Lightweighting strategies with TALC in automotive TPOs

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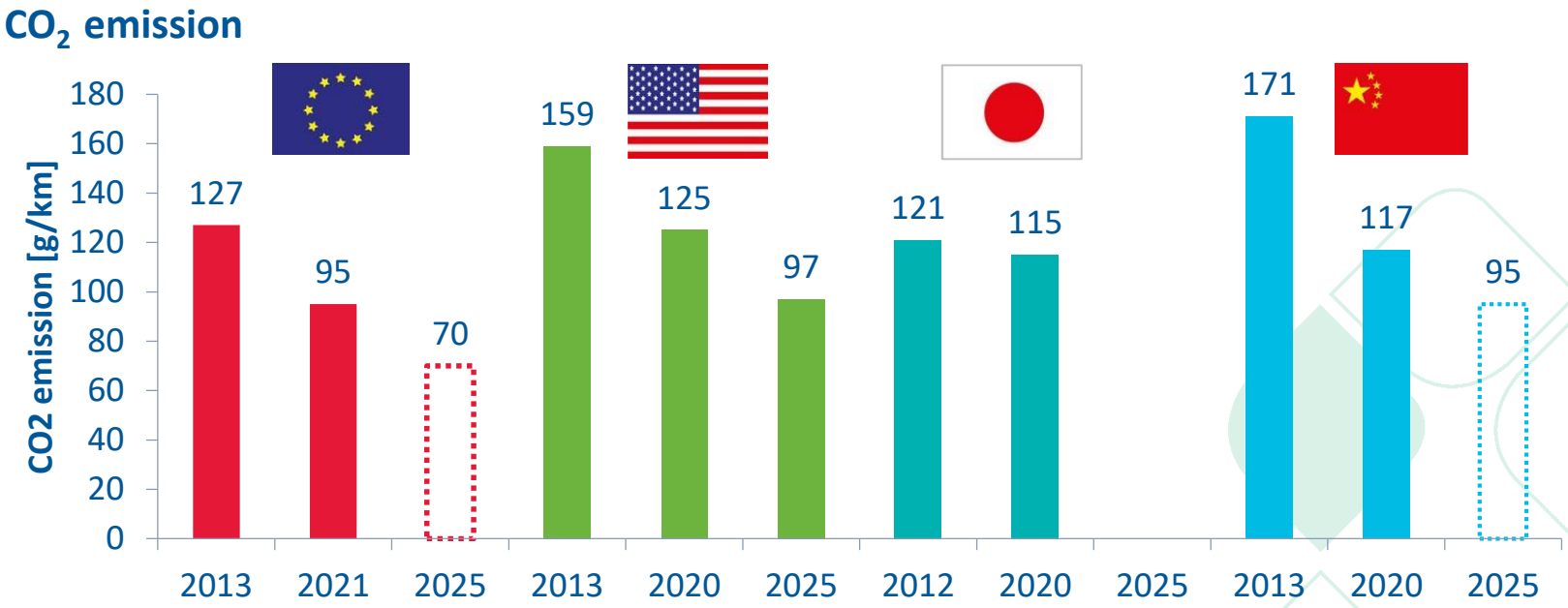
Takeaway messages

- IMI Fabi GLOBAL approach to AUTOMOTIVE industry
- TALC is a functional mineral used to improve properties of TPOs
- The right TALC selection allows to different lightweighting strategies

Background

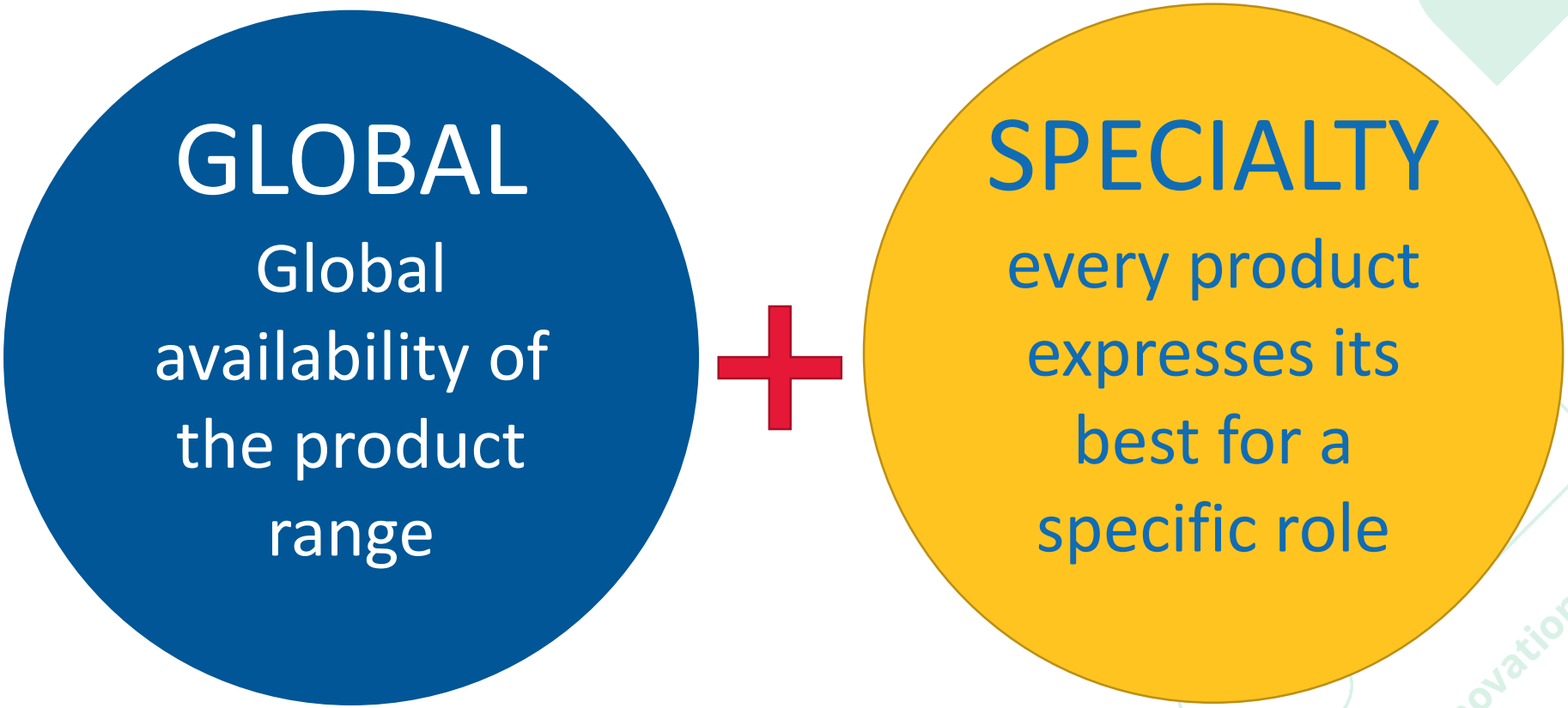
- Stringent emission regulations for vehicles



Source: ICCT/Roland Berger

- Need to lower GHG emissions/fuel consumptions
- Relevant amount of talc modified TPOs in vehicles
- **Lightweighting contributes to such process**

