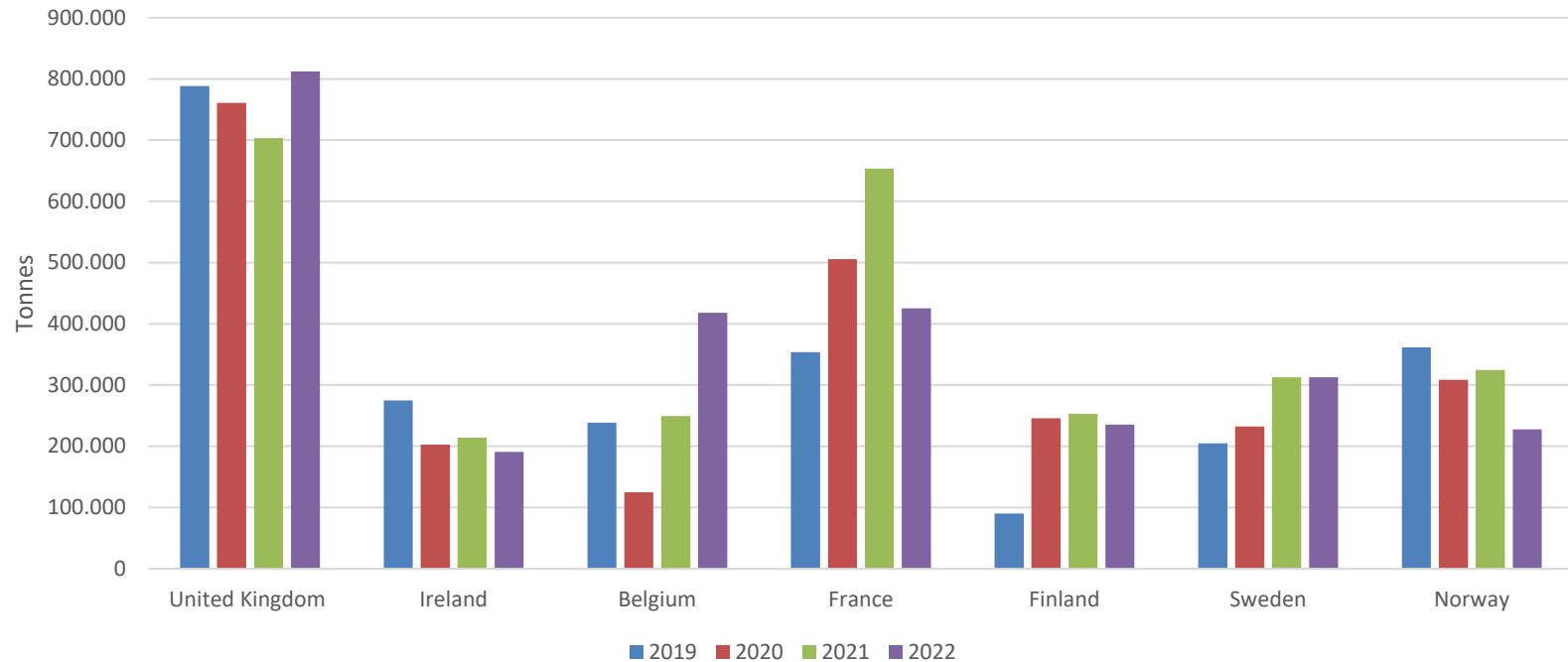


- Northern European exports and imports
- Mediterranean exports and imports
- Where have European exports been going?

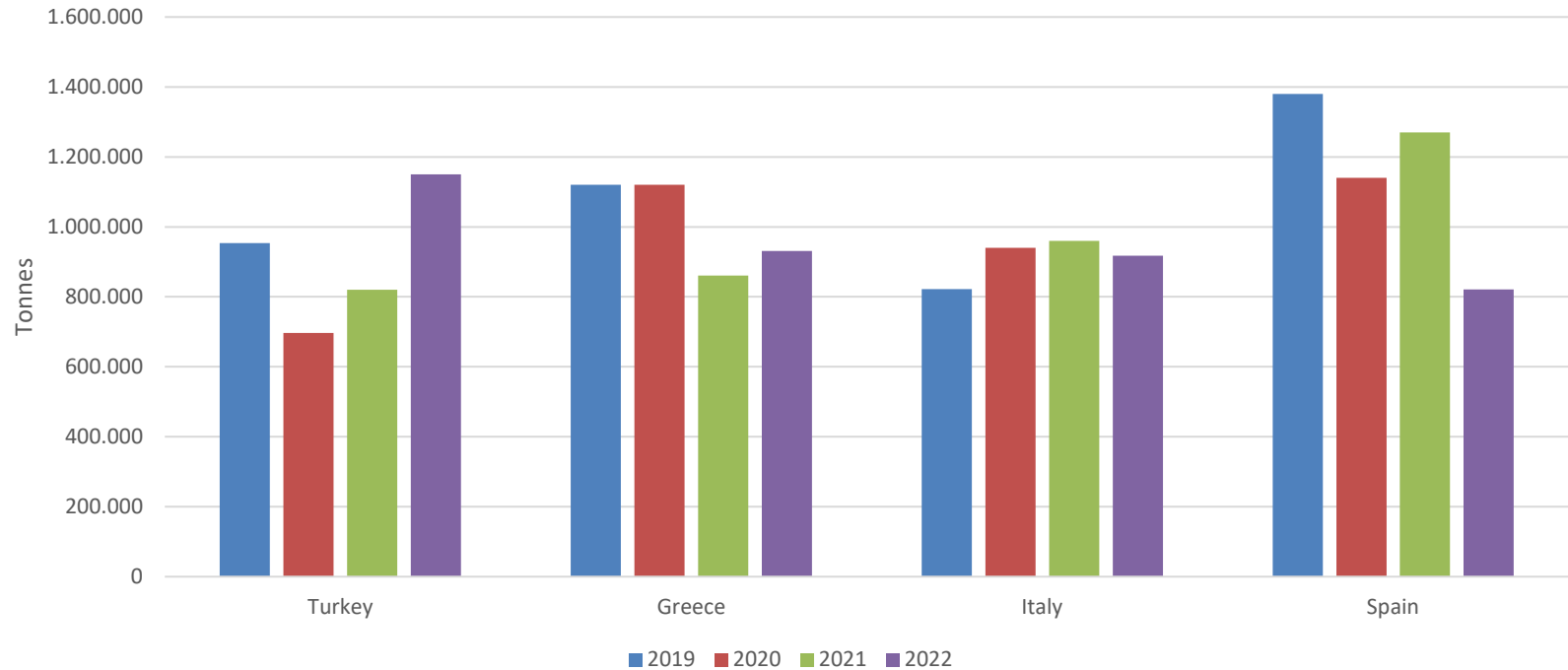
Northern Europe Bitumen Cargo Exports



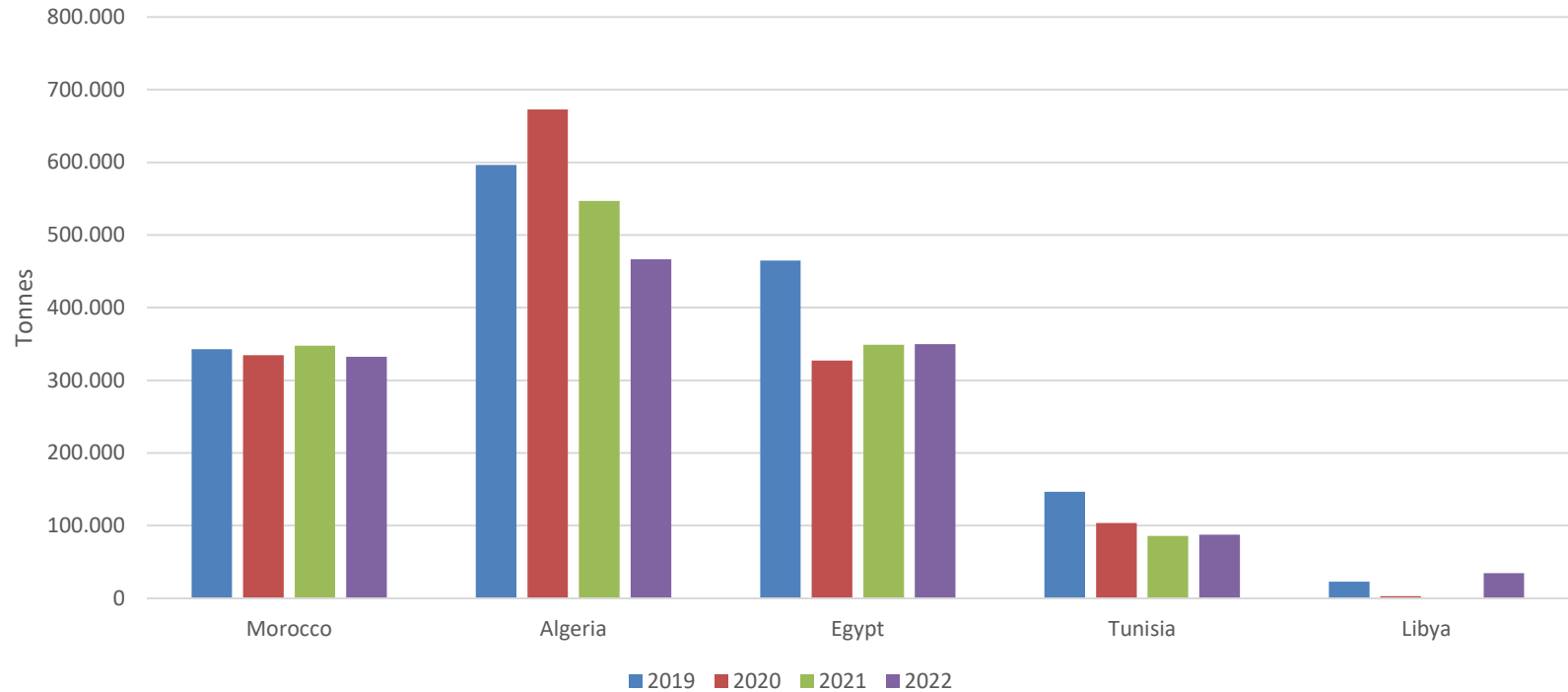
Northern Europe Bitumen Imports



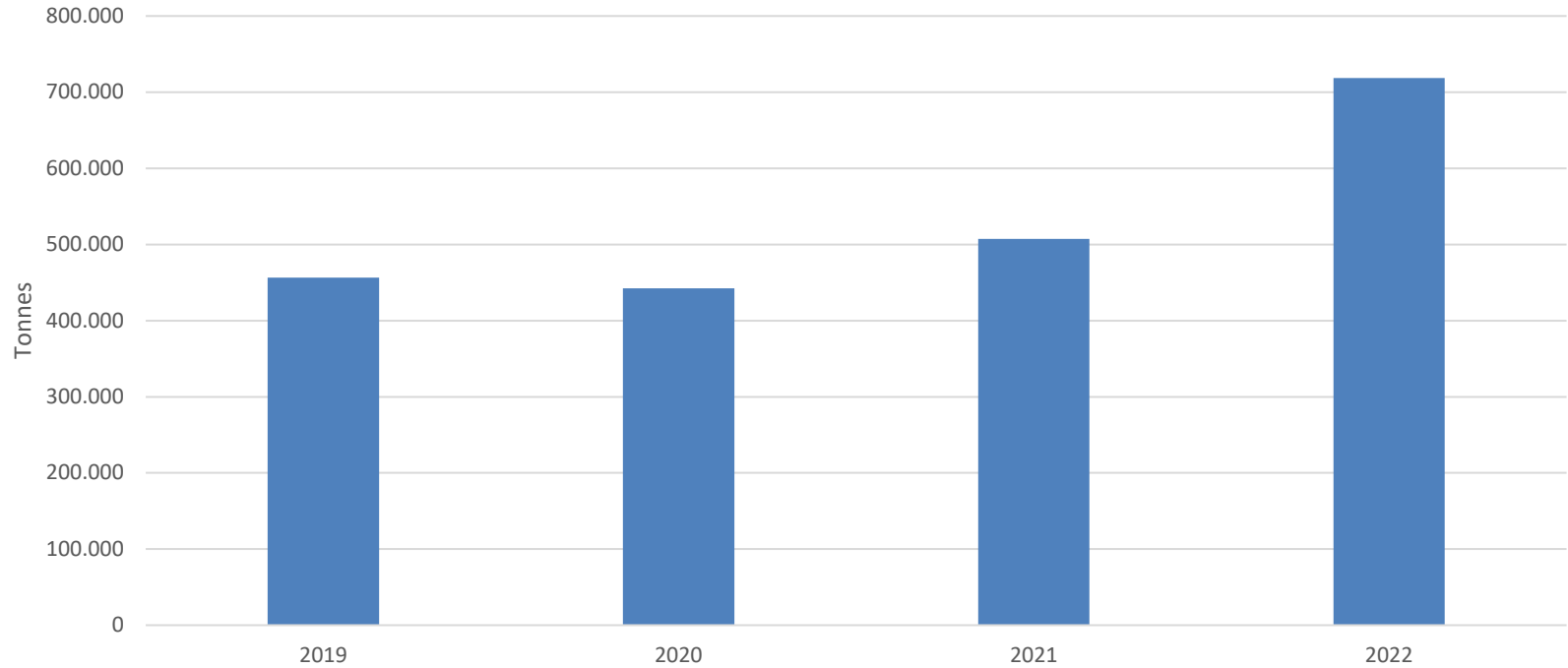
Mediterranean Bitumen Exports



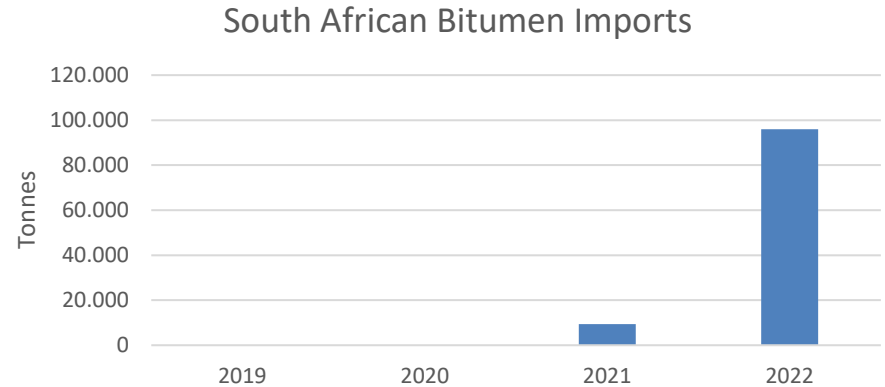
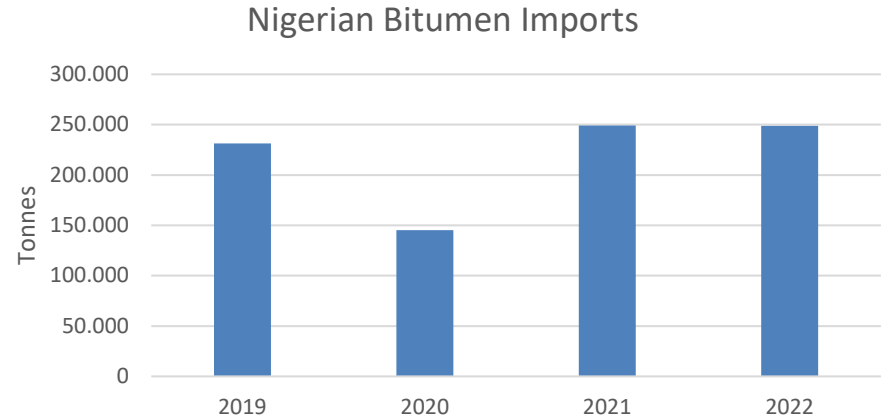
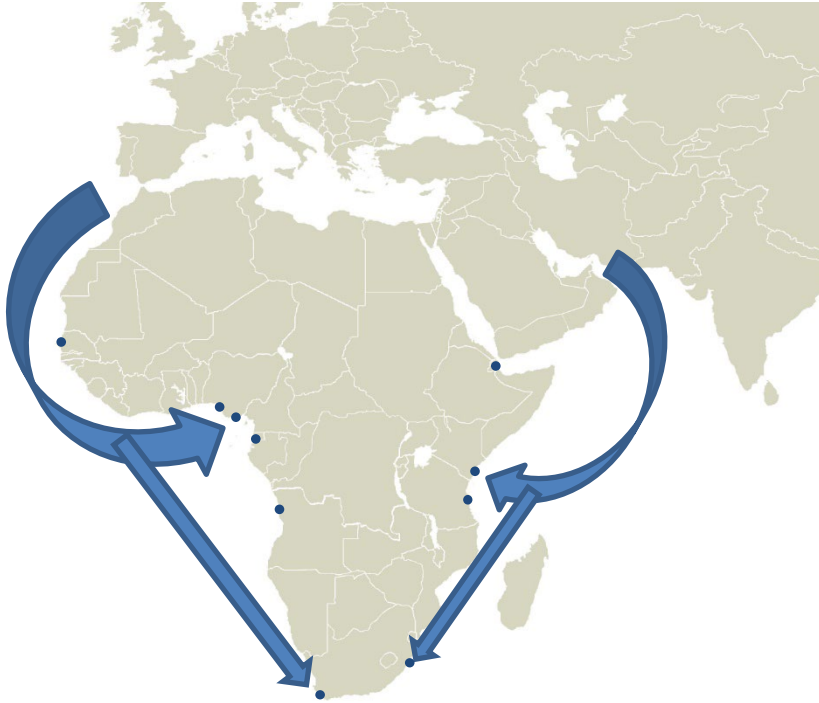
North African Bitumen Imports



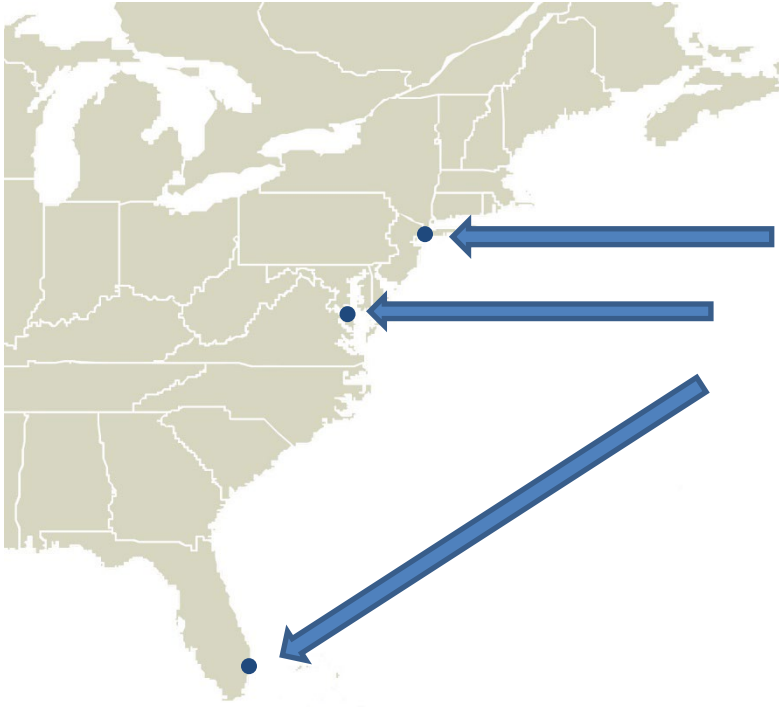
Mediterranean Exports to Northwest Europe



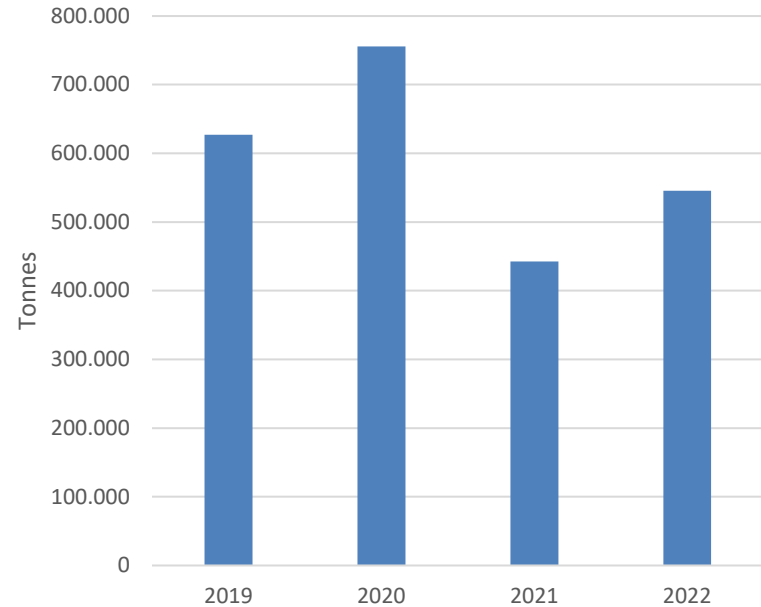
Sub-Saharan Bitumen Imports



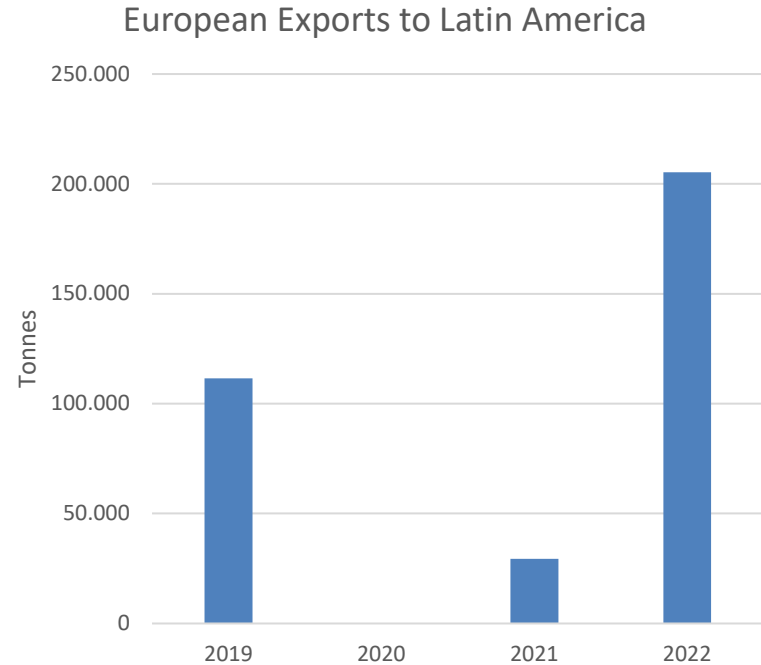
Where are European exports to the US going?



European Exports to US



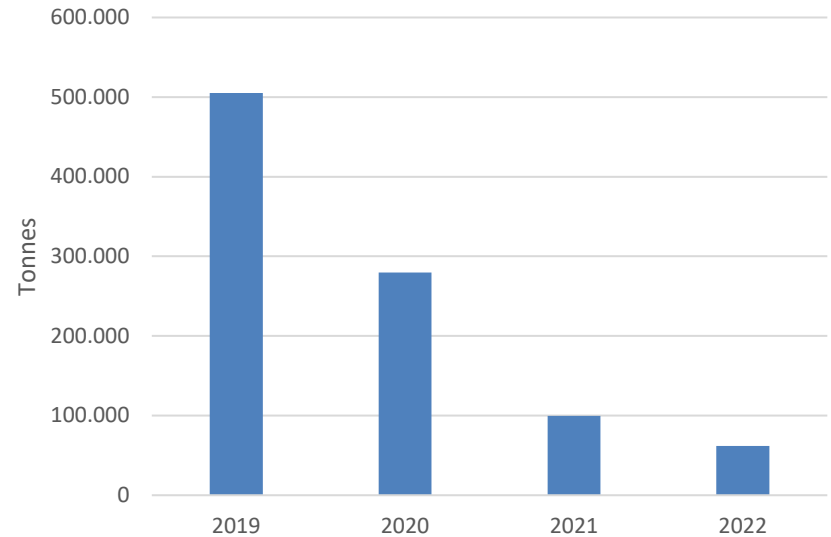
Where are European exports to South America going?



Where are European exports to the East going?



European Exports to the Middle East and Asia



Conclusions

- Volatile crude and products markets not necessarily aligning with the price of bitumen. Outright pricing rather than peg to HSFO best way to value bitumen;
- European & N.African demand likely to slip again overall in 2023;
- Growing east Med (and potentially Mideast Gulf) export flows seen countering impact of EU and UK sanctions on Russian crude and products;
- LatAm, S.African, WAF – and potentially US, Mideast and Asia-Pacific demand – drawing more bitumen from Europe – especially the Med;
- Refineries traditionally dependent on Russian crude/feedstocks having to readapt, while others (like Livorno) lined up for conversion to biofuels.



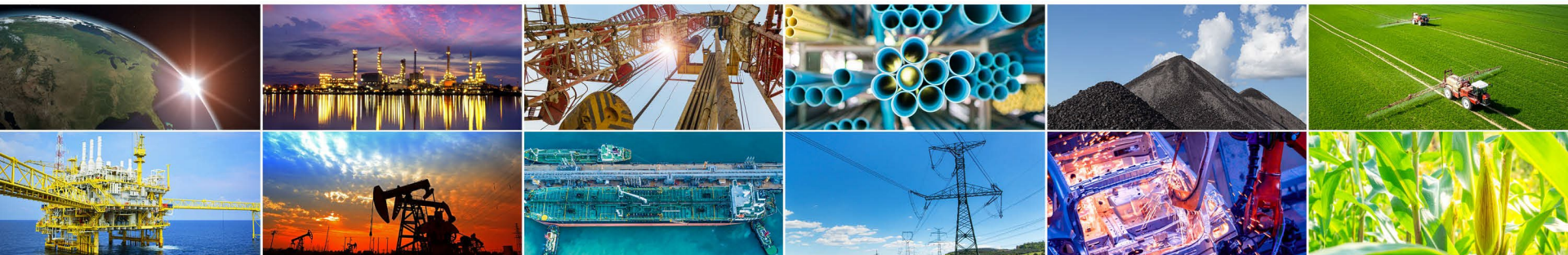
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MBP

UNA GRANDE STORIA ITALIANA

Modified bitumen roofing membranes, a great italian history

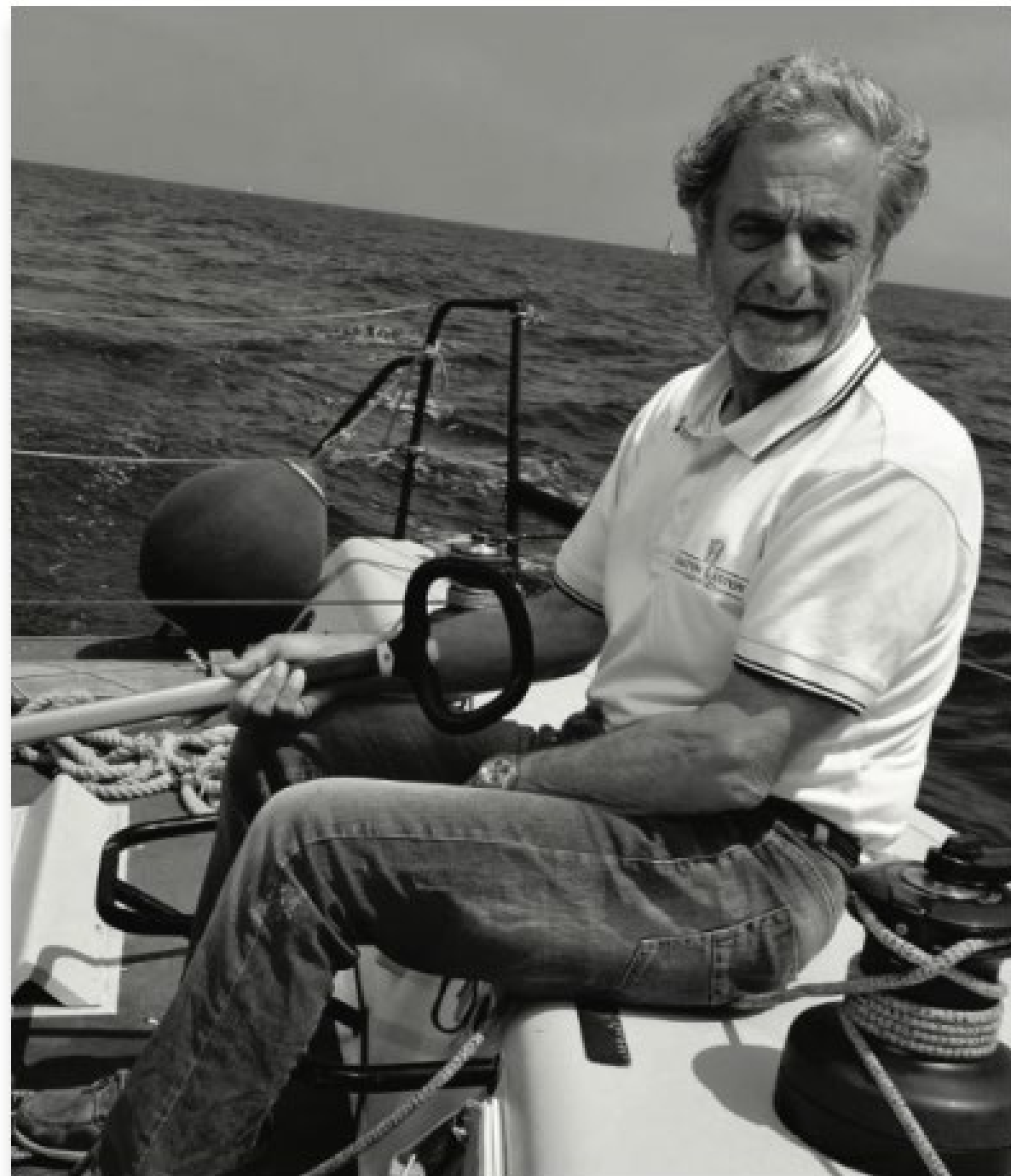
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Impervius 2023 – Sitges
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MASSIMO SCHIERONI

Chemical Engineer ex-CEO Imper Italia,
President of GRUPPO **PRIMI** – **Produttori
Italiani Membrane Impermeabilizzanti** of SITEB
- Strade Italiane e Bitumi



THE BOOK: WHEN & WHY

- **Ring the bell:** November 2019
- **The goal:** preserve the memory of Italy as the cradle of MBP torch on applied in single or double layer.
- **Worldwide revolution in the roofing market**



MBP HISTORY IN FIVE CHAPTERS

PART 1 – 50'S: waterproofing state of the art

PART 2 - 60'S : the atactic and the birth of MBP

PART 3 - 70'S : years of adolescence

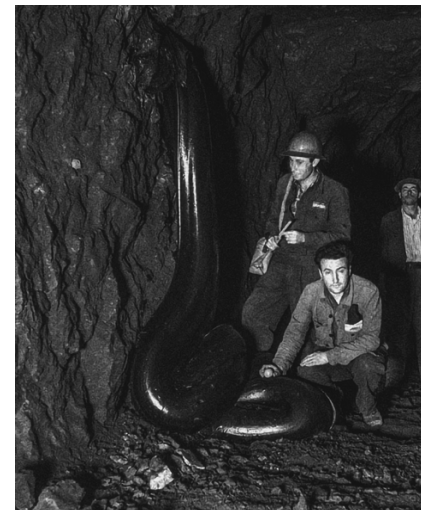
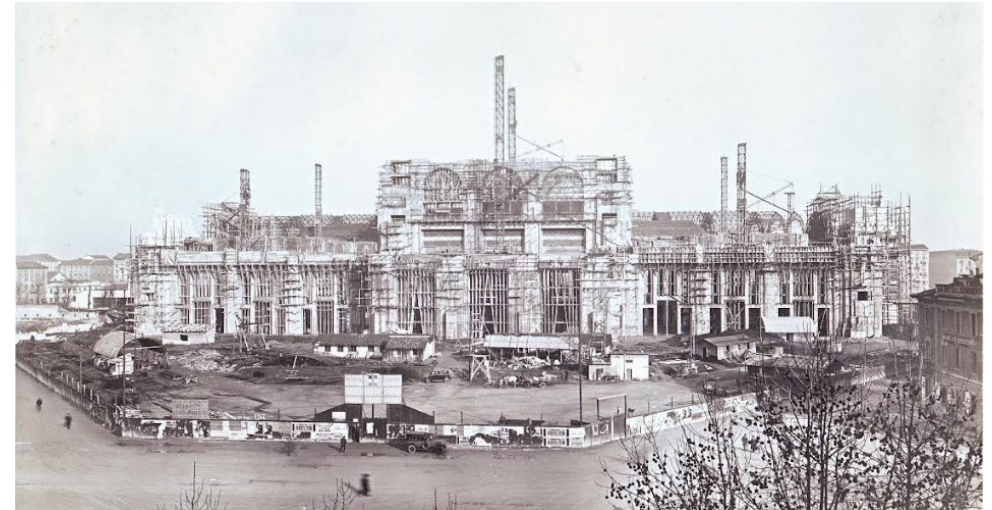
PART 4 - 80'S : years of development

PART 5 - 90'S : maturity of the sector and new millennium



THE 50'S: WATERPROOFING STATE OF THE ART

- **Reconstruction after the war**
- **New building technics:**
precasting and thermal insulation
- Historical hot applied bitumen systems:
 - **Natural Mastic Asphalt** – Mines in Sicily and Abruzzi (second half XIX century)
 - **Multilayers BUR** (Built Up Roof). (1847 Cincinnati USA)



MBP: THREE COMPONENTS INVENTION



Bitumen



Glass Fiber



Atactic

BITUMEN - ITALY AS EUROPE REFINERY

- Thanks to its geographic position in the center of Mediterranean Sea (Suez opening -1869) Italy developed a great refining industry
- 50's: **20** refineries. 70's **35** refineries. Today **11** refineries (7 producing bitumen)
- This industry provided great quantities of bitumen for waterproofing market. On the contrary the rest of the world needed to count on great quantities tar (Coal distillation)



GLASS FIBER: THE NEW REINFORCEMENT

- Traditional reinforcements of BUR were:
 - **Feltpapers and Jute.**
Limits: putrescible and hydrophilic.
'Trojan Horse of waterproofing'
 - **Glass net.**
Limits: Surfacing risk
- In 1952 Glasswerk Schuller GmbH introduced **Glass fiber** branded as Microlith .
Key features: Non-putrescible, flexible, competitive



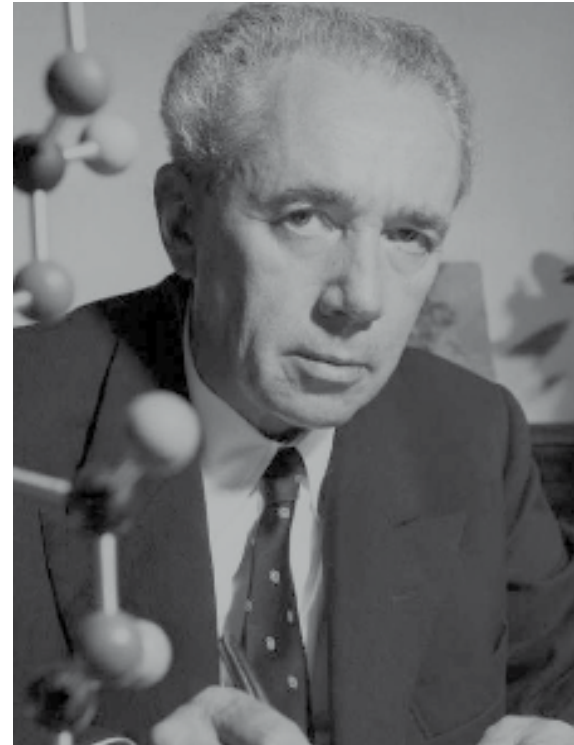
ATACTIC: A REVOLUTION TO MODIFY BITUMEN

Bitumen is unfortunately for refineries a by-product, bulky and uncomfortable, because it needs a heated stock; It is also a material of seasonal use and, given its low yield in economic terms, is considered the Cinderella of the refinery. BUR workers are thus faced with a difficult job, normally superior to their capabilities and equipment.

Ervino Breitner, 1963

PROFESSOR NATTA AND ISOTACTIC POLYPROPYLENE

- **1952** Karl Ziegler patents ethylene polymerization catalysts
- **1954** Giulio Natta patents isotactic polypropylene polymerization catalyst
- **1957** in Ferrara Montecatini starts the first plant producing isotactic polypropylene (IPP) branded as MOPLEN
- **1962** Nobel a Giulio Natta and Karl Ziegler are awarded with Nobel Prize for Chemistry

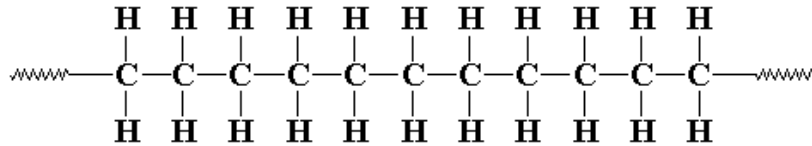


ATACTIC (APP)

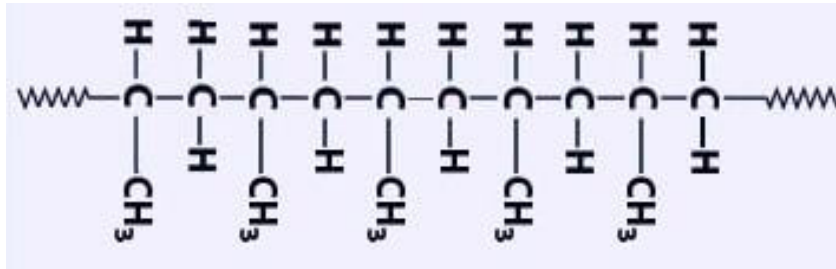
- During polymerization of IPP (in orderly form) some monomers aggregates in disorderly way: this is **atactic polypropylene (APP)**, waxy consistency material with same chemical structure.
- At that time it represented a waste to be isolated and disposed



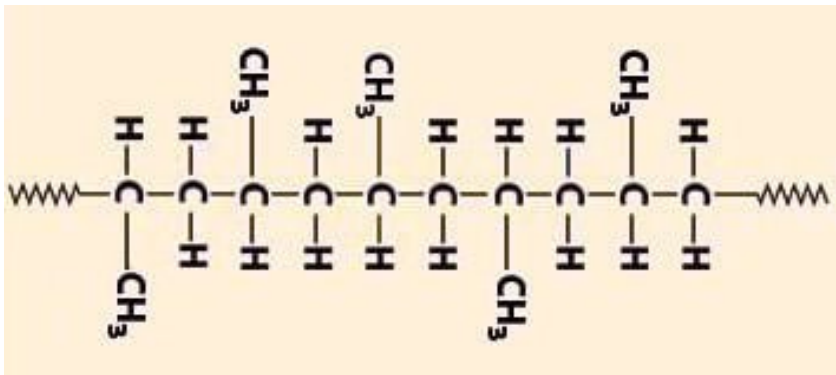
POLYETHYLENE AND POLYPROPYLENE MONOMERS STRUCTURE



Poliethylene



Isotactic polypropilene



Atactic polypropilene

ERWINO BREITNER: MBP INVENTOR

- Early 60's: all ingredients to produce MBP are available
- **Breitner invention:**
- use of APP as bitumen modifier, melting @180 – 200 °C 25 parts of APP with 75 parts of bitumen.
- Coat a glass-fiber with the obtained compound.
- Cool and roll the realize membrane.
- **1964:** in his factory Vetroasfalto in Concorezzo (MI) Breitner produced **the first MBP-APP modified torch-on membrane** under the brand Viapol.



OTHER PIONEERS

- **Breitner didn't patented his invention;** letting others following his example:
 - **Dott. Lelio Vitale**, IRCA's founder. In 1964 patented a Bit-Ox/PE modified extruded membrane
 - **Ing. Franco Schieroni**. In 1966 produced MBP, branded as Paralon, in his factory Imper in Turin
 - **Ing. Romolo Gorgati**. In 1966 produced MBP branded as Derbigum in his factory Derbit in Castenaso (BO)
 - **Luigi and Romano Zanchetta** brothers. In 1968 produced MBP branded Polyglass in their factory Super Asfalti Zanchetta in Negrisia (TV)



Lelio Vitale



Franco Schieroni



Romolo Gorgati



Luigi Zanchetta



Romano Zanchetta

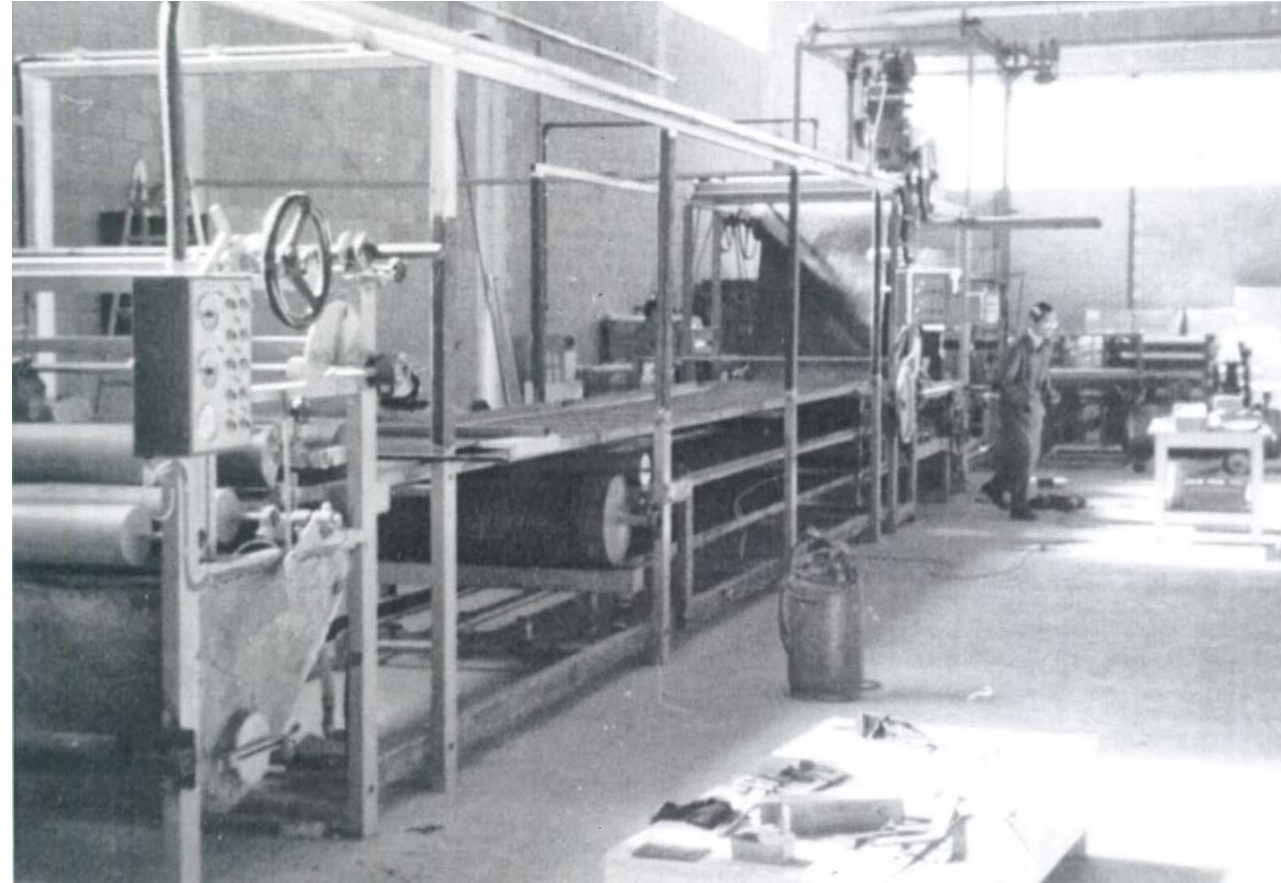
ATACTIC, LIGHTS AND SHADOWS

- Atactic cumulated in Montedison petrochemical poles (Ferrara, Terni and Brindisi) was inconsistent in quality and purity, mainly due to solvents used for stripping and improper storage also.
- To purify and homogenize APP coming from Polymer (the Montedison chemical pole in Terni), Miss Maria Perotti founded '**Interchimica**', a dedicated compounding company
- **Miss Maria Perotti**, was a lay nun, founder of the congregation 'Le operaie della Grazia', managing a house of prayer "Domus Gratiae" in Terni
- Very soon Interchimica became the monopolist of atactic sales for all Montedison plants in Italy and worldwide (under license)

70'S : YEARS OF ADOLESCENCE

MBP market grew very fast. Growth was supported by:

- The birth of dedicated plants manufacturers (Boato, Menestrina etc.) with some key characteristics:
 - Reduced dimension of impregnation tank
 - Water cooling trays instead of big metal cooling cylinder (Reiser)
- Atactic highly available, with consistent quality, thanks to Interchimica operation
- Glass Fiber substitution with the new nonwovens polyester



NONWOVEN POLYESTER

- Use of PET nonwovens substituting or coupling Glass Fiber reinforcement, dramatically enhance mechanical performances of MBP (tensile elongation, puncture and shear resistance)
- The innovation was supported by road engineer Marcello Filomarino in 1971, pushing use of dutch Colbond N.V. nonwovens as reinforcement, opening new MBP application fields (first of all viaducts, later on basins and channels, foundations, greenroofs)



VENICE 1977 – AIE CONVENTION – THE INTERNATIONAL RECOGNITION FOR MBP

- ‘MBP producers’ group has been constituted in 1971 inside **Federchimica** association in order to sustain the Italian industry in regulatory activities in Italy and world wide
- First and most important international opportunity was **Journées d’Etude** hold by AIE in 1977 in Venice that registered an outstanding Italian contribution
- From this moment on, Italian MBP industry received ‘**the international passport**’ to the world scene.



80'S : YEARS OF DEVELOPMENT

- These years registered remarkable results also thanks to increasing shares of international markets.
- Iconic was **USA market conquest** where in few years 10 Italian MBP Producers started manufacturing plants, quickly reaching 25% of the market share (replacing traditional BUR system).
- **Not only USA:** Algeria, Belgium, Brazil, China, Cyprus, Egypt, Japan, UK, Portugal, Romania, Russia, Saudi Arabia, South Africa.



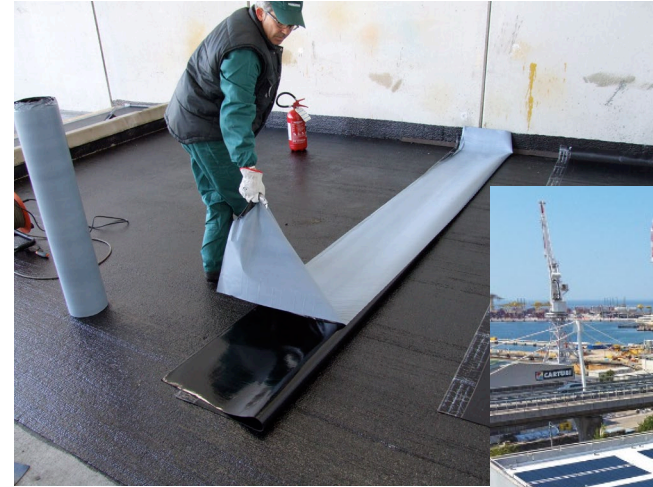
90'S : MATURITY OF THE SECTOR AND NEW MILLENNIUM

During 90's further **improvements** of bitumen membrane arise thanks to:

- nonwovens polyester stabilization
- on purpose APP production (new TPO)

New Millennium most important **innovations** :

- Self adhesive membranes (USA market demand)
- Integrated photovoltaic waterproofing membranes (green energy)
- Road reinforcement geomembranes (paving industry demand)



CONCLUSIONS

- MBP Italian industry numbers:
- **45 companies** along his history
- **Highest production peak** reached in **2006**: 240 millions sqm (25% foreign market, 75% Italy)
- **Current production**: 150 millions sqm (45% foreign market, 55% Italy) thanks to **11 Companies** with **13 operating plants** (5 of them owned by multinational groups)



Thanks for the attention



TO PURCHASE
THE BOOK

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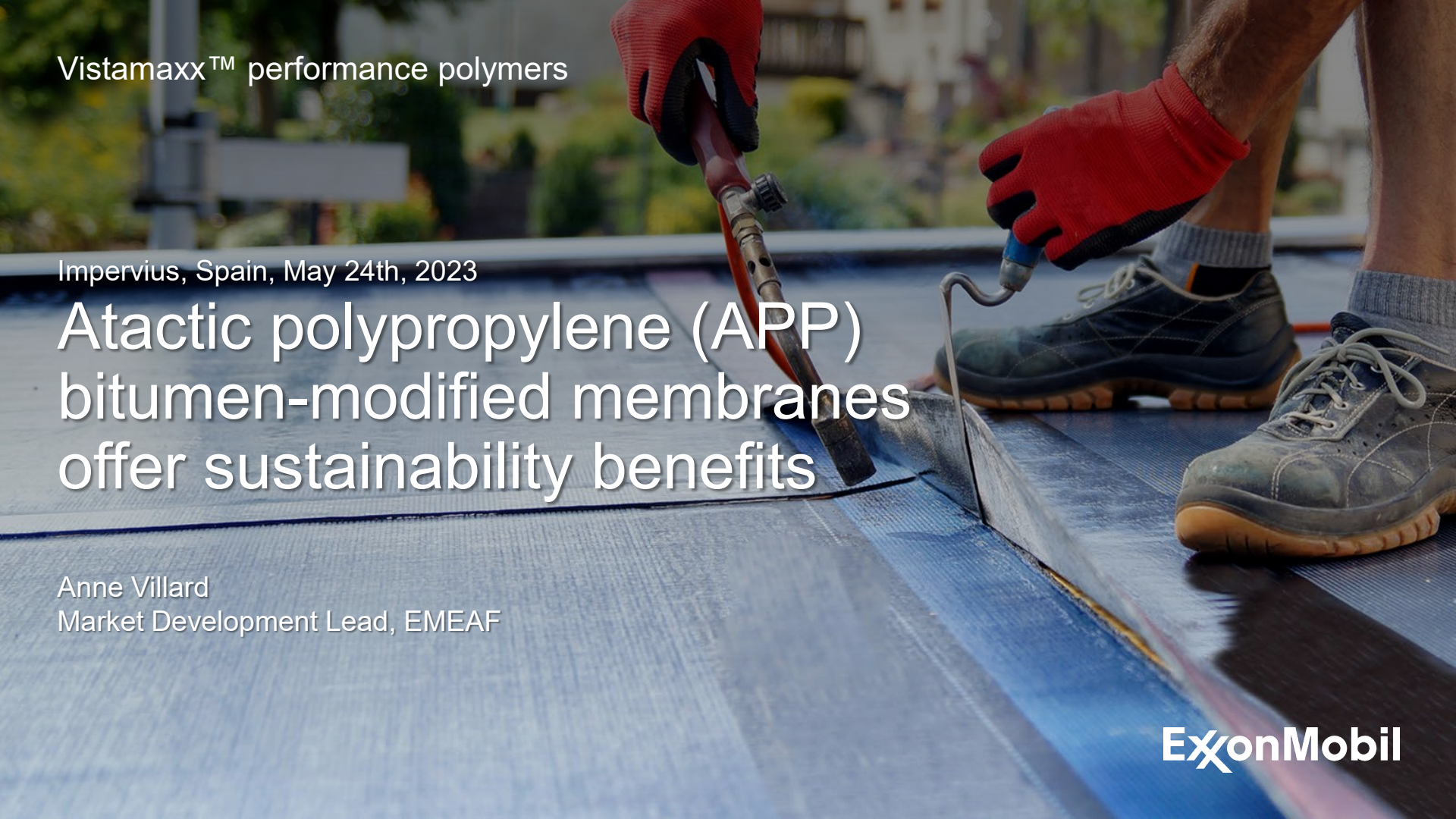
Impervius 2023 – Sitges

24-25 May 2023

MASSIMO SCHIERONI

MBP

UNA GRANDE STORIA ITALIANA



Vistamaxx™ performance polymers

Impervius, Spain, May 24th, 2023

Atactic polypropylene (APP) bitumen-modified membranes offer sustainability benefits

Anne Villard
Market Development Lead, EMEAF

ExxonMobil

ExxonMobil Product Solutions

Lead industry in the energy transition

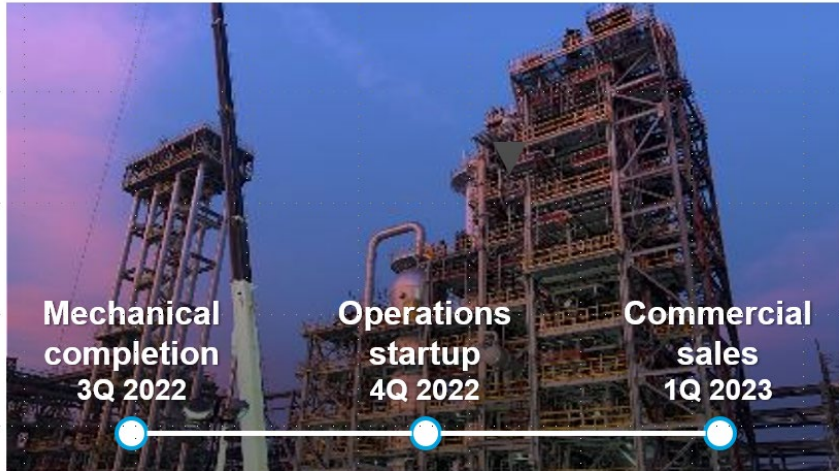
Leveraging centralized expertise and capabilities to grow the portfolio



Support growth with new investments

ExxonMobil™ PP

- 450 kTa reactor delivers impact co-polymer performance products
- Strategically located in Baton Rouge, Louisiana to improve global supply capability



Vistamaxx™ and Exact™

- Largest 400kTa solution polymerization reactor
- Strategically located in Baytown, Texas
- 2Q 2023 startup, with availability in 3Q 2023

2x capacity for solution performance plastics



Baytown, TX (Under construction, 400 kTa)

- Capable of producing **Vistamaxx™ (propylene-based) performance polymers** and **Exact™ plastomers (ethylene-based)**
- Adjacent alpha-olefin investment for octene supply

Fit of Vistamaxx™ performance polymer in bitumen

Modified bitumen roofing trends and drivers

Macro-economic drivers

- Urbanization in developing countries
- Increase in housing construction and renovation
- Increase in commercial real estate investment

Trends

Cost

- Increased incorporation of recycled content
- Increased filler content
- Movement to harder bitumen pen hardness
- Use of recycled bitumen

Performance

- Ease of installation – including DIY
- Sheet flexibility and cold flexibility requirements
- Burning behavior
- Service time
- Potential Recyclability

Market

- Maintaining growth
- New functional roofing solutions
- Roofing solutions that potentially address environmental concerns on the rise
- Environmental legislation

Expanding growth potential

Key attributes inspire innovative solutions

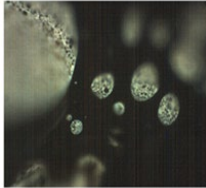
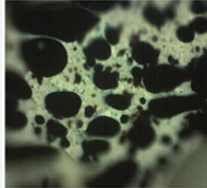
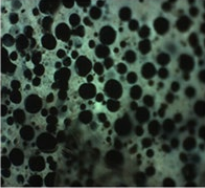


Olefin-based product testing in different bitumen types

Influence of Vistamaxx™ 6502 on blend properties

Vistamaxx 6502 achieves phase inversion at around 20 wt% addition

Different levels of Vistamaxx 6502 content in bitumen (Gravenchon 70/100)

Vistamaxx™ 6502 performance polymer in bitumen 70/100	Method	0 wt%	15 wt%	20 wt%	25 wt%
Microscopy with UV illuminant					
Penetration at 25 degC in mm/10	EN1426	79	103	52	48
Softening point in degC	EN1427	46.2	71.2	77.6	81.2
Viscosity at 195 degC and 106 s ⁻¹ in mPa.s	EN13302	40	208	965	1208

Vistamaxx™ performance polymer portfolio


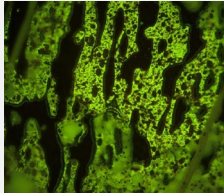

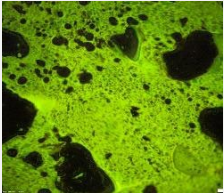
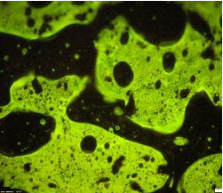
	Typical grades used					Fine tuning special case with Low Viscosity Vistamaxx (LVV)	
	Vistamaxx 3000	Vistamaxx 3980FL	Vistamaxx 6202	Vistamaxx 6502	Vistamaxx 6902	Vistamaxx 8380	Vistamaxx 8880
Pen hardness	=	+	-	-	-	=	+
Foot step	=	+	-	-	-	=	+
Flexibility	=	-	++	+	++	=	-
Ring and ball	=	=	=	-	=	=	=
Viscosity reduction	=	=	+	++	+++	++++	+++++

Directional difference between Vistamaxx polymer grades compared to Vistamaxx 3000

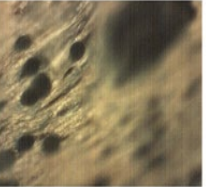
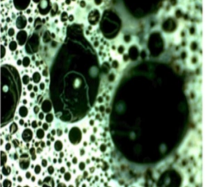
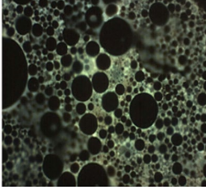
Highly flexible/highly amorphous Vistamaxx polymer offers potentially:

- Similar sheet flexibility at lower level of modifier (higher level of recycled PP content incorporation)
- More flexible sheet at same modifier level
- Better dispersion of fillers
- Higher filler concentration with maintained flexibility

Vistamaxx™ performance polymer portfolio - Blend properties

20 wt% Vistamaxx polymer in bitumen 70/100	3980FL	6102	6202	6502	6902
Microscopy with UV illuminant					
Penetration at 25 degC in mm/10 per EN1426	18	28	33	64	31
Softening point in degC per EN1427	90.0	105.5	100.5	77.2	92.5
Viscosity at 195 degC and 106 s ⁻¹ in mPa.s per EN13302	not measured	2722	1175	1024	769
Typical properties per PDS extracted	3980FL	6102	6202	6502	6902
MFI at 230 degC (g/10 min)	8	3	20	45	100
Glass transition (degC)	-21	-30	-29	-27	-31
Flexural modulus (MPa)	117	14	32	41	47

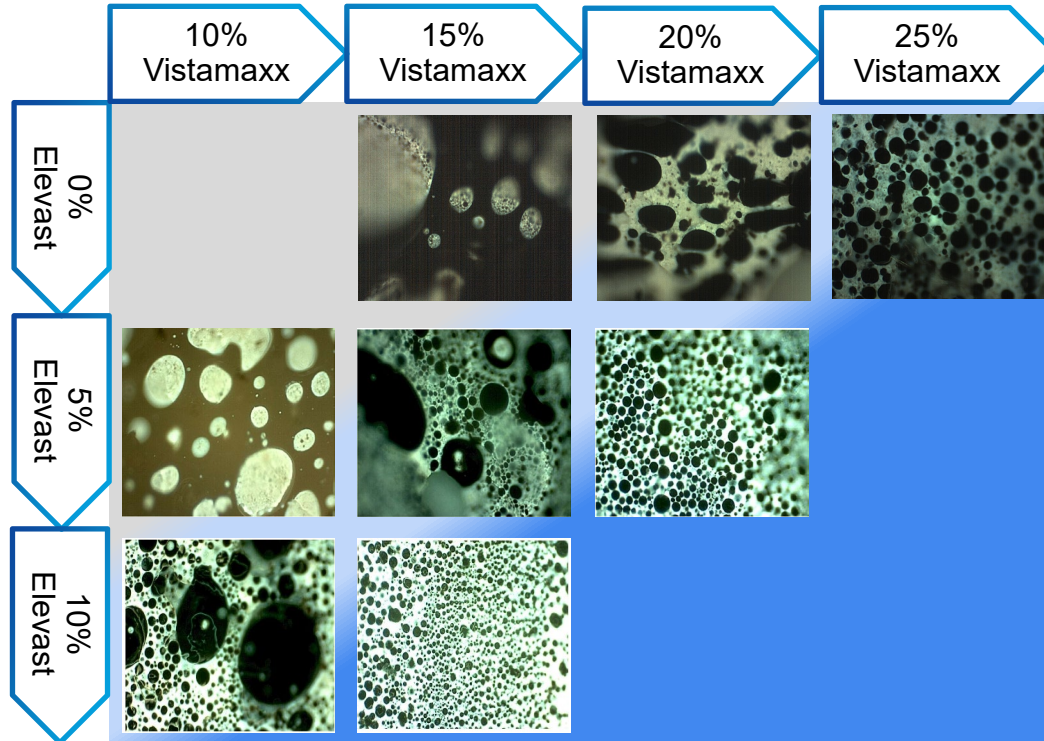
Introducing Elevast™ polymer modifier and LVV*

Vistamaxx™ 6502 performance polymers in blend Gravenchon 70/100 + liquid	Method	76,5% 70/100 8,5% flux oil +15% 6502	81%70/100 9% Elevast D50 +10% 6502	80%70/100 10% 8380 +10% 6502
Microscopy with UV illuminant				
Penetration at 25 degC in mm/10	EN1426	158	146	33
Softening point in degC	EN1427	67.6	65.4	88.0
Viscosity at 195 degC and 106 s ⁻¹ in mPa.s	EN13302	155	673	588

- Higher viscosity achieved with Elevast D50 at same addition level
- Higher chemical compatibility of Elevast D50, allows reaching phase inversion faster
- Fine tuning possible with Vistamaxx 8380: polymeric viscosity modifier
 - increase softening point while maintaining the viscosity: lower risk of migration

Vistamaxx™ polymer phase inversion with Elevast™ D50

Addition of Elevast™ polymer modifier to bitumen allows reaching phase inversion at lower polymer content



Formulation contents

Gravenchon bitumen 70/100

Vistamaxx 6502

Elevast D50

Asphaltic phase

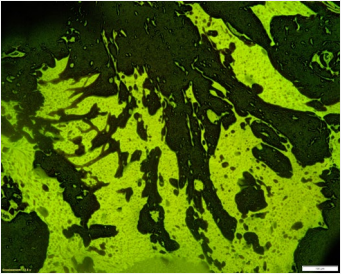
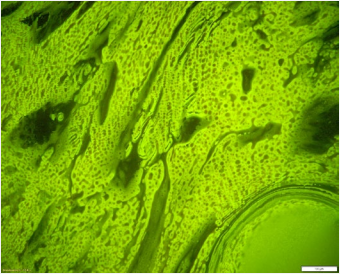
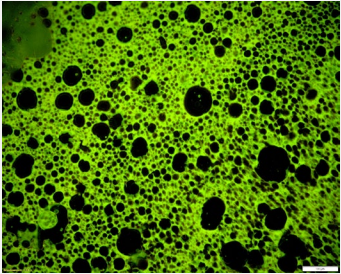
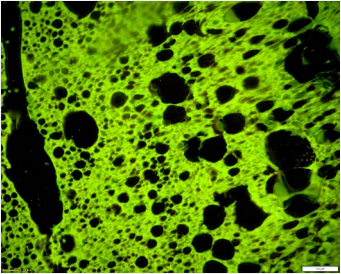
Phase inversion

Polymeric phase

Phase inversion of linear SBS occurs at ~8% in Gravenchon 70/100



Influence of bitumen grade on blend properties

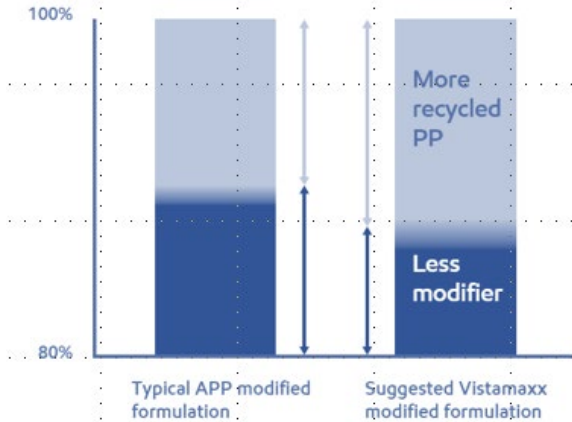
20 wt% Vistamaxx™ 6502 polymer per type of bitumen	35/50	70/100	160/220	260
Microscopy with UV illuminant				
Softening point in degC per EN1427	82.5	76.8	74.4	71.6
Viscosity at 195 degC and 106 s ⁻¹ in mPa.s per EN13302	968	925	836	743

- Phase inversion achieved with all bitumen types
- Higher chemical compatibility potential with softer bitumen

Sustainability benefits

ExxonMobil Product Solutions providing products with sustainability benefits

Waterproofing membranes



- Vistamaxx™ can boost performance of recycled PP and PE content
- Adding Vistamaxx polymers to formulation can enable higher recycled content polymer loading

Pavement

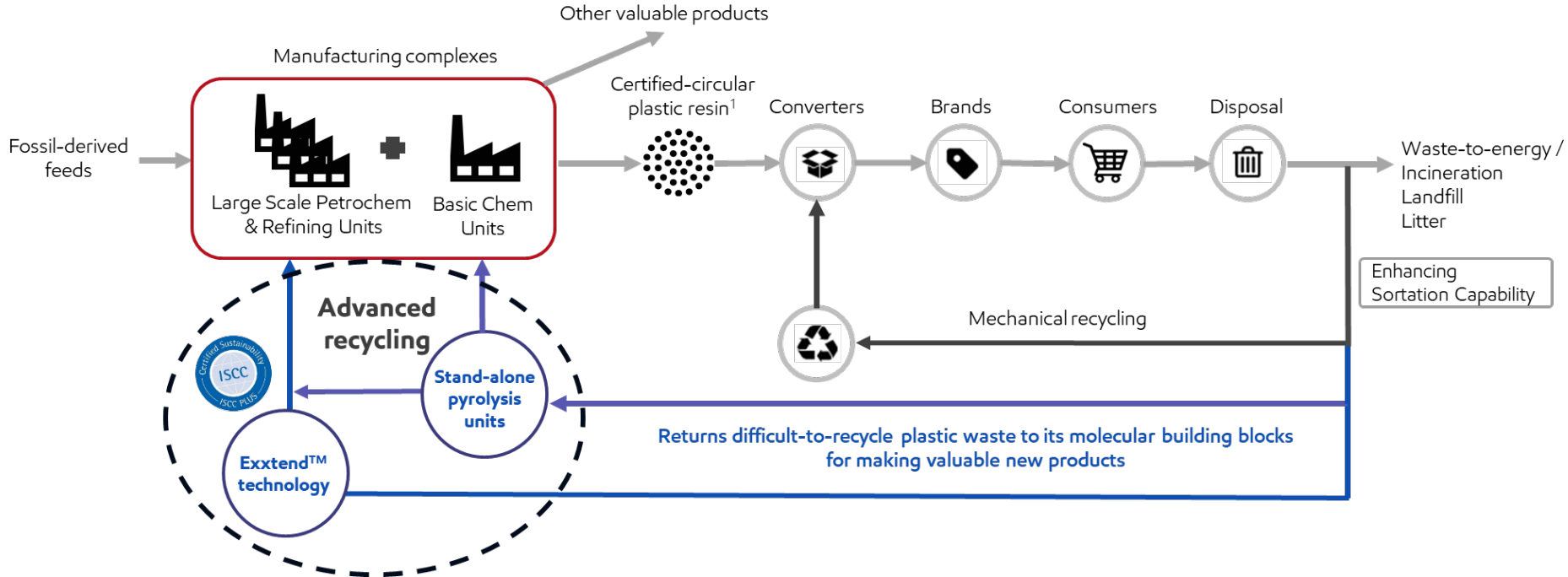


- Bitumen is recyclable*
 - Can be reused over and over, with very little loss, through re-heating
- Bitumen roads have the potential to offer a lower carbon footprint than the alternative products

Source: Eurobitume & other public resources

* Recyclable in communities that have programs and facilities in place that collect and recycle bitumen

Exxtend™ technology aims to accelerate progress towards a more circular economy with certified-circular polymers



¹Attributed via ISCC PLUS mass balance approach.

For illustrative purposes only.

Exxtend™ technology for advanced recycling

**Video: ExxonMobil's Exxtend™
technology for advanced recycling
virtual tour**

Summary

- New ExxonMobil Product Solutions will leverage synergies between refining and chemicals
- Growing capacities to provide essential products that sustainably meet society's growing needs
- Fit of Vistamaxx™ performance polymer in various bitumen hardness and different viscosities
- Support to design solutions that offer sustainability benefits required by the market



Improvement needed?

Facing challenges?

New ideas?

Please contact us



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Thank you

ExxonMobil

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Test methods

Test method	Test method based on
Melt Mass-Flow rate (MFR) (230°C/2.16 Kg)	ExxonMobil method
Flexural Modulus – 1% Secant	ASTM D790
Flexural Modulus	ISO 178

Properties and benefits of using lightweight fillers / microspheres in bitumen waterproofing membranes

David Gonzalez Amago

Director Global Business Development

Omya International AG

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THINKING OF TOMORROW

omya.com

Agenda

1. Company introduction
2. Lightweight Fillers / Microspheres Overview
3. Lightweight Fillers / Microspheres based on Closed-Cell Expanded Perlite
4. Benefits of using Microspheres / Lightweight Fillers in Waterproofing Bitumen Membranes
5. Summary

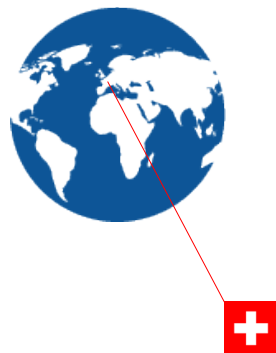


Global producer of
Industrial Minerals

Worldwide distributor of
Specialty Chemicals

Facts & Figures

More than **175** plants
and offices in **50**
countries



7 laboratories and
7 pilot plants for
innovation



9,000 employees



Global ownership of mineral
deposits (**calcium carbonate,**
perlite) for the next **100 years**

Privately-owned **Swiss**
corporation with headquarters in
Oftringen, Switzerland

CHF **3.8** billion turnover

Lightweight Fillers / Microspheres Overview

- *Lightweight filler/
Microsphere types*
- *Main Objectives*
- *Applications*

Main Lightweight Fillers/ Microspheres



Density makes the difference...

Barium Sulfate	4.50
Titanium Dioxide	4.17
Wollastonite	2.99
Talc	2.80
Calcium Carbonate	2.71
Feldspar	2.65
Solid Ceramic Microspheres	2.50
Alumina Trihydrate	2.42
Clay	2.20
Fumed Silica	2.10
Cenospheres	< 0,95
Closed-Cell Expanded Perlite	< 0.4
Expanded glass	< 0.8
Hollow Glass Bubbles	< 0.6

Lightweight Filler / Microsphere → Spherical morphology, hollow structure, effective particle density ≤ 1 g/cc



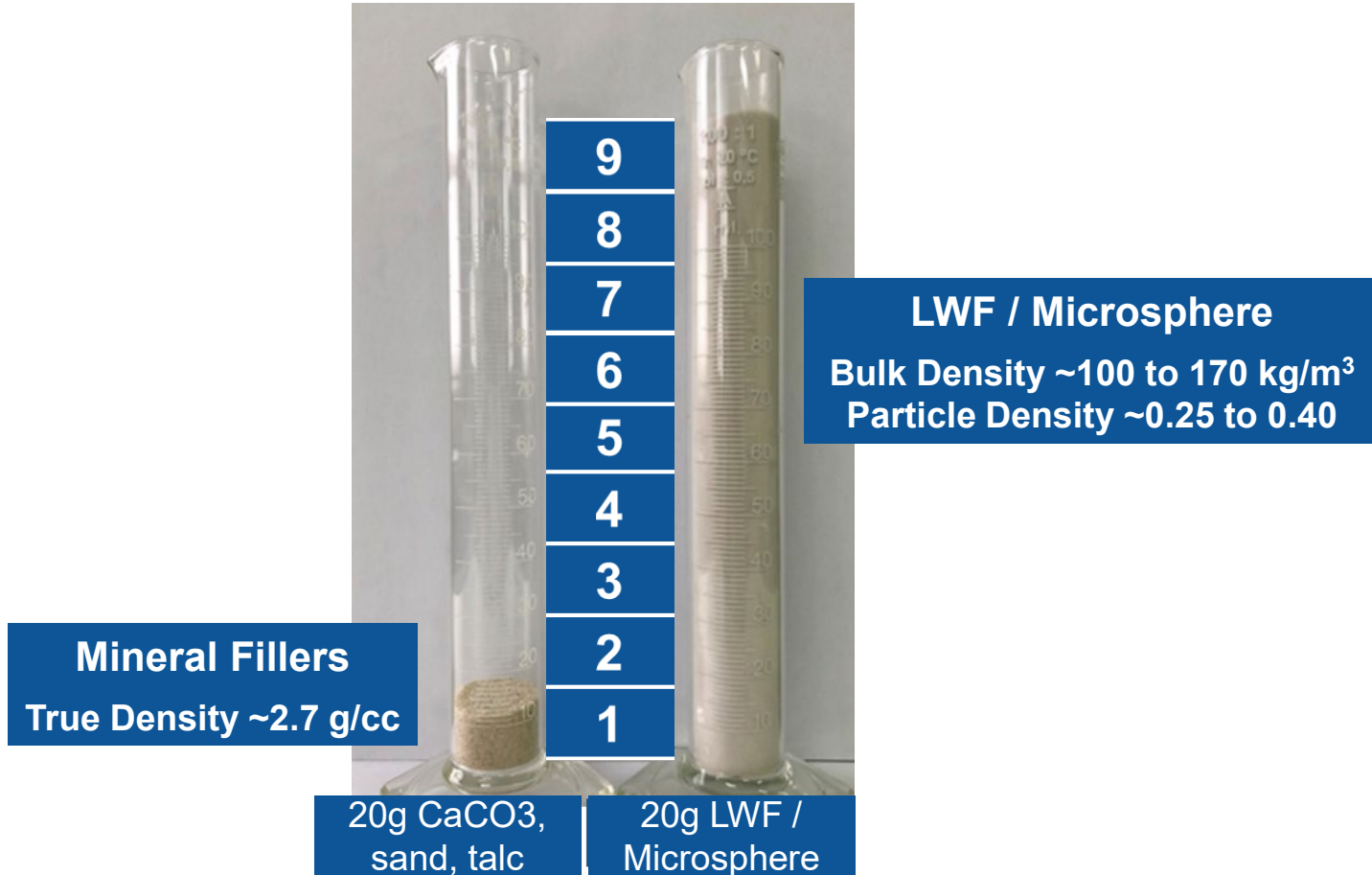
Functionalities → Weight reduction, insulation and rheological properties enhancement

Lightweight Fillers / Microspheres at a glance

- **Replacing “heavier” materials (e.g., mineral fillers, sand) in different systems leads to:**
 - **Reduced weight of a final product**
Easier-to-use and makes work conditions healthier and safer
Increased loading capacity for trucks
 - **Increased yield**
Higher spread rate / coverage area at the same weight leading to tangible savings
Less material to carry and reducing operations / installation
 - **Additional benefits such as:**
Insulation (conductivity, solar reflectivity, dampening)
Rheological behavior (binder optimization, easy flowability, cracking reduction)



LWF Density – Volume Approach



LWF comparison on the volume basis, not by weight. Replacement on the weight basis will lead formulation issues (oversaturating/ the system)



Approaching LWF by volume rather than by weight

Barium Sulfate	4.50
Titanium Dioxide	4.17
Wollastonite	2.99
Talc	2.80
Calcium Carbonate	2.71
Feldspar	2.65
Solid Ceramic Microspheres	2.50
Alumina Trihydrate	2.42
Clay	2.20
Fumed Silica	2.10
Cenospheres	< 0,95
Closed-Cell Expanded Perlite	< 0.4
Expanded glass	< 0.8
Hollow Glass Bubbles	< 0.6

Market Segments & Applications

Tile Fixing & Flooring

- Tile Adhesives & tile grouts, thick bed & thin set mortars
- Self levelling screeds & underlayment
- Caulks & Sealants

Coating

- Elastomeric roof coating
- **Waterproofing Bitumen Membranes**
- Asphalts Sealers, Waterproofing Coatings, Mastics

Reparation

- Concrete Repair
- Paste Products, smoothing joint fillers

External Facade

- Renders, ETICS and base coat (cement and polymeric based)
- Insulating Paints & primers

Internal

- Joint compounds/ joint fillers & spackles (ready to use or dry mix)
- Plasters, paints & primers

Panels & Boards

- Cement & gypsum panels, tile backers
- Ceiling systems



Introduction to Lightweight Fillers / Microspheres based on Closed-Cell Expanded Perlite

- *What is perlite?*
- *Types of perlites*
- *Benefits & savings*

What is Perlite?

Unexpanded Perlite
“Amorphous Volcanic Glass”
High Water Content
Density ~ 1100 kg/m³



70–75% SiO₂
12–15% Al₂O₃
3–4% Na₂O
3–5% K₂O
3–5% H₂O

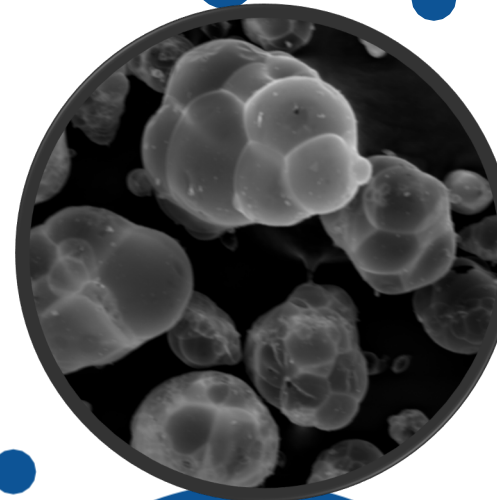
Perlite Mined Globally:

- USA
- Mexico
- Greece
- Turkey
- China

Introduction Expanded Perlite

TRANSFORMATION

Perlite softens when it reaches temperatures of 850–900 °C. Water trapped in the structure vaporizes and causes expansion 7–16 times original volume.



Different temperatures give different particle size / density

Different Ore give different properties

Different expansion techniques give different bubble

Grinding / Sieving before expansion gives different sizes

Coatings gives Hydrophobic properties

Expanded Perlite: Closed-cell vs. Open-cell Expanded Perlite

Closed-Cell Expanded Perlite



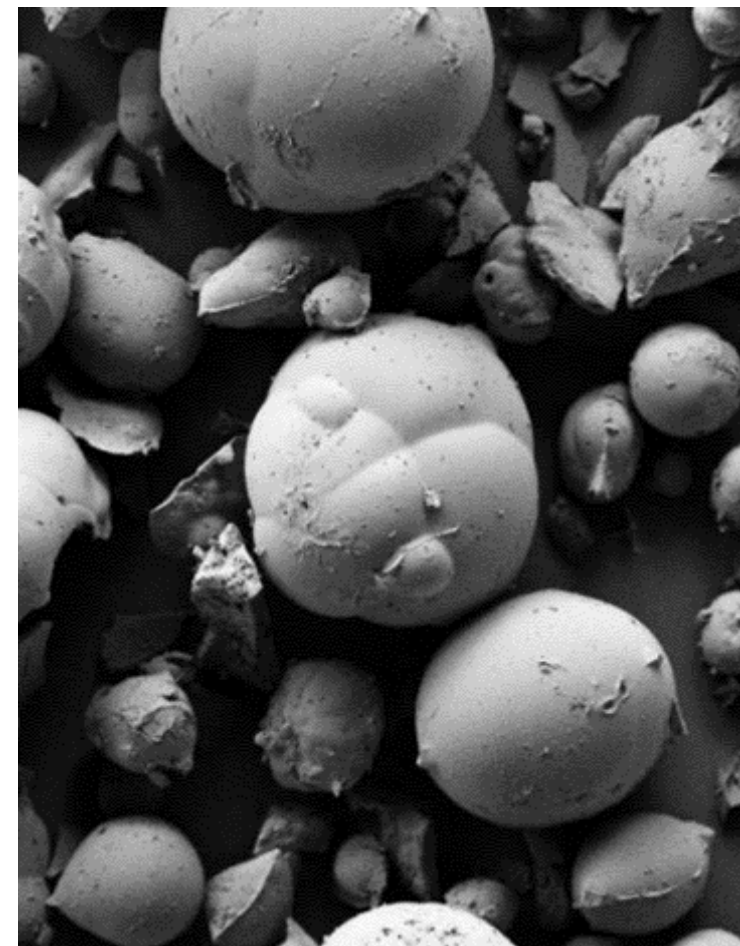
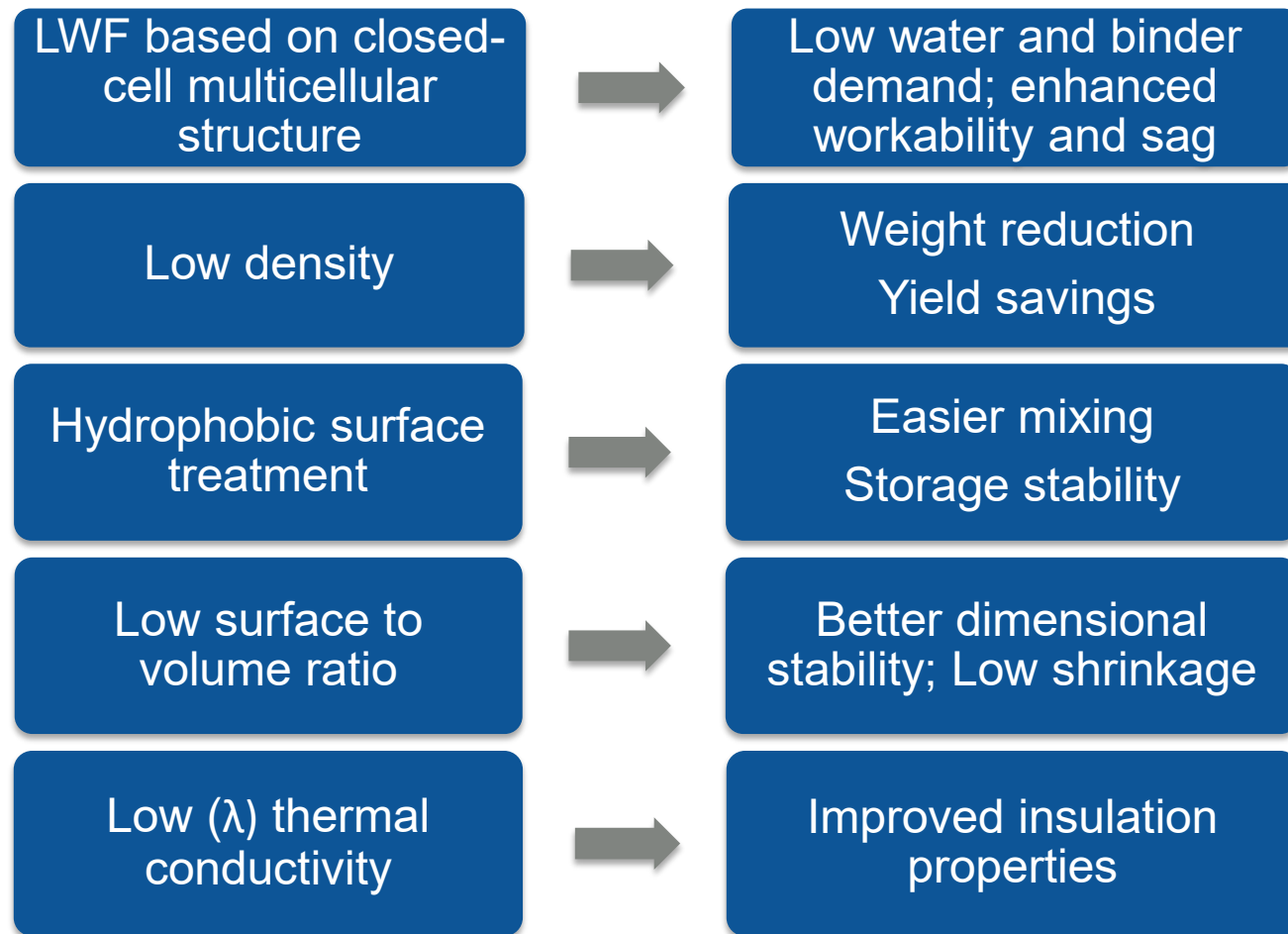
- Closed-cell
- Spherical multicellular morphology
- Some crush resistance (~1MPa)
- Lower absorption

Open-Cell Expanded Perlite



- Open-cell
- Flakes, non-spherical morphology
- Negligible crush resistance
- Higher absorption

What is this new technology for waterproofing asphalt membranes?