“GLOBALTY”



GLOBALTY

is the new mineral product range specifically developed for automotive TPOs

GLOBALTY
Novel talc product range for automotive

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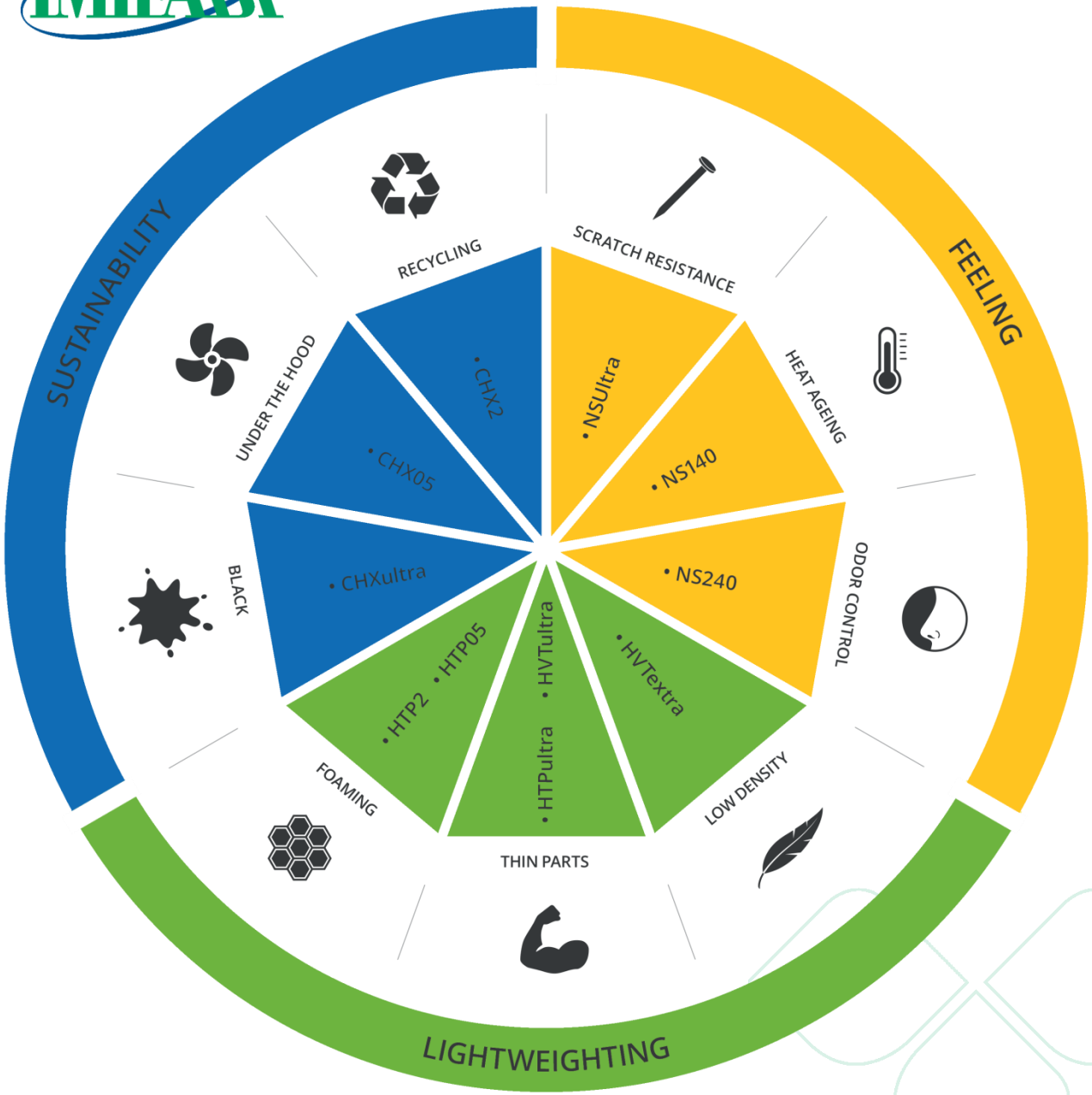
GLOBALTY



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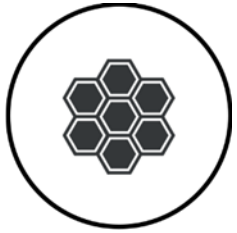
Lightweighting approach with TALC

Low Density: reduction of TPO specific gravity by lowering talc loading

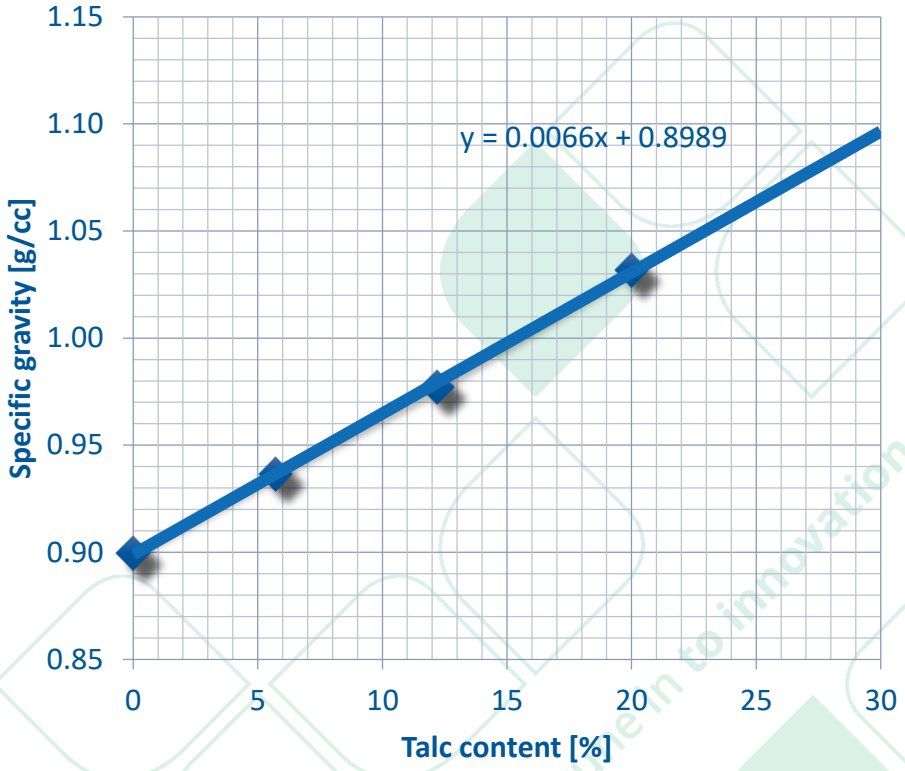
Thin parts: items down gauging by using stiffer TPOs



Foaming: talc as functional nucleating agent for TPO foaming

Low density

- considering to keep the same item dimension (=same volume), the easiest way to lower weight is to **reduce the material specific gravity** (SG).
- In talc modified TPOs, because of the higher SG of talc, the only possibility is to **minimize the talc loading**