LWF = Lightweight filler

Benefits of using Microspheres / Lightweight Fillers in Waterproofing Bitumen Membranes

- *Overall Benefits*
- *Case Study*

Overall Benefits of using LWF in waterproofing bitumen membranes



Lower weight / yield enhancement
More rolls/ membranes at same weight.
Transportation Savings

Enhancing bitumen softening and penetration reducing viscosity

Cost reduction
By using less polymer or bitumen allowing the introduction of higher recycled material content
Energy reduction

Enhanced flexibility
Better performance at lower T^a

Enhances comfort
E.g., emittance, ISR and potentially acoustic



- ✓ The benefits vary depending on dosage of LWF and bitumen type
- ✓ Approach may vary depending on raw materials and regulations

LWF / Microsphere used in this study

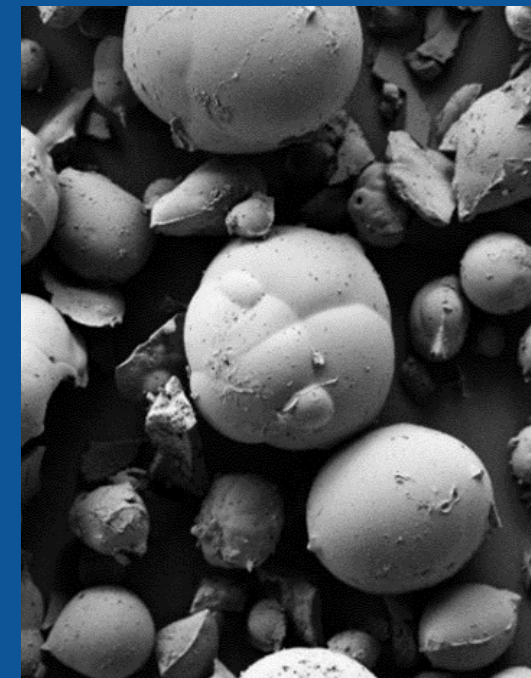
Particle Size d_{50} / d_{98} (μm)	Bulk density (g/cc)	Effective density (g/cc)	Surface Treatment
110 / 270	0.14	0.27	Siloxane Based

% by weight of LWF / microsphere	Ratio of (partial) filler replacement
4%	1:10 by weight meaning 1:1 by volume

LWF = Lightweight filler

“

Closed Cell Expanded Perlite alumina-silicate based



Formulations

Reference without LWF / Microsphere

Material	Weight (%)	Volume (%)
Binder	60	80
Filler (CaCO ₃)	40	20
LWF / Microsphere	-	-
Total	100	100
Density (g/ml)	1,39	

Alternative 4% LWF / Microsphere

Material	Weight (%)	Volume (%)
Binder	82	80
Filler (CaCO ₃)	14	5
LWF / Microsphere	4	15
Total	100	100
Density (g/ml)	1,02	

- ✓ Replacement on the **volume basis** of part of the filler by LWF / microsphere
- ✓ Keeping constant volume of binder (it can be adjusted later after performance test)

LWF = Lightweight filler

Results

	Reference No LWF / Microsphere	4% LWF / Microsphere
Density (g/ml)	1,39	1,02
Penetration (0.1 mm)	27	35
R&B (°C)	115	125
Viscosity @180°C (mPa.s)	8500	3500
Cold Bending (°C)	-21	-25
Weight of roll (3.5mm)	50	39

- ✓ Binder softer and less viscous, higher flexibility leads to lower energy and polymer reduction
 - ✓ Density reduction leads to higher yield and transportation savings

Summary

Summary

Lightweight Fillers / Microspheres based on Closed-Cell Expanded Perlite in waterproofing asphalt membranes leads to:

- **Weight reduction** at the same thickness ➡ **Transportation Savings**
- Increased **yield** ➡ **Doing more with less**
- **Enhanced** Penetration, R&B, Flexibility properties ➡ **Energy savings**
- **Enhanced rheological** properties ➡ Act as buffer adding other materials
- **Lower polymer** content ➡ **Binder savings** or **higher recycled** content
- Ongoing testing confirming **Comfort Properties improvements:**
Reflectivity, Emittance and Sound dampening

Make Your Life Easier with LWF / Microspheres based on Closed Cell Expanded Perlite



Visit our website for
lightweight fillers:
lightweightfillers.omya.com
omyasphere200.omya.com

Get in Contact:

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Director Global Business
Development

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+34 672 310 807

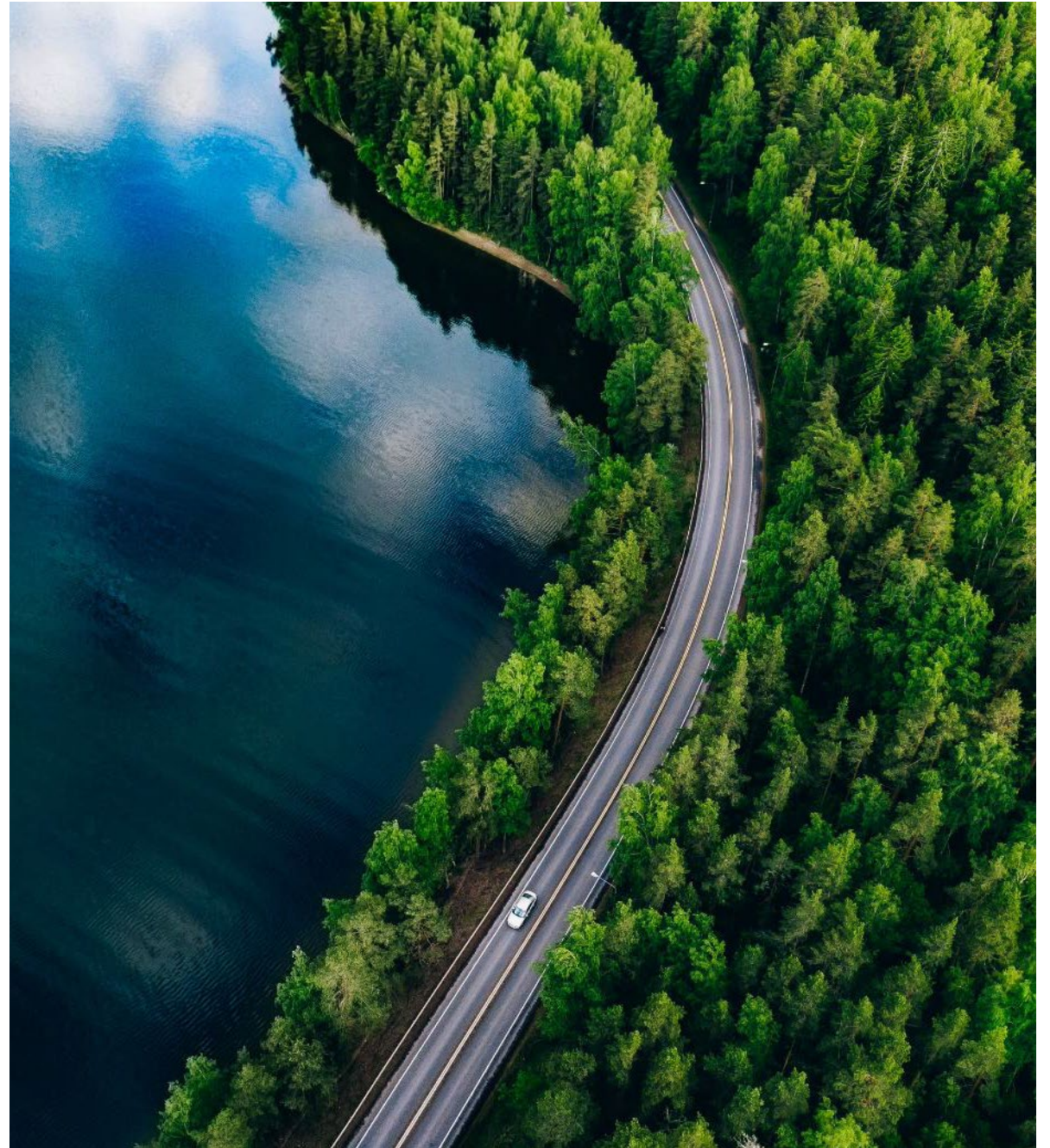


THINKING OF TOMORROW

**Sustainable Solutions.
Endless Innovation.™**

New developments for sustainable roofing membranes

**Erik Scholten – Sales Director EMEA Kraton Polymers
Almere, The Netherlands**



Advancing The Circular & Biobased Economy

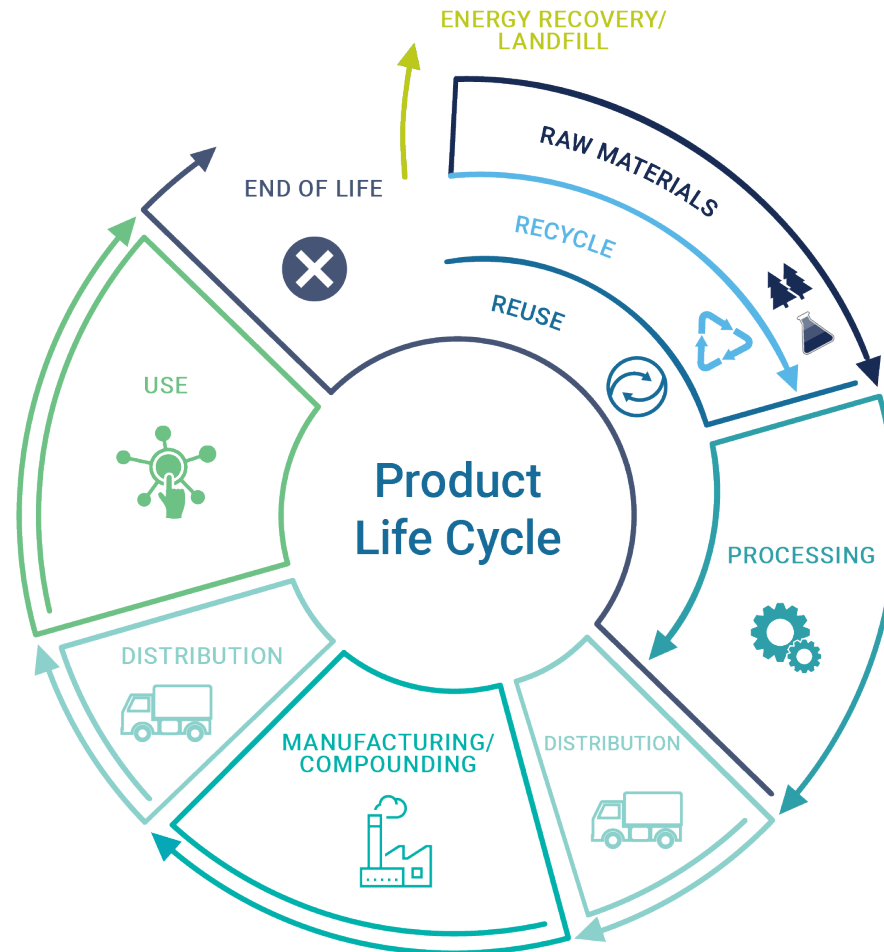
Rethinking Solutions With Circularity In Mind Requires A Holistic Approach

END OF LIFE

- Retain Component Value
- Enable Re-use, Recycling, Biodegradability

USE

- Extend Life, Reduce Cost In Use
- Improve Product Performance
- Lower Energy Consumption
- Fuel Economy
- Reduce Weight



RAW MATERIALS

- Allow Uptake Of Recycled Plastics
- Shift To Renewable Materials
- Reduce Scope 3 Emissions
- Responsible Procurement

PROCESSING / MANUFACTURING

- Reduce Operational Emissions
- Process Efficiencies
- Reduce Waste, Water
- Reduce VOC
- Safe Handling
- Meet H&S Requirement

Different routes to reduce the environmental impact of bituminous roofing membranes

Using raw materials with lower Global Warming Potential (Carbon Footprint)

- polymers made with bio-circular or circular Butadiene and Styrene
- SBS made with ISCC PLUS certified mass balanced bio-circular or circular feedstocks is now available

Extending life or lower energy consumption

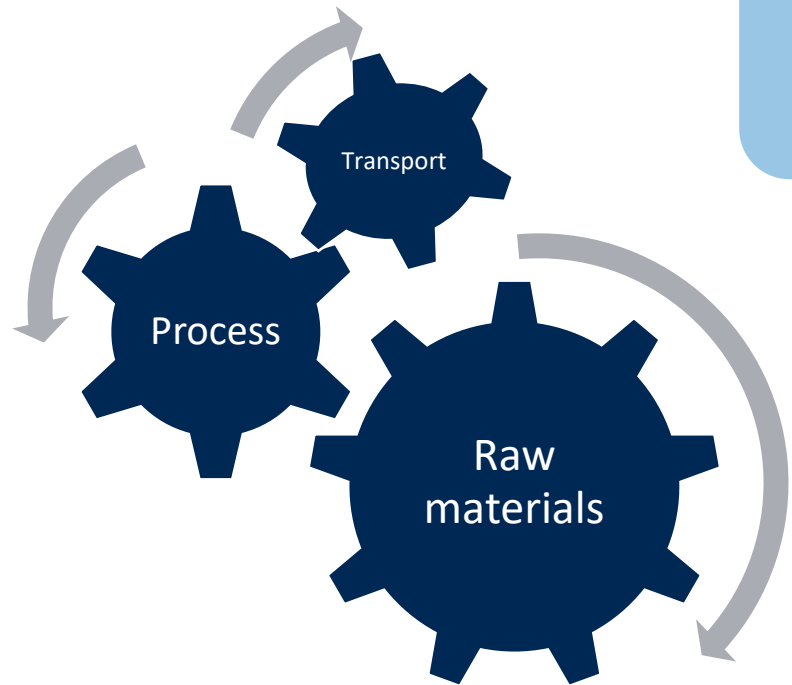
- Lower viscosity polymers allowing temperature reductions in process
- Improved performance (example self adhesive membranes)

Adding bio-renewable material to reduce Carbon Footprint

- Pitch allows use of harder bitumen grades with potential cost saving
- Rosin esters act as tackifier in self adhesive membranes



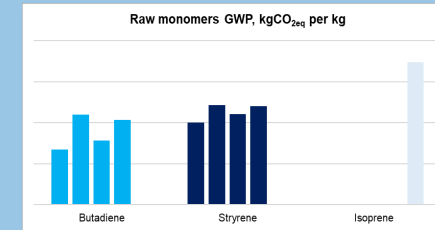
LCA modelling parameters



LCAs are specific and with degree of variability

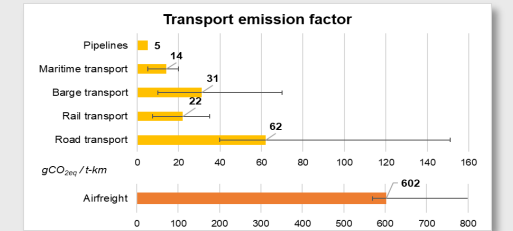
Raw materials for polymers

- The main materials are monomers Butadiene, Styrene, Isoprene
- Regional data from Gabi database



Transportation

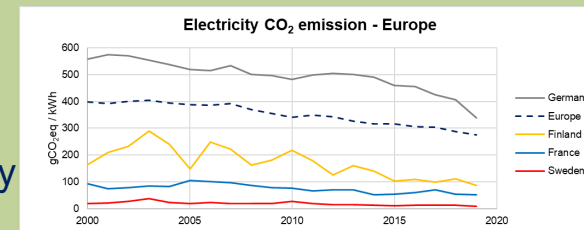
- Take into account proximity of local supplier
- Depends on transport mode



<https://www.ecta.com/wp-content/uploads/2021/03/ECTA-CEFIC-GUIDELINE-FOR-MEASURING-AND-MANAGING-CO2-ISSUE-1.pdf>

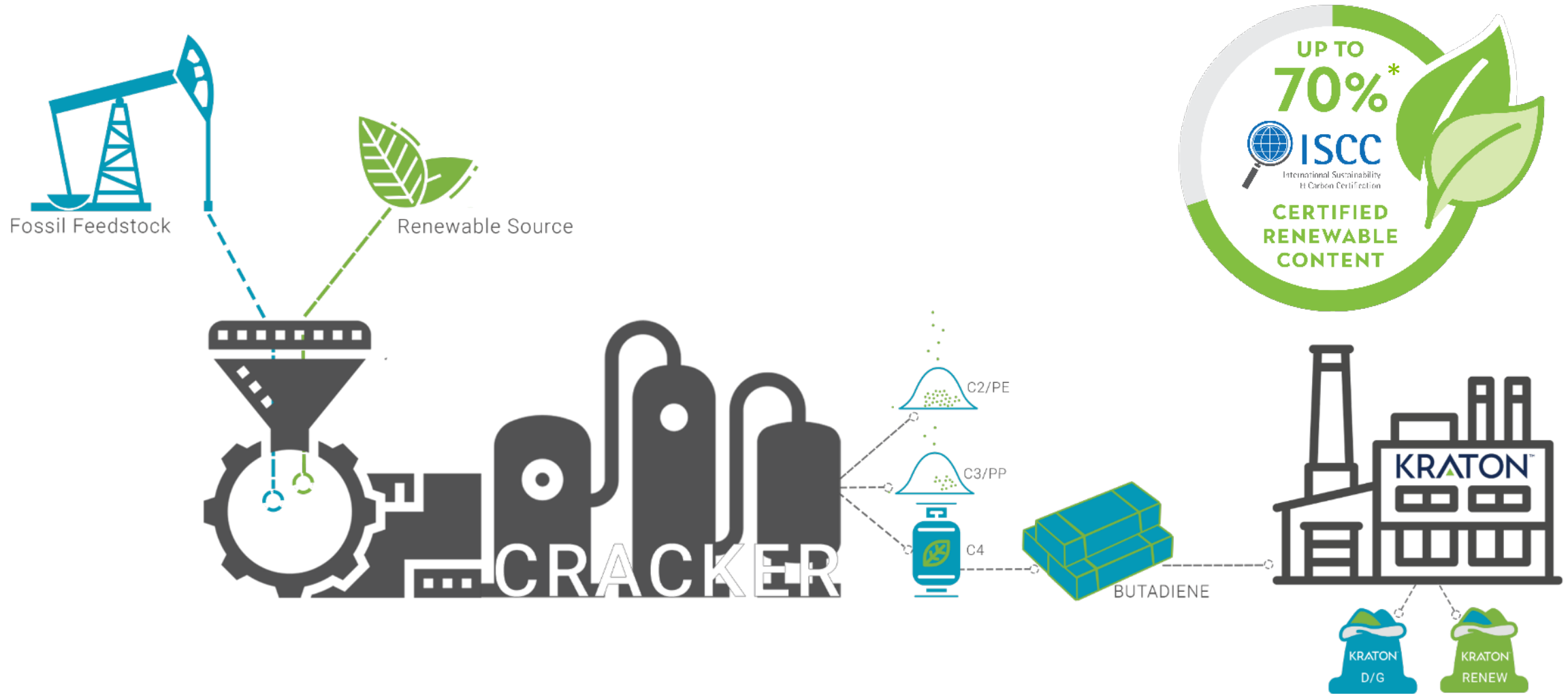
Process

- Specific to plant
- and regional energy
- Total average vs. specific intensity



<https://www.eea.europa.eu/data-and-maps>

CirKular+ Renew series ISCC PLUS certified solutions*



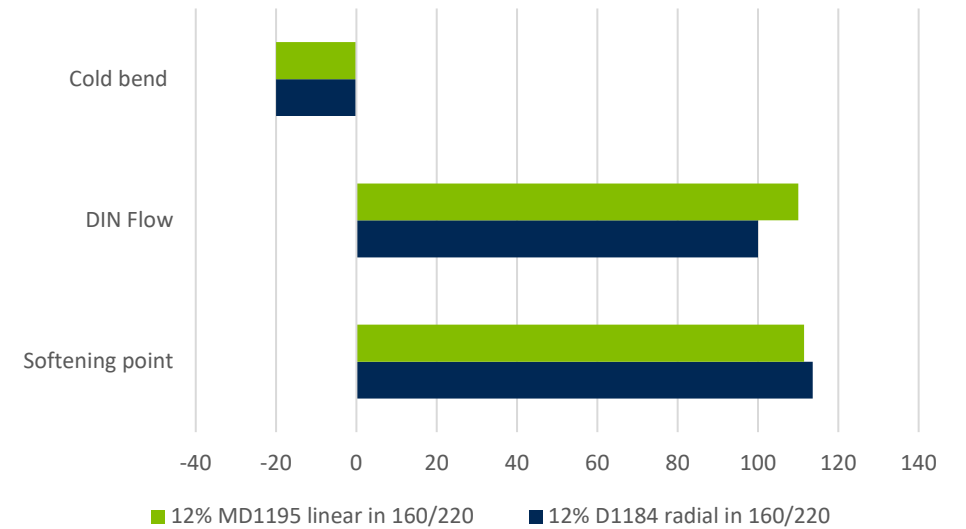
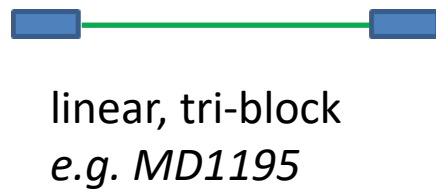
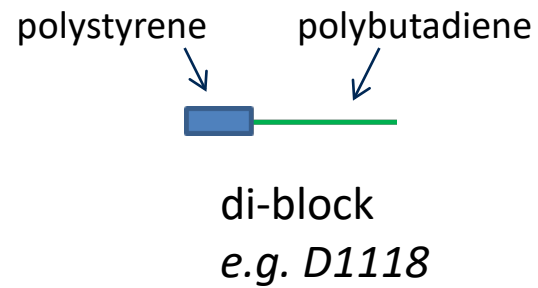
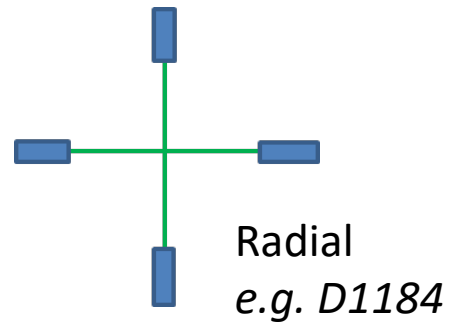
*attributed via mass balance accounting

Improved performance

Radial SBS traditionally polymer of choice for roofing membranes

New linear SBS type MD1195 opens opportunities

- Similar high temperature performance as radial but softer compound



Self adhesive membranes

New linear SBS type MD1195 opens opportunities for example in self adhesive membranes

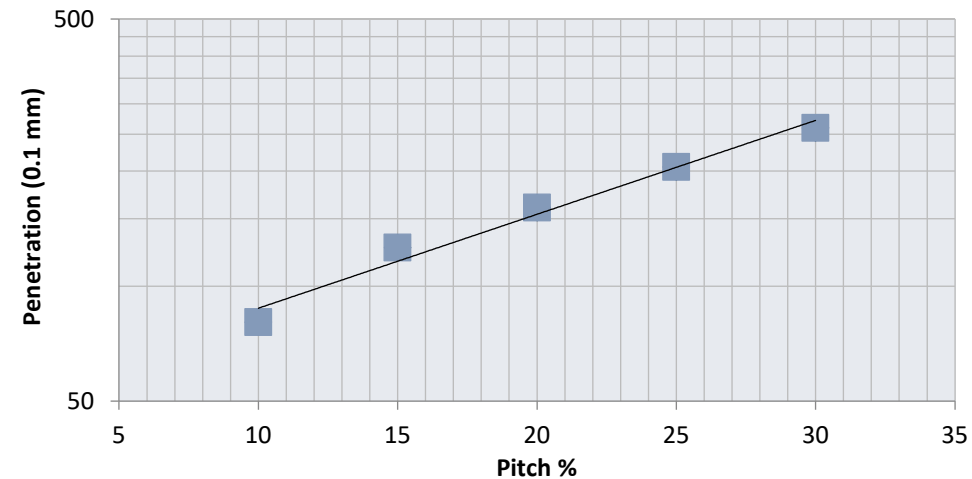
- Improved peel values at room temperature

	160/220 bitumen + 5% oil + 6% D1184 radial + 10% D1118 diblock	160/220 bitumen + 5% oil + 6% MD1195 linear + 10% D1118 diblock
T-peel @ 5°C (N/25 mm)		
- Directly	22	10
- After 1 hour	63	47
- After 24 hours	102	88
T-peel @ 23°C (N/25 mm)		
- Directly	29	18
- After 1 hour	29	32
- After 24 hours	38	85

Adding bio-renewable material to reduce carbon footprint*

Tall Oil Pitch

- Bottom of bio refining of Crude Tall Oil
- Compatible with bitumen
- Softening effect allows use of harder bitumen grades

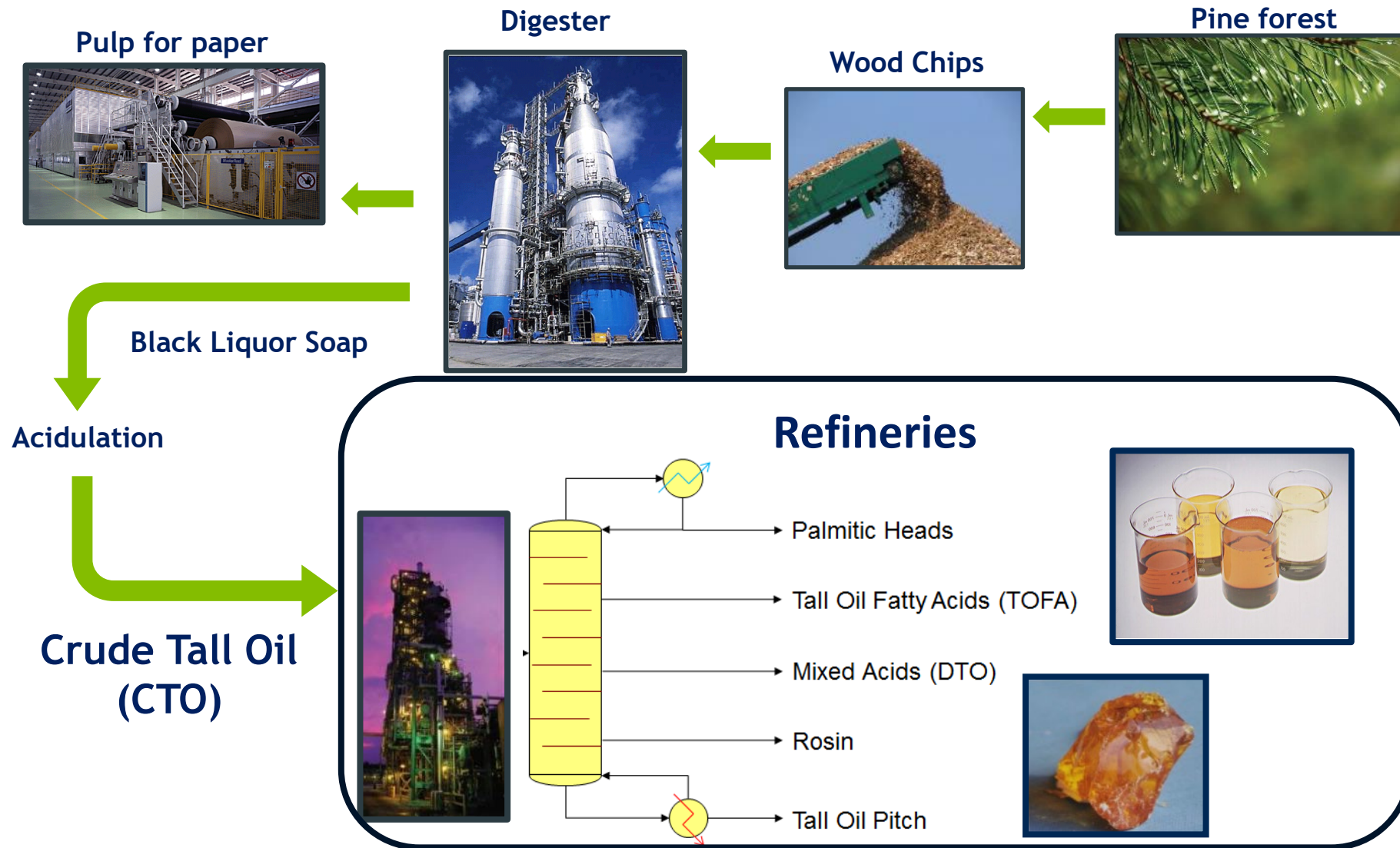


Rosin esters

- Tackifier with potential application in self adhesive membranes
- Compatible with bitumen

* The actual life cycle performance improvement that is achieved can only be concluded through an ISO certified process.

Bitumen additives from pine chemicals



Impact of alternative binder composition - cradle to gate

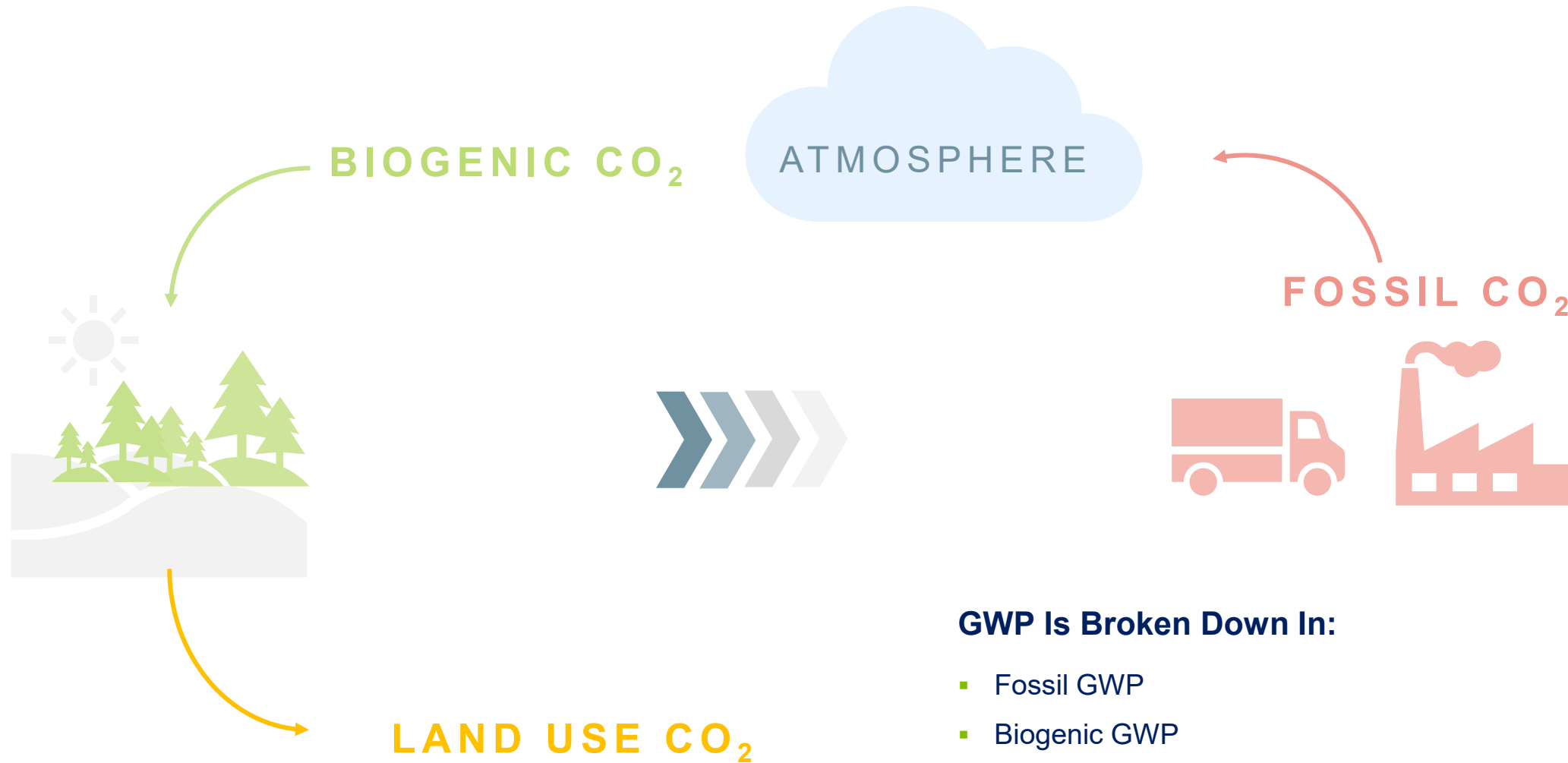
Comparing options

- Base option with standard SBS
- Alternative option with specific SBS and pine based tackifier
- Alternative option with ISCC PLUS mass balance certified SBS and pine based tackifier

Cradle-to-gate approach

- On basis of equal performance in waterproofing system
- Processing, installation, use and end of life being equal

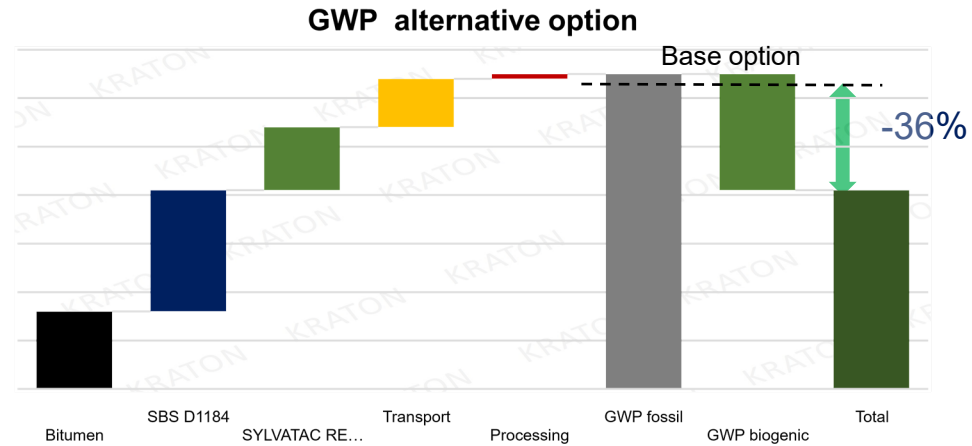
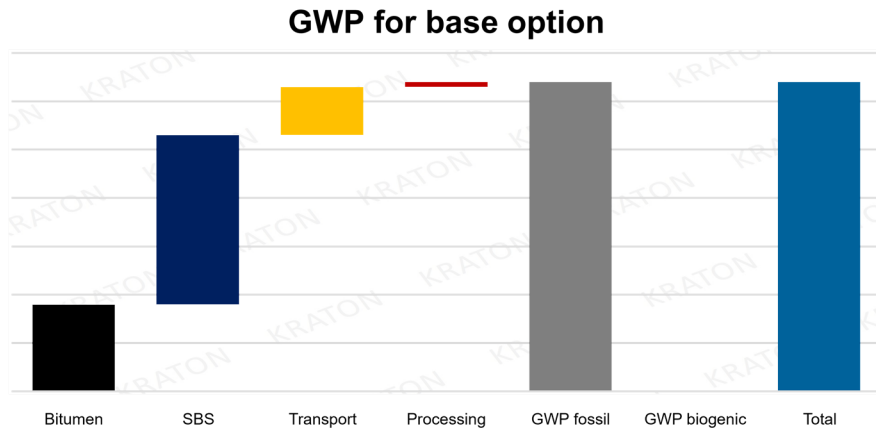
Global Warming Potential (GWP) - Polymer



GWP Is Broken Down In:

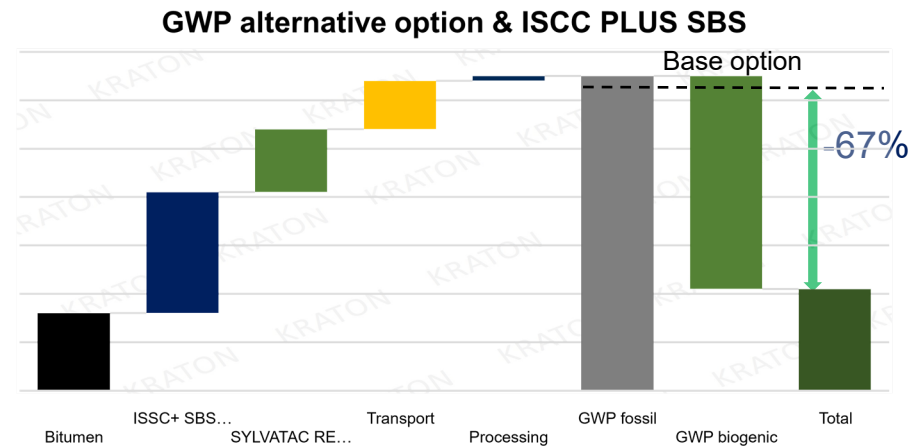
- Fossil GWP
- Biogenic GWP
- Land Use GWP
- And Should Be Recorded Separately Until End-of-Life

Impact alternative binder – cradle-to-gate results



- Formulation:
- 80% bitumen
 - 10% SBS
 - 10% pine chemistry

- Alternative option with specific SBS + pine chemistry → 36% GWP reduction
- Alternative option with ISCC PLUS + SBS + pine chemistry → 67% GWP reduction



Concluding remarks

Different options available today to reduce the GWP of bituminous roofing membranes

- Using raw materials with lower GWP, such as polymers made with bio-circular or circular Butadiene and Styrene
- Performance enhancements and production efficiencies by using for example lower viscosity polymers
- Adding bio-renewable material to the formulation for example as partial bitumen replacement

SBS made with ISCC PLUS certified bio-circular or circular Butadiene and Styrene

- Large impact on GWP of SBS
- No changes in technical performance

New polymer technologies offer performance and processing improvements

- Lower viscosity polymers allowing temperature reductions and reduced energy consumption

Cradle-to-gate comparison of GWP bituminous compounds

- GWP of polymer can be reduced with selection of SBS (LCA per SBS type / production plant)
- Adding bio-renewable material from pine chemistry greatly reduces GWP
- Further reductions can be obtained by using SBS made with ISCC PLUS certified (bio) circular Butadiene and Styrene

Thank you for your attention

Special thanks to Laurent Porot, market development manager

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EU Single Market for construction products

Current rules & foreseen changes

Impervius Conference 2023

Introduction

- ▼ Established in 1988;
- ▼ Work towards **consensus** on generic issues;
- ▼ Membership made up of national and EU associations.

Purpose:
Lobby on CE marking & sustainable construction

We deliver ...

▼ Networks:

- Internal, we bring together experts from all sectors of our industry;
- External, we know and collaborate with all construction-related stakeholders;
- Established and lead the Construction 2050 Alliance.

▼ Knowledge:

- Champion competitiveness through improved Construction Products Regulation;
- Leading debates on affordable/sustainable/circular/net-zero/digital construction.

▼ Visibility:

- To our members and industry through social media and events.



EU Green Deal & construction



Ongoing EC research projects:

- Measuring the application of circular approaches in the construction industry
 - Innovative circular solutions and services for the housing sector (Houseful)
 - EU-wide whole life carbon roadmap
 - EU framework for Digital Building Logbooks
- Feasibility Study on an EU Database for Construction Products (announced)

Regretfully, no EC coordination between projects nor EC construction strategy.



Where are we now?



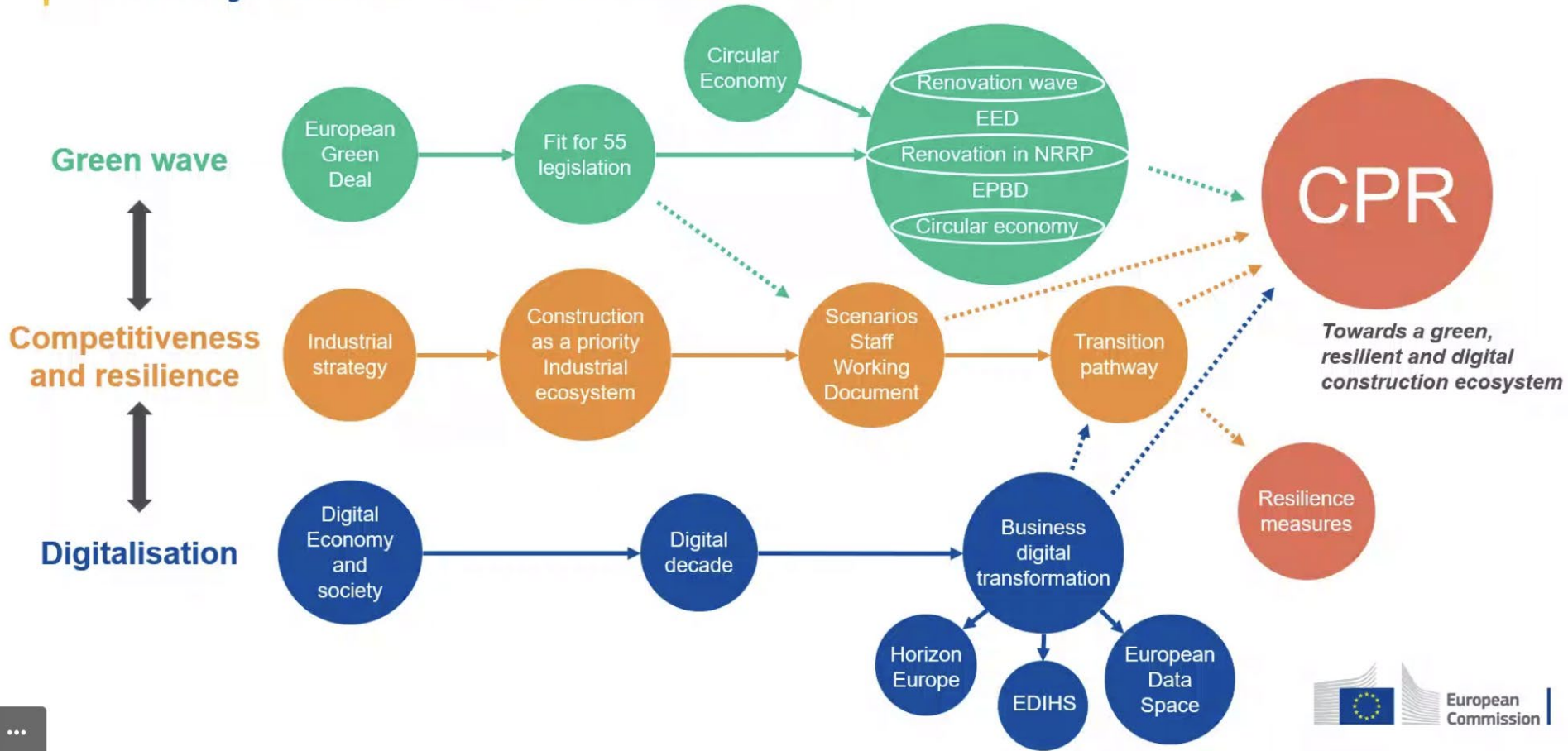
CONSTRUCTION PRODUCTS EUROPE
LET'S BUILD AN EFFICIENT EUROPE

EU construction-related topics	EU legal framework	EU tools
Skills/Labour		
Safety at works	EU-OSHA Framework Directive Technical specifications	
Raw materials	Waste Framework Directive	
Energy supply	Renewable Energy Directive Proposed Directive on the internal market in ... hydrogen	
Substances/mixtures	Construction Products Regulation REACH/CLP Ecodesign for Sustainable Products Regulation (ESPR) Restriction of Hazardous Substances (ROHS)	
Sustainability	Directive on corporate sustainability due diligence Ecodesign for Sustainable Products Regulation (ESPR)	Standards EU Taxonomy technical screening criteria
Placing on the market	Construction Products Regulation REACH/CLP Waste Framework Directive Revision of Directive on packaging and packaging waste Carbon Border Adjustment Mechanism (CBAM) Proposal for a Regulation on substantiating green claims Regulation on market surveillance and compliance of products Restriction of Hazardous Substances (ROHS)	Standards Product passport
Digitalisation	Construction Products Regulation REACH/CLP Waste Framework Directive Ecodesign for Sustainable Products Regulation (ESPR) Public Procurement	Standards Digital building logbook Product passport
(Green) Public Procurement		EU Taxonomy technical screening criteria
Construction works	Construction Products Regulation Waste Framework Directive	Standards Level(s) Digital building logbook
Safety of works	Construction Products Regulation	
Fire safety	Construction Products Regulation	Standards
Circularity/waste/reuse/recycling	Construction Products Regulation Waste Framework Directive REACH/Classification, Labelling and Packaging (CLP) Regulation Ecodesign for Sustainable Products Regulation (ESPR) Waste from Electrical and Electronic Equipment (WEEE)	Standards
Climate/emissions/energy efficiency	Construction Products Regulation Emissions Trading Scheme Carbon Border Adjustment Mechanism (CBAM) Energy efficiency Directive Ecodesign for Sustainable Products Regulation (ESPR) Industrial Emissions Directive Energy Performance of Buildings Directive	Standards



CONSTRUCTION CHALLENGES
What's Holding You Up?

Transition pathway of the construction ecosystem and the CPR





Focus on CE-marking

Construction Products Regulation (CPR) revision

- ▼ CPR entered into force in 2013;
- ▼ Main concern: legal status of (harmonised) product standards;
- ▼ **EC published revised CPR proposal April 2022;**
- ▼ Construction products to be excluded from Ecodesign for Sustainable Products Regulation (ESPR);
- ▼ **Council:** ongoing discussion in under SW Presidency, to be followed by ES;
- ▼ **European Parliament:** IMCO vote delayed to 23rd May & plenary in July.