Rigidity of talc in TPOs

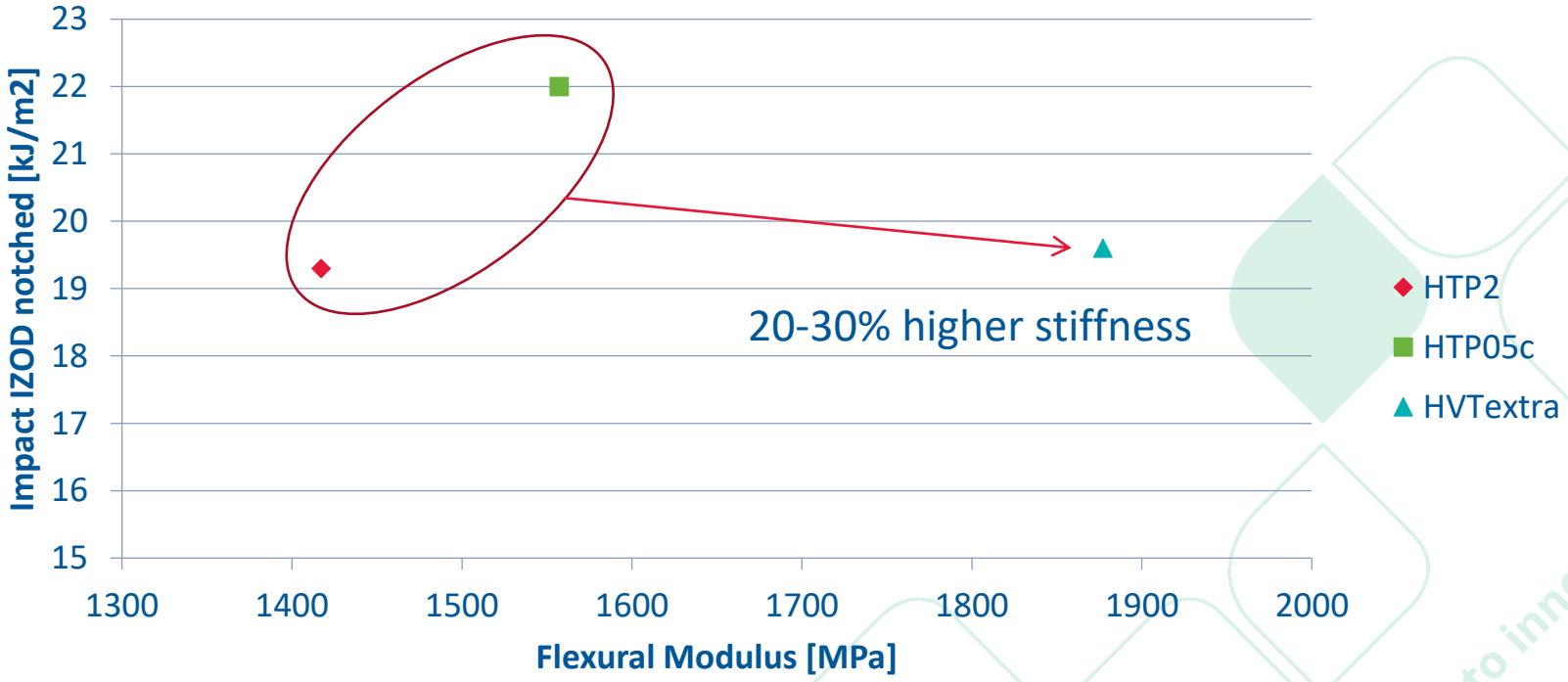
- Talc increases stiffness in polymers
- Excellent for PP/TPO modification (highly hydrophobic, easy compatible with polyolefins)
- Highly micronized talc grades are preferred for best results

Some talc grades in TPO modification

Class	Name	Compacted	Fineness D_{50} laser [µm]	Specific surface [m^2/g]	Color CIE L [-]
FINE	**HTP2**	N (*)	8.5	8.0	96.5
MICRO	**HTP05c**	Y	5.5	11.0	96.5
HIGHLY ENGINEERED	**HVTextra**	Y	12.0	20.0	96.5