Construction Products Regulation (CPR) revision

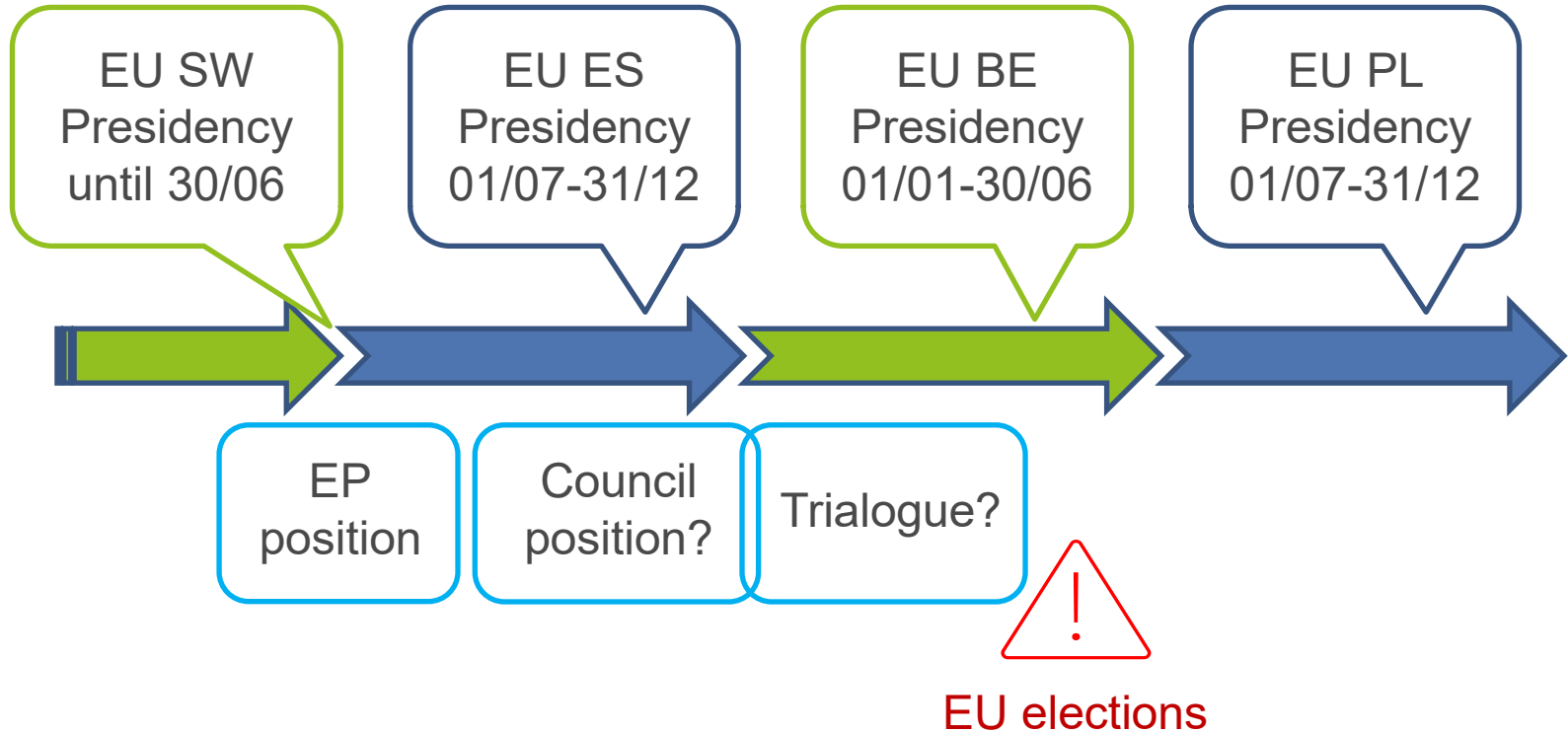
Proposed definition:

A construction product is any formed or formless physical item ... or a kit or assembly combining such items, that is placed on the market or produced for incorporation in a permanent manner in construction works or parts thereof ..., with the exception of items that are necessarily first integrated into an assembly, kit or other construction product prior to being incorporated in a permanent manner in construction works.

Current definition:

A construction product is any product or kit which is produced and placed on the market for incorporation in a permanent manner in construction works or parts thereof ...

Construction Products Regulation (CPR) revision



Construction Products Regulation (CPR) revision

What if?

- ▼ New CPR finalised & published in OJ in 2025;
- ▼ New Declaration of Performance (DoP) should include sustainability indicator(s);
- ▼ Announced entry into force 2045.

What does it mean?

- ▼ All those construction product families that will have completed the “acquis” process, will be CE marked according to new CPR;
- ▼ All other will CE mark according to existing CPR;
- ▼ One industry, two overlapping legal frameworks...

CPR acquis process

- ▼ EC invited Member States to adapt the harmonised standards (hEN), assessment documents, i.e. the acquis;
- ▼ A priority list was established, with each product family in turn working on their revised mandate and hEN;
- ▼ There are currently 444 hEN!
- ▼ The **roof covering mandate listed as n°21** (might get up to n°8 initiated this year);
- ▼ Fast track procedure launched, explanatory EC/CEN workshop suggested, most probably held in September.

For full list see here <https://ec.europa.eu/docsroom/documents/42129>

CPR acquis process

- ▼ CEN Technical Committee 189 Geosynthetics:
- ▼ CEN Technical Committee 254 Flexible sheets for waterproofing;
- ▼ Both groups already at work preparing the Acquis process;
- ▼ The **roof covering mandate listed as n°21 so *guesstimate* 2026-2027;**
- ▼ Construction Products Europe only industry representative in Acquis Steering Committee, providing support to our members.



What happens next?

Nonwoven textiles

- ▼ With revised CPR, **you will be classified as construction products**;
- ▼ No harmonised standard (hEN)? **Obligated to meet manufacturers' obligations**;
- ▼ Obligation to deliver conformity declaration including sustainability indicator(s);

Once the CPR is finalised, you may wish to consider requesting a hEN; a lengthy process but it may justify your exemption from ecodesign (ESPR).



Waterproofing membrane

- ▼ hEN for waterproofing membrane: EN 13707:2004+A2:2009 - EN 13707:2004+A2:2009 Flexible sheets for waterproofing - Reinforced bitumen sheets for roof waterproofing;
- ▼ No CE mark for components, unless these have specific hENs;
- ▼ **WARNING!** Component manufacturers may have to deliver technical and/or sustainable declarations to membrane manufacturers.

**Must consider your involvement in the Acquis process
& support CEN TCs**



Summary

CPR summary

- ▼ A revised CPR will be finalised in 2025/2026;
- ▼ Entry into force 2035-2045 depending on triaologue negotiations;
- ▼ Do not forget the acquis process;
- ▼ Plan ahead, get involved.



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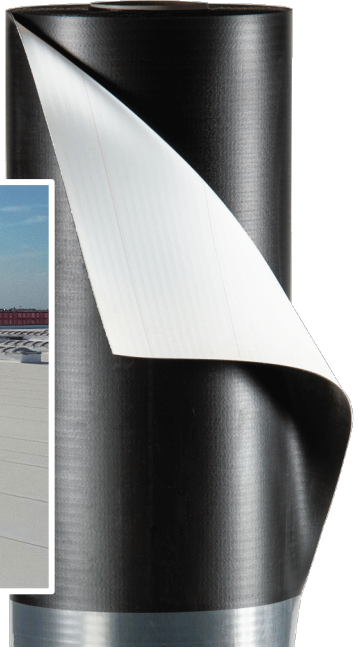
New analytical approach to formulate bituminous compound with REOBs

Ing. Antunes Ines

A. De Rosa – A. Massari - C. Oliviero Rossi



Polyglass R&D



Formulate bituminous compound with REOBs

Polyolefin polymers (APP) are used as bitumen modifiers due to the relatively low cost and good performance in compounds for waterproofing membranes

Main bitumen currently used in Italy is Industrial grade 160/220 aliphatic and it shows good phase inversion (compatibility) with APP

Industrial bitumen is only 14% of global Italian bitumen production

Sustainability/Green Economy is a driver

Sustainability as a driver to formulate

It's not just about the environment

Sustainability target is to focus on product quality

Durable products means less waste and less exploitation of resources and therefore less impact on the environment



R&D Main Topics on Sustainability

Selected Recycled Raw Materials

- High performance recycled polymers
- Raw materials from highly selected waste
- **Re-refined Engine Oil Bottoms REOBs**

Reduced Energy
Consumptions



Sustainable product

(almost) Zero Waste
Production

Reduced Emissions

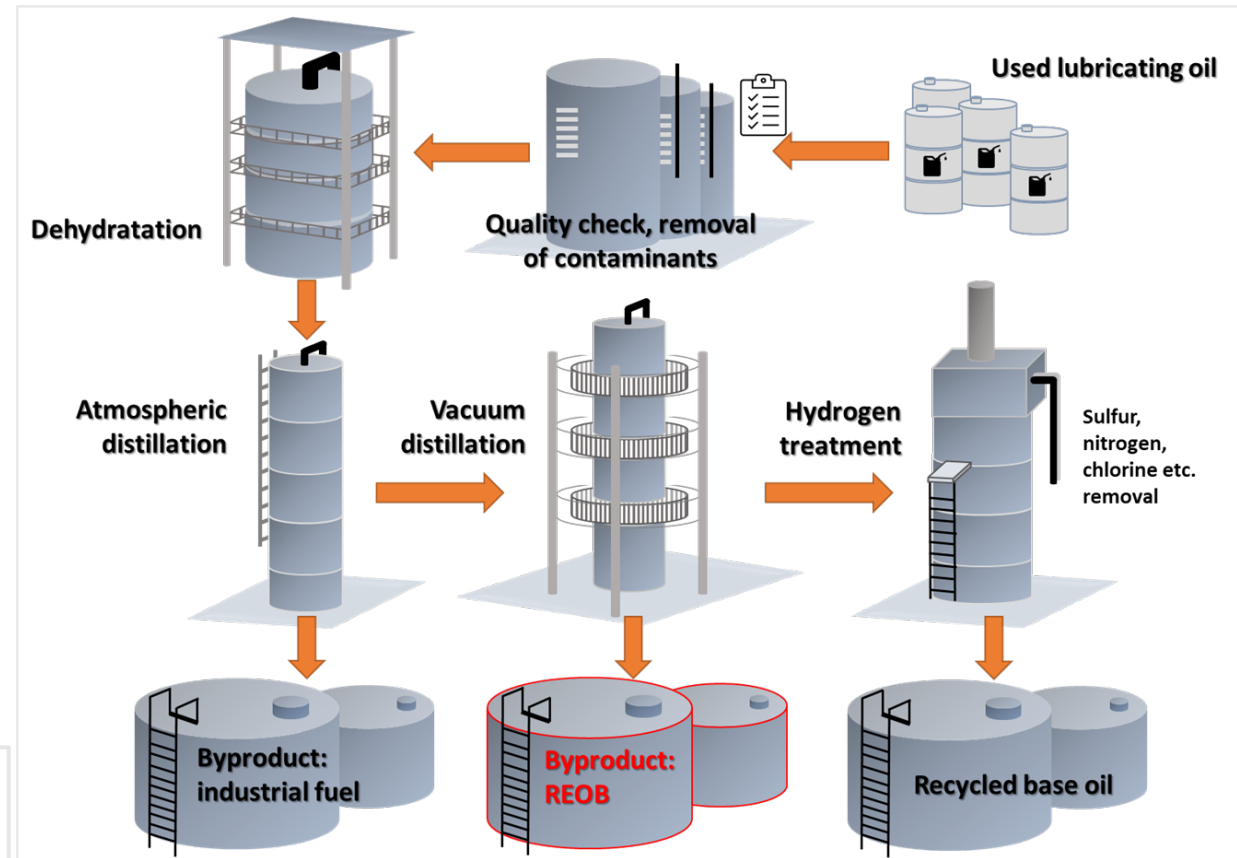
Why REOBs?

REOBs can be an alternative to virgin bitumen into polymer modified bitumen (PMB) formulations

There is a good literature about this argument but mainly the bitumen used is a paving bitumen

Expected performance:

- Reduce bitumen hardness (higher penetration grade)
- Decrease viscosity

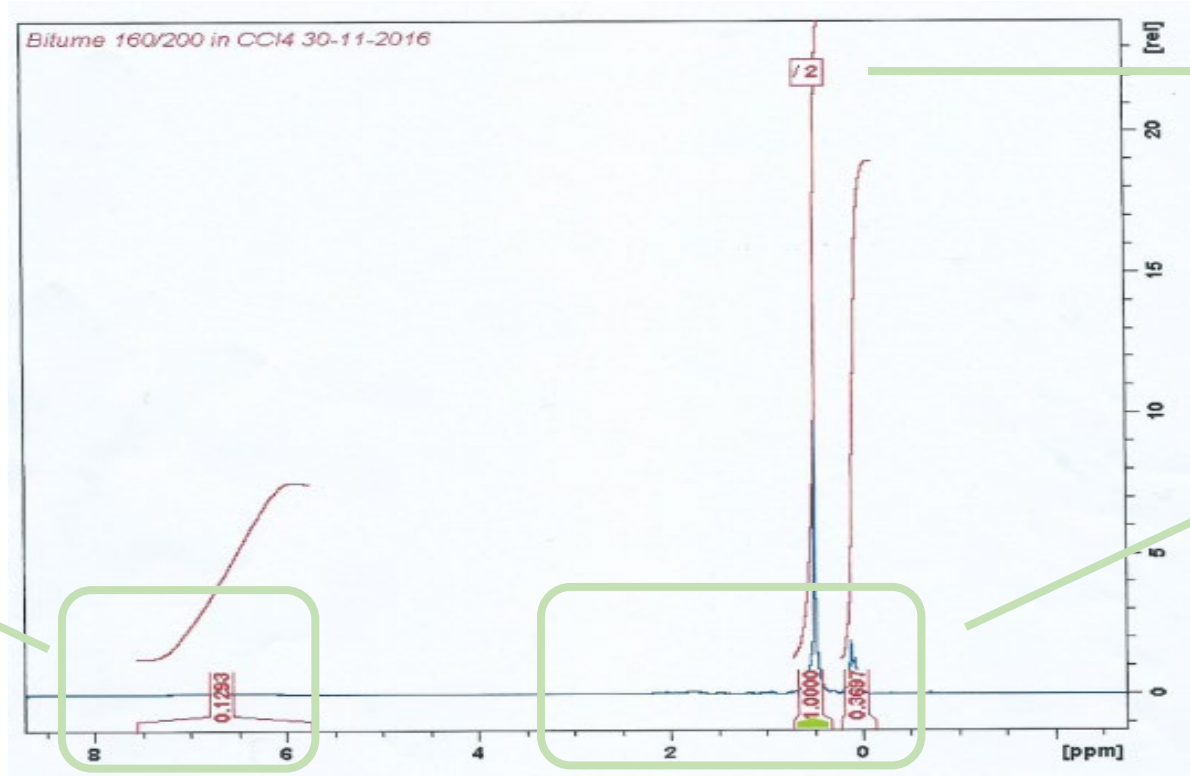
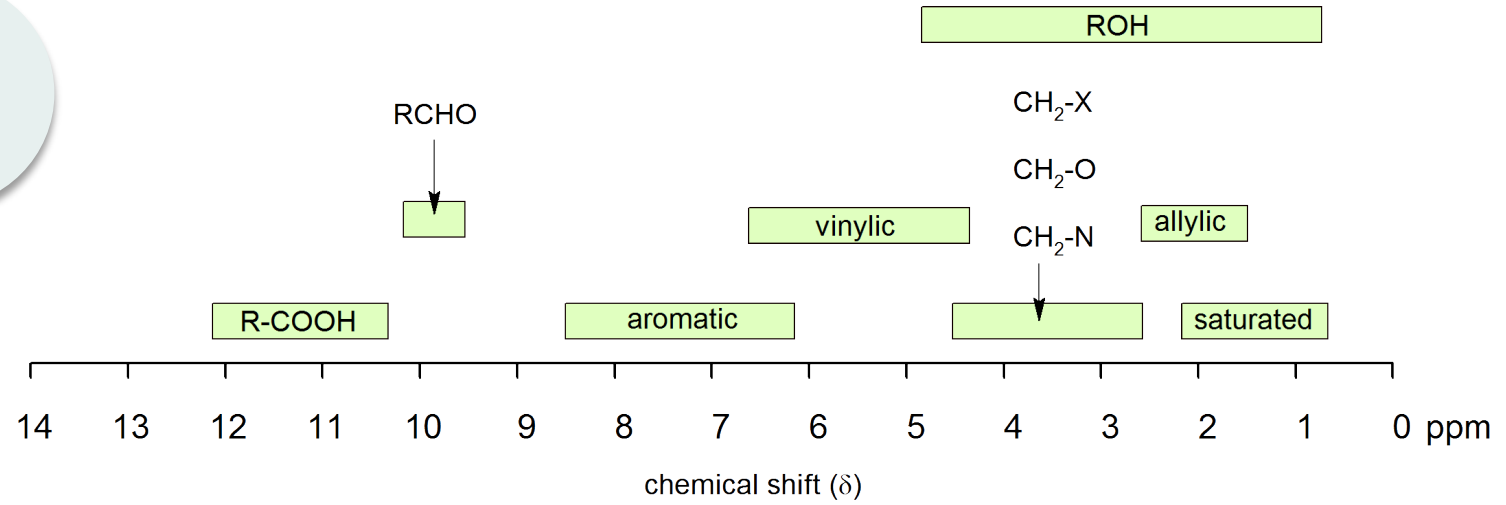


REOB is the result of a vacuum distillation of pre-treated used engine lubricating oil

Step 1 Project

^1H - NMR

^1H -NMR Spectroscopy

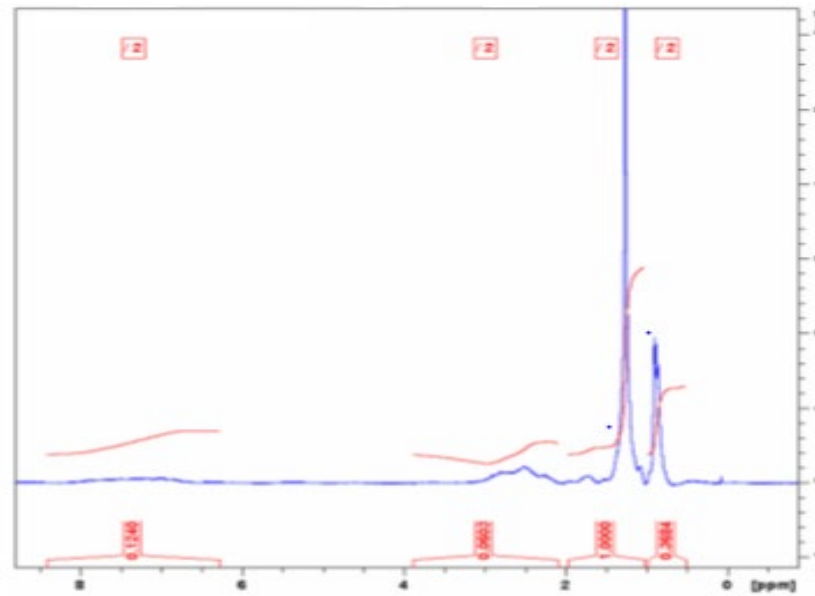


Reference signal

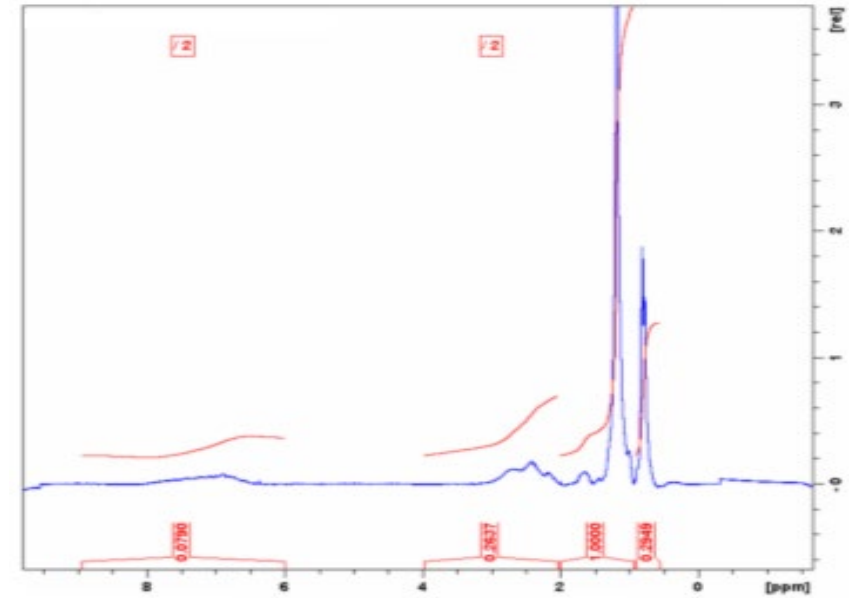
Aliphatic zone

Aromatic zone

NMR Neat Bitumen



Industrial 160/220

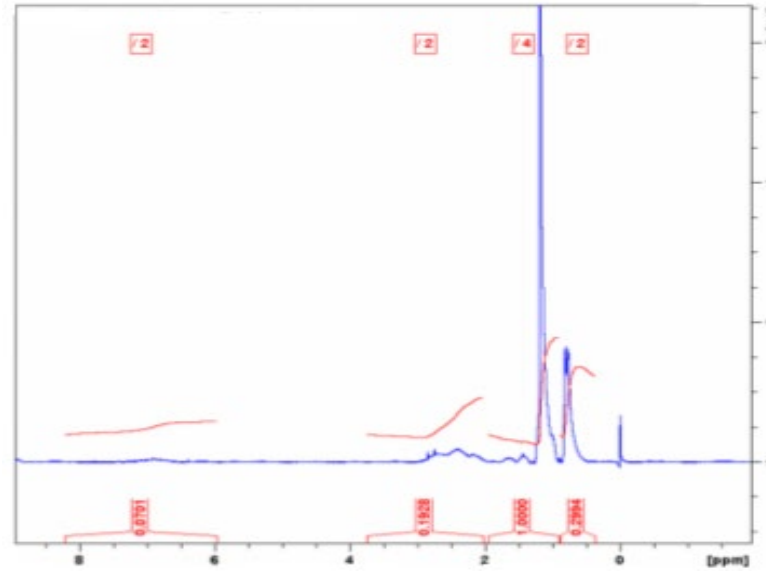


Paving 70/100

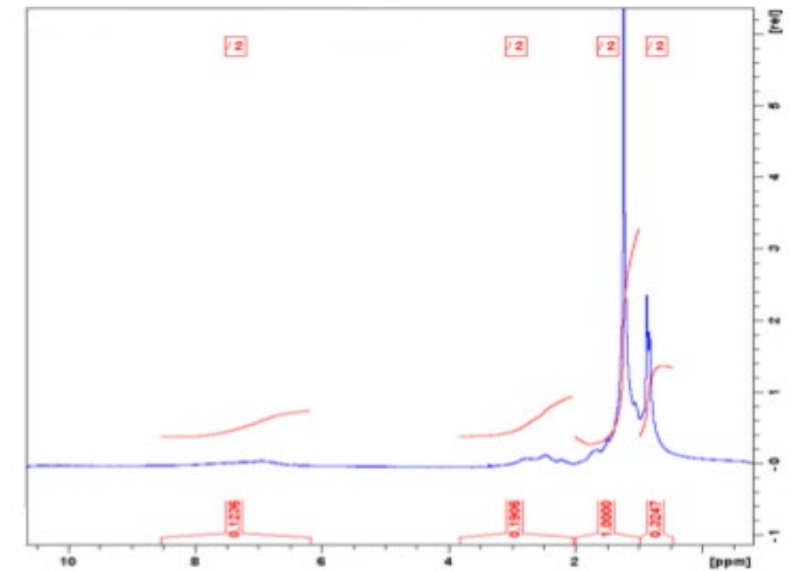
Sample	H _{ar}	H _α	H _β	H _γ
160/220	7,99	3,88	64,40	23,73
70/100	4,82	16,10	61,06	18,01

- Comparing the values of hydrogen distribution it can be observed that the bitumen have different distribution of hydrogen types
- Industrial bitumen shows a high percentage of aliphatic proton
- H_α percentage of 70/100 is much higher

NMR Maltene Fraction



Industrial 160/220

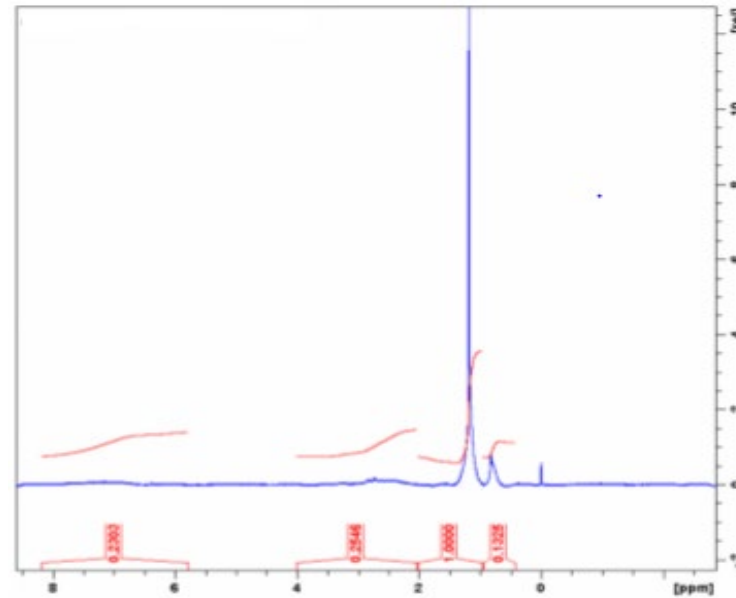


Paving
70/100

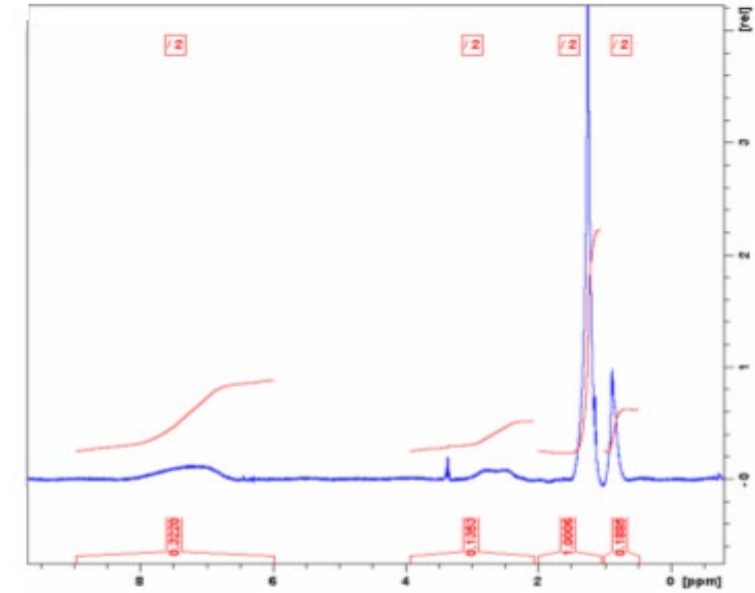
Maltene sample	Har	H α	H β	H γ
160/220	4,49	12,34	64,01	19,16
70/1100	7,54	11,61	61,00	19,86

- The maltene samples from the Industrial 160/220 shows a lower aromatic percentage

NMR Asphaltene Fraction



Industrial 160/220



Paving 70/100

Asphaltene sample	Har	H α	H β	H γ
160/220	14,25	15,75	61,80	8,19
70/100	19,58	8,19	60,79	11,44

- From the asphaltene fractions it can be declared that while no significant differences were observed between both types of aromatic hydrogens there is an apparent difference between the aliphatic hydrogens

NMR REOBS

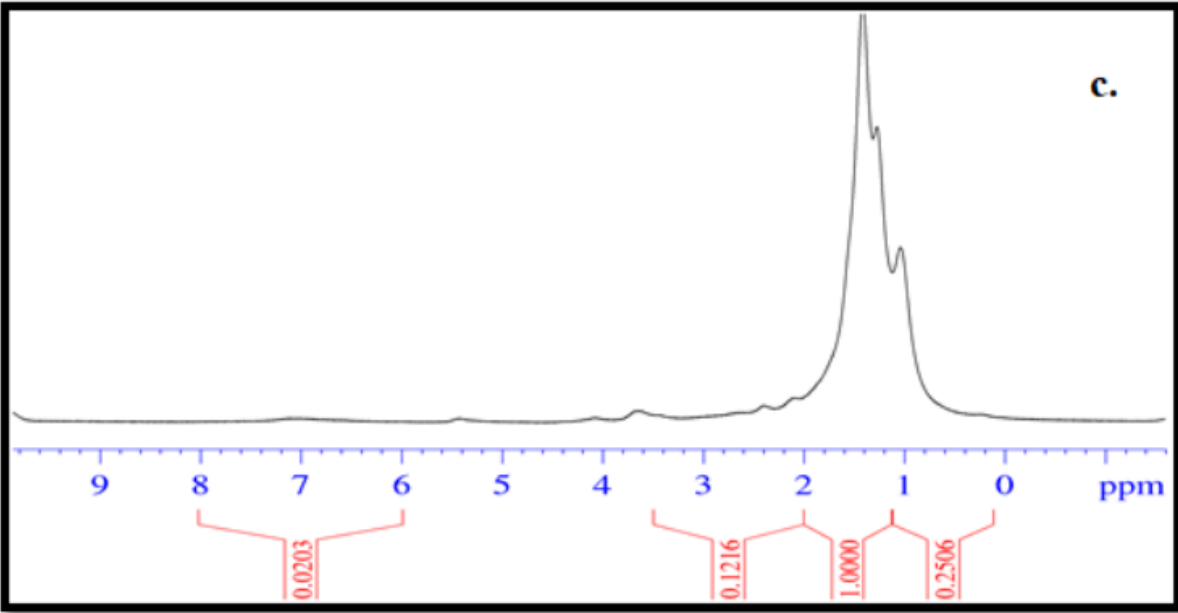
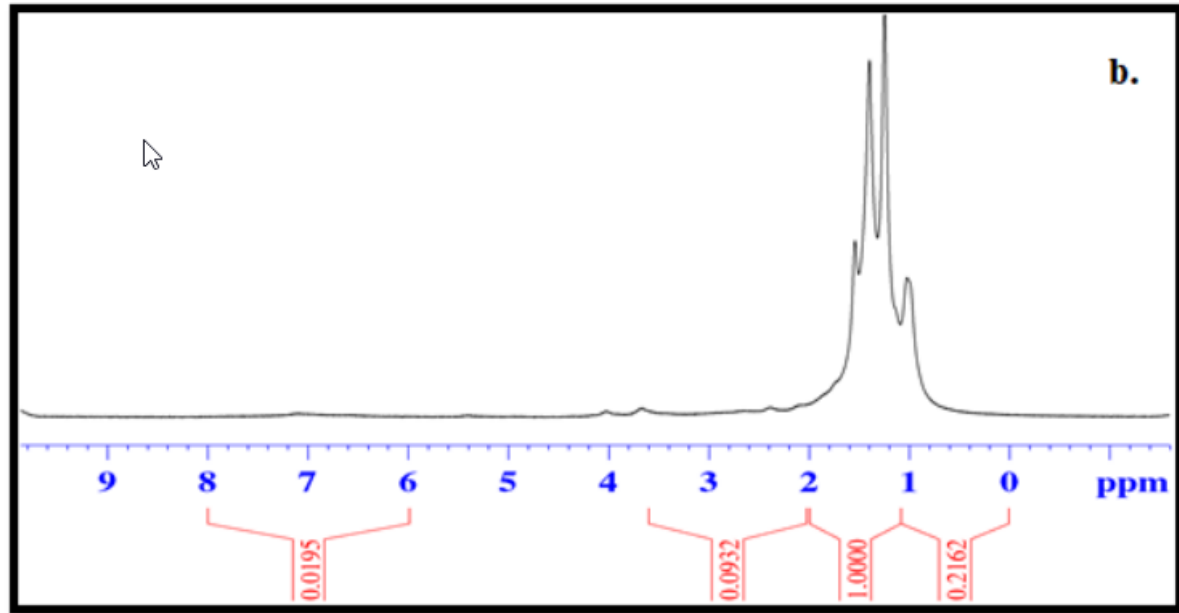
NMR 70/100

Maltene modification with
Flux/Plasticizer

Asphaltene modification
by surfactant

REOBS 1

REOBS 2



- Both are characterized by a rich aliphatic part

Step 2

BITUMEN

- Aliphatic Industrial bitumen
- Paving Aromatic bitumen

BITUMEN + PLASTICIZER (FLUX)

- Paving Aromatic bitumen + Oil
- Paving Aromatic bitumen + REOBs

BITUMEN + PLASTICIZER + POLYMER

- Paving Aromatic bitumen + polymer
- Paving + Oil + polymer
- Paving + REOBs + polymer

The impact of REOBs presence in formulation will mainly be evaluated through:

- Dynamic Scanning Calorimetry analysis (DSC) to assess glass transition shift
- Rheological investigation to understand compound behavior
- Ageing after RTFOT and PAV

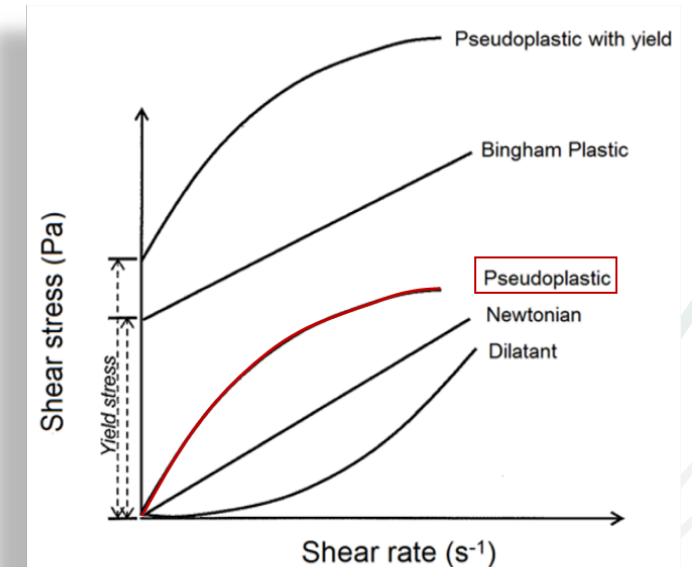
Setup DSC+DSR

Differential scanning calorimetry DSC

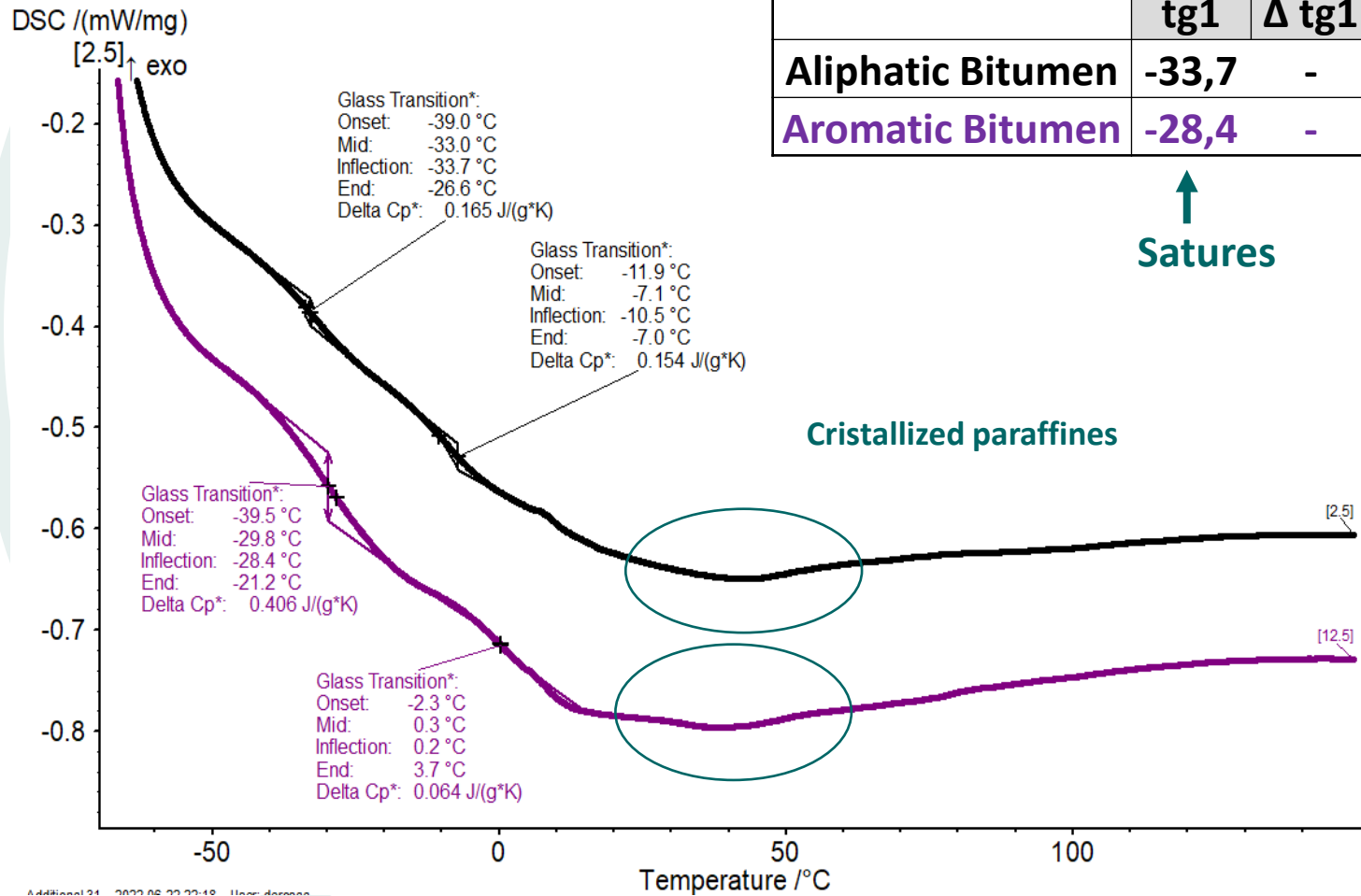


	MCR 302	
Bearing		Air
Min. Torque rot	nNm	1
Min torque osc.	nNm	0.5
Max torque rot/osc	mNm	200
Torque resolution	nNm	0.05
Deflection angle (preset)	μ rad	0.05 to ∞
Internal angular resolution	nrad	<10
Min angular velocity	rad/s	10^{-9}
Max angular velocity	rad/s	314
Time const. speed (66 %)	ms	5
Time const. Angle (66 %)	ms	10
Step time speed (99 %)	ms	30
Step time angle (99 %)	ms	30
Min. angular frequency	rad/s	$1.0E-07$
Max. angular frequency	rad/s	628
Normal force range	N	0.005–50
Normal Force resolution	mN	0.5

Rheology analysis DSR



1. DSC Results



	tg1	Δ tg1	tg2	Δ tg2	Pen.25°C	Δ Pen.25°C
Aliphatic Bitumen	-33,7	-	-10,5	-	170	-
Aromatic Bitumen	-28,4	-	0,2	-	175	-

↑
Satures

↑
Aromatics

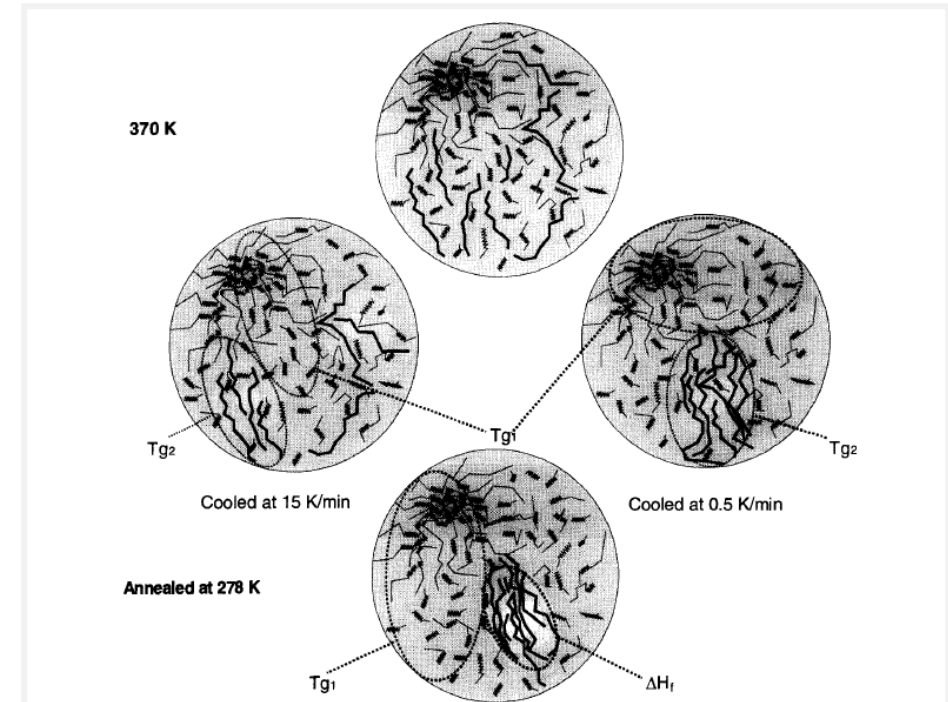
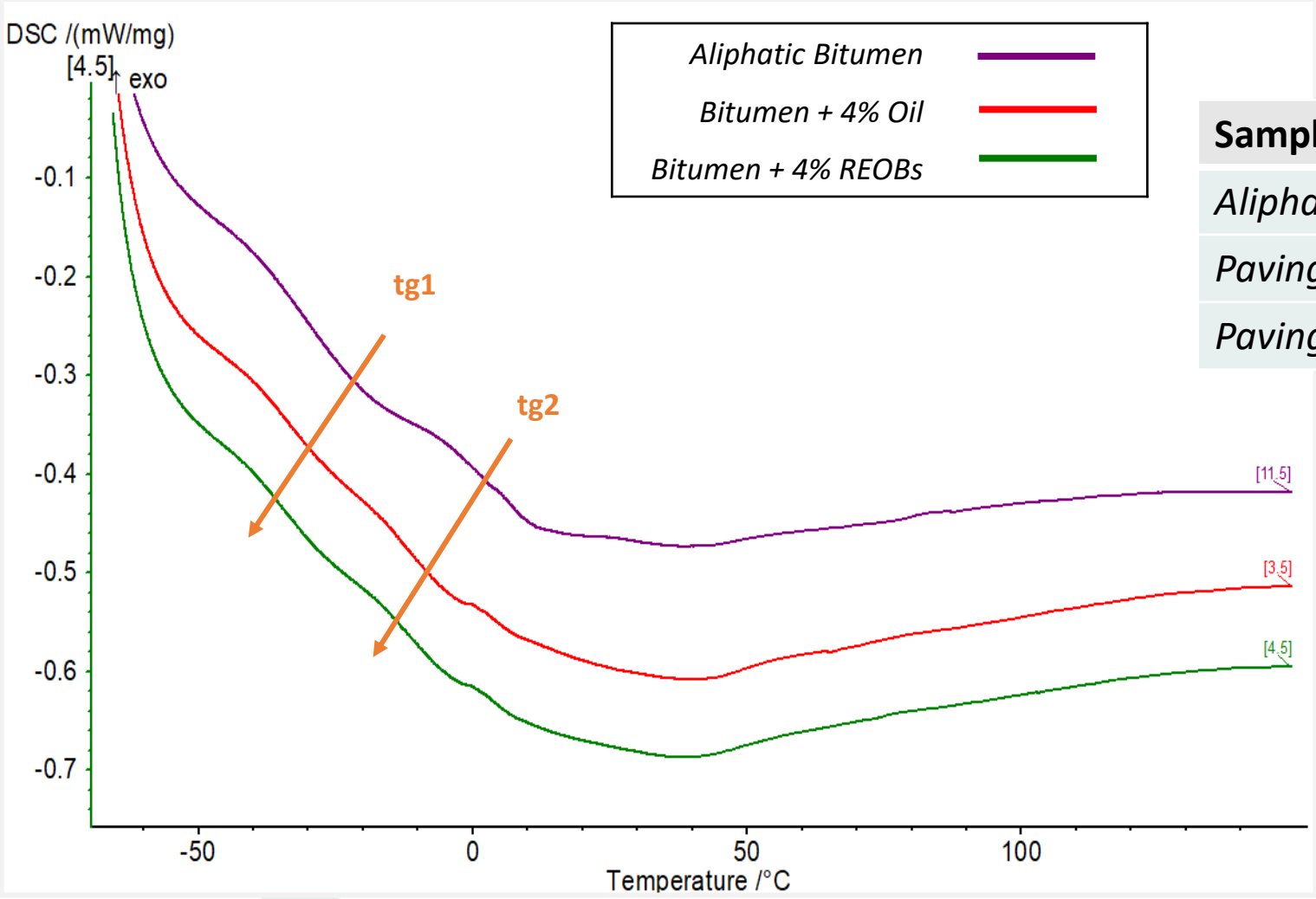


Figure 5 Representation of bitumen structure in the course of solidification. Shaded, Aromatics, wavy line, aliphatics, irregular shape, resins, asphaltenic micelles