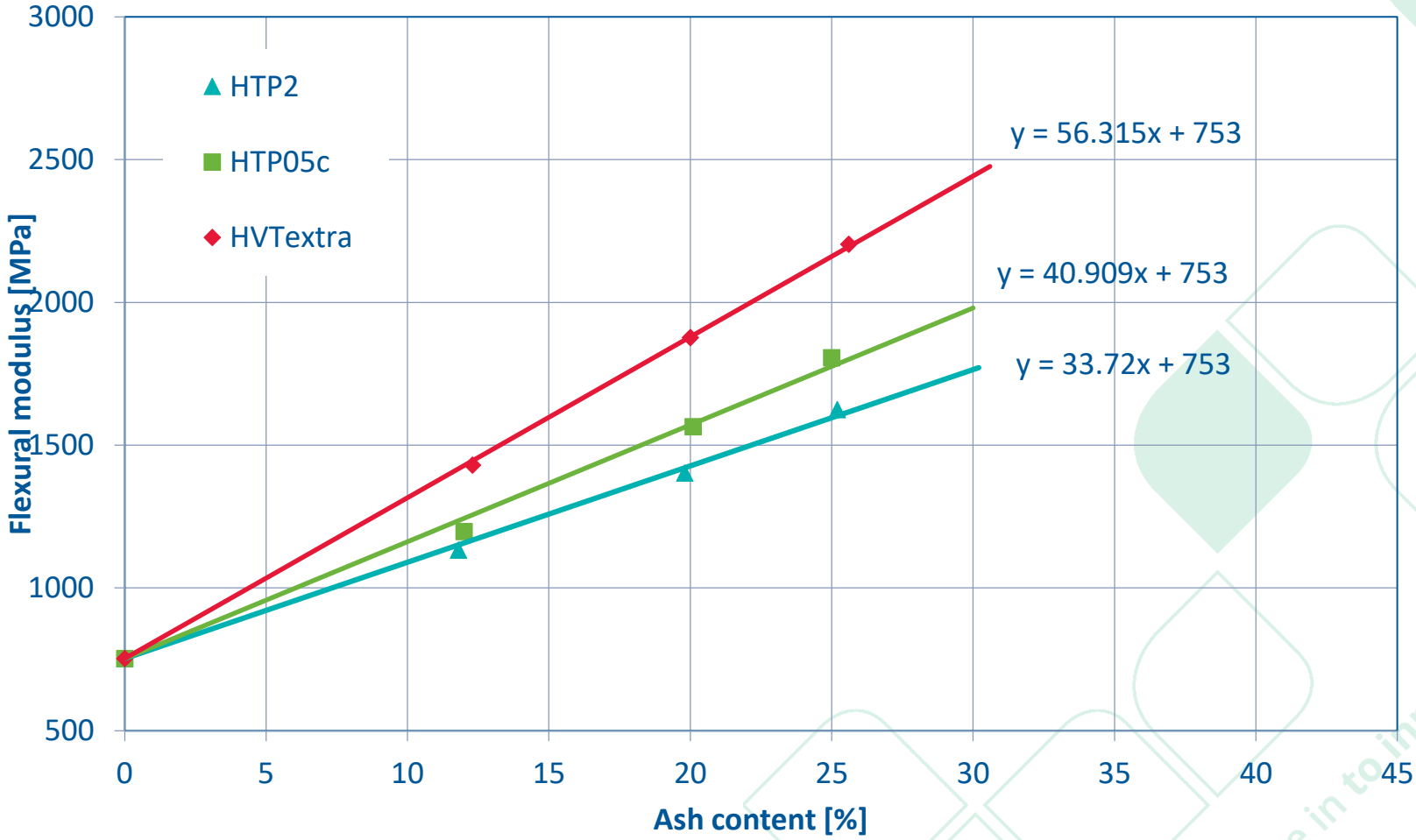
(*): available in compacted form too

Stiffness-to-toughness trade-off



TPO composition→ block copo PP:POE = 2.95:1.00 (w/w) + 20% TALC

TPO rigidity vs TALC loading



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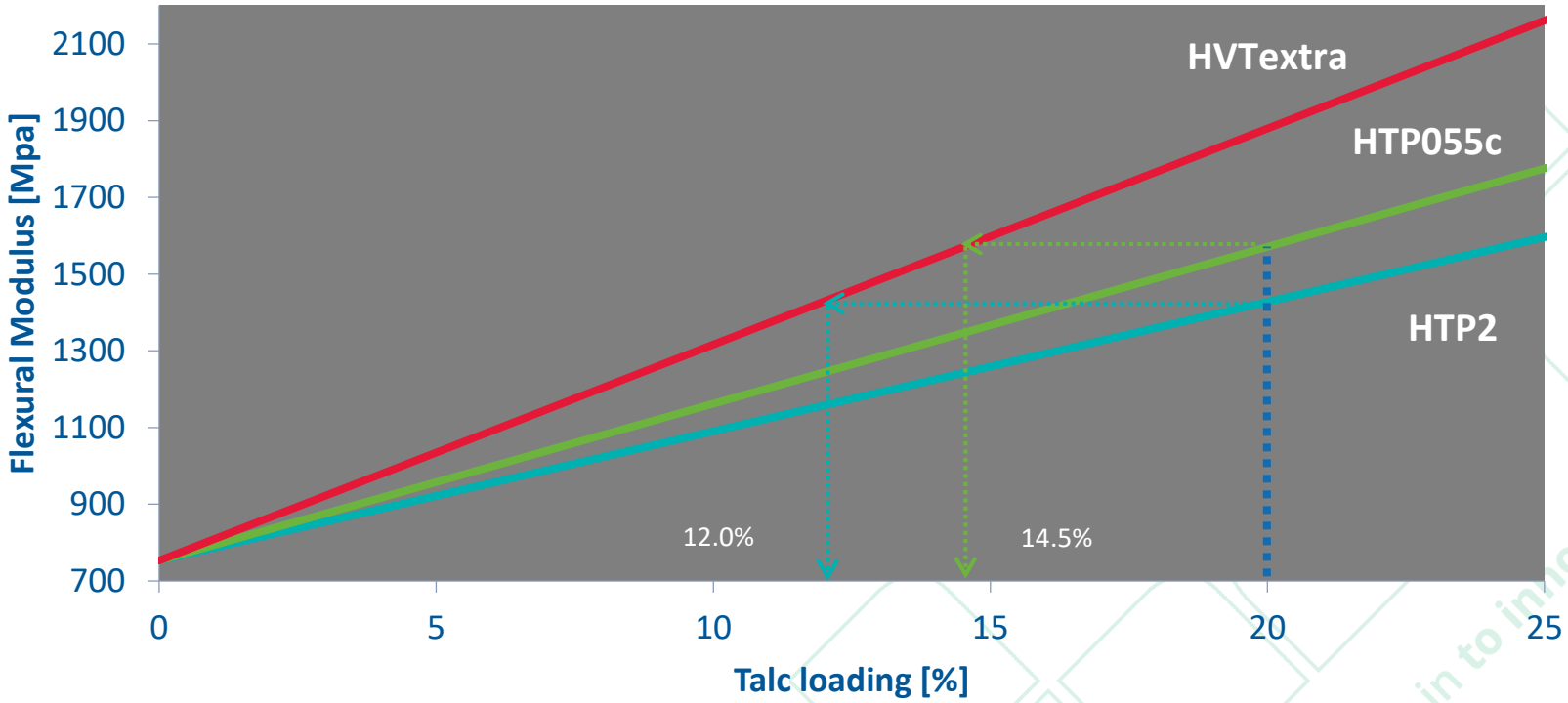
Case study: density reduction

- Target: to match 20% talc TPO (SG: 1.03 g/cm^3) stiffness with lower SG.

Talc @ 20% loading	Flex modulus [MPa]	Equivalent loading of HVTextra [%]	Final density [g/cm$_3$]	Weight saving [%]
HTP05c	1571	14.5	0.995	**3.5**
HTP2	1427	12.0	0.978	**5.1**

Weight reduction percent when **TALC HVTextra** is used at lower loading to get the same final Flexural modulus

Case study: density reduction (cont'd)



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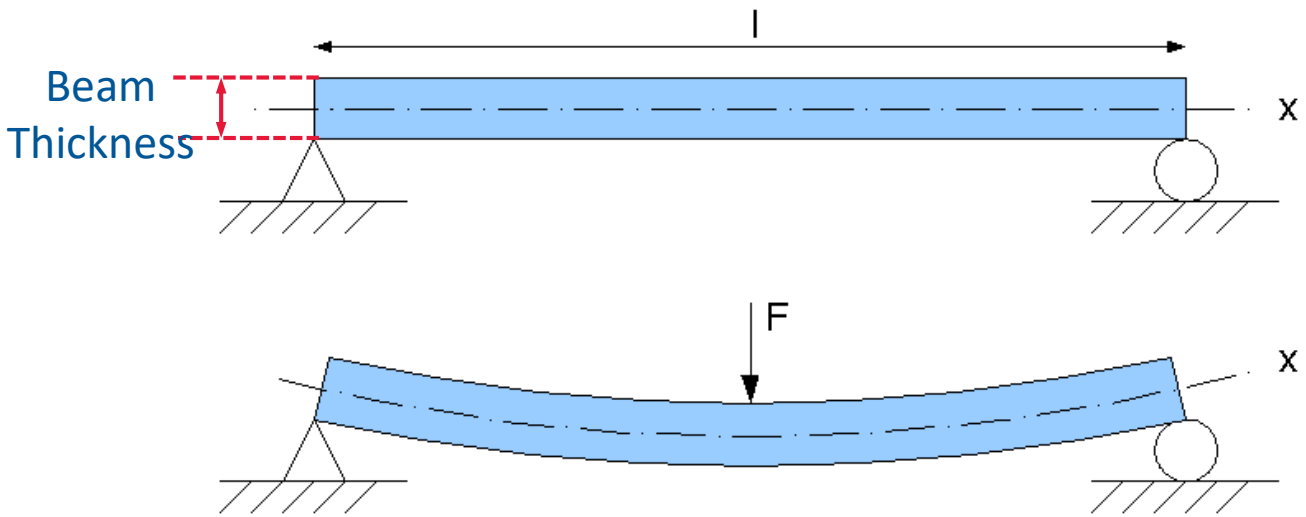
Thin Parts

- Other possible lightweighting solution is to lower the item volume, **reducing the part thickness**
- Part functionality must be granted with new design solutions, but also with **improved material performances**

Case study: down gauging in beam deflection



Beam thickness variation to achieve same deflection under same loading

→ **Thickness is linked to material stiffness**

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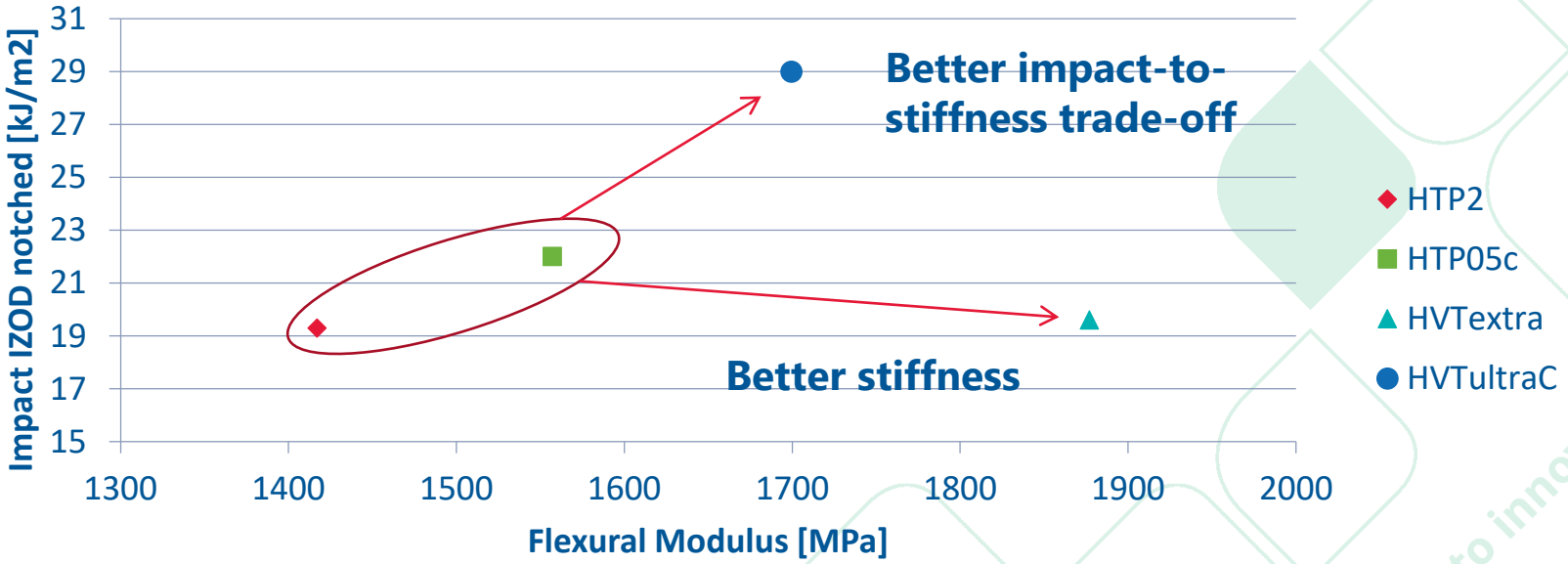

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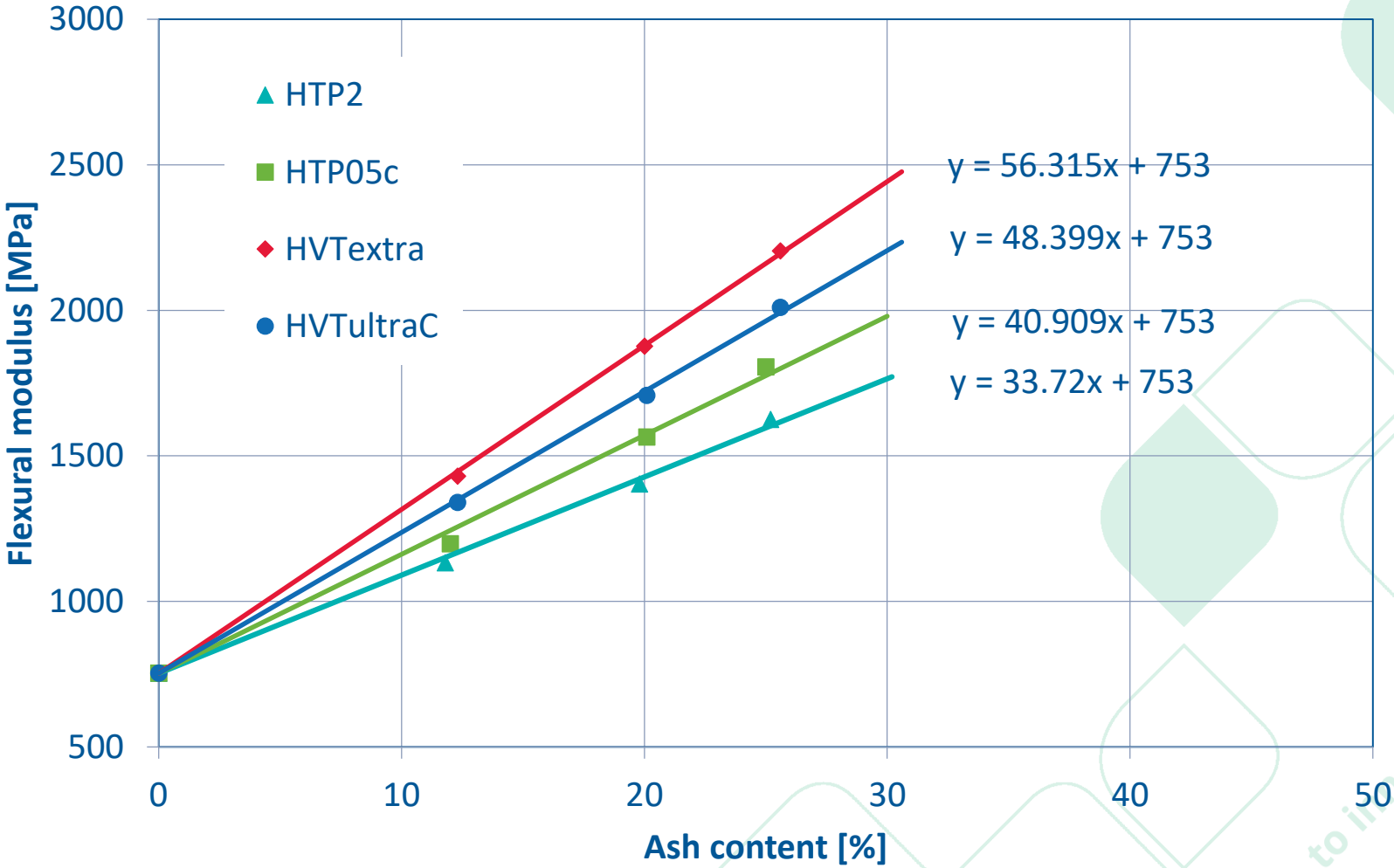
TPO rigidity vs TALC loading



TPO composition→ block copo PP:POE = 2.95:1.00 (w/w) + TALC

Case study: down gauging in beam deflection (cont'd)