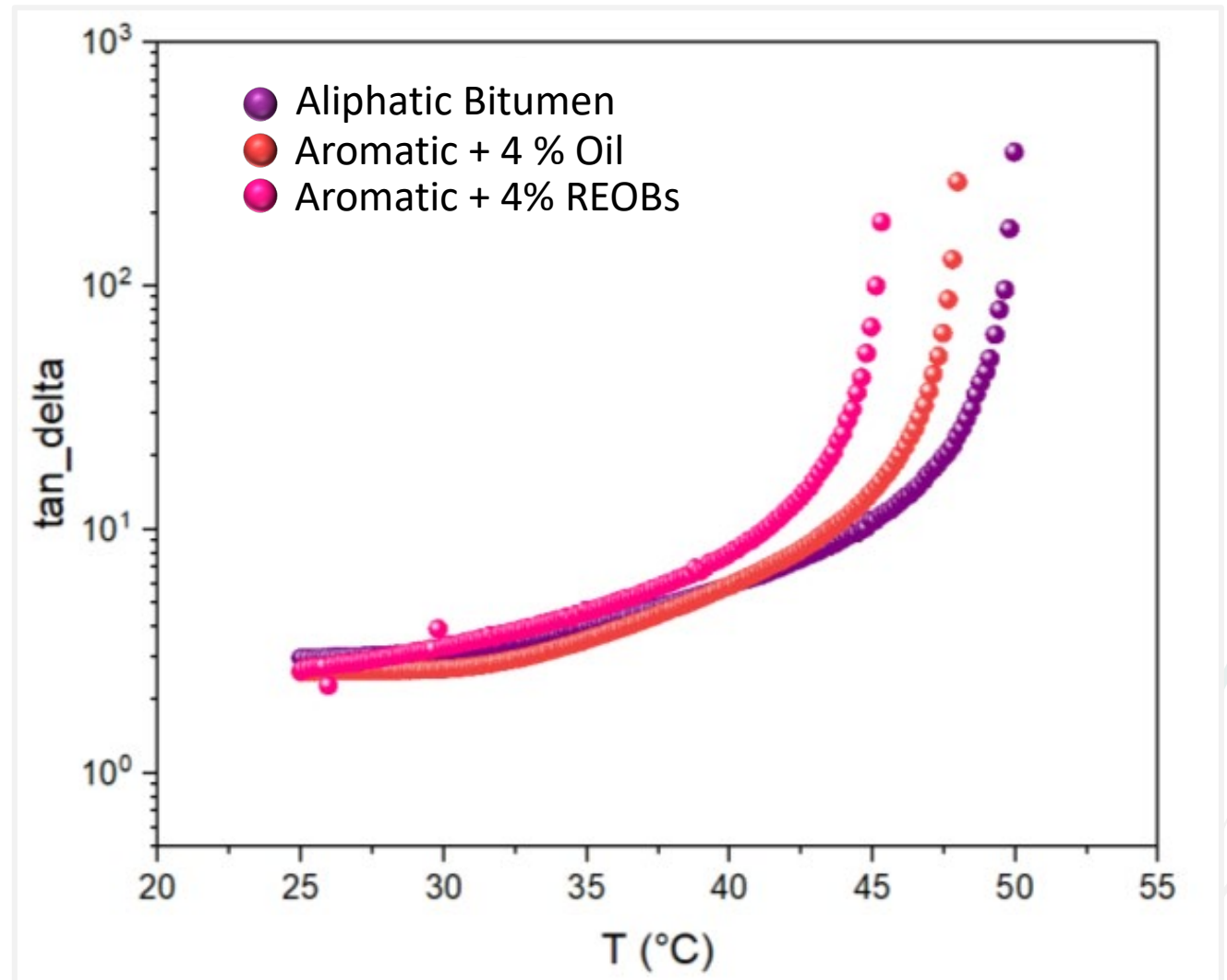
1. DSC Results



Sample	Tg 1	ΔTg1	Tg 2	ΔTg2
Aliphatic Bitumen	-33,0	-	-10,5	-
Paving + 4% Oil	-37,0	-4	-10	0
Paving + 4% REOBs	-39,5	-6,5	-11,3	-1,3

2. Rheological Analysis

	$T(^{\circ}\text{C})$	$\Delta T(^{\circ}\text{C})$
<i>Industrial Bitumen</i>	50	-
<i>Paving + 4% Oil</i>	47,9	-2,1
<i>Paving + 4% REOBs</i>	45,5	-4,5



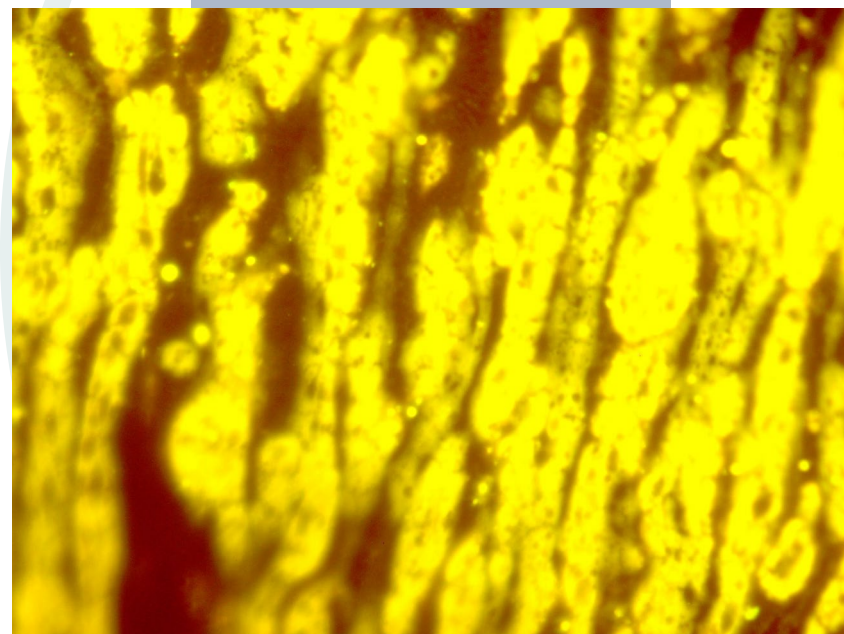
3.1 APP compound analysis

Sample	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
Aromatic Bitumen	72%	70%	68%	66%	70%	68%	66%
Filler	15%	15%	15%	15%	15%	15%	15%
IPP	13%	13%	13%	13%	13%	13%	13%
Oil	-	2%	4%	6%	-	-	-
REOBs	-	-	-	-	2%	4%	6%

	Reference	Oil				REOBs		
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	
<i>Pen. At 60°C (dmm)</i>	92	105	120	140	92	100	130	
<i>R&B (°C)</i>	155	156	156	156	153	155	156	
<i>Viscosity at 180°C (s.28)</i>	3700	2400	2200	2800	3500	3000	3100	
<i>Cold flexibility (°C)</i>	+5	0 lim	- 5 lim	- 10	0 lim	-5 lim	-15	
<i>Cold flex after aging 24h at 70°C (°C)</i>	n.d.		0			0 lim		

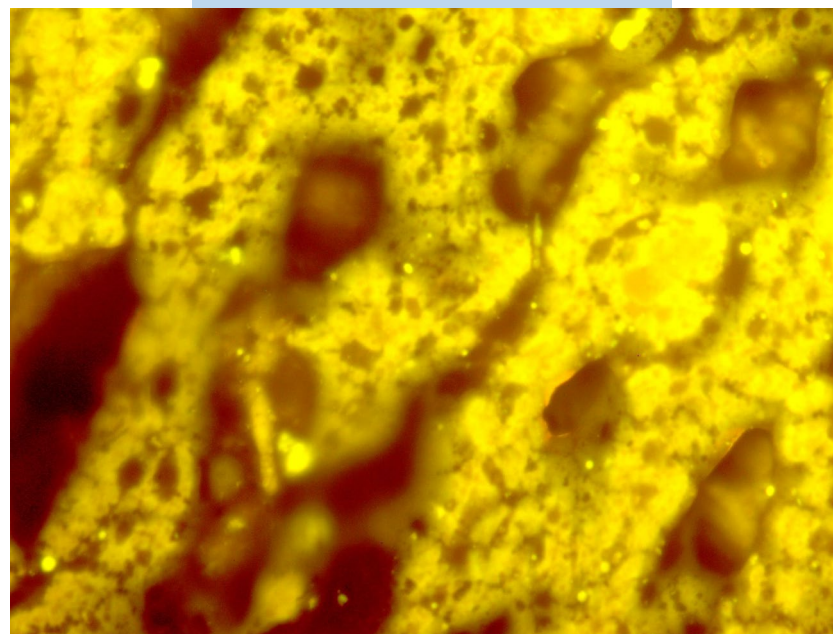
3.1 APP compound analysis

Sample 1



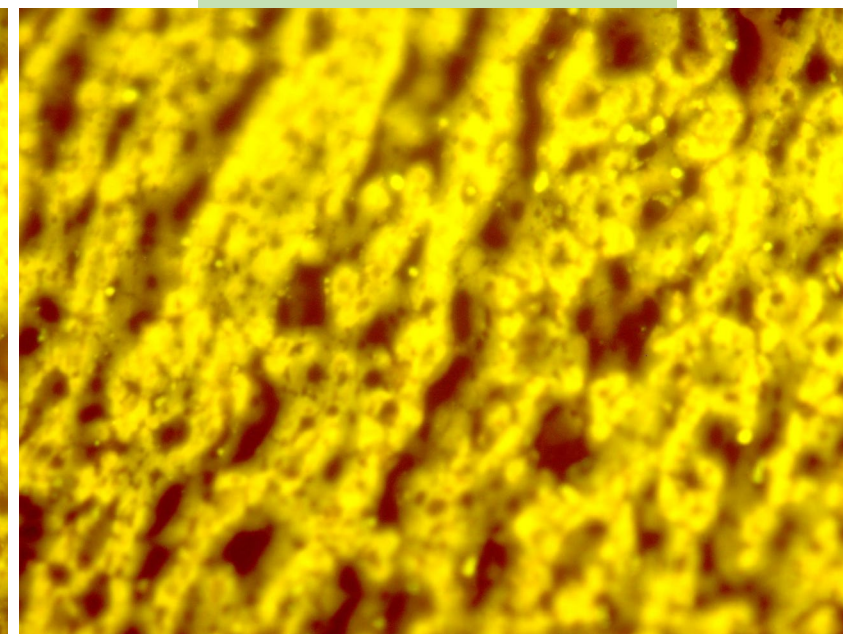
Compound without plasticizer

Sample 3



Compound with 4% Oil

Sample 6



Compound with 4% REOBs

3.2 SBS compound analysis

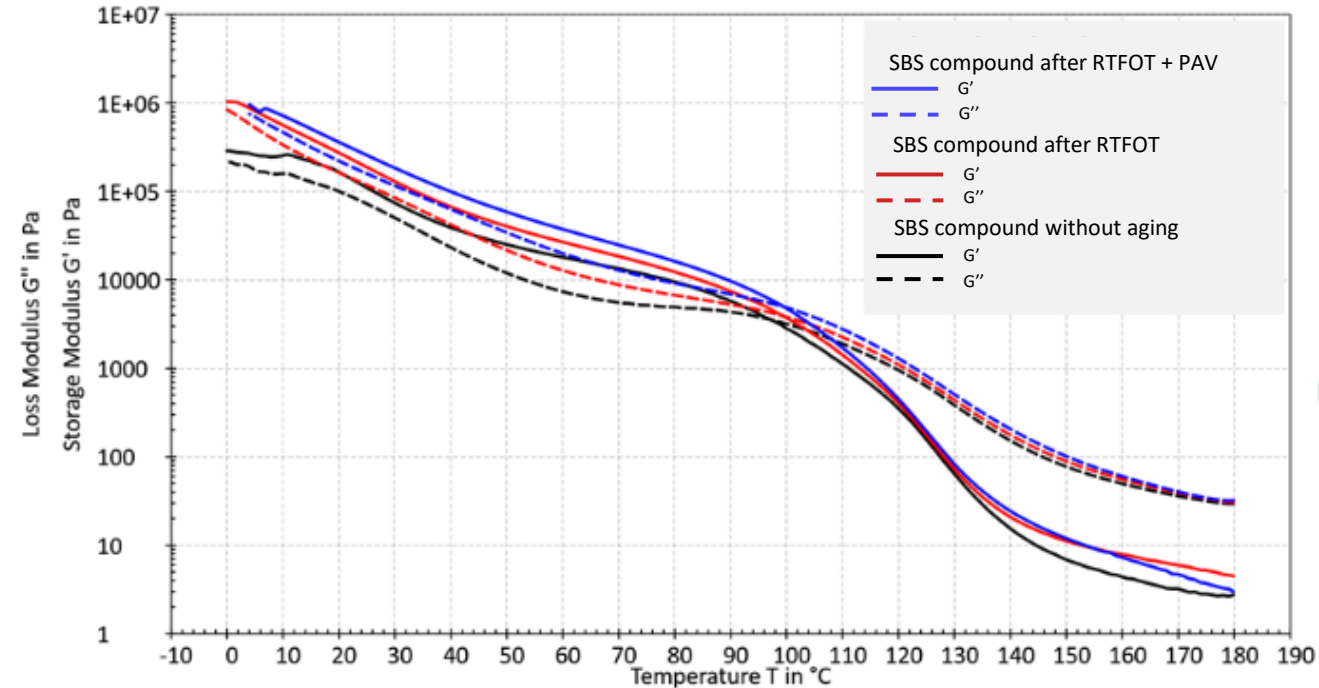
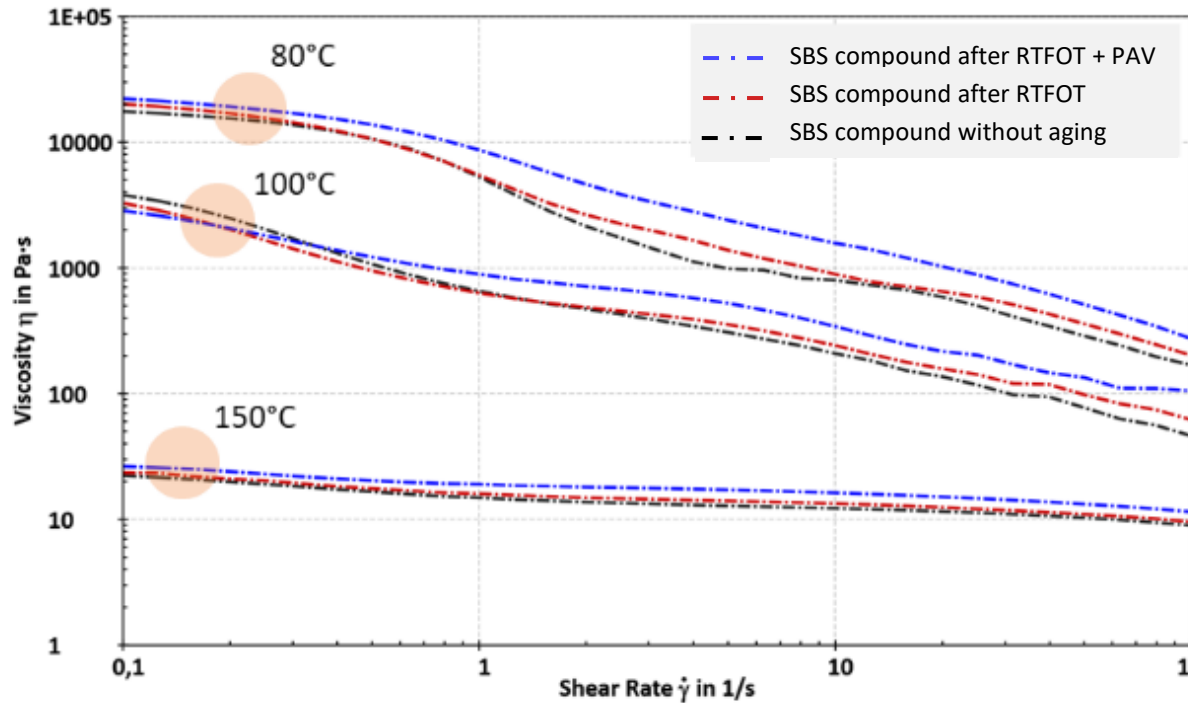
Sample	Sample 1	Sample 2	Sample 3
Aromatic Bitumen	95%	91%	91%
SBS	5%	5%	5%
Veg. Oil	-	4%	-
REOBs	-	-	4%

Aging parameters

Type of aging	Reference standard	Test temperature	Aging time	Additional parameters
Rolling Thin Film Oven Test (RTFOT)	EN 12607-1	163°C	75 minuti	Airflow 4000 ± 200 ml/min
Pavement Aging Vessel (PAV)	EN 14769	100°C	20 ore	Test pressure 2,1 ± 0,1 MPa

4. Aging Impact on Rheology

SBS formulation + REOBs



Aging doesn't have significant impact regarding compound performances

Conclusions

- REOBs are good plasticizers for APP formulations, providing:
 - Compatibility with bitumen and polymers
 - Good cold flex
- REOBs are good compatibilizers in SBS formulations with antioxidant properties

Enhanced durability → More sustainable product

**We love bitumen.
Ask us why!**



ines.antunes@polyglass.it





Thank you for your attention

Ing. Antunes Ines





Spin-off Company of
Italian National Research Council (CNR)



Flame retardant bitumen membranes: the key role of the textile support in combination with mineral FR

IMPERVIUS 2023

The Bitumen Waterproofing conference

May 24th – 25th 2023, Sitges/ Barcelona

Dr. Vanessa Matteucci
materiali@i-pool.it
[https:// www.ipoolsrl.com/](https://www.ipoolsrl.com/)

IPOOL's Company profile



IPOOL is specialist in:

- Raw materials and **flame retardant fillers** for PVC and HFFR compounds for cables
- Compounding of flame retardant and highly filled materials
- Cost and performance optimization of polyolefin and PVC compounds
- Specialist in **flame retardant bitumen formulation**
- Laboratory testing equipment for **R&D** and QC
- Design of marketing strategy for new products and new additives

IPOOL, working in international projects from Europe to Middle East, Asia, from Northern to Southern America, is technical specialist in **cables**, ACP composite panels, **TPO/ PVC/ bitumen roofing membranes**, pipes and **rubbers**.



R&D - Technology company, Spin-Off company of Italian National Council of Research institute (CNR), established on July 2011 in Pisa (ITALY).

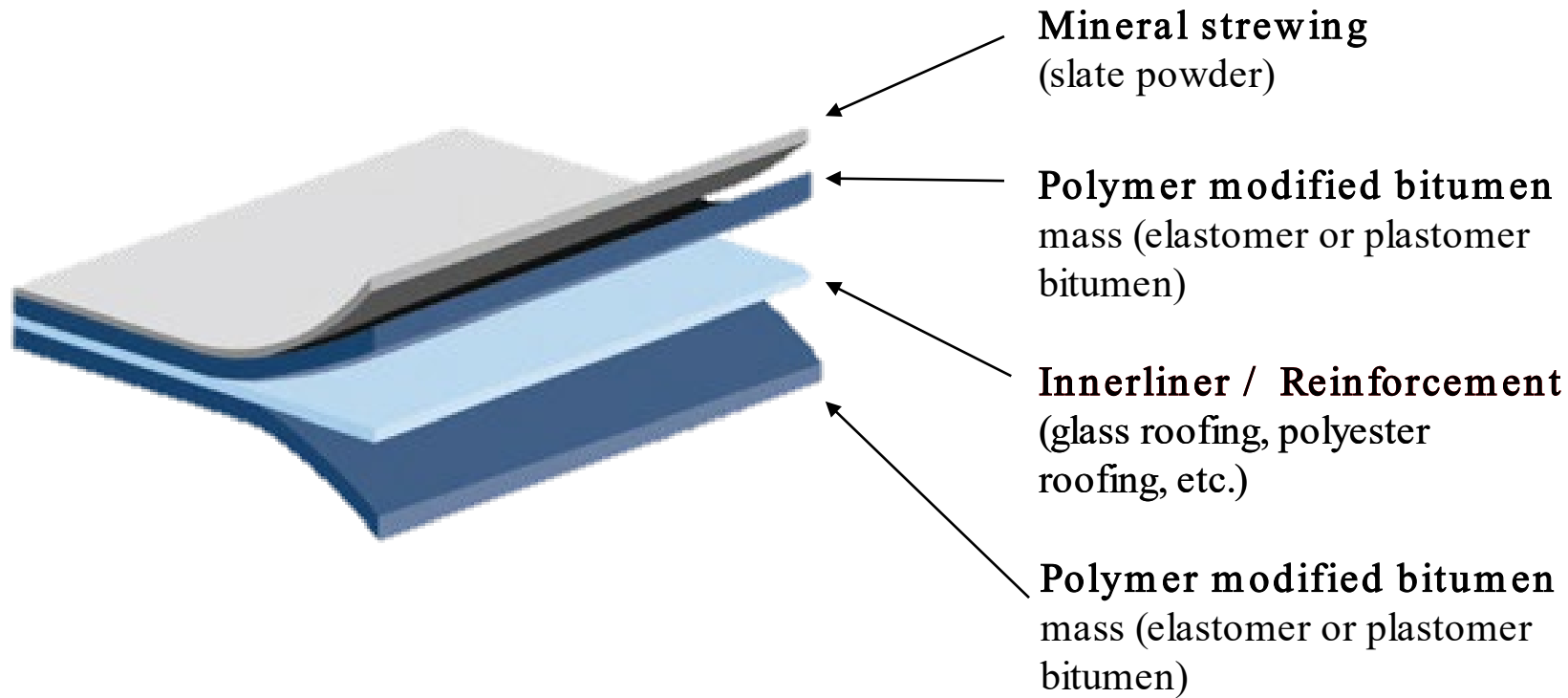
Objectives of the work



- Comparison between the fire properties of common **reinforcements** and a new fire barrier reinforcement, used as supports for the **bituminous membranes**
- Preparation of flame retardant and non flame retardant bituminous membranes
- Small-scale **fire test** optimization



Structure of a bituminous waterproof roofing membrane



Basic reinforcement characteristics



- Mechanical properties:
 - Elongation
 - Tensile strength
 - Flexibility
- Workability / Runnability
- Impregnation
- Tear Strength
- Laceration
- Fire behavior
- Grammage
- Specific weight
- Thickness

Common reinforcement for bituminous membrane



Fiberglass



Grammage: 80g

Polyester



Texbond R

Grammage: 220g



	Fiberglass	Polyester
Fire behaviour	✓	✗
Elongation	✗	✓
Tensile strength	✗	✓
Flexibility	✗	✓
Puncture resistance	✗	✓

New reinforcement for FR bituminous membrane



Fiberglass



Grammage: 80g

Polyester



Texbond R

Grammage: 220g



FB Polyester



Texbond R FB

Grammage: 220g

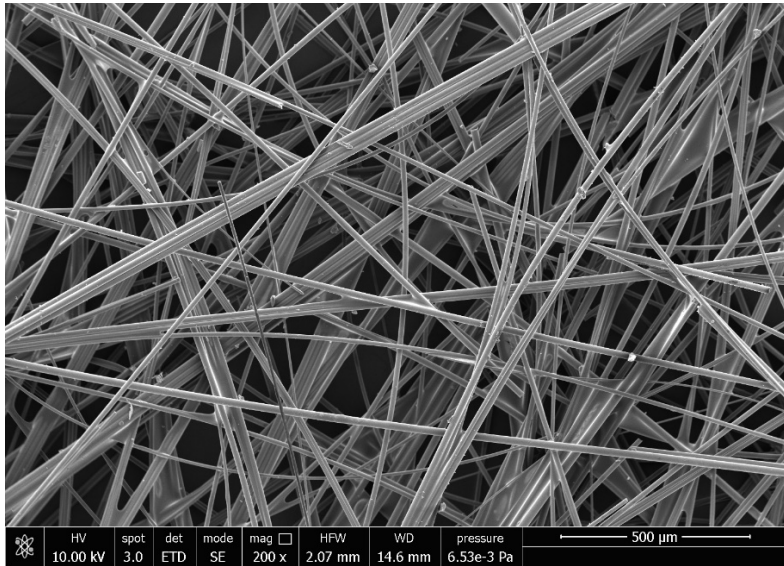


	Fiberglass	Polyester	FB Polyester
Fire behaviour	✓	✗	✓
Elongation	✗	✓	✓
Tensile strength	✗	✓	✓
Flexibility	✗	✓	✓
Puncture resistance	✗	✓	✓

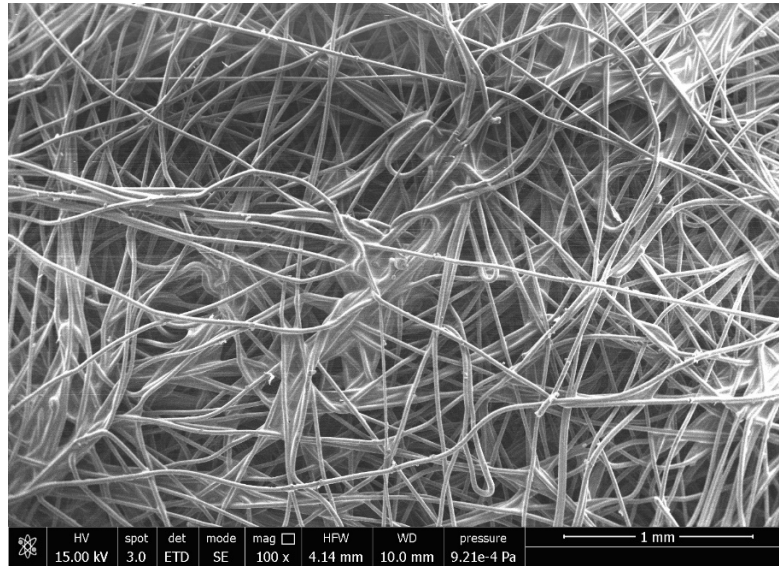
Reinforcement analysis: Scanning Electron Microscopy (SEM)



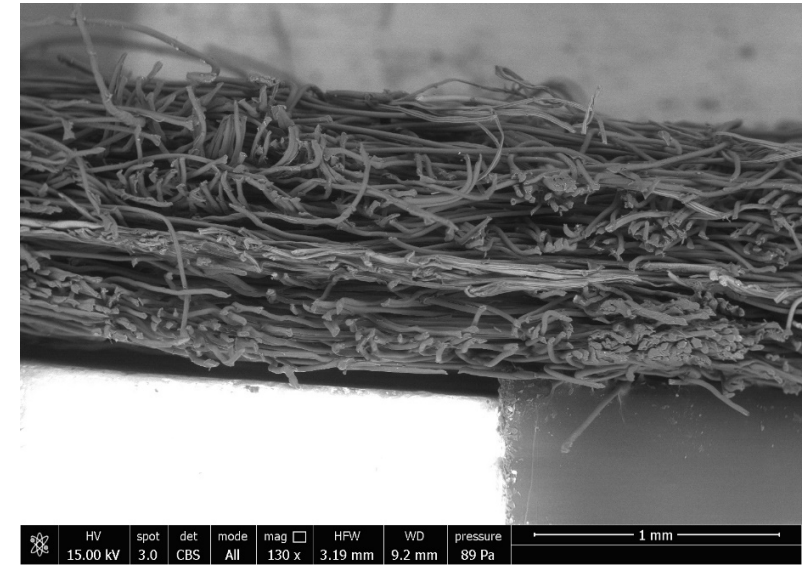
Fiberglass



Polyester

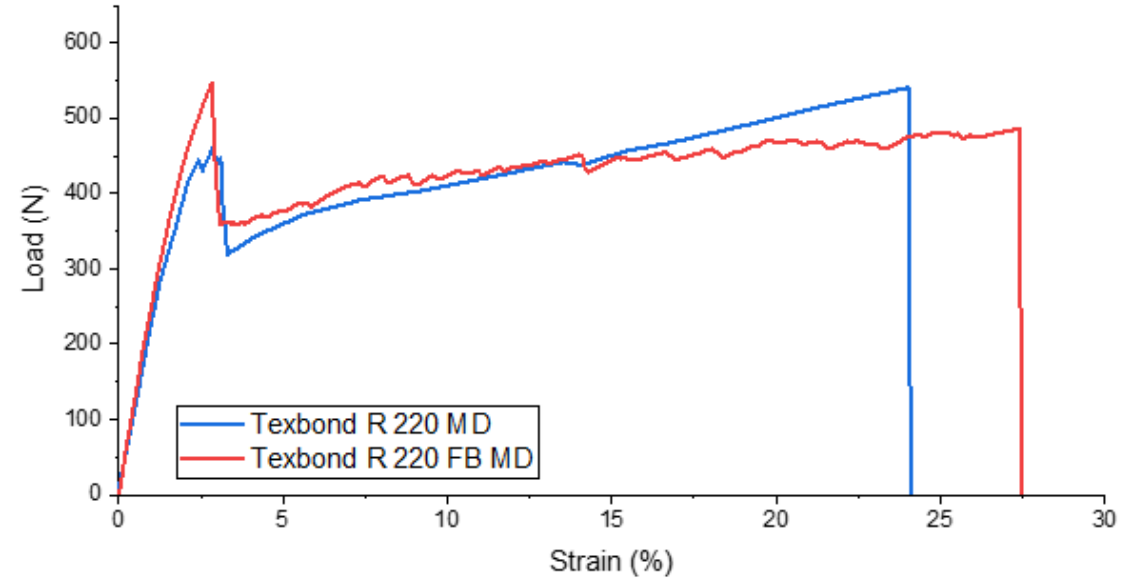
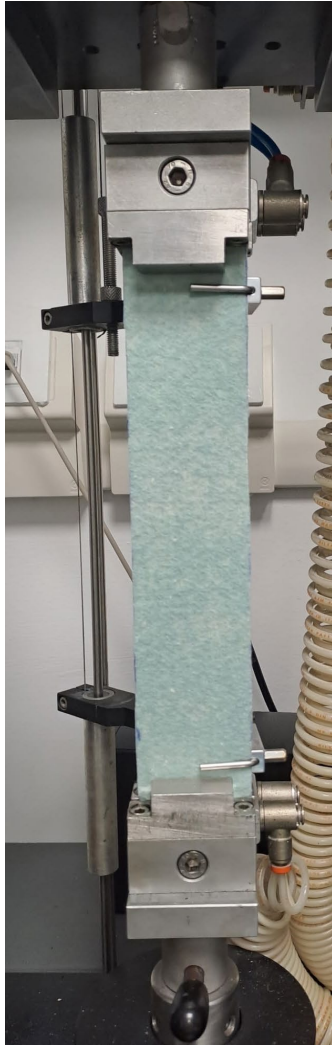


FB Polyester



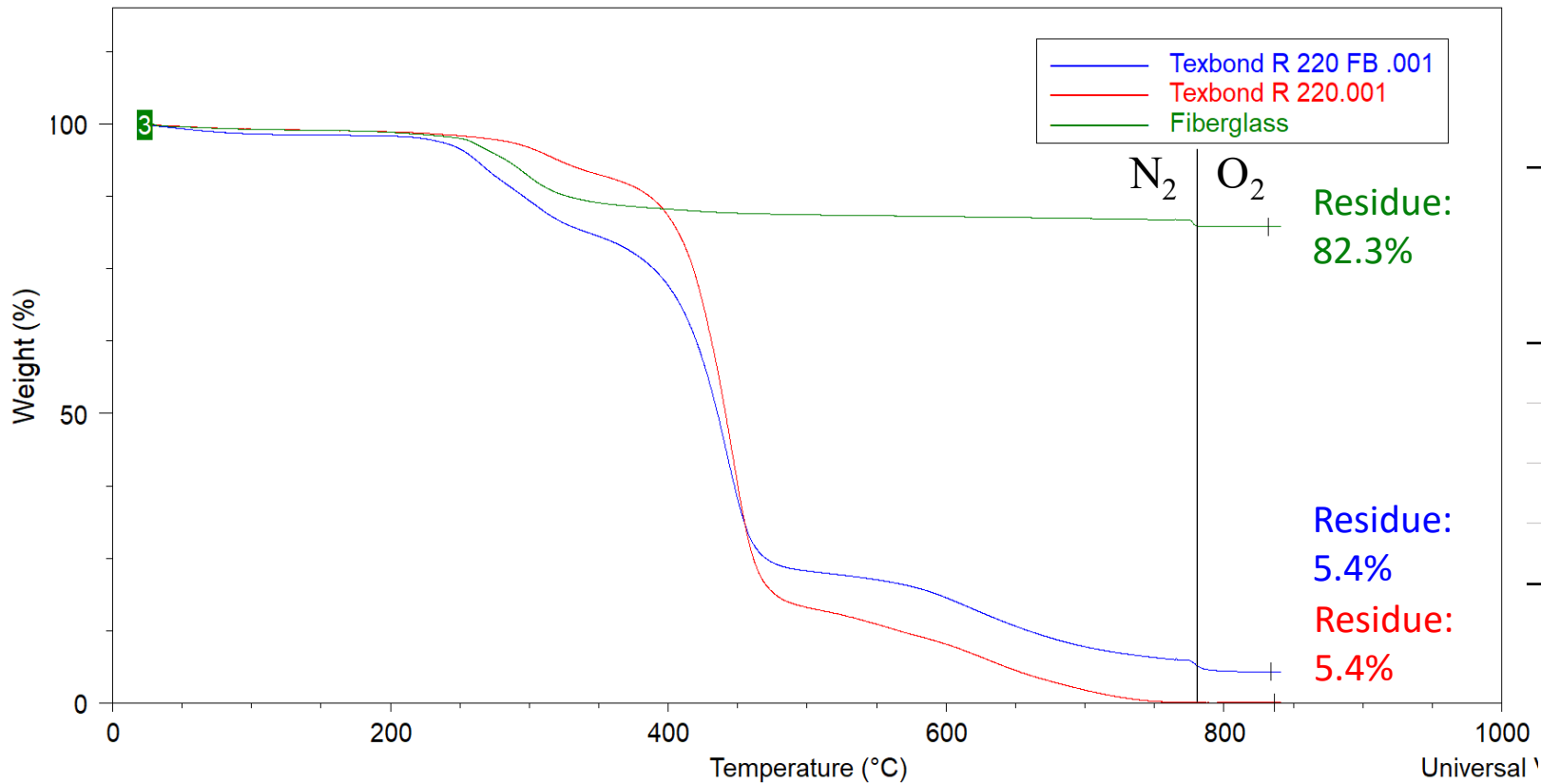
Section

Reinforcement analysis: Mechanical properties (ISO 9073-3)



Properties	Direction	Fiberglass	Polyester	FB Polyester
Tensile strength (N/ 5cm)	MD	150	560	520
	CD	/	490	475
Elongation at break (%)	MD	<3	24	26
	CD	/	35	43

Reinforcement analysis: Thermogravimetric analysis (TGA)



Temperature (°C)	Weight loss (%)		
	Fiberglass	Polyester	FB Polyester
250/ 350	14.5	8.8	19.2
350/ 500	/	74.6	58
750/ 800	2.1	16.2	16.7
Residuo	82.3	0	5.4

Reinforcement analysis: Vertical burning test



Fiberglass



Polyester



FB Polyester



Conditions:

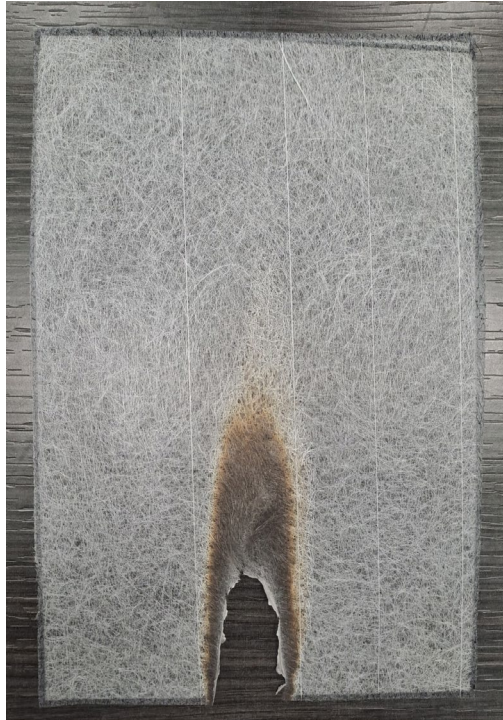
- 20 × 12 cm
- 15 sec flame application

Results	Fiberglass	Polyester	FB Polyester
Self extinguish	YES	NO	NO
Time flame base to high limit	-	15s	27s
Char forming	NO	NO	YES

Reinforcement analysis: Vertical burning test



Fiberglass



Polyester



FB Polyester

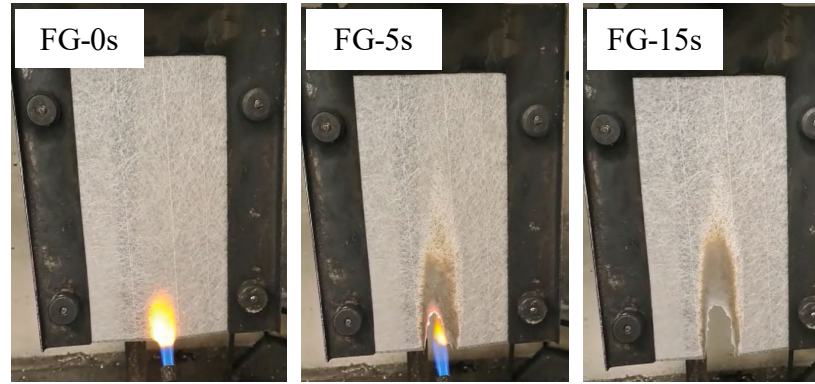


Results	Fiberglass	Polyester	FB Polyester
Self extinguish	YES	NO	NO
Time flame base to high limit	-	15s	27s
Char forming	NO	NO	YES

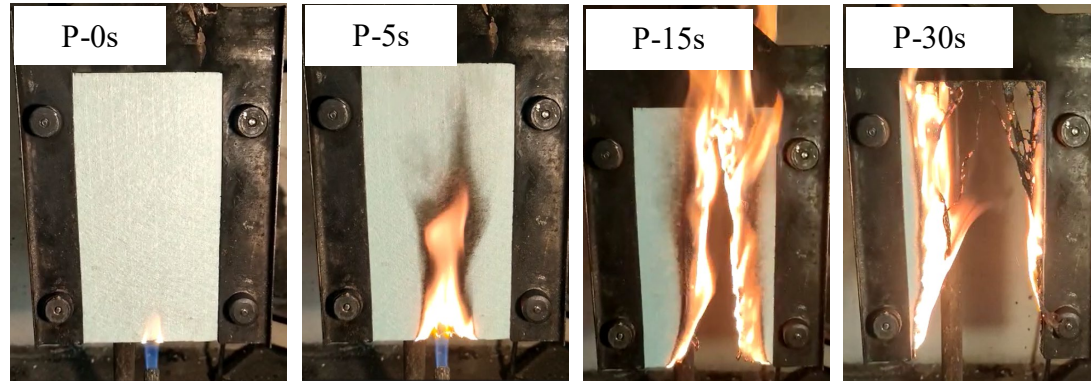
Reinforcement analysis: Vertical burning test



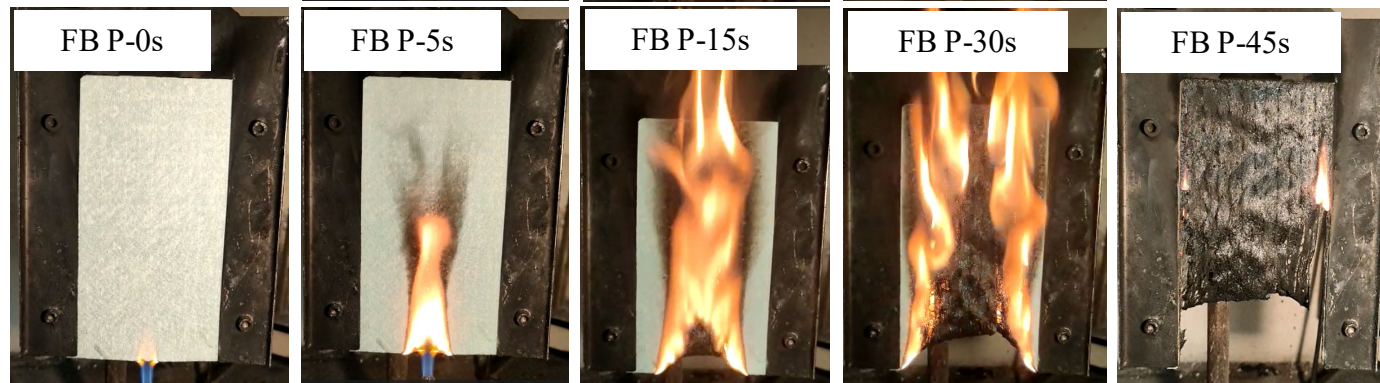
Fiberglass



Polyester



FB Polyester

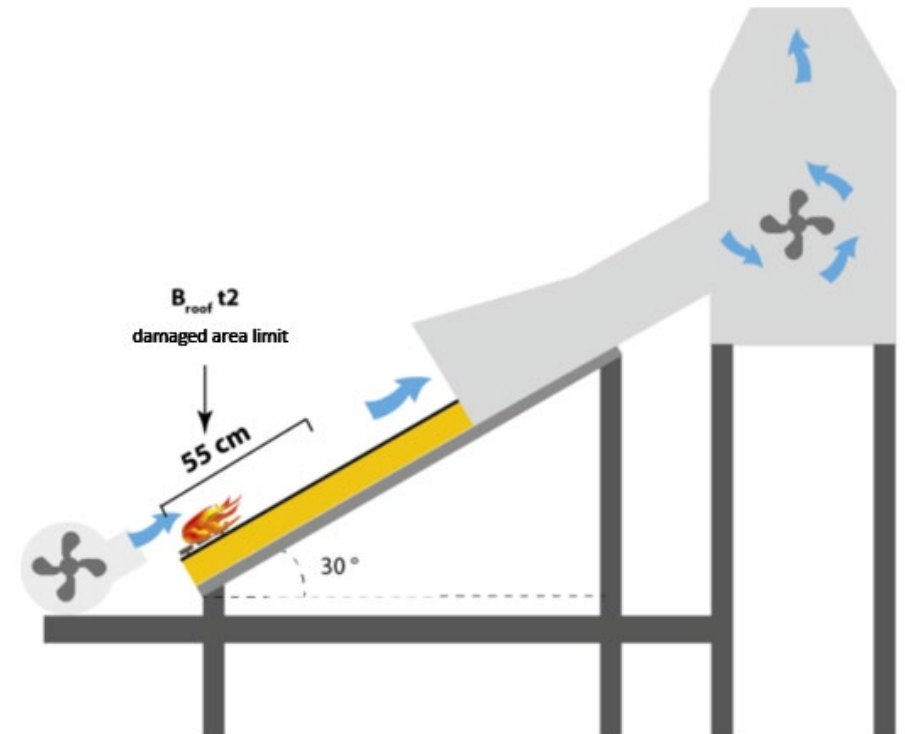


B_{roof} T2 test (UNI CEN TS 1187-2012)