	Loading [%]	Modulus [MPa]	Thickness [mm]	SG [g/cm³]	volume [cm³]	Weight [kg]	Weight reduction
HTP2	20	1427	2.80	1.03	699	0.72	**ref**
HTP05c	20	1571	2.71	1.03	677	0.70	**3.2%**
	30	1980	2.51	1.10	627	0.69	**4.5%**
HVTultraC	20	1721	2.63	1.03	657	0.68	**6.1%**
	30	2205	2.42	1.10	605	0.66	**7.9%**
HVTextra	20	1879	2.55	1.03	638	0.66	**8.8%**
	30	2442	2.34	1.10	585	0.64	**11.0%**

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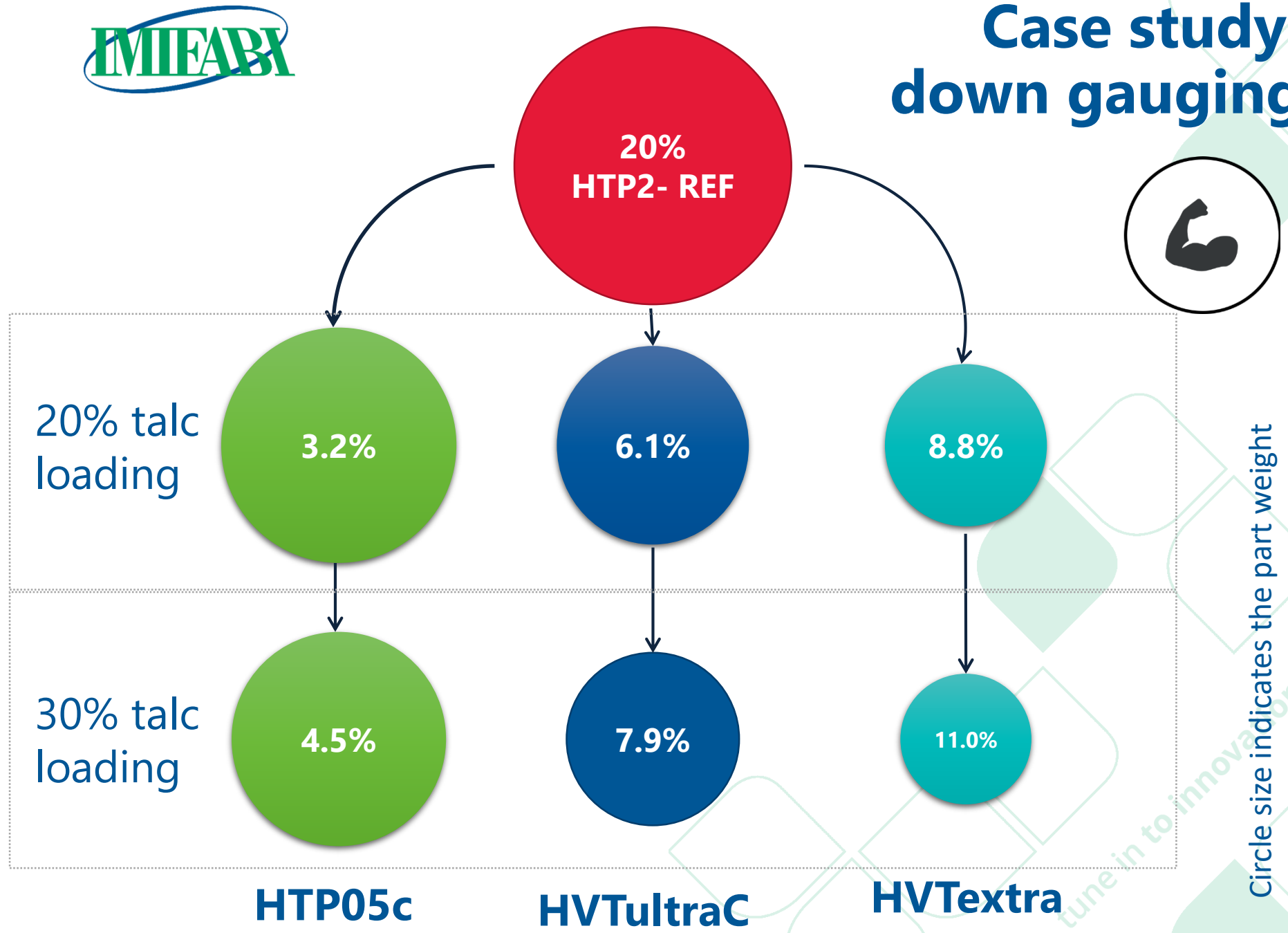
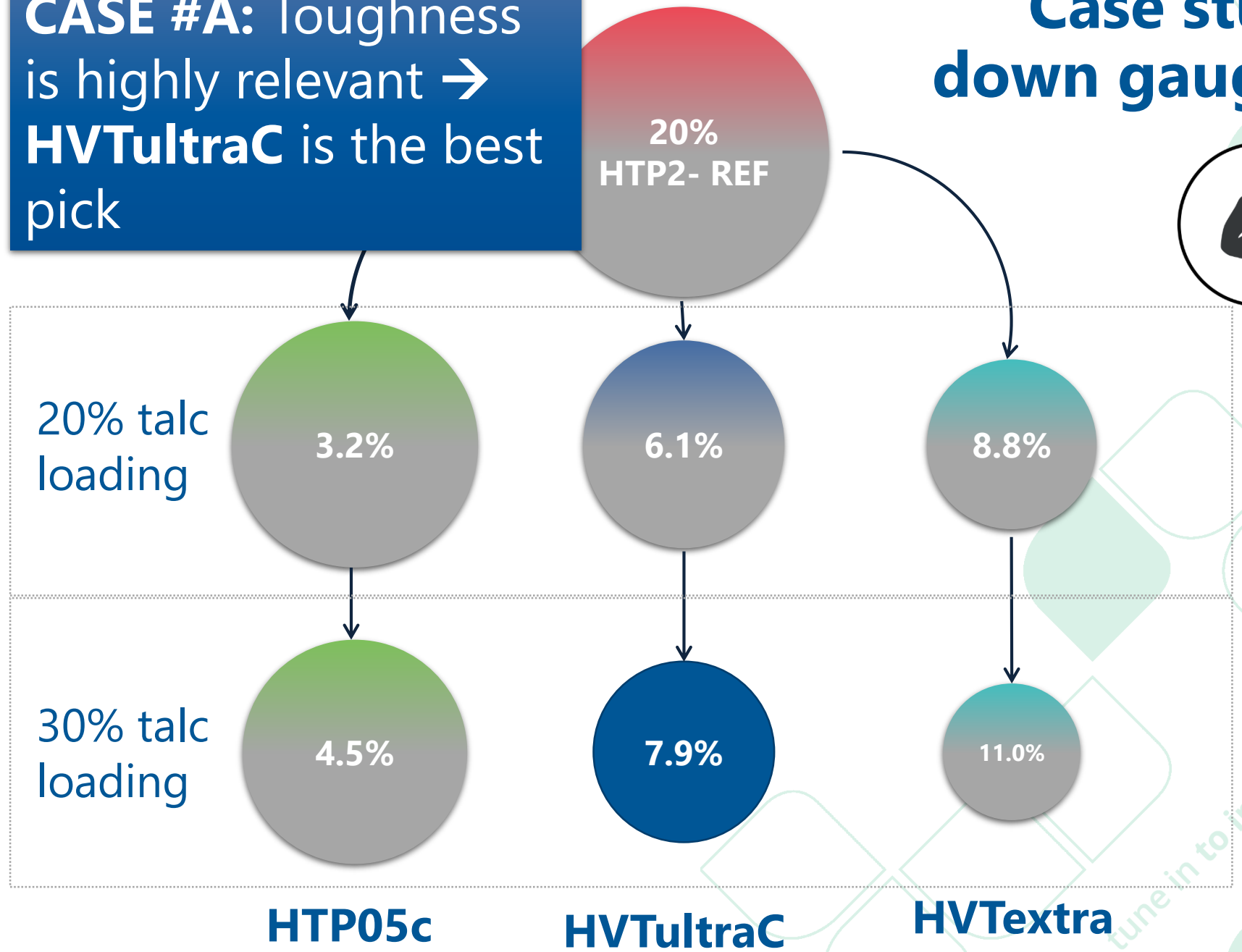
Case study: down gauging



Circle size indicates the part weight
data in the circle indicate the weight saving percent

Case study: down gauging

CASE #A: Toughness is highly relevant → **HVTultraC** is the best pick



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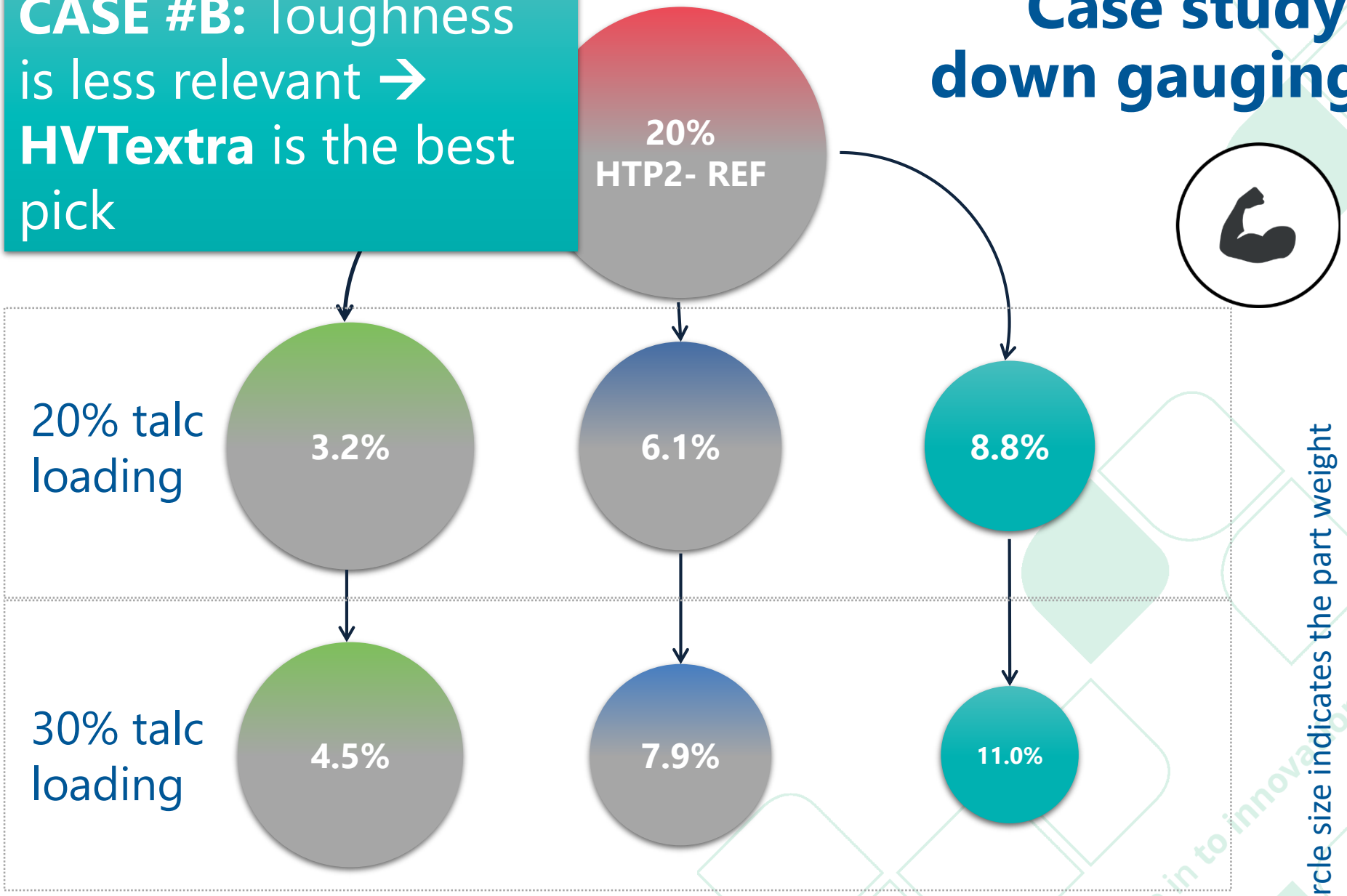
Case study: down gauging

CASE #B: Toughness is less relevant → **HVTextra** is the best pick



Circle size indicates the part weight
data in the circle indicate the weight saving percent

Foaming

- Foaming is the fastest lightweighting solution, but it can heavily affect mechanical performances
- Weight saving is achieved by incorporating gas into the final item significantly reducing the final average SG
- It can be used in specific applications where mechanical properties are less relevant
- **Talc works as nucleating agent in the bubble growth heterogeneous nucleation process**

Foaming (cont'd)

- Thanks it its hydrophobicity and high lamellarity, TALC is ideal nucleating agent for bubble growth nucleation:
- Easy dispersible
- Excellent affinity with POs (talc surface wetting)
- Large interface area per dosing unit, for high efficiency