Test 2: Method with burning brands and wind

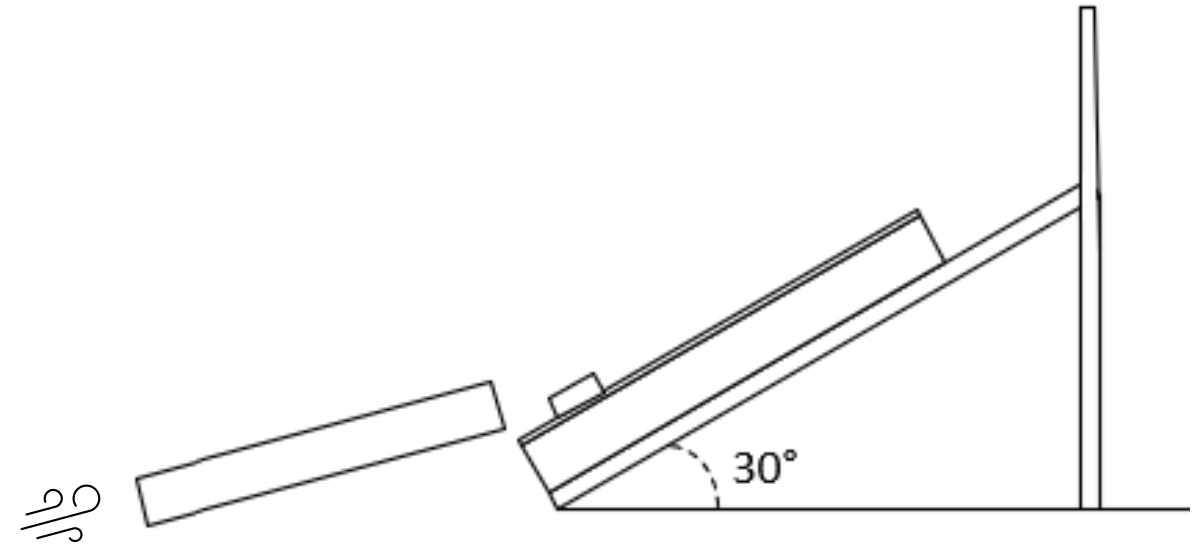
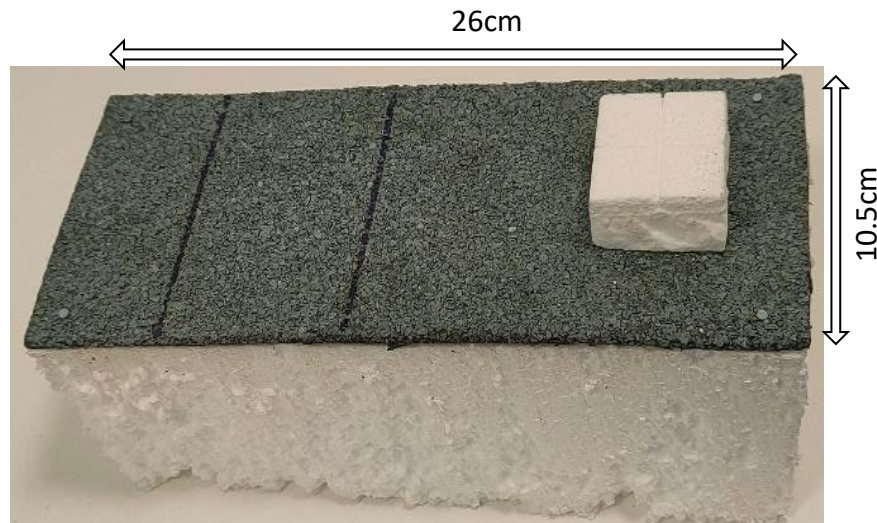
- Burning wood crib
- Air velocity ($2.0 \pm 0.1 \text{ m/s}$) or ($4.0 \pm 0.1 \text{ m/s}$)
- Roof pitch 30°
- Specimens dimension: 40cm x 100cm
- Standard substrates:
 - **Non-combustible** (fiber reinforced calcium silicate, density $680 \pm 50 \text{ kg/m}^3$, thickness $5 \pm 1 \text{ cm}$)
 - **Combustible** (EPS, density $150 \pm 20 \text{ kg/m}^3$, thickness $5 \pm 1 \text{ cm}$)



Scale down B_{roof} T2 test: Conditions



Parameters	
Sample size	26 × 10.5 × 0.5 cm
Air velocity	1.5 m/ s
Support	Expanded Polystyrene (EPS)
Slope	30°



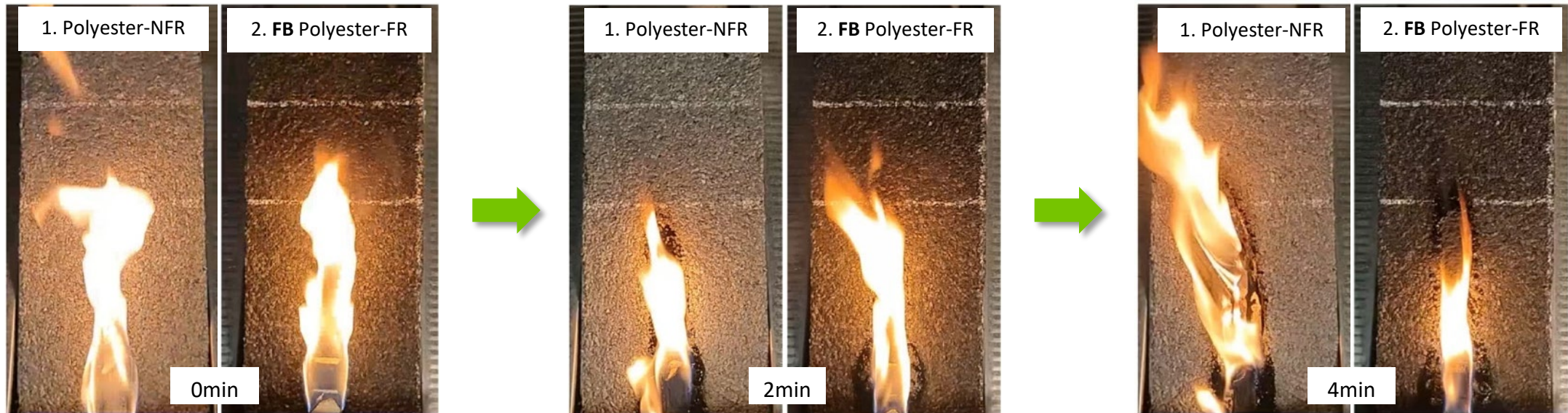
Measurements:

- Fire penetration
- Fire spread

Scale down fire test: Commercial membranes



1. Regular Polyester reinforcement with non flame retardant (NFR) formulation
2. FB Polyester reinforcement with flame retardant (FR) formulation



Scale down BROOF t2 test: Commercial membranes



Non-flame retardant formulation



Flame retardant formulation

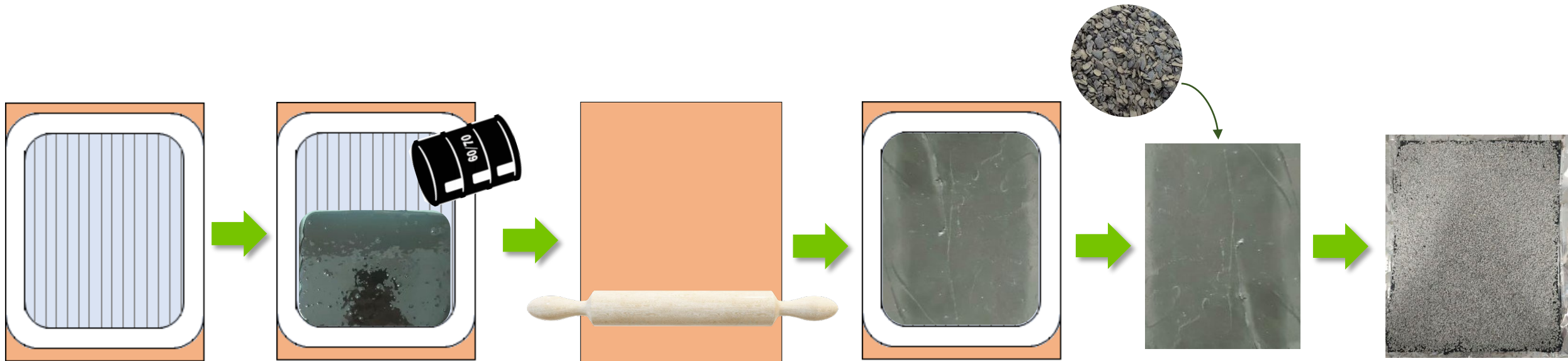


APP bituminous compound formulations



Ingredients		NFR	FR
Bitumen 160/ 220		48	48
Plastomer	APP	12	12
Filler	CaCO ₃	40	
Ecopiren 200	Mg(OH) ₂		40

- Natural milled MDH
 - **Regular Polyester** + non flame retardant (NFR) formulation
- Environmentally friendly
 - **FB Polyester** + non flame retardant (NFR) formulation
- Granulometry: 200 μm
 - **Regular Polyester** + flame retardant (FR) formulation
- $Mg(OH)_2 + Heat \rightarrow MgO + H_2O$
 - **FB Polyester** + flame retardant (FR) formulation
- Composition: 90-94% MDH, 6-8% Magnesite/ Calcite, <2% other minerals



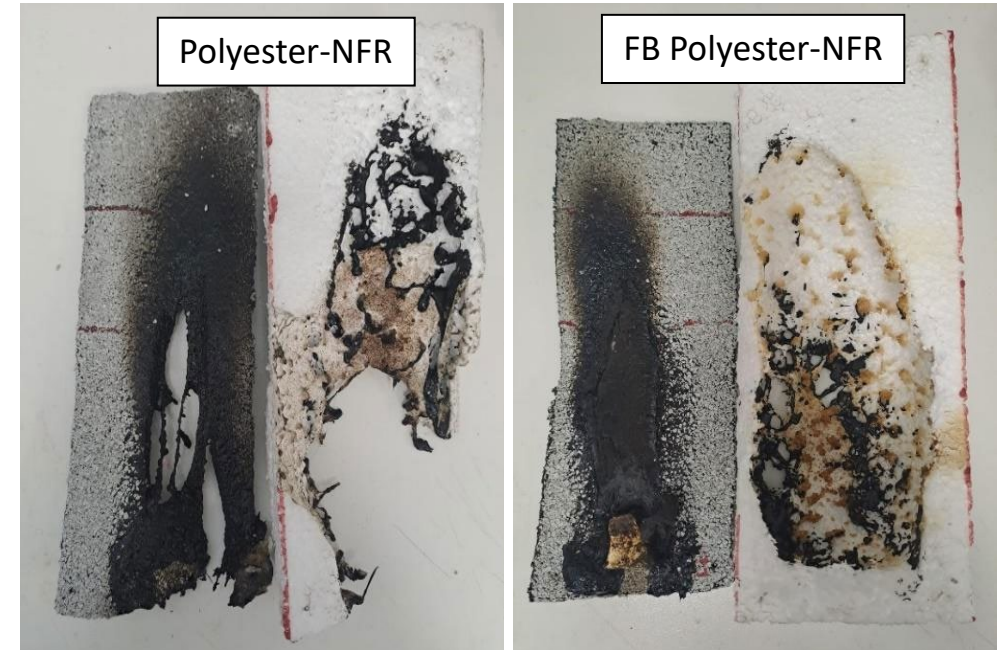
Scale down B_{roof} T2: Non-Flame Retardant



Polyester-
NFR



FB Polyester-
NFR

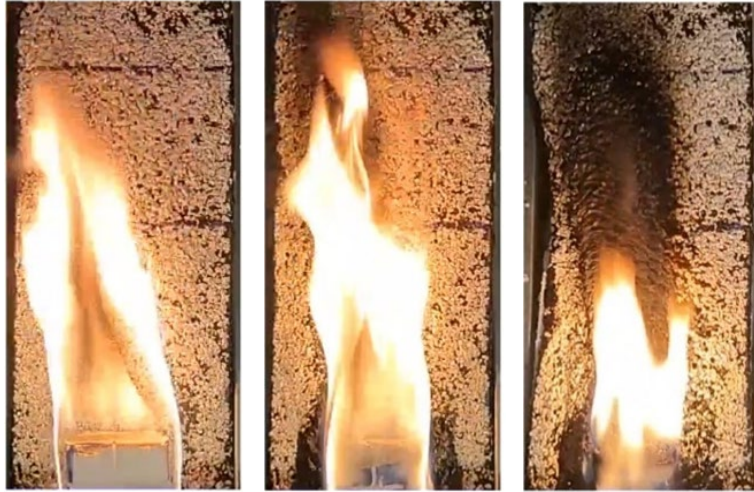


Scale down B_{roof} T2: Flame Retardant

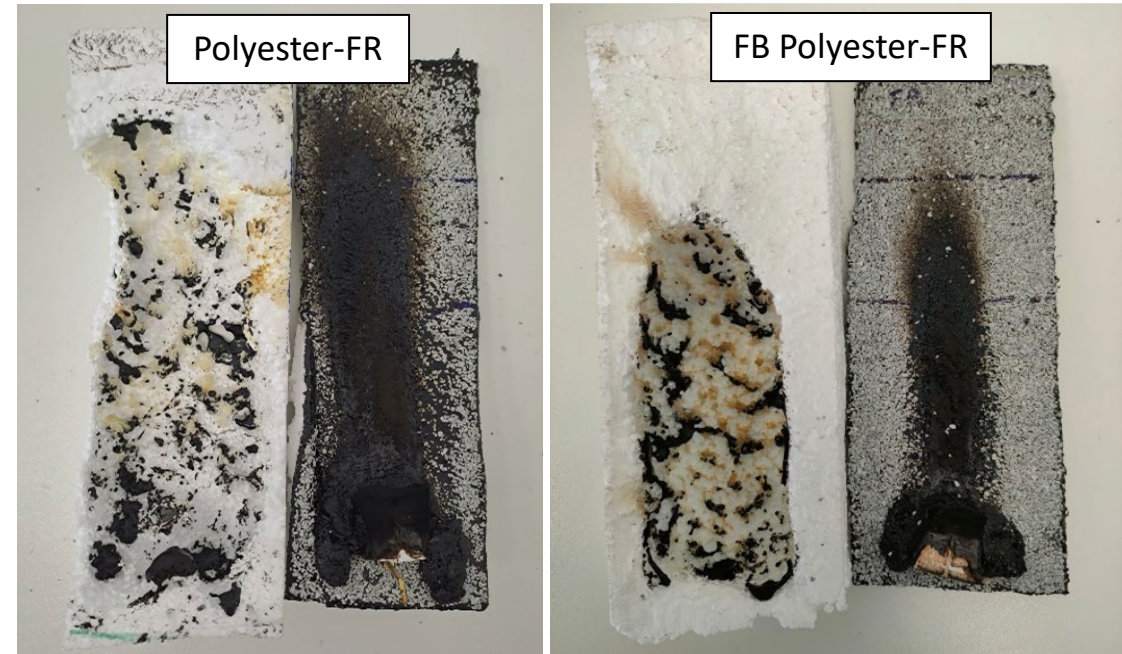


0min 3min 7min

Polyester-
FR







FB Polyester-
FR



Comparison of the 4 membranes



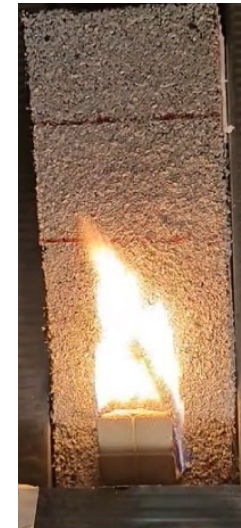
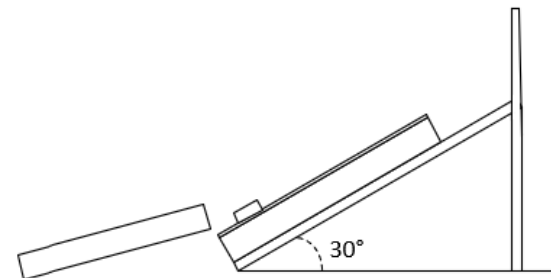
Polyester - NFR	FB Polyester - NFR
 <ul style="list-style-type: none">X Membrane <u>collapse</u>X Flame spread on the substrate	 <ul style="list-style-type: none">✓ Containment of the flame on the membraneX High flame spread
Polyester - FR	FB Polyester - FR
 <ul style="list-style-type: none">✓ Containment of the flame on the membraneX High flame spread	 <ul style="list-style-type: none">✓ Containment of the flame on the membrane✓ Less flame spread

Summing up - 1



Ipool successfully developed the following laboratory scale procedure:

- Method for the preparation of complete bituminous membranes
- Laboratory method for comparative fire testing of membranes



Summing up - 2



Texbond R 220:

- ✓ Good flexibility
- ✓ Good elongation
- ✓ Good tensile strength
- ✓ Good impregnation
- ✗ No fire resistance



New Texbond R 220 FB:

- ✓ Good flexibility
- ✓ Good elongation
- ✓ Good tensile strength
- ✓ Good impregnation
- ✓ **Fire resistance**

Polyester *vs* FB Polyester

- Same mechanical properties
- Same impregnation properties
- Improved fire barrier properties for FB Polyester

The best fire results are obtained by combining FB reinforcement with FR formulations

Thanks to all suppliers of raw materials:



www.europiren.com, producer of high quality, high purity, fine milled, natural magnesium hydroxide



www.generalmembrane.it, producer in Italy and all over the world of waterproofing systems



www.freudenberg-pm.com, Politex S.r.l. section, producer of polyester nonwovens, products for waterproofing and for thermal and acoustic insulation



Spin-off Company of
Italian National Research Council (CNR)



Thanks for your attention

IMPERVIUS 2023

The Bitumen Waterproofing conference

24 - 25 May 2023, Sitges/ Barcelona



<https://www.linkedin.com/company/ipool-srl>

Dr. Vanessa Matteucci

✉ materiali@i-pool.it

🌐 [https:// www.ipoolsrl.com/](https://www.ipoolsrl.com/)

Scale down B_{roof} T2 video



NFR formulation



FR formulation





**Bitumen: a building product
ready for the future.**

Wim Teugels
Crude & Feedstock Specialist



What are the main points for this presentation...



Bitumen market in Europe

What is the short term outlook and which are the main trends.



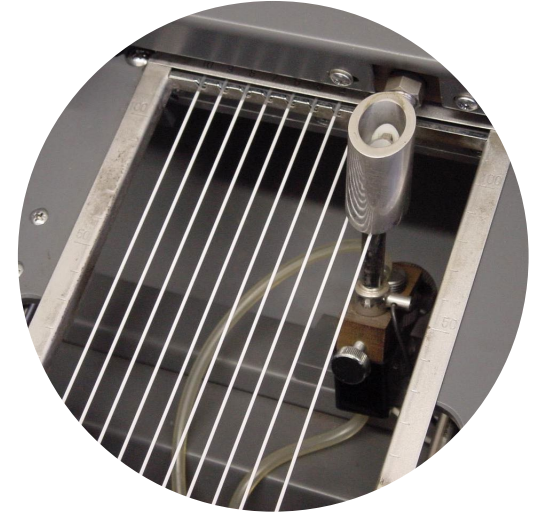
Refined products demand

After IMO 2020, countries under sanctions, energy transitions, economical situation,....



What type of crudes can be used

What type of crudes can refineries select to distil – but what are the constraints.



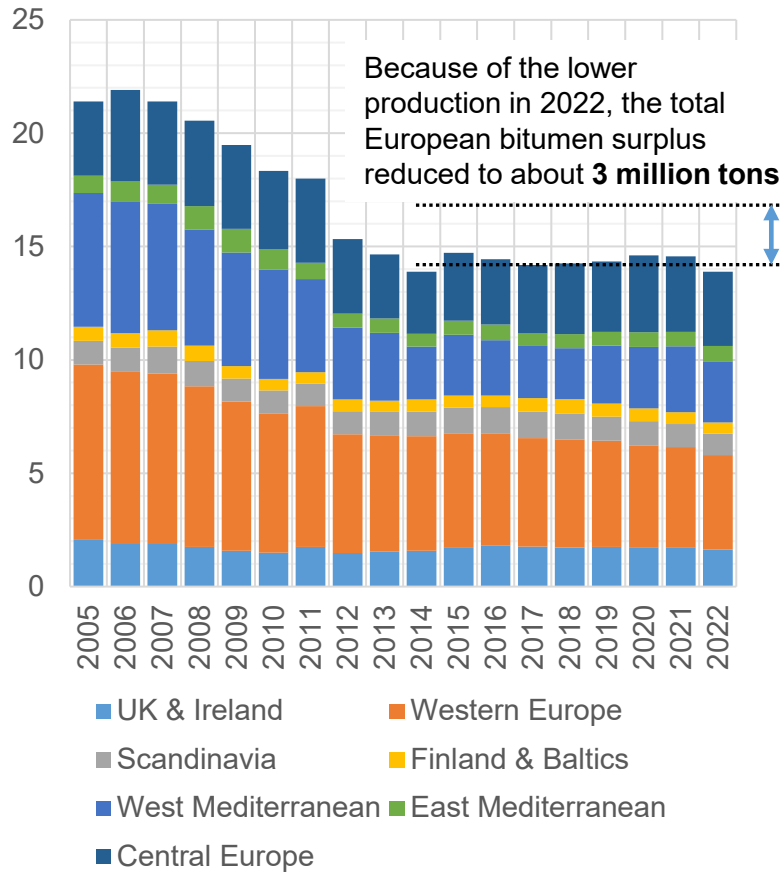
Bitumen quality & chemistry

How is bitumen produced and what are the possible effects on bitumen chemistry.

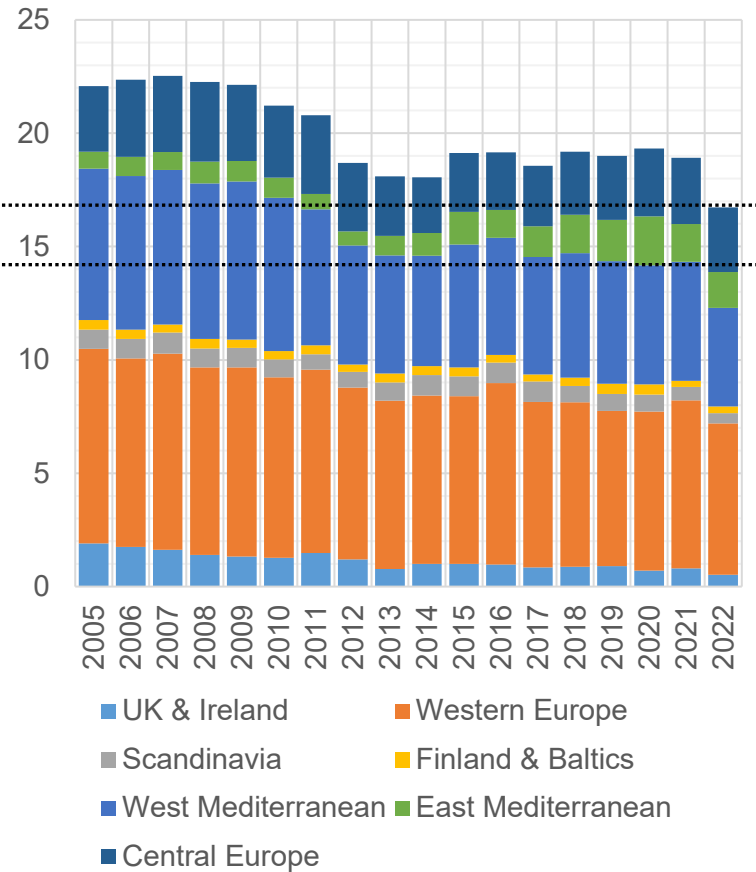
In 2022, the European bitumen demand has been somewhat lower compared to previous years (~ 5% less than 2021). Production however has seen a downfall of about 10%, mainly due to the lower production outputs in Western Europe and in the Western part of the Mediterranean.

Source : Nynas Market Data

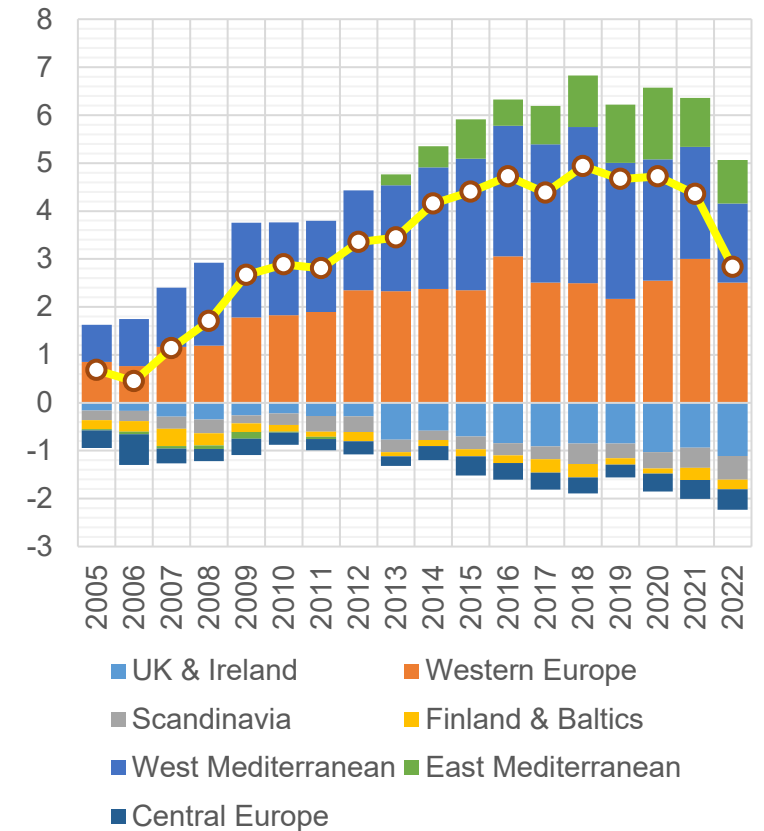
Europe - Demand



Europe - Production

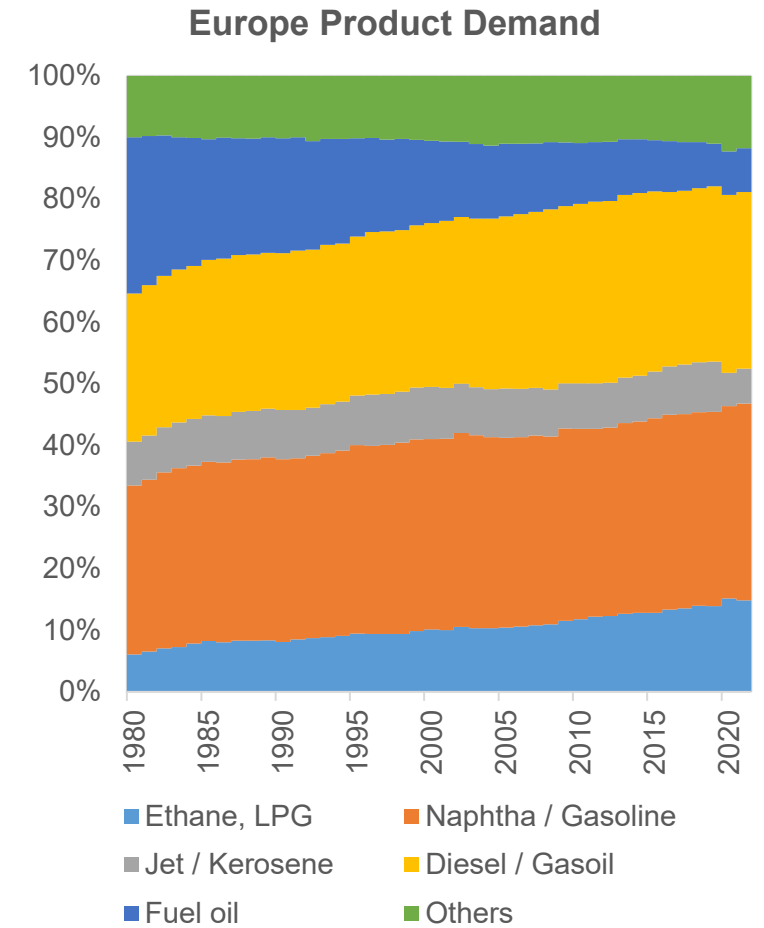
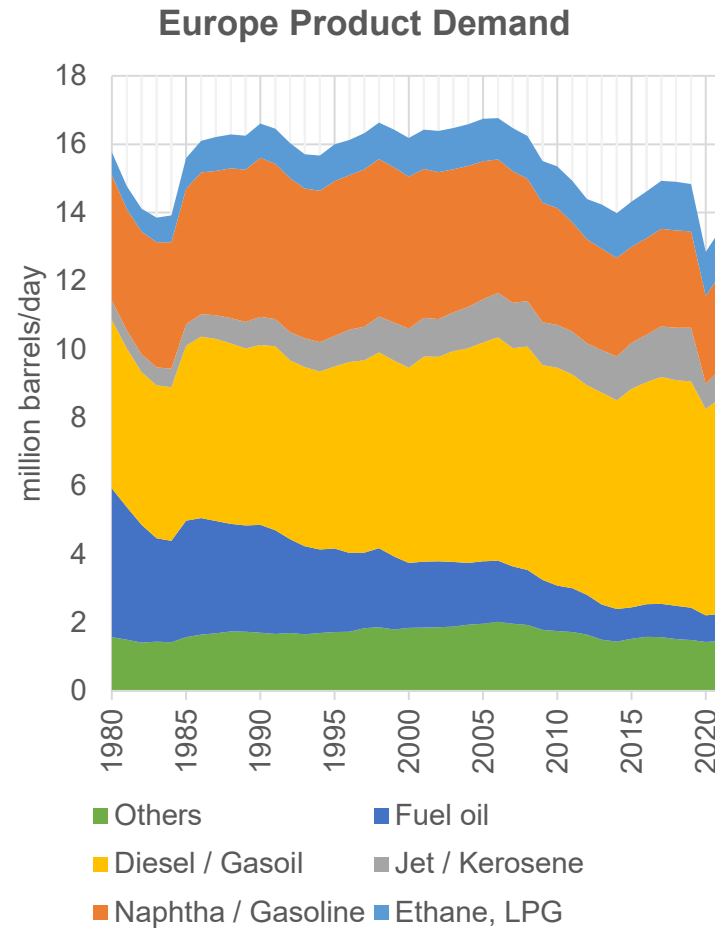
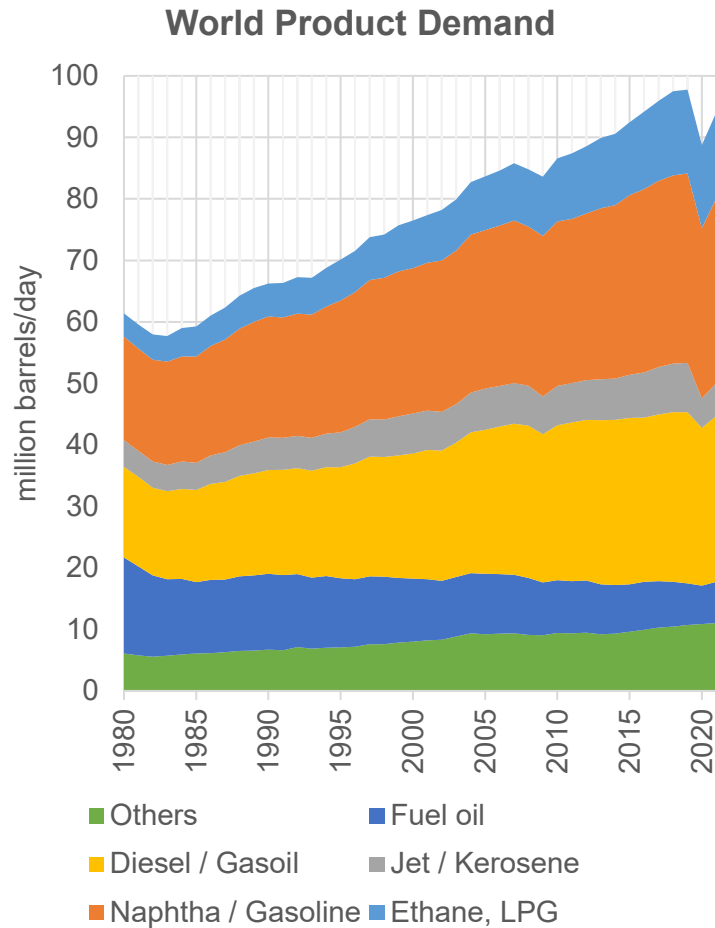


Regional Production/Demand Surplus/Deficit.



Worldwide product demand increased during previous decades, but in Europe, demand dropped, combined with a shift in product type. Different product demands trigger refineries to invest in processing units – like more residue upgrading with a reducing fuel oil demand outlook. An increased demand of base-products for the petro-chemical industry and a reduction in transportation fuels are some of the current challenges.

Source : BP Statistical Review 2022



Crudes are mostly identified by the API gravity and sulphur content.

Low API = a heavy crude and a high API = a light crude.

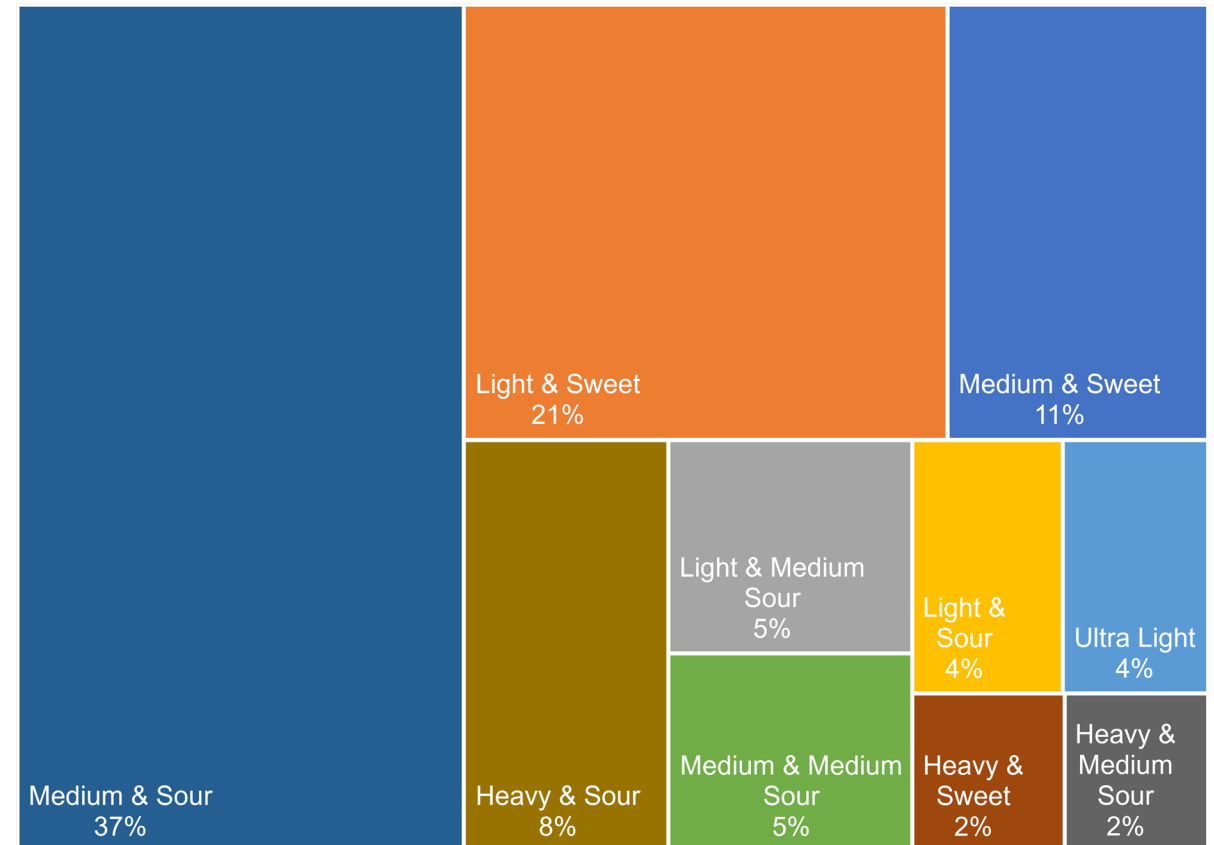
A low sulphur crude is called “sweet”, while a crude with a high sulphur content is called “sour”.

Source : ENI

Crudes used for bitumen production are mainly coming from these types.



Contribution of crude types to world oil production.

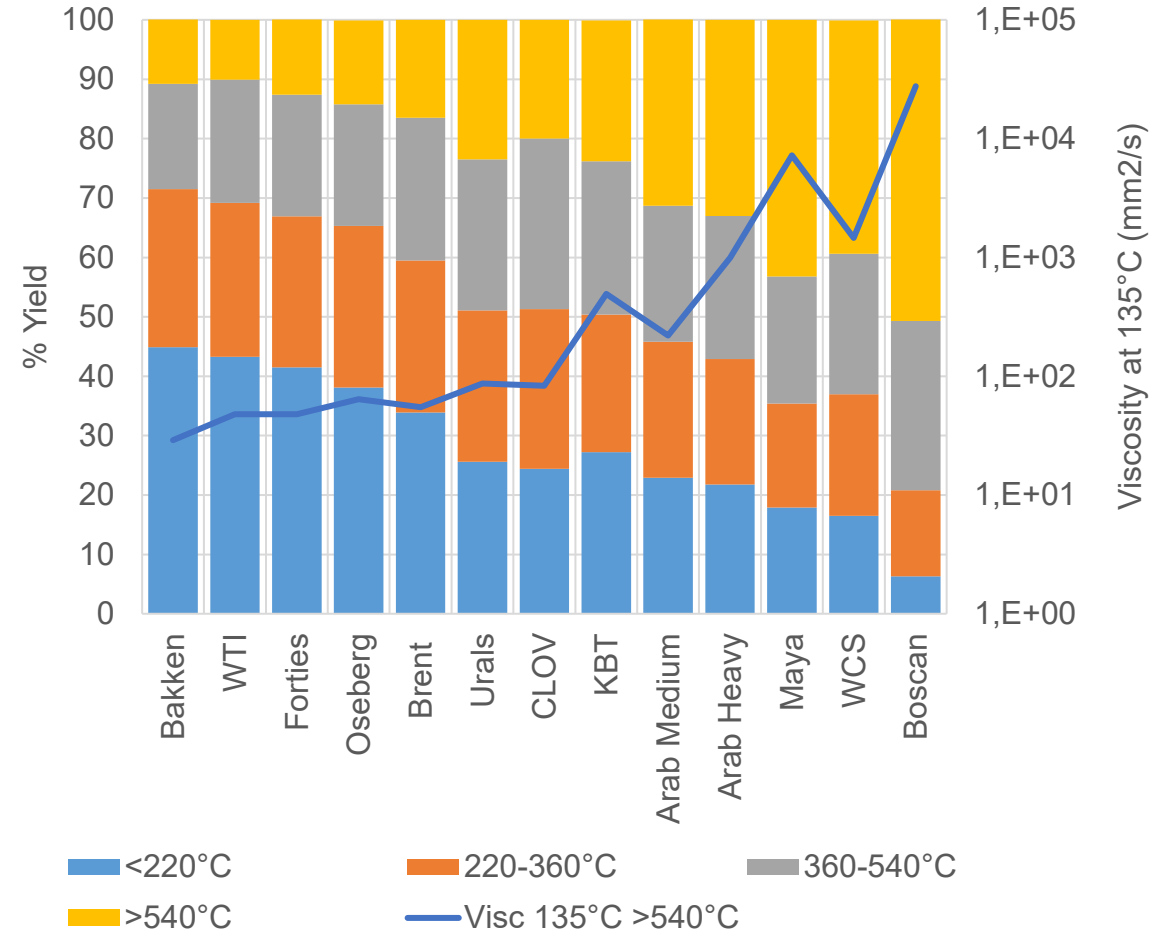
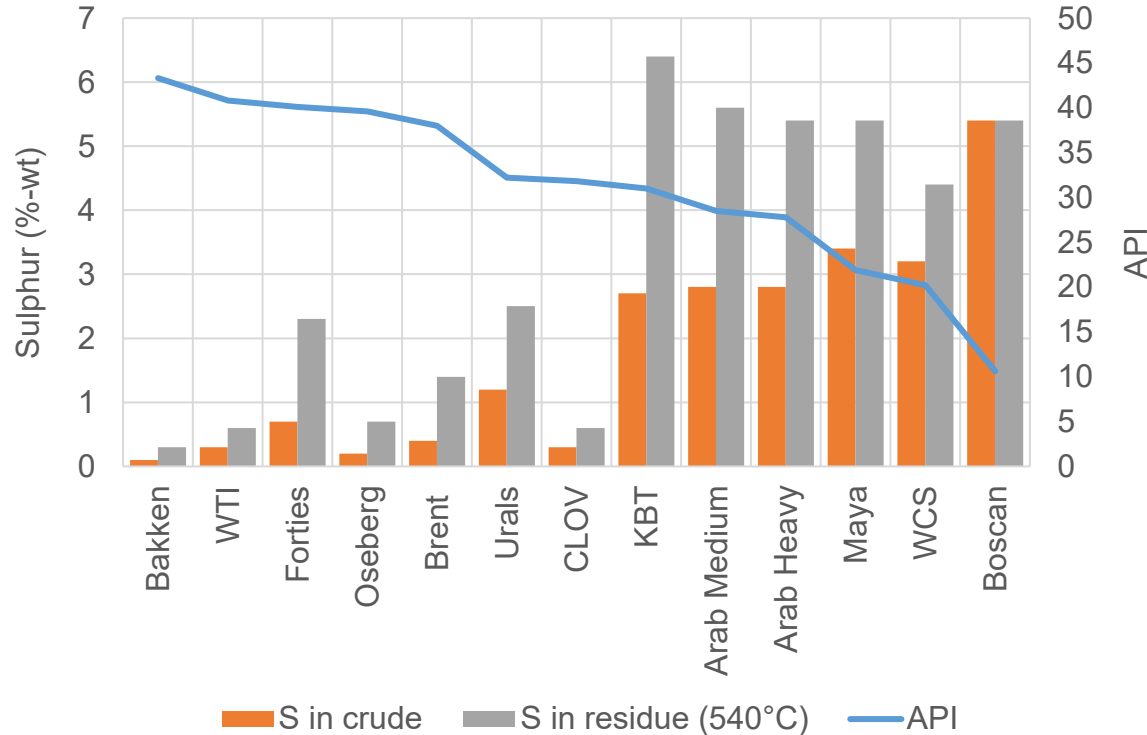


Refineries are often configured to process crudes with a specific fraction yield – refineries designed to process medium crudes can not easily change to heavy – or even – lighter crudes.

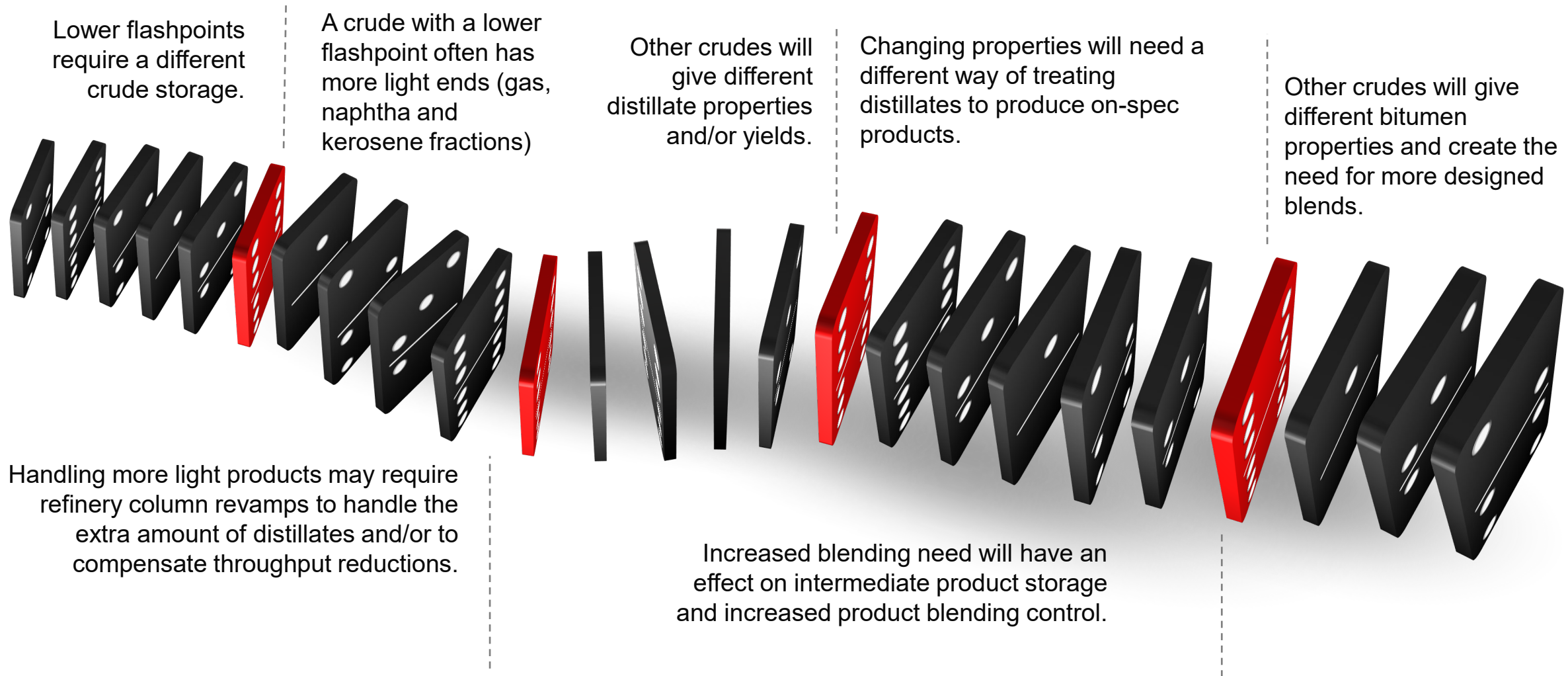
With various countries under supply sanctions, European refineries are adapting the crude slate accordingly.

Source : Nynas Crude Calculation Model

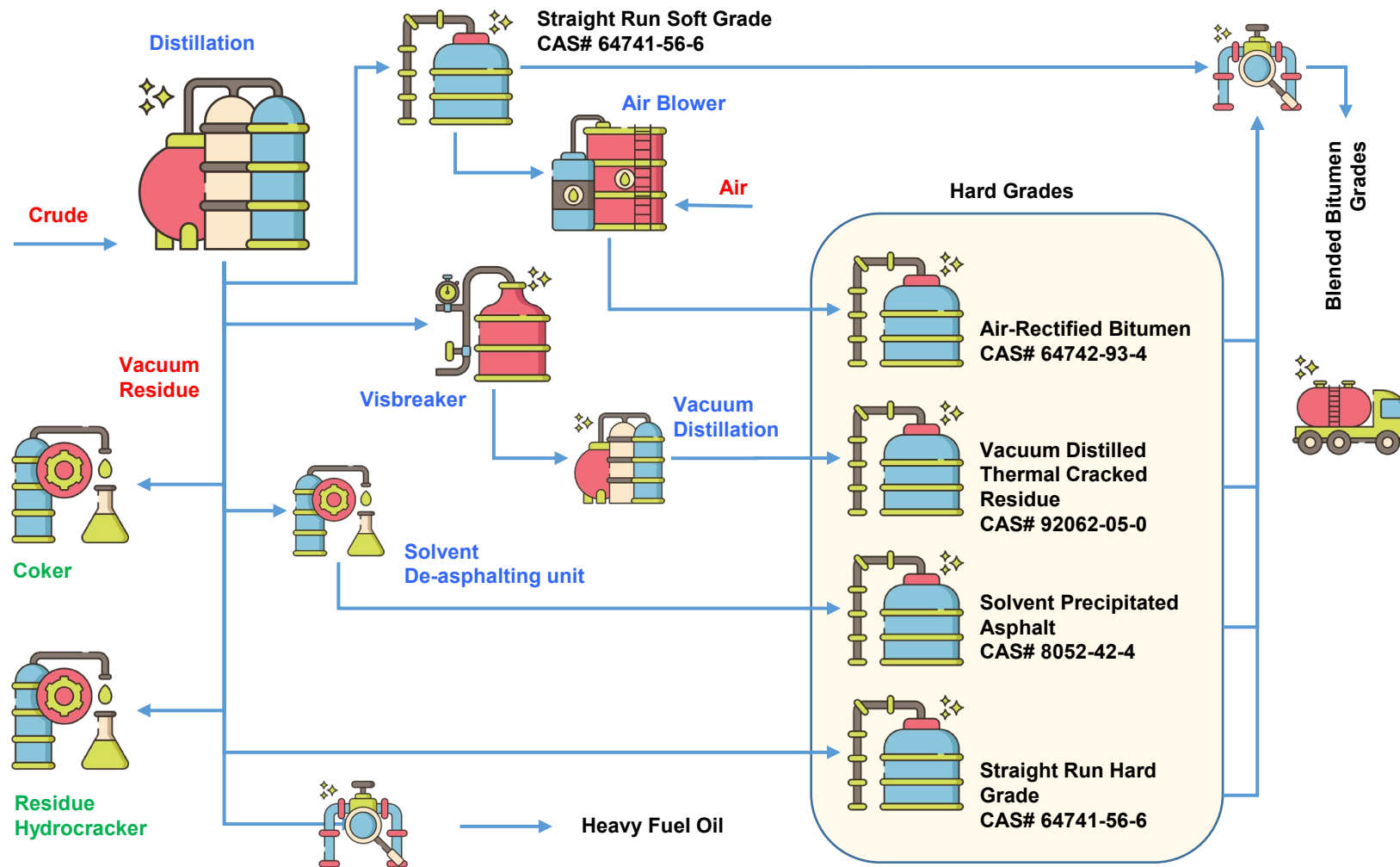
The use of high sulphur residues as HFO component has become more difficult with the IMO 2020 requirement of sulphur levels below 0.5% (most bitumen crudes have higher sulphur contents).



Changing the crude portfolio, especially in the more “simple” refinery configurations, has a domino effect - other product properties also have significant economical aspects.



A refinery has various options towards the vacuum residue and depending on the selected strategy, there will be a bitumen outlet or there will be no bitumen at all. The refining complexity largely depends on what the refinery focusses on. This is based on crude availability, refinery configuration, product market and product logistics. To improve margins, refineries will upgrade heavier products to lighter, more valuable, products.



Bitumen manufacturing – most common production routes.

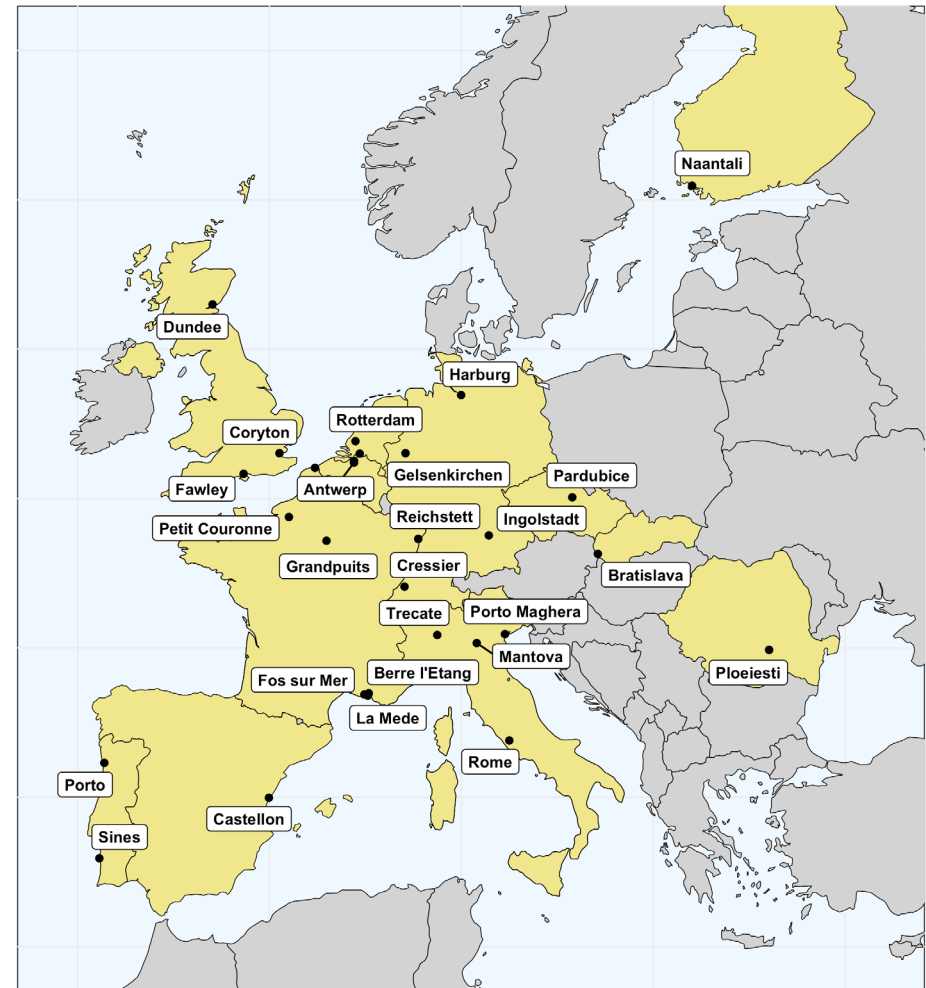
- ▶ Bitumen in a refinery is not by accident, it is a decision.
- ▶ As bitumen crudes are mostly higher in sulphur content, it will become difficult to simply blend away residues into heavy fuel oil when bitumen demand is lower.
- ▶ Bitumen is a seasonal product requiring a specific logistics and supply chain.
- ▶ **Refiners make strategic decisions about their business model: which crude type to use, which products to produce and the necessary investments to achieve these goals.**

During the last 20 years, many European refineries have stopped with the production of bitumen – often as a result of investing in bottom-of-the-barrel upgrading which allows the refinery to produce more lighter products and less fuel oils and/or bitumen products. **During 2023, some more refineries might change their views towards bitumen production.** In average, bitumen is less than 3% of the refined products.

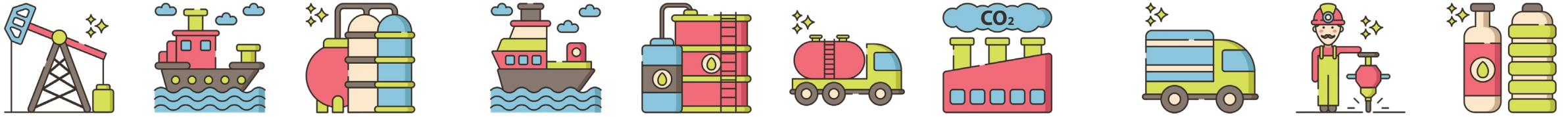
Refineries in Europe with bitumen production



Refineries in Europe with bitumen production closed 2000 - 2022

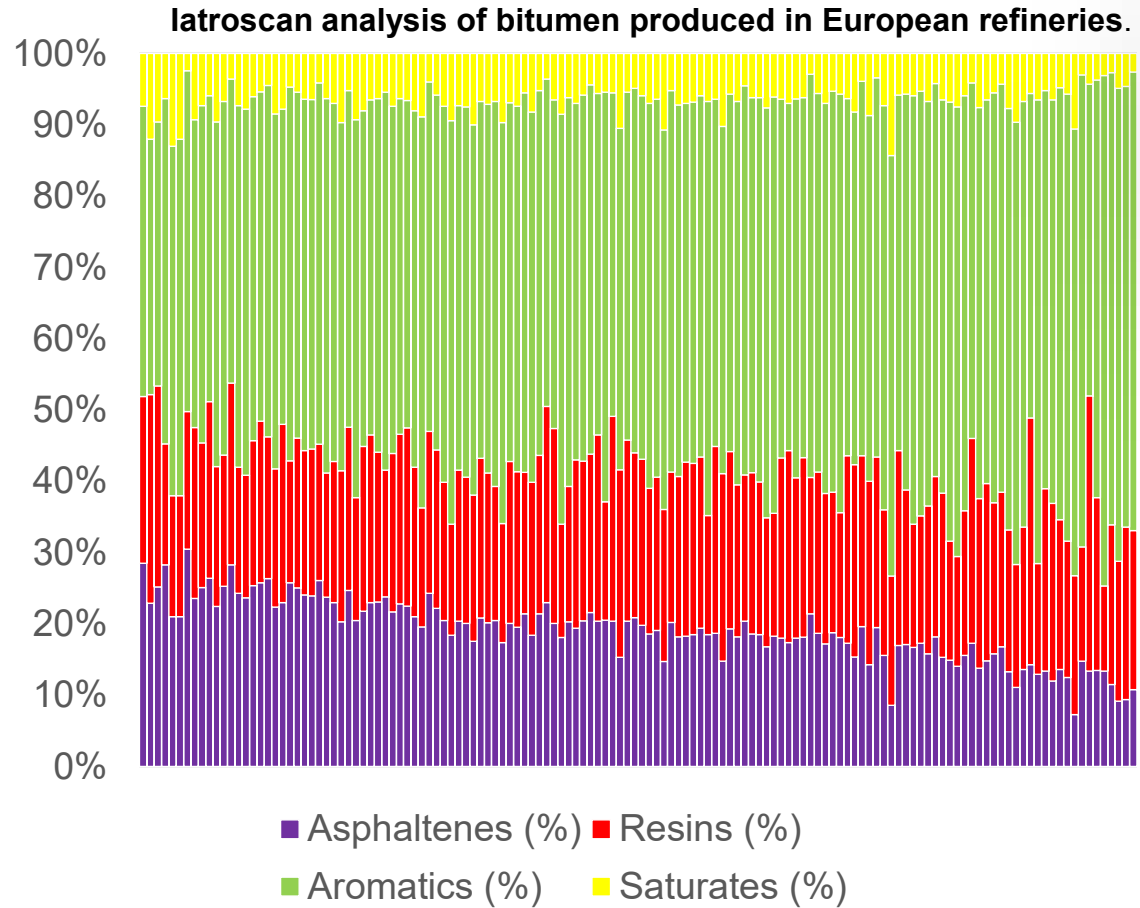


Bitumen chemistry is important for bitumen modification - but while “in the old days” bitumen was produced in a refinery, loaded at the refinery and transported to the customer, the current bitumen supply chain has become much more complex. **Bitumen is a complex product, and more aspects need to be considered. These include recyclability, health & safety, REACH and CAS conformity, environmental regulations, LCI/EPD,...**

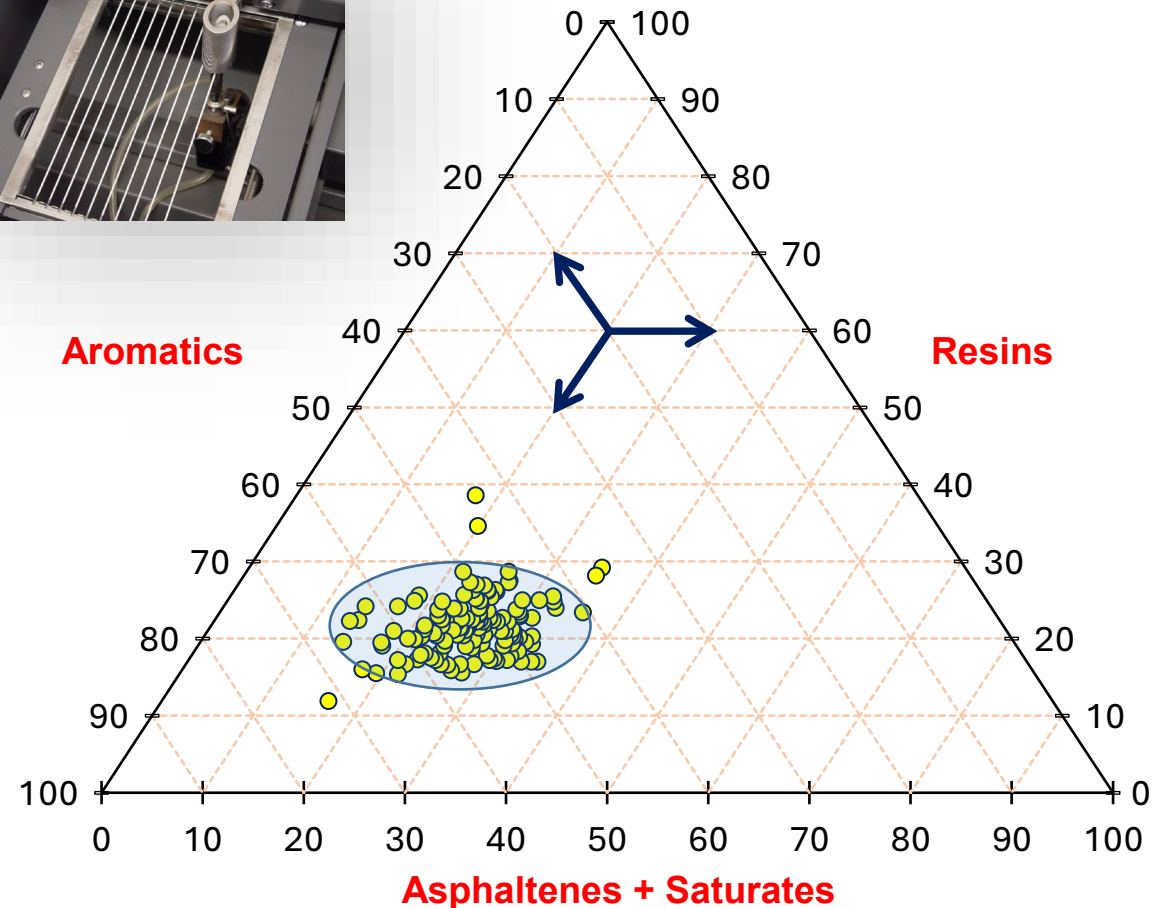
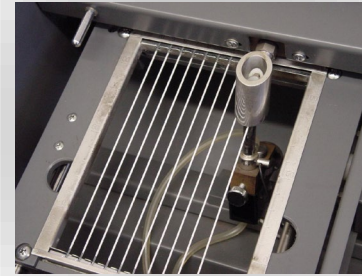


- ▶ Bitumen produced in a refinery will be produced following one of the registered manufacturing routes.
- ▶ **But, the way from the refinery gate to the final user is not always a straight line.**
 - ▶ Delivery to depot, blending, additives,...
 - ▶ Bitumen trading, imports & exports....
- ▶ Quality traceability during the whole supply chain is not becoming easy.
- ▶ Certain products, like eg. REOB, are using the same CAS number for bitumen (in Europe) and can be blended into bitumen.

More than 80% of the bitumen produced is used in road construction. Bitumen specifications are driven by the needs of this application. The specific aspects of bitumen modification (PmB and roofing) are not included. **The bitumen chemistry – related with the crude origin, refining conditions and bitumen production process – is for roofing applications of importance to understand the possibilities towards modification.**



Bitumen samples ranked by IC (– from low (left) to high (right))

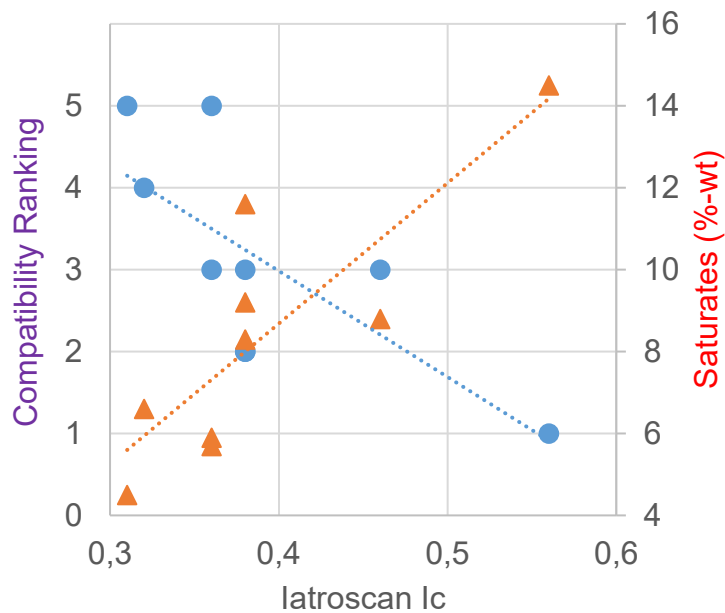


The Iatroscan method is a “simple” way to monitor the quality – and consistency – of a bitumen, but it can also be used to “position” various bitumen grades with respect to the “compatibility prediction”.

Some examples of laboratory optimization work (APP or SBS modification).

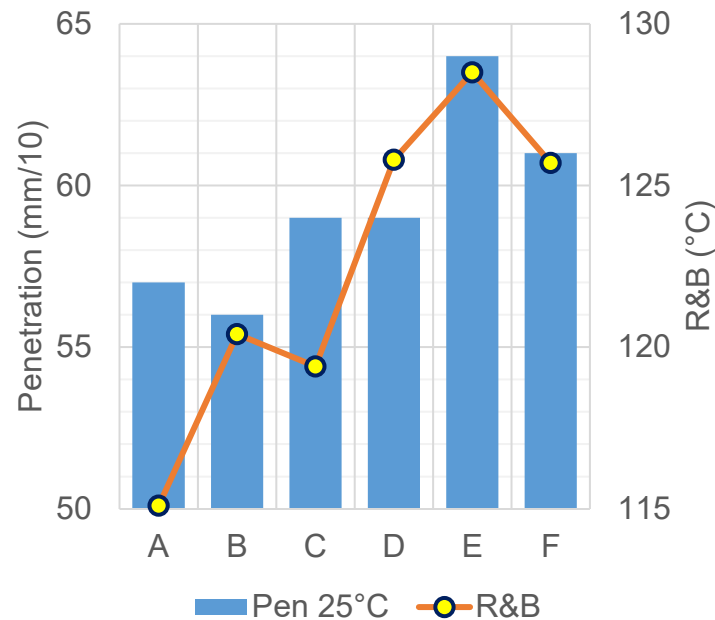
Various bitumen grades (different refineries) with APP polymer. Ranked on an evaluation from “good” to “bad” in 5 steps.

Clear trend between I_c and saturates content.



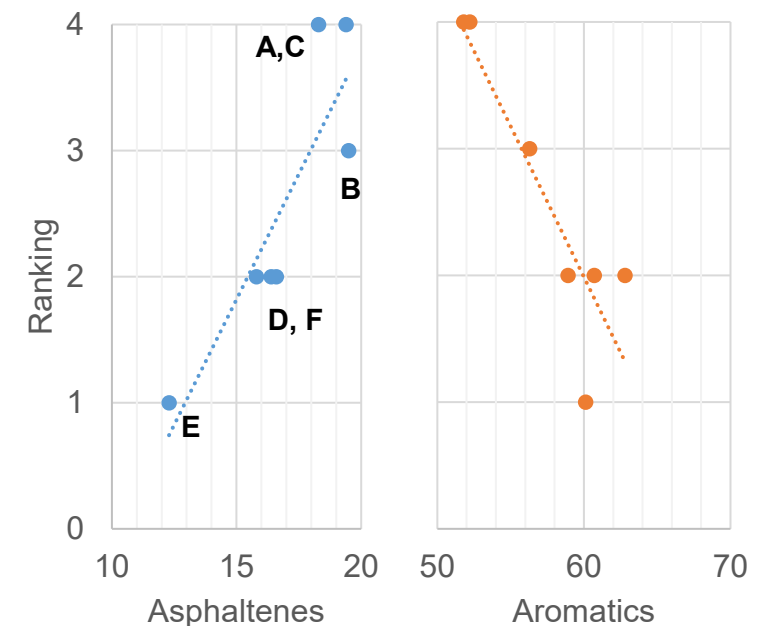
Optimization of bitumen composition to improve R&B (viscosity) levels – 12% radial SBS in 160/220 bitumen.

Trend between higher R&B and reduced asphaltene content.



Selection of most suitable bitumen composition for SBS modification.

Trends between compositional data and performance ranking.

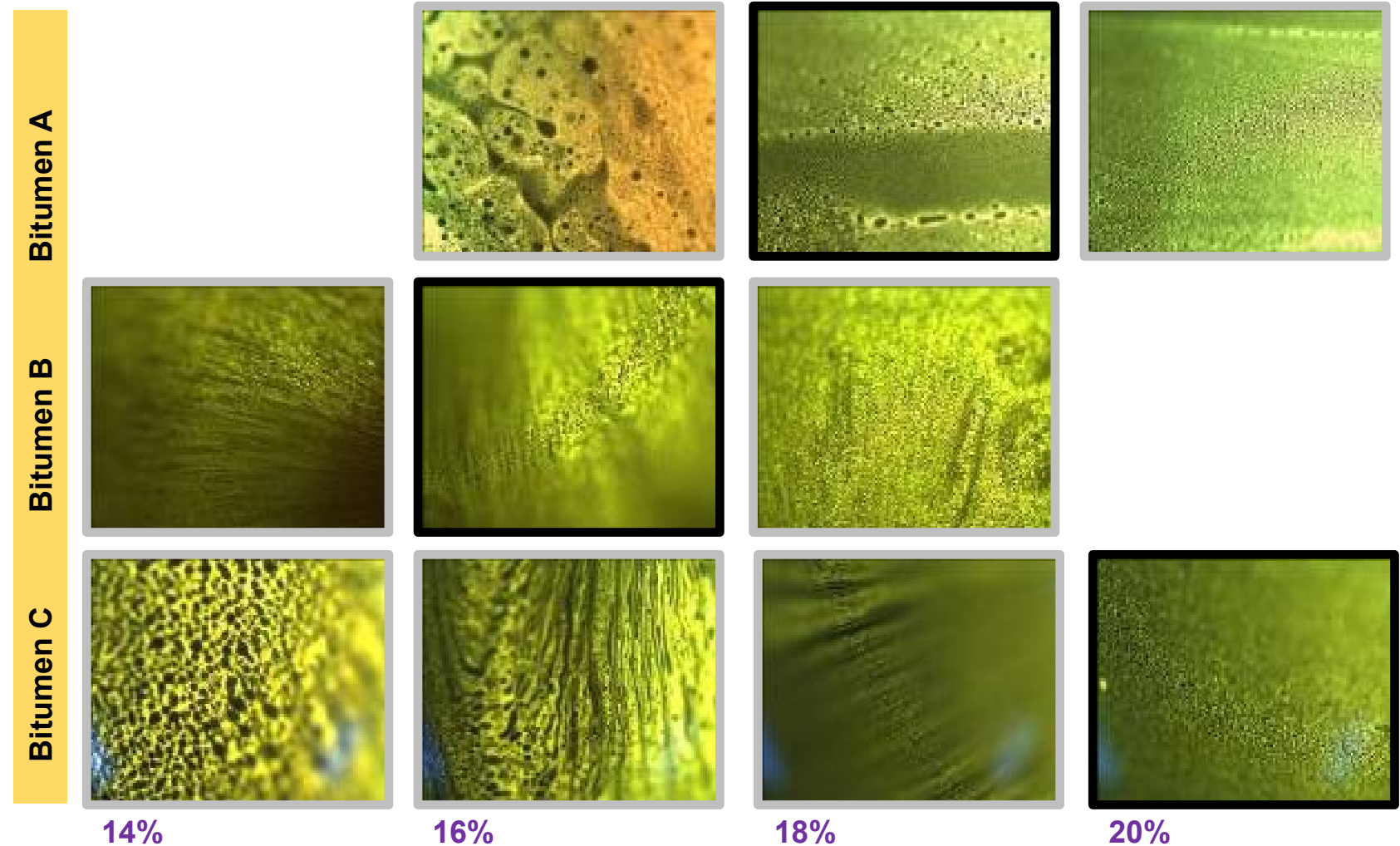


Small changes in bitumen chemistry can improve polymer compatibility.

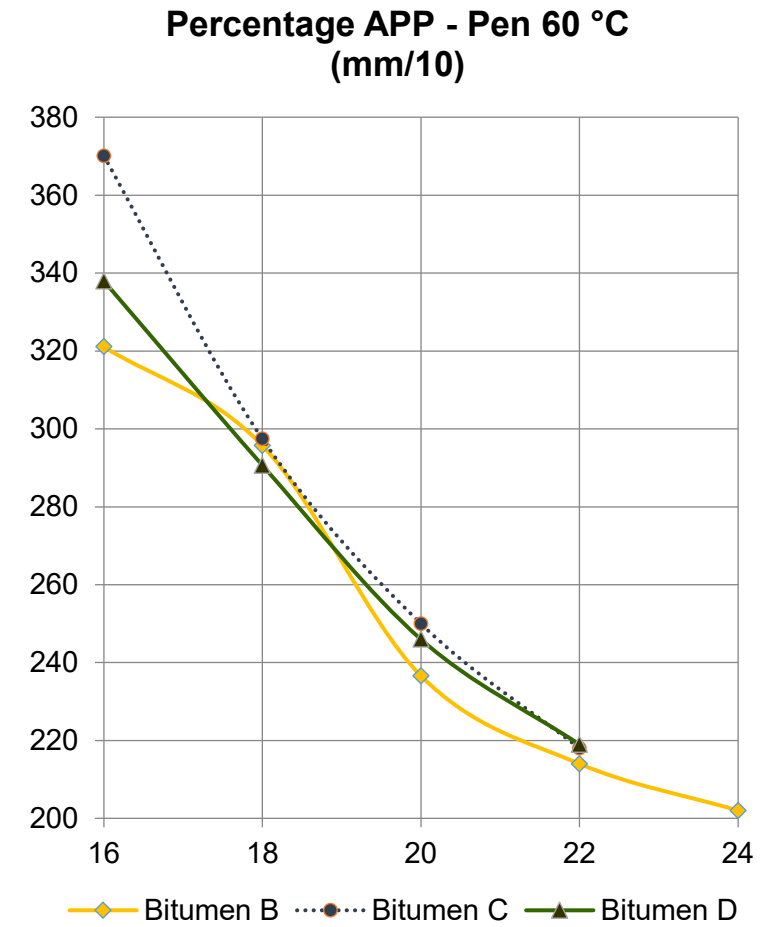
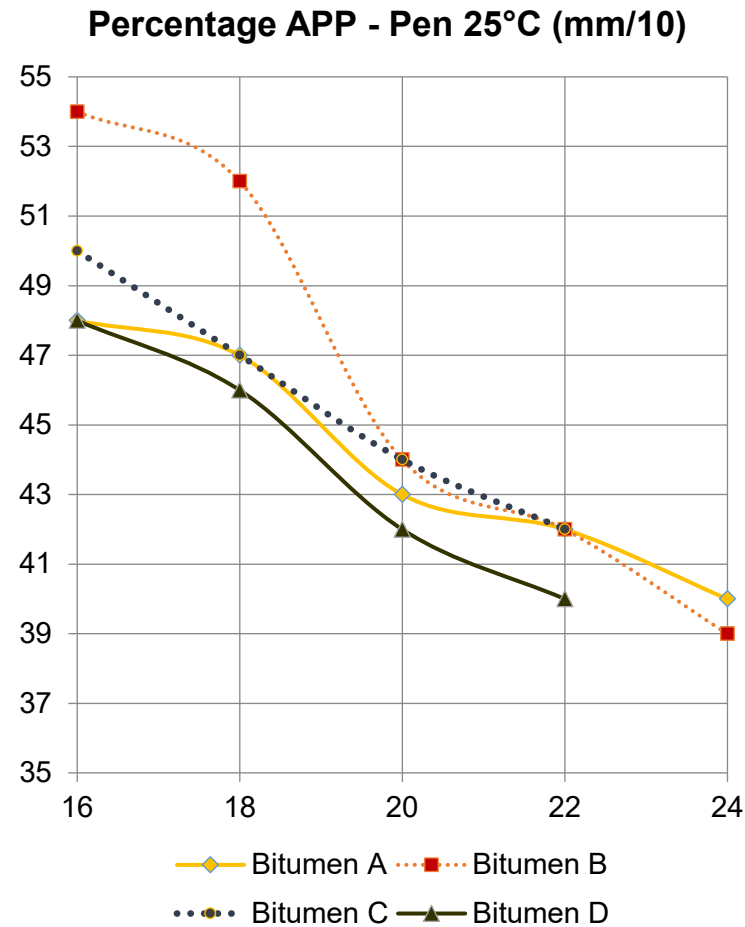
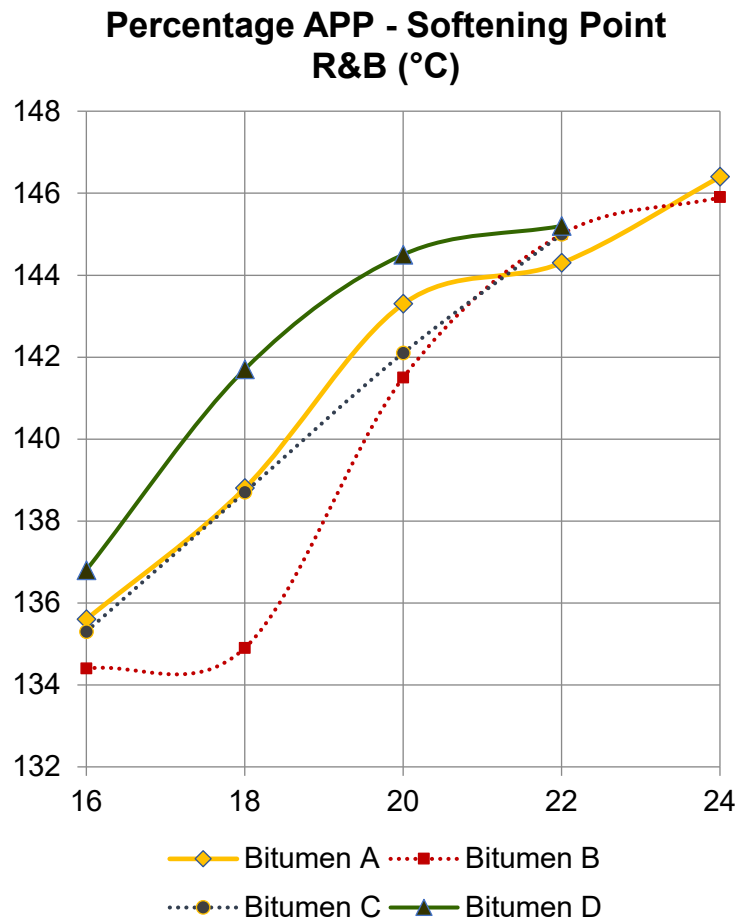
In this example, 3 binders are blended with an APAO polymer – the phase-inversion point is used as “optimization” criterium. The **SARA** composition can be used to “estimate” bitumen compatibility.

	A	B	C
Asphaltenes (%)	18	16	20
Resins (%)	21	25	26
Aromatics (%)	52	46	46
Saturates (%)	8	13	8
IC	2.8	2.5	2.6
Pen	190	190	150
Saturates / Aromatics	0.15	0.28	0.17

The saturates/aromatics ratio is often used as a criterion (a low ratio is said to be better for SBS while a higher ratio should favour APP polymers).



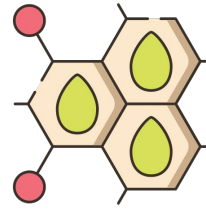
Not only phase inversion points are influenced by the bitumen/polymer chemical interactions, but performance properties are impacted as well. Having a better polymer compatibility, target aspects like softening point R&B, Penetration and viscosity (flow) can be obtained with less polymer addition.



The refinery flexibility towards bitumen is different between refineries, but despite this, several levels of support are possible. However, the limited flexibility options, refineries may have mostly end at the refinery gate as refiners have no impact on what happens afterwards.



- A refinery has limited flexibility.
- A significant change in crude or feedstock has many impacts and refiners will look for similar crudes with a comparable fraction yield distribution.



- The chemical composition of the bitumen is impacting the interaction between bitumen and polymer.
- **Knowing the bitumen chemistry can help optimizing formulations.**



- Bitumen suppliers can support the roofing industry by segregating suitable roofing bitumen, by facilitating the use of specific additives or by providing specific compositional information.

Sustainability is another main aspect in today's refining world. Changing the composition of a bitumen to improve performance should not jeopardize future recyclability (or re-use) of the product and not introduce negative HS&E aspects into the product life.

The quality of bitumen is an important aspect (and bitumen specification do not cover the needs of the roofing industry), but bitumen must comply with various other regulations.

These include recyclability, health & safety, REACH and CAS conformity, LCI/EPD,.... **Producers are actively working on these fields to provide suitable answers to bitumen users.**

- **PAH levels are more and more part of bitumen testing.**

▶ In general, small amounts of PAH, alkylated PAH and sulphur-containing PAH are found in refined bitumen.

The addition of certain products during the supply chain could change the PAH profile of the refinery bitumen drastically.

- **Bitumen can be recycled and re-used in asphalt. The re-use in roofing materials is a more difficult process.**

▶ Considering the impact of a product over the whole life cycle, including what happens at the end of its service life, is important.

Increasing the presence of existing products in circular product flows is essential for the efficient use of finite resources.

- **Reducing emissions is having a major focus, and each product in the chain must contribute → EPD.**

▶ An Environmental Product Declaration is a document which describes the environmental performance or impact of any material over its lifetime.

It is important to understand the whole supply chain to provide the correct bitumen LCI data.

As the bitumen demand outlook is positive, refineries will continue to produce bitumen but the logistical chain might become more complex and less transparent.

TAKING OIL FURTHER

We take oil further to bring lasting value
to customers and the world we live in.



Biobased, a Future for bitumen?

Dr. Hans Aerts

Content

1. BMI Group
2. What drives the industry - and what is the impact for the bitumen industry
3. Something about biobased raw materials
4. Are biobased raw materials alternatives for bitumen?
5. Some examples
6. Conclusions

Content

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We are a Standard Industries Company

BMI Group is a **standard industries** company.

Standard Industries is a privately-held global industrial company operating in more than 80 countries with over 20,000 employees.

It includes our sister company GAF, the leading manufacturer of roofing and waterproofing solutions in North America.




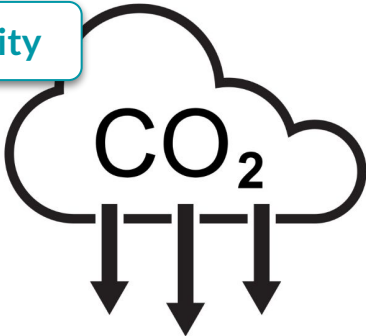
Together, we are the largest roofing and waterproofing business in the world.



Content

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What drives the industry ...

Sustainability	Availability		
			
			
<ul style="list-style-type: none">■ There is enough crude oil in the world, but not enough room to burn it■ CO₂ restrictions, Paris agreement	 <ul style="list-style-type: none">■ Journey towards circularity and reduction of the CO₂ footprint of construction products■ Become Sustainable	<ul style="list-style-type: none">■ Installation of crackers in the process■ Same amount of bitumen available?	<ul style="list-style-type: none">■ Transport towards electric, hydrogen, based on renewable energy (wind, solar, biomass)■ Less crude oil needed■ Less bitumen available?

So, what does this mean for us?

Some more context ...

- **Industrial switch to biobased** feedstock (biorefinery) has started
 - Focus on drop-in and high added value chemicals
 - E.g. sugar based industry can provide biobased PE and PP
- Some products could be made already **fully biobased** ... but costly
- Today, mostly **fine chemicals** are available
- **Full transformation of feedstock will take years ...**

- **Our customers like to work with bitumen membranes**
 - Peace of mind - Easy to apply - Easy to repair - Good performance

So what would we need, to start working with biobased bitumen alternatives

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From Bitumen to Biobased raw materials



Known technology with a **long history**
Coming from petrochemical industry
From distillation of crude oil



**“A resource that
can be replenished
in a human time
scale”**
Wikipedia

Few years of experience, but industry is
picking up speed
From renewable raw materials

Biobased raw materials



Vegetable and animal fats and oils

- Part of food / feed chain
- E.g. Rapeseed oil, ...



Components from non food raw materials

- E.g. wood and grass based chemicals



Heat treated waste materials

- E.g. Pyrolysis products, ...

Learnings from using biobased raw materials for bitumen technology ...

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Alternative for bitumen?

Bitumen Waterproofing Membrane

Waterproof material



Biobased Bitumen Waterproofing Membrane

Initially waterproof is possible, **durable?** Not **biodegradable?** H&S?

- **Standard Watertightness test (fresh material)** needs to pass
- **What about water tightness after ageing**
 - 3 months 70/80°C - UV - real life roof - ...
- **Biodegradability** - 30 day test to measure organic carbon loss (**OECD 301B test**)
 - Water tightness should pass after this test
 - What if the raw material is biodegradable, but not the blend
 - What about biodegradability after ageing? Mechanical actions can impact too ...
 - If not biodegradable, than recyclable?
- **Biobased does not mean 'not dangerous'**

Alternative for bitumen?

Bitumen Waterproofing Membrane

Easy to melt, weld and repair

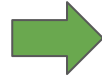
Bulk chemistry



Biobased Bitumen Waterproofing Membrane

Consequence of the raw material properties

Similar way of thinking so **similar equipment** possible?



- Do we provide a 'bitumen'-like technology **or** a more 'synthetic'-like one
- **Drop-in** technology for bitumen so that it can be mixed
 - 'invisible for our roofers' (or not?)
 - fitting to the current production process (vs e.g. extrusion, ...)
 - step-by-step introduction of biobased materials - when will bitumen become biobased in properties?
- Strength of our industry - we are used to work with 'less defined' materials
- Can it be recycled within the same streams - think about the **end-of-life**
 - We cannot create issues for the future
- What about the reinforcement and the filler?

Alternative for bitumen?

Bitumen Waterproofing Membrane

Material cost is 'low'



Biobased Bitumen Waterproofing Membrane

Will we find an alternative **at the right cost?**

- Less (r)(d)efined raw materials should lead to a better cost
- Availability today is limited so cost still high, but the biobased industry is picking up speed
- Recipes will not be the same as today, so potentially the final product cost can be more reasonable
 - a biobased/bitumen 'hybrid' product can therefore be more expensive as its future '100%' version
 - do the membranes need to be exactly the same or can we change the parameters/norms/standards while introducing this raw material

What about sustainability?

Biobased Bitumen Waterproofing Membrane

Recyclable



Recycling technology of bitumen membranes exist, biobased should fit in here. Mixable?

Circular



If bitumen is recycled and reused it is circular

- The producer is responsible for the **end-of-life** of his products (EU law)
- Or **recyclable or biodegradable ... ?**
- Can we/do we need to **separate** when a roof is renovated / demolished?
- Bitumen membrane recycling process exist today - we need to treat our biobitumen membranes in the same way
- Reusing the output of recycling into the same products? Or fully circular?
 - This impacts strongly the direction of development

What about sustainability?

Biobased Bitumen Waterproofing Membrane

Renewable Raw materials



Renewable Raw materials

LCA & EPD



Decreases the impact of our materials?

- Construction products based on renewable raw materials can **fixate short term carbon** for a longer period of time - can be **prolonged by renovation & recycling**
- Work with suppliers of raw materials is needed to have **correct LCA data** & push the process **versus lower impact** - partnerships are needed to accomplish this

What about performance?

Durability 35 years + for bitumen membranes



Biobased Bitumen Waterproofing Membrane

Artificial ageing tests can be done. New technology works in real life? Degradation?

- What tests are needed to validate the lifetime of a new product?
 - Bitumen or/and Synthetic membrane standard ageing tests?
 - Others
- Having a gradual introduction will teach us more about the behaviour
 - Through artificial ageing
 - Through real life roof behaviour
- An understanding of the raw materials and their interactions within recipes is very important
- Close cooperation with suppliers is needed

What about performance?

Biobased Bitumen Waterproofing Membrane

Waterproofing properties



More polar, so more risks?

Mechanical properties



Linked to the reinforcement

Touch and feel



Will our customers accept? It will be different

- **Waterproofing** properties: basic promise we make to our customers
- The **reinforcement** impacts the final mechanical properties - biobased?
- What about **norms and standards** - some will stay (fire testing), others can change?
Do we stick with a 'thicker' bitumen technology vs a 'thin' synthetic technology
- Will our customer like the '**new colour & smell**'?

So ... based on different raw materials



Vegetable and animal fats and oils

- High modification needed as very low viscous products
- Partial substitute for bitumen
- Seen as an additive
- High cost as highly priced raw materials
- Relatively well known final product properties



Components from non food raw materials

- More polar polymers needed
- Partial substitute for bitumen
- Raw material modification
- Medium cost as medium cost raw materials
- Unknown final product properties



Heat treated waste materials

- Specific polymers needed
- Full substitute for bitumen
- Competitive cost to bitumen
- Unknown final product properties

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Some examples of biobased alternatives

- **Rapeseed oil**, ... used in bitumen already today to change bitumen properties
- Companies like Shell and Colas have **polymer modified vegetable oil** products but mainly for use in road the industry
- **Tall oil derivatives** from wood industry ... used already into some bitumen membranes - main focus on decreasing the CO₂ impact
- **Lignin** is being used in road industry ... positive testing has been done in the Netherlands where up to 50% of the bitumen was replaced by lignin
- **Heat treated products** ... promising as the structure of the compounds is close to the one of bitumen, but far from implementation

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To take away

- **Fully biobased** alternative for bitumen is for the **longer term future**
- Raw material **development is only into its initial phase**
 - Co-development with suppliers is needed
- **Step-by-step** introduction is recommended
 - Impact on properties of the waterproofing membrane is to be understood
- Driver **today** is to reduce the **CO₂** impact, **tomorrow** it can be about **availability**

Thank you



OXIBOOST: a new versatile technology to improve bitumen

MOPI s.r.l.