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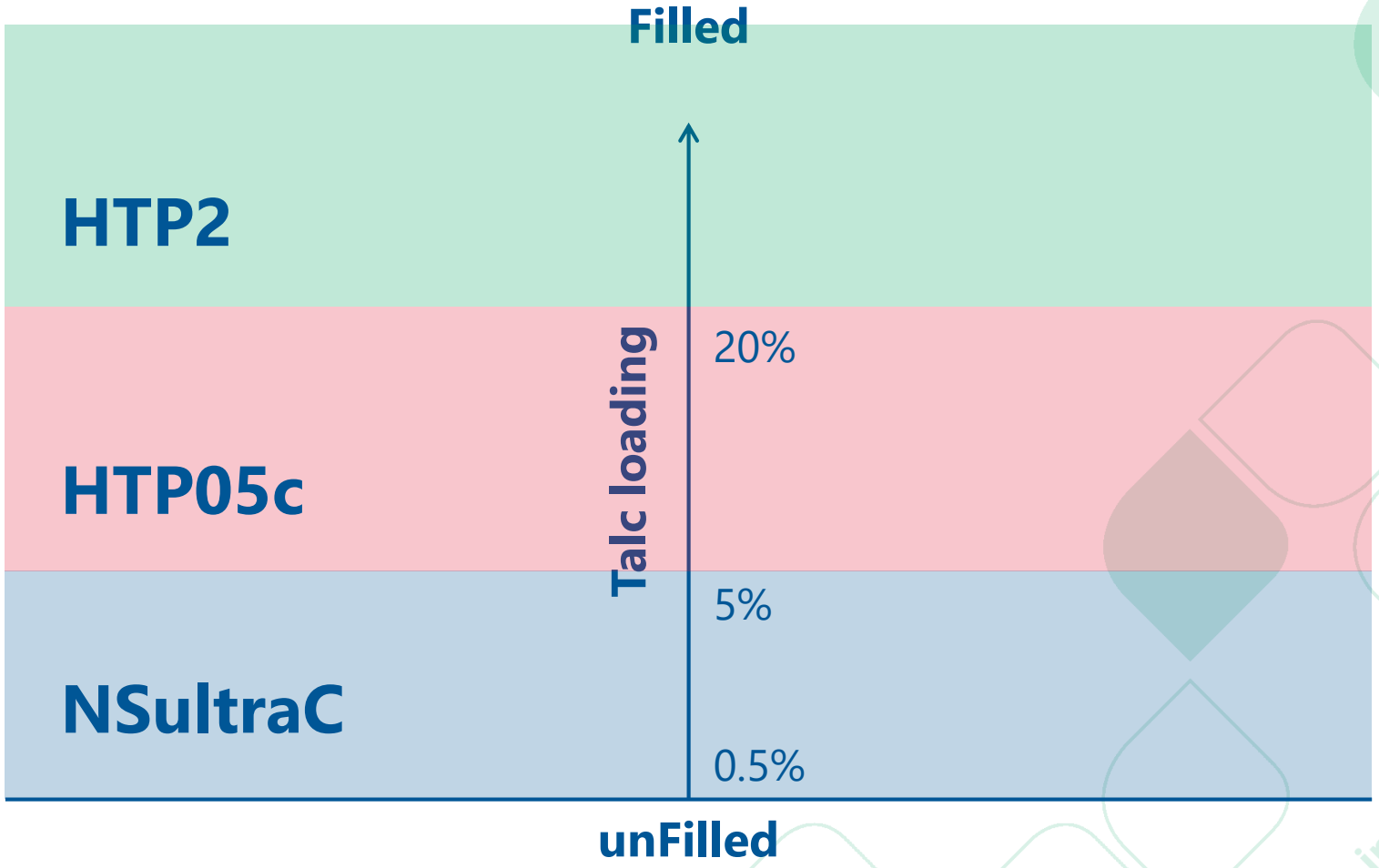
Foaming


Filled
HTP2
HTP05c
NSultraC
Talc loading
20%
5%
0.5%
unFilled
Chemical Blowing Agent
Physical Blowing Agent

Some talc grades in TPO foaming

Class	Name	Suggestion of use
FINE	**HTP2**	Highly filled foamed compounds
MICRO	**HTP05c**	Filled PP and TPOs
ULTRA FINE	**NSultraC**	Unfilled PP and TPOs

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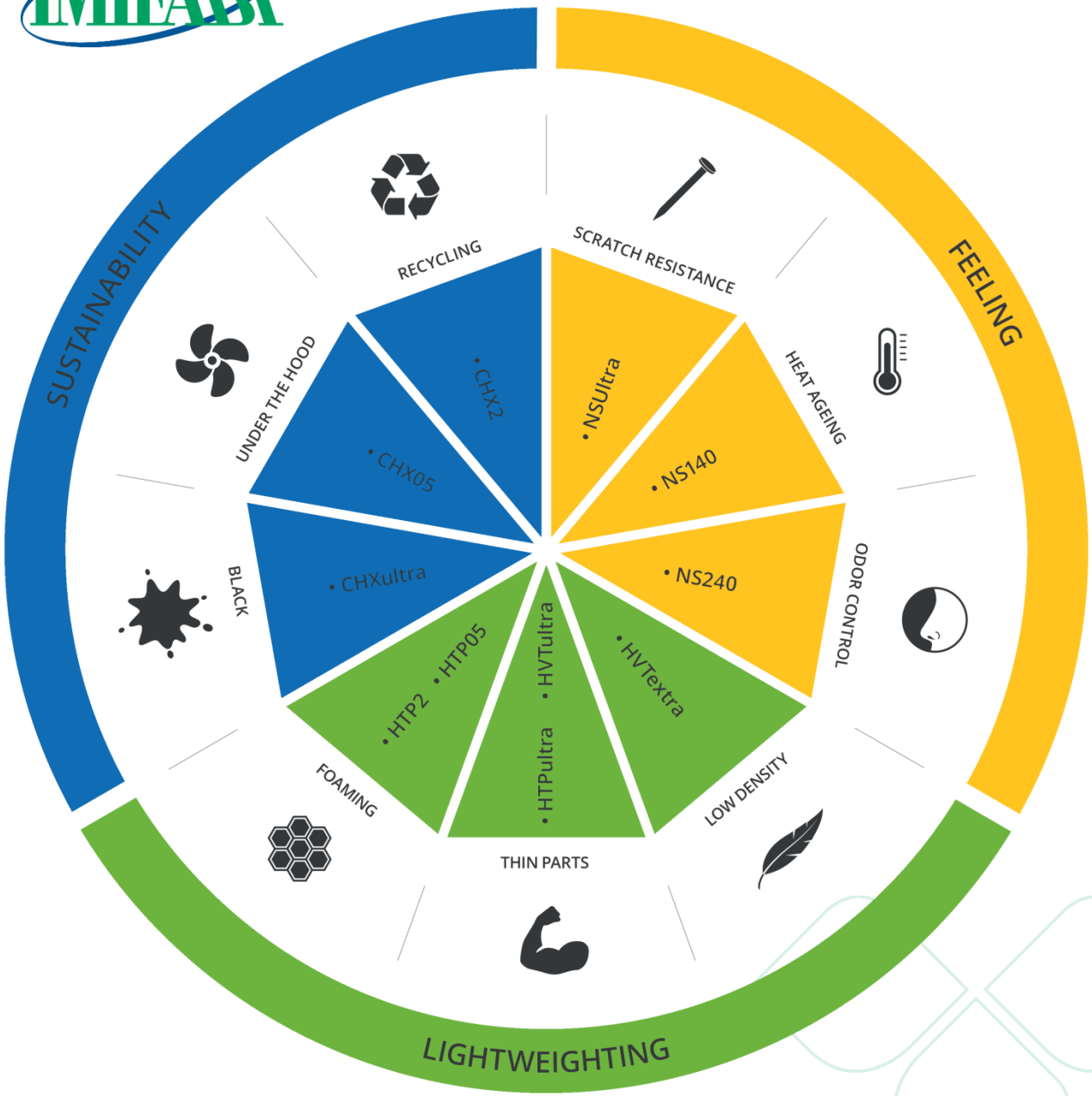

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Novel talc product range for automotive

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The End

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Thank you!

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