Dr. Camillo Cardelli
E-mail: tech@mopilab.com

IMPERVIUS - Barcelona May 24th-25th 2023



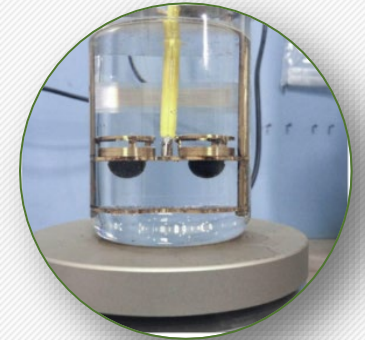
Bitumen Lab

certified ISO
9001:2015



2

- Research center in Pisa
- Instruments for laboratory tests
- Compatibilization and employing of recycled polymers
- Production of bitumen sheets





Polymer Lab

certified ISO
9001:2015



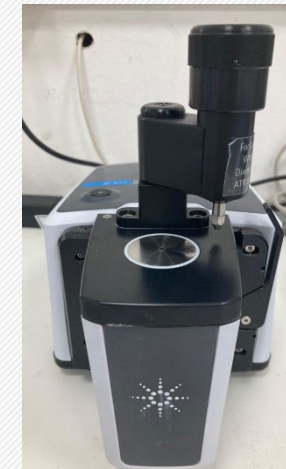
3



Twin-roll
mill
compounder



Moisture
analyzer



FT-IR ATR



DSC



Balance
for
density



MFI



Ventilated
oven



TGA

Air blowing of bitumen

4

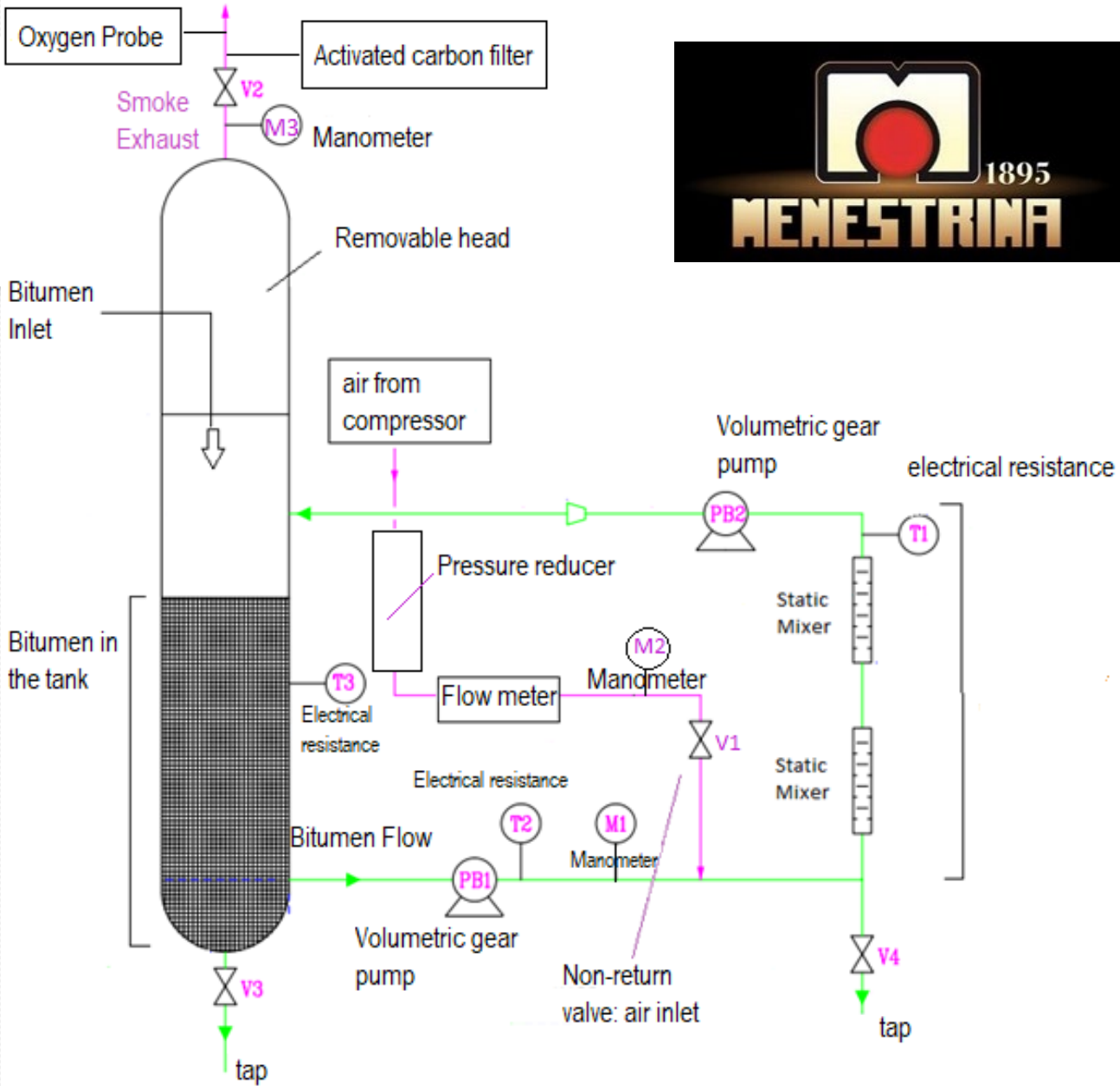
Blowing air at high temperature through bitumen at 250°C

Air blowing increases hardness, R&B and viscosity, and reduces penetration and cold-bend performances

Kinetic/efficiency of the air blowing is proportional to:

- Temperature
- Air/Oxygen flow
- Pressure
- Extension of interphase between air and bitumen





Oxiboost

5

- Patented technology by MOPI and **Menestrina**
- Air rectification of bitumen in external loop under controlled conditions of temperature and pressure
- Electrically heated tank and circuit
- Two taps for sampling and easy clean
- Online analysis of exhausted smokes and collection of volatile organic compounds (VOC)



Oxiboost

6

Laboratory equipment installed on 2020 in MOPI lab for thermal and chemical treatment of bitumen and its mixtures with oils and polymers

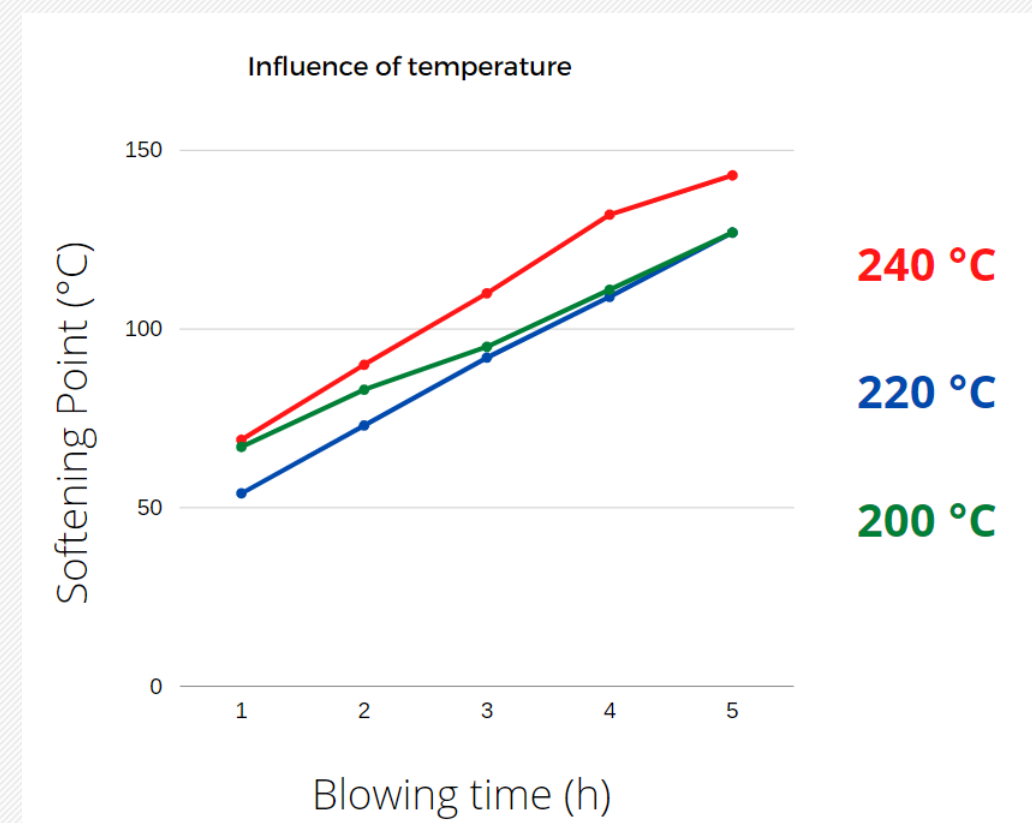
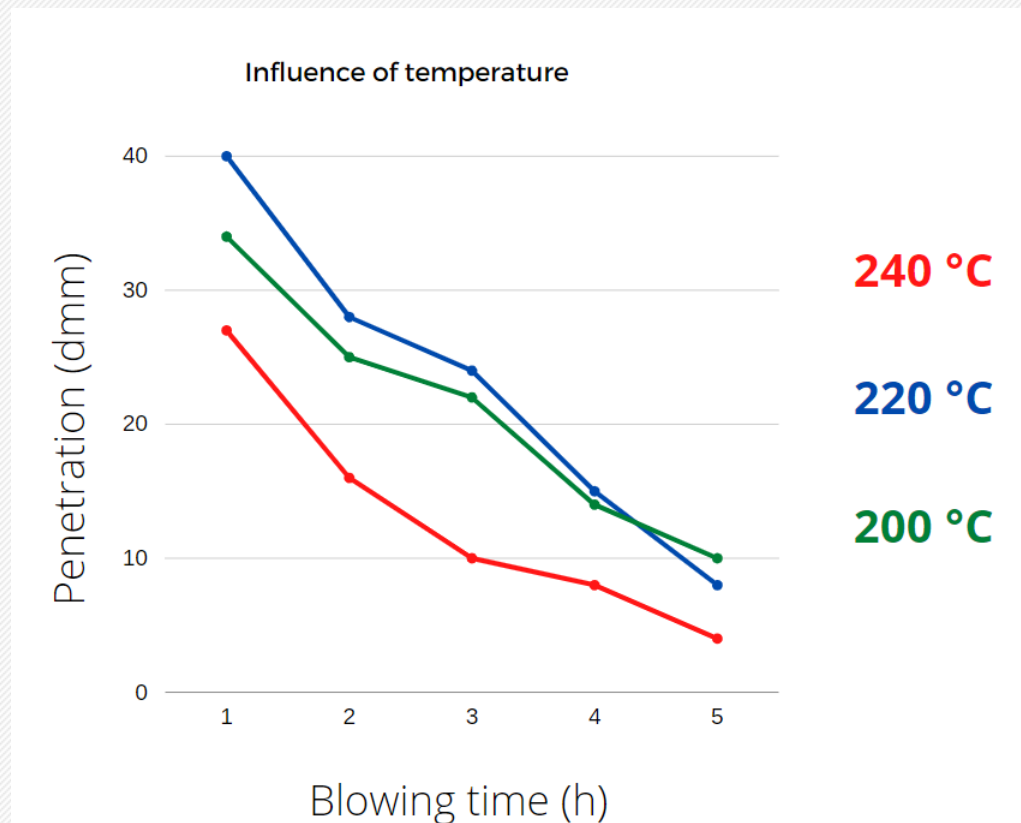
- Batches of 5-7 kg
- Thermal treatment till 310° C
- Gas injection till 6 bar
- Gas flow till 6 liters/minute
- Turbulent flow of bitumen+gas

Thesis with Pisa University /1



UNIVERSITÀ DI PISA

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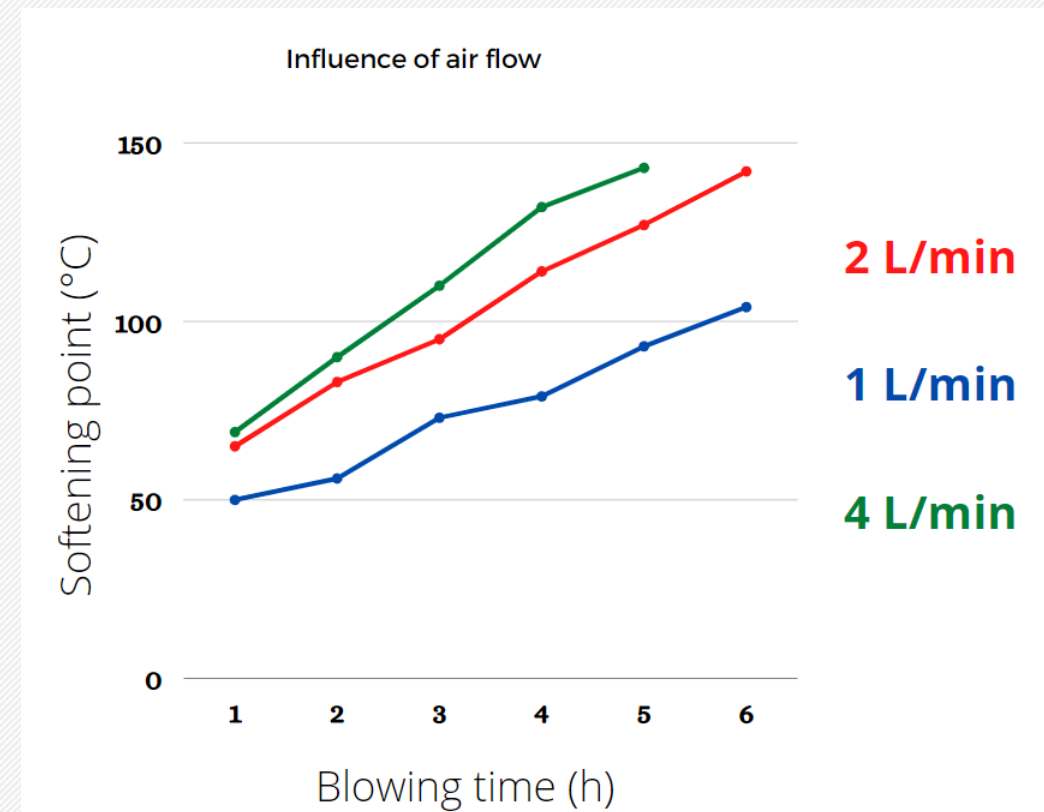
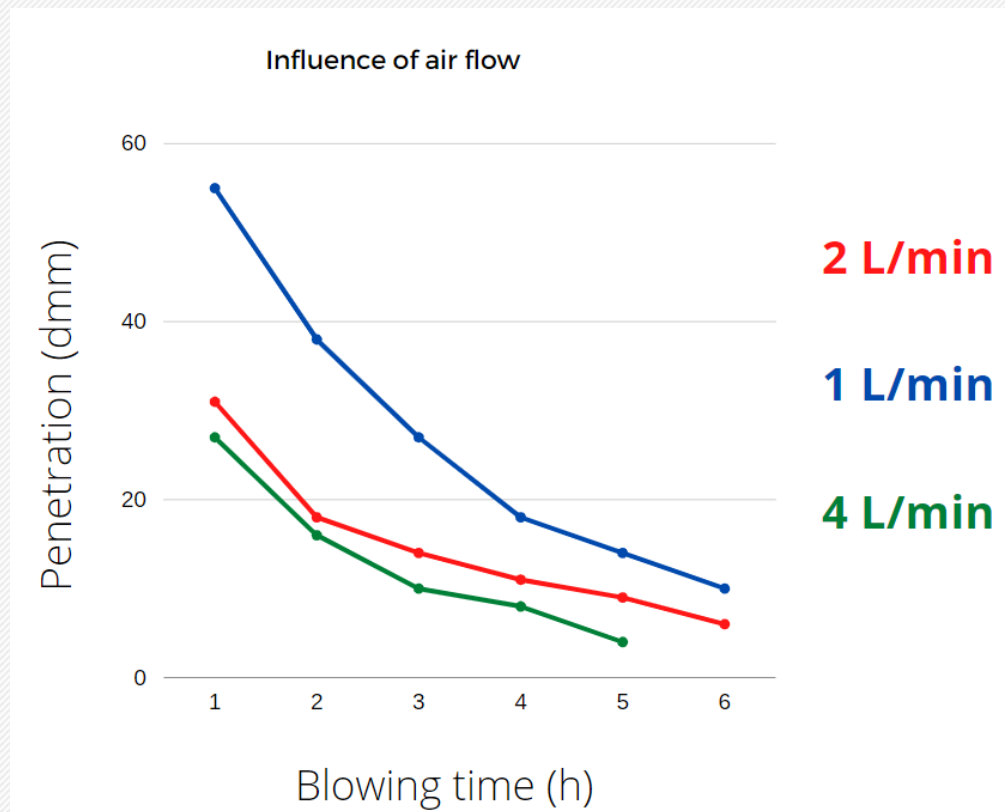


Thesis with Pisa University /2



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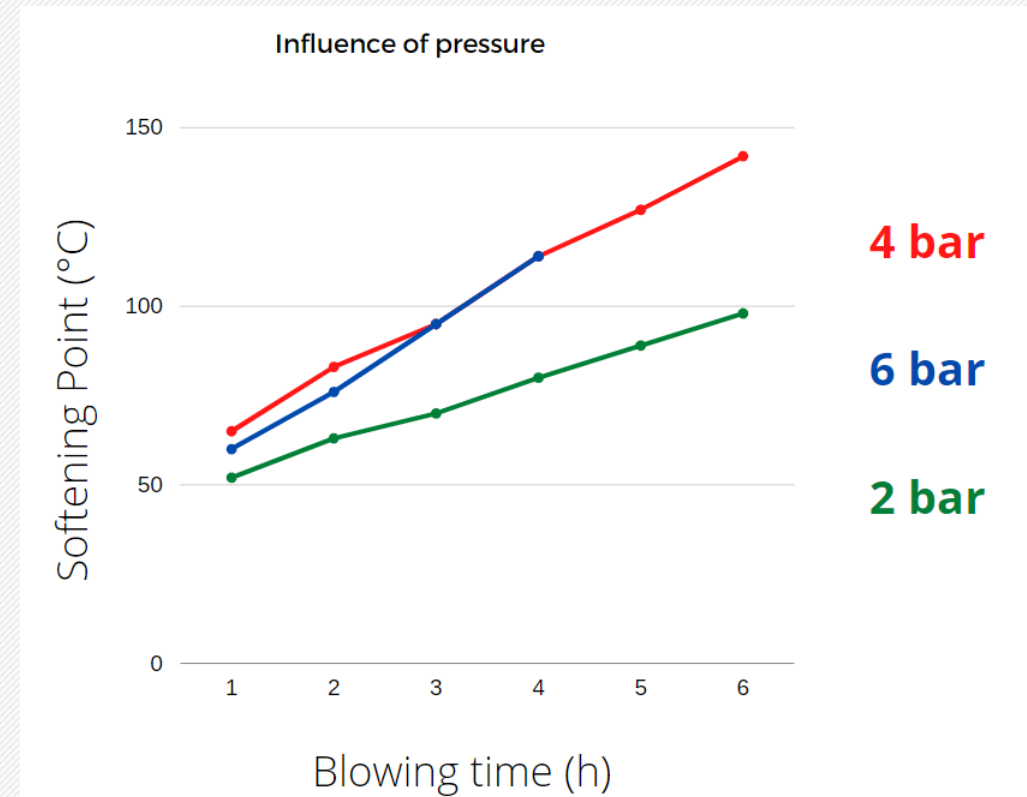
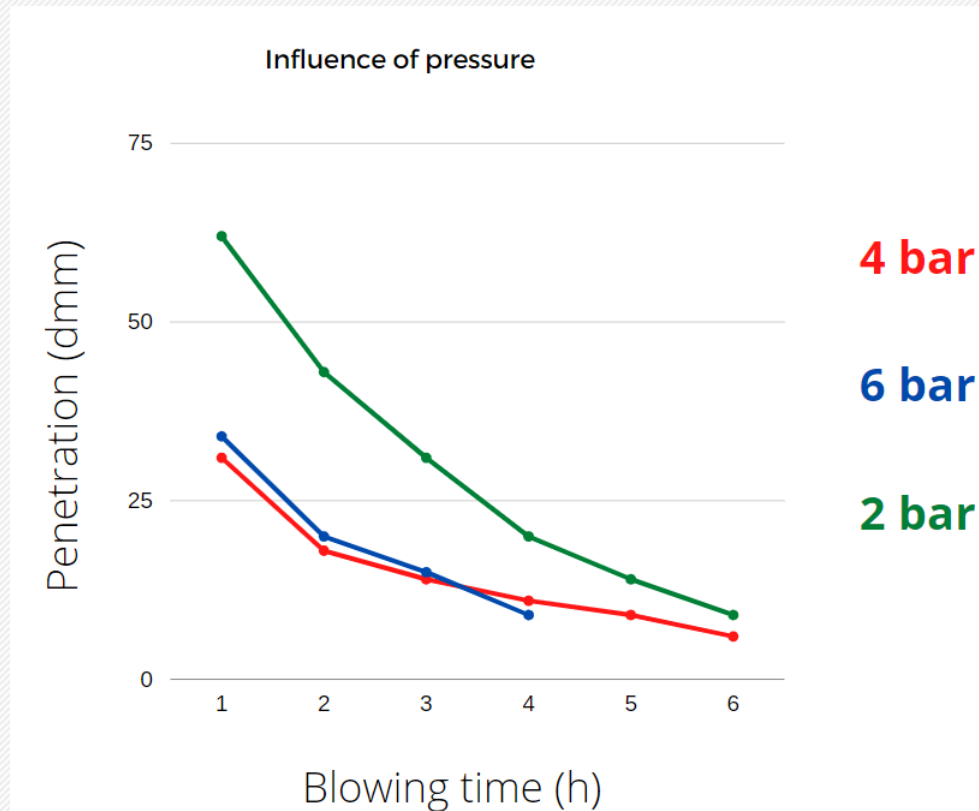


Thesis with Pisa University /3



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9



Reclaimed tire rubber: «new» raw material



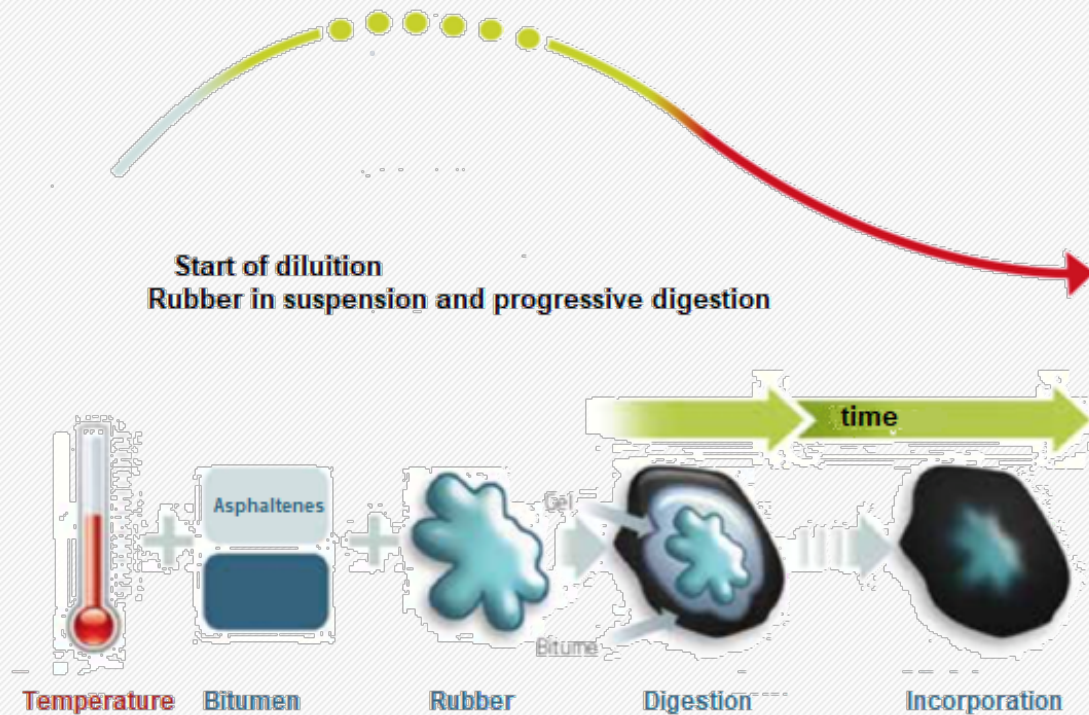
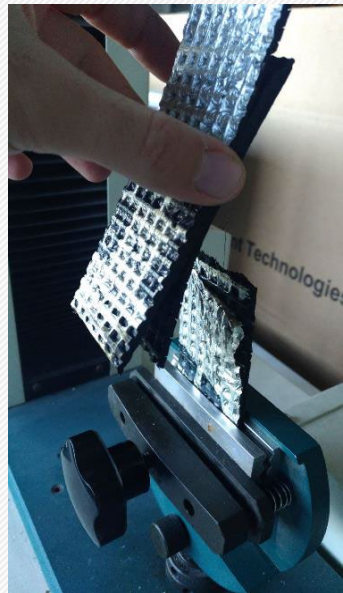
DM 78/2020 (Italian Law)

The end-of-waste for end-of-life tires (ELT) of March 2020 establishes unambiguous criteria throughout the national territory, a guarantee for those who recycle tires and for those who use recycled rubber to produce soccer fields, playgrounds for children, street furniture.

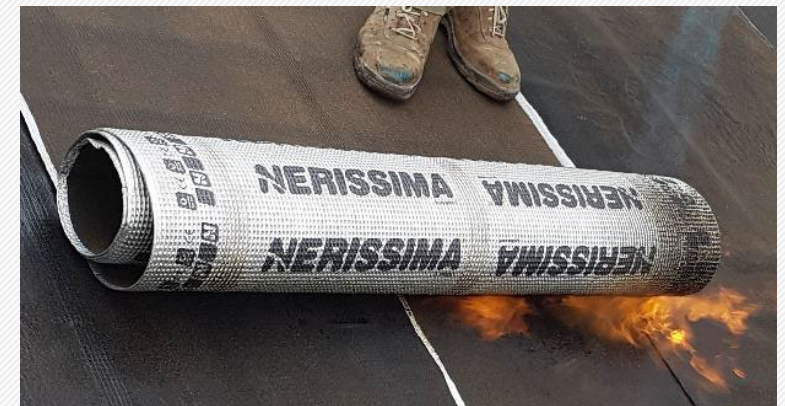


⇒ **Certified quality, from end-of-life tyres (ELT) till reclaimed tire rubber (RTR)**

RTR in APP/SBS roofing membranes



Baveno 5-6 June 2019



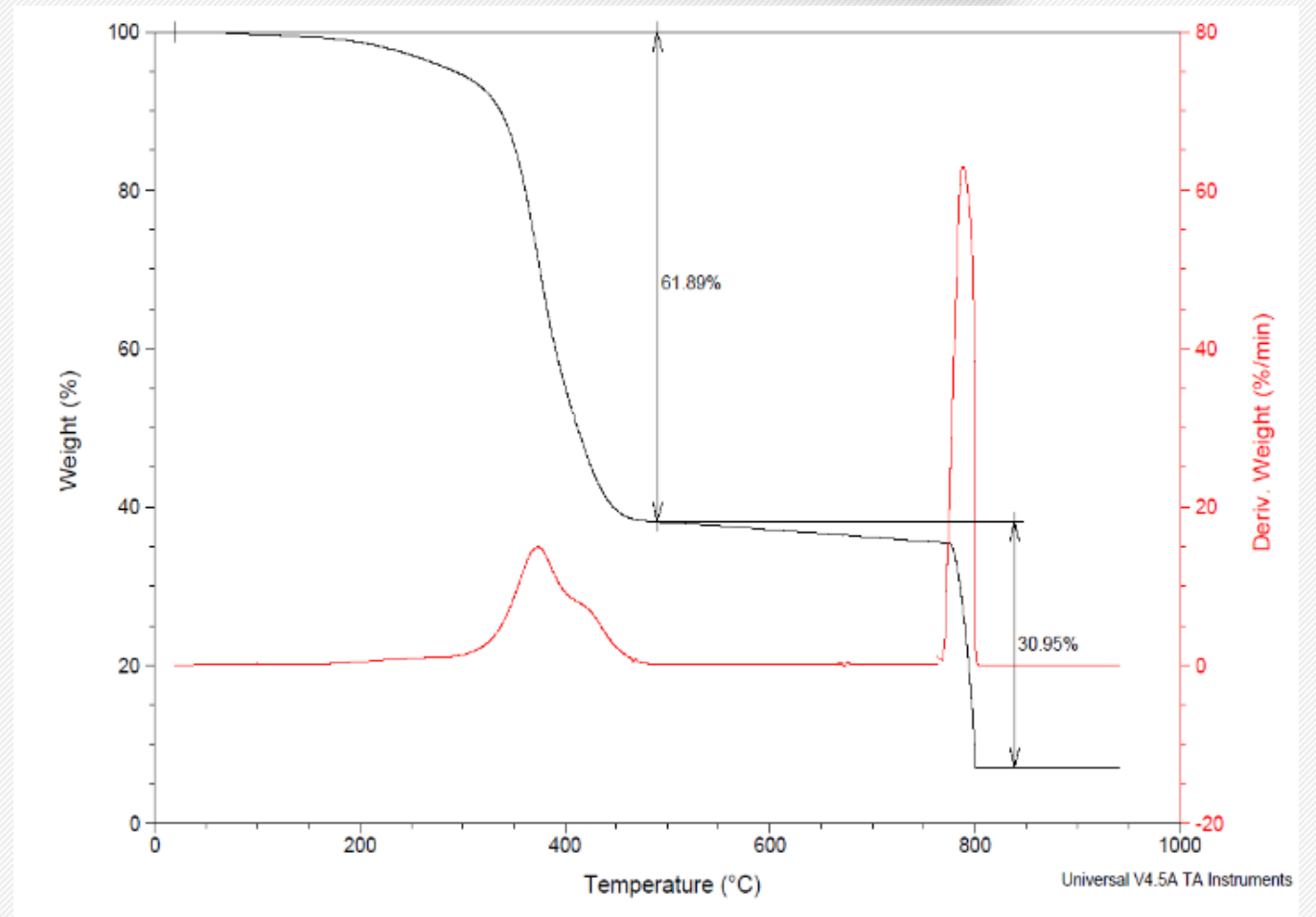
⇒ Growing use of RTR in bitumen roofing membranes

Composition and decomposition of RTR

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	RTR from cars	RTR from trucks
Natural rubber	24,8	47,1
Synthetic rubber	28,7	12,7
Process oil	5,1	1,0
Carbon black	22,1	28,3
Silica	9,0	1,7
Additives	10,3	9,1
total	100	100

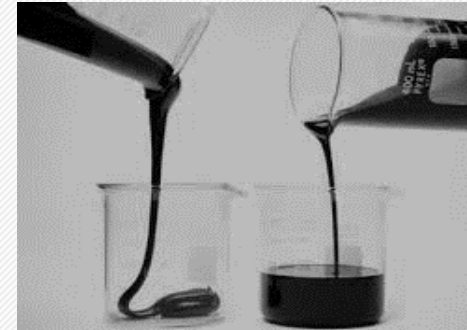
⇒ Decompositon from 300° C



Conversion of RTR to «bitumen»

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- Mixture bitumen + RTR treated at $T=300^{\circ}\text{C}$
- Thermolysis of C-C, S-C, S-S chemical bonds of rubber
- Dissolution into bitumen of soluble oligomer fractions



The strategy of the project is to obtain the complete «digestion» of RTR into bitumen thanks to controlled thermolysis inside the Oxiboost.

A kind of «mild» pyrolysis promoted by solvent properties of bitumen

Experimental procedure



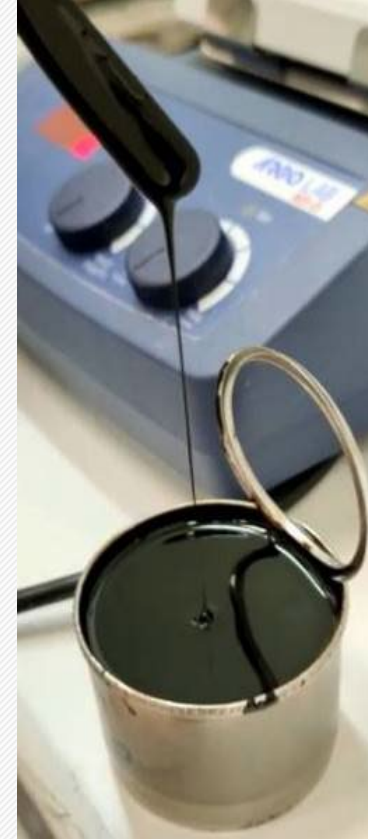
14

- Insertion of preheated bitumen at 150° C with the addition of rubber powder with a particle size of 0-800 microns
- Headspace closure and connection with activated carbons trap
- Heating up to the thermolysis temperature (typically 300-310° C)
- Sampling of a cup of bitumen every hour
- Possible blowing of air for rectification of the bitumen
- At the end of the test (generally 4 hours), unloading of the bitumen and cooling of the equipment at 200° C
- Cleaning of the equipment with virgin bitumen at 200° C and preparation for the next test.

Visual control of «digestion» of rubber /1

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Before:
Elastic,
due to
rubber



After:
Liquid,
Fluid,
Rubber
Totally
disappeared

Analyses and controls



On the samples obtained from intermediate samplings:

- Penetration
- Softening point
- Brookfield Dynamic Viscosity

Additional analyses on the bituminous mixture at the end of the test:

- TGA (Thermo-Gravimetric Analysis)
- Breaking Point Frass
- Solubility Test in Organic Solvents
- Ductility
- Elastic Return Test
- Flash point

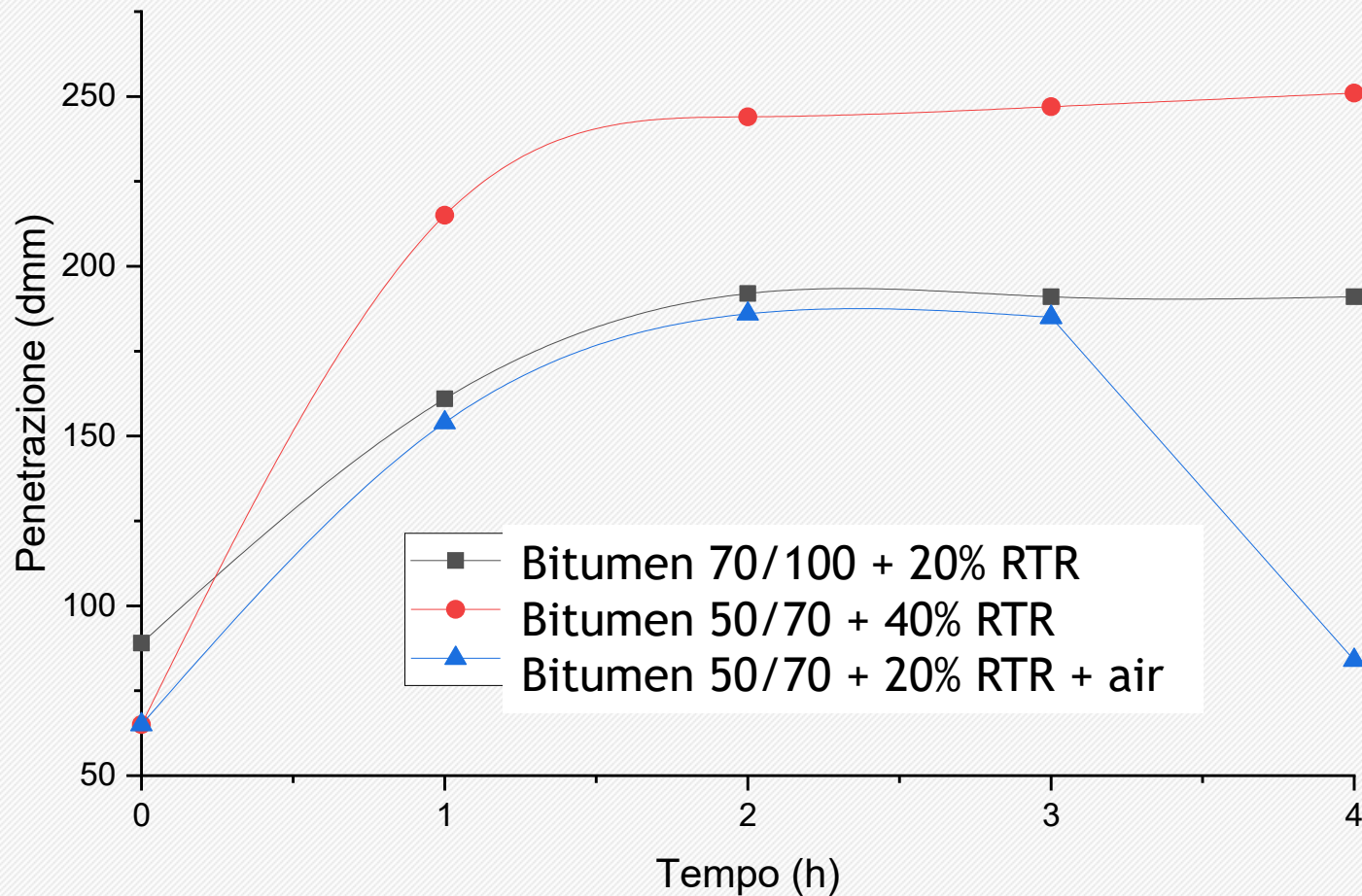
Properties of thermally treated bitumen+RTR

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Properties	Bitumen 70/100	Bit 70/100 + 20% RTR - 4h
Ring & Ball (°C)	46	38
Penetration 25°C (dmm)	75	300
Fraass (°C)	-12	-24
Solubility in organic solvent (%)	99,8	95,5
Viscosity@100°C (cps)	4605	1780
Viscosity@110°C (cps)	2295	1200
Viscosity@120°C (cps)	1295	770
Viscosity@130°C (cps)	715	450
Flash point (open cup)	>340°C	>340°C

⇒ *The flash point of the final bitumen did not drop, i.e. the degradation product of RTR acted as “oil” but did not increase the flammability*

Penetration over the time

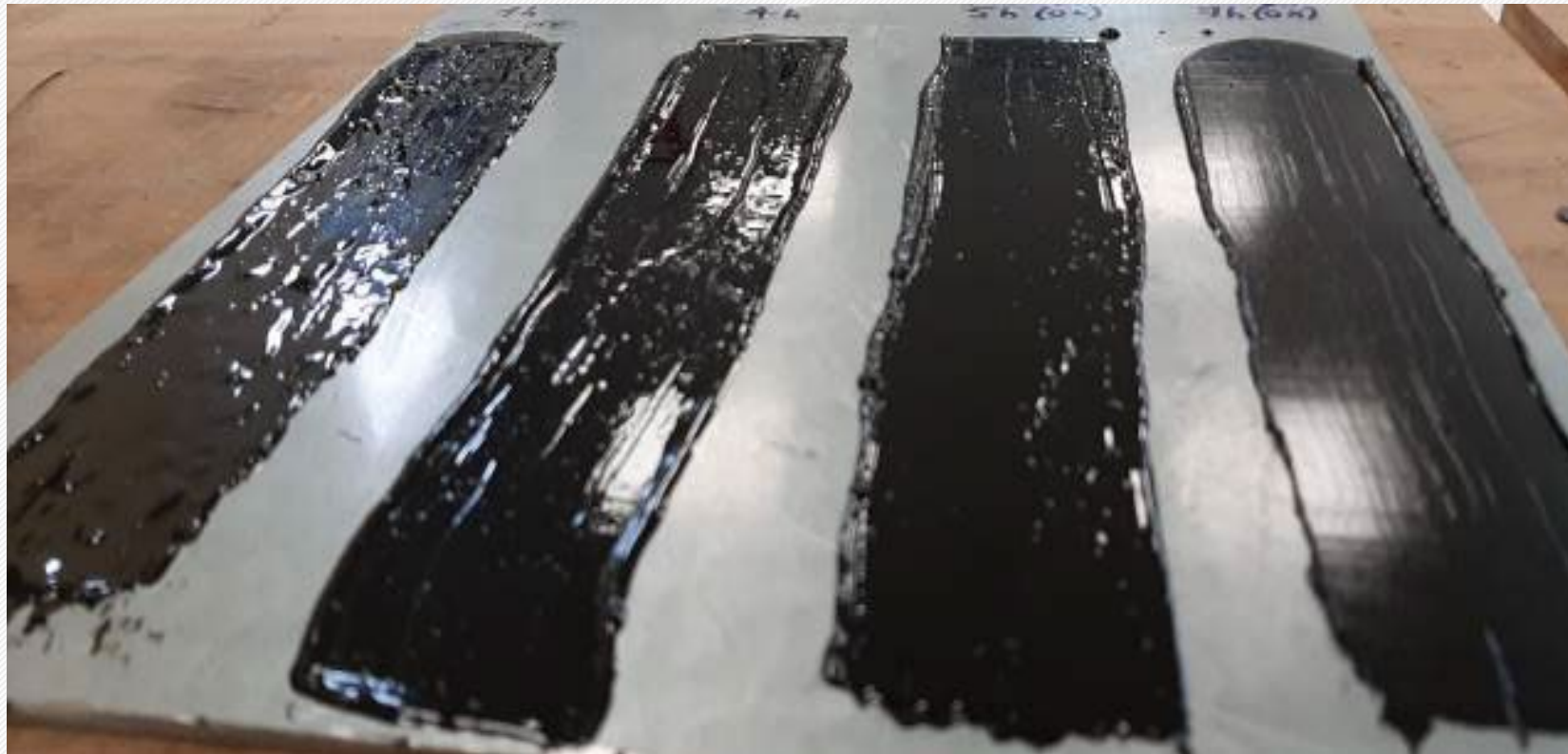


⇒ *Digestion of RTR is almost completed after 2h*

⇒ *Blowing air after the thermal treatment brings back the penetration to original value*

Visual control of «digestion» of rubber /2

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Bitumen 50/70
+ 20% RTR
+ 3h 300° C
+ 1h air

Conclusions

- Oxiboost is new laboratory equipment for optimised blowing of bitumen following the new patented concept of air rectification in external loop
- Suitable for thermochemical modification of bitumen and mixtures bitumen+polymers
- Flexible operating conditions and extremely easy and safe use
- Ready to be scaled-up

**First promising result:
from ELT (waste) to bitumen (not renewable resource)**



Next steps for the «new bitumen»

- R&D of low-temperature conditions for thermal degradation ($T < 260^{\circ}\text{C}$)
- Chemical characterisation of the «new bitumen» obtained by RTR
- Treatment into Oxiboost by air or other gases to reduce/remove smell
- Modification of the «new bitumen» with APP and SBS
- Development of application of «new bitumen» for:
 - asphalt, reclaimed asphalt, warm mix asphalts
 - roofing membranes
 - bitumen emulsions





Special thanks to:

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MENESTRINA, over 100 years old Italian company producing plants for bitumen (www.menestrina.com)

Alma Petroli, Italian producer of bitumen (www.almapetroli.com)

Graneco Rubber srl, Italian company producing milled rubber from end-of-life tires (www.graneco.it)

Ecopneus for technical and economical support (www.ecopneus.it)



⇒ ...and all of you for the kind attention