SOLVAY

asking more from chemistry®

Solkane® 365/227
A high-performance alternative for HCFC 141b

Thermal Insulation Seminar– FEIPUR 2014

SOLKANE®

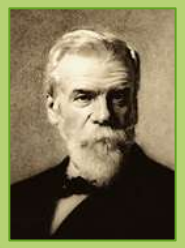
17/11/2014

Solvay Key Facts

We are a major global player in Chemicals with compelling strengths

Our strengths

- 90% of sales in businesses among the top 3 global leaders
- A balanced portfolio of activities, directed at growth regions
- A culture of sustainability, innovation and operational excellence



Created by Ernest Solvay in 1863, Solvay is a Global company, with historical anchorage in Europe, and headquartered in Brussels.

€9.9 bn
NET SALES

€1,663 bn
Adjusted REBITDA

117
INDUSTRIAL SITES

15
MAJOR R&I

29,400
EMPLOYEES
55 COUNTRIES

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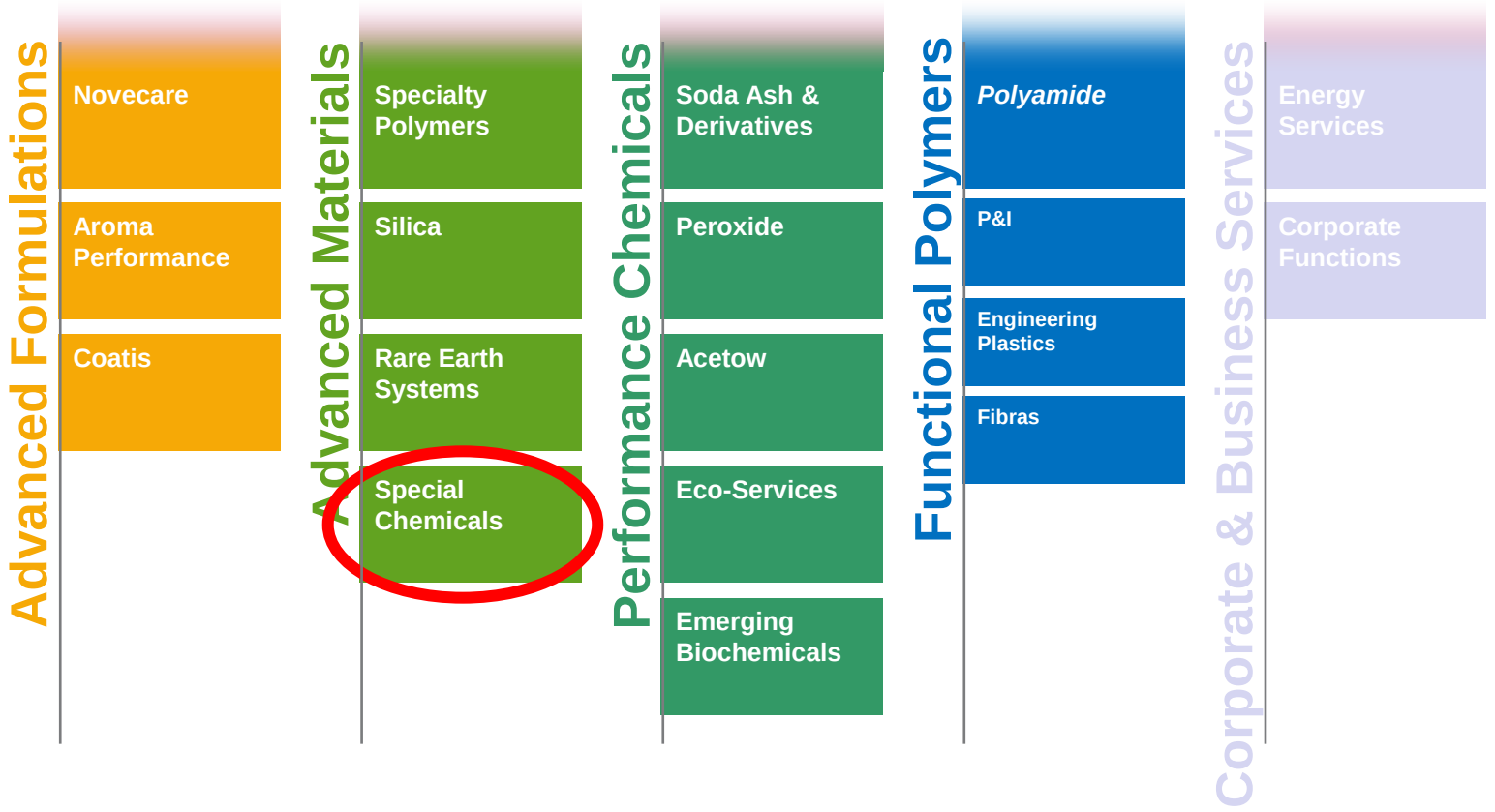
Organization structure



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HCFC 141b Phase-out

A need for change

HCFC 141b phase-out …a need for change
Montreal Protocol and UNEP

Background

- The Montreal Protocol (MP) on Substances that Deplete the Ozone Layer (MP) is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. Info to come
- The United Nations Environment Programme (UNEP) is an agency of the United Nations that coordinates its environmental activities, assisting developing countries in implementing environmentally sound policies and practices.
- One of the UNEP's tasks is the implementation of the MP. This is done together with the Multi Lateral Fund (MLF) and the United Nations Industrial Development Organization (UNIDO).

HCFC 141b phase-out …a need for change
Montreal Protocol and UNEP

CFC / HCFC

- Ozone Depleting Substances (**ODS**) are gaseous compounds with at least one Chlorine or Bromine atom in their molecules.
- Depending on the grade of halogenation ODS are classified as brominated Halons (R12B1), as fully halogenated CFCs (e.g. R12=CCl_2F_2) or as partly halogenated HCFC (e.g. 141b).
- Halons and CFCs have a much higher impact on the ozone layer compared to HCFCs. Hence they are already totally phased out since 2010.
- The ozone depleting potential (**ODP**) of HCFCs is less than 10% of CFCs.

HCFC 141b phase-out …a need for change
Montreal Protocol and UNEP

Phase out HCFC 141b on Country level….

- Countries under the Art.2 of the MP (Article 2 Parties) will complete the accelerated phase-out of production and consumption in 2020, on the basis of the following reduction steps:
  - (a) By 2010 of 75 per cent;
  - (b) By 2015 of 90 per cent;
  - (c) While allowing 0.5 per cent for servicing the period 2020–2030

- Art. 5 Countries (Art.5 Countries) have to complete the accelerated phase-out of production and consumption in 2030, on the basis of the following reduction steps:
  - (a) By 2015 of 10 per cent;
  - (b) By 2020 of 35 per cent;
  - (c) By 2025 of 67.5 per cent;
  - (d) While allowing for servicing an annual average of 2.5 per cent during 2030–2040

HCFC 141b phase-out …a need for change

Phase-out at a glance

Total R141b consumption

	R141b [mt]
Total NAFTA	5882
Total Mercosur	9200.9
Total Africa	4058.6
Total Europe	2863
Tota Asia	76236
Total WW	98240.5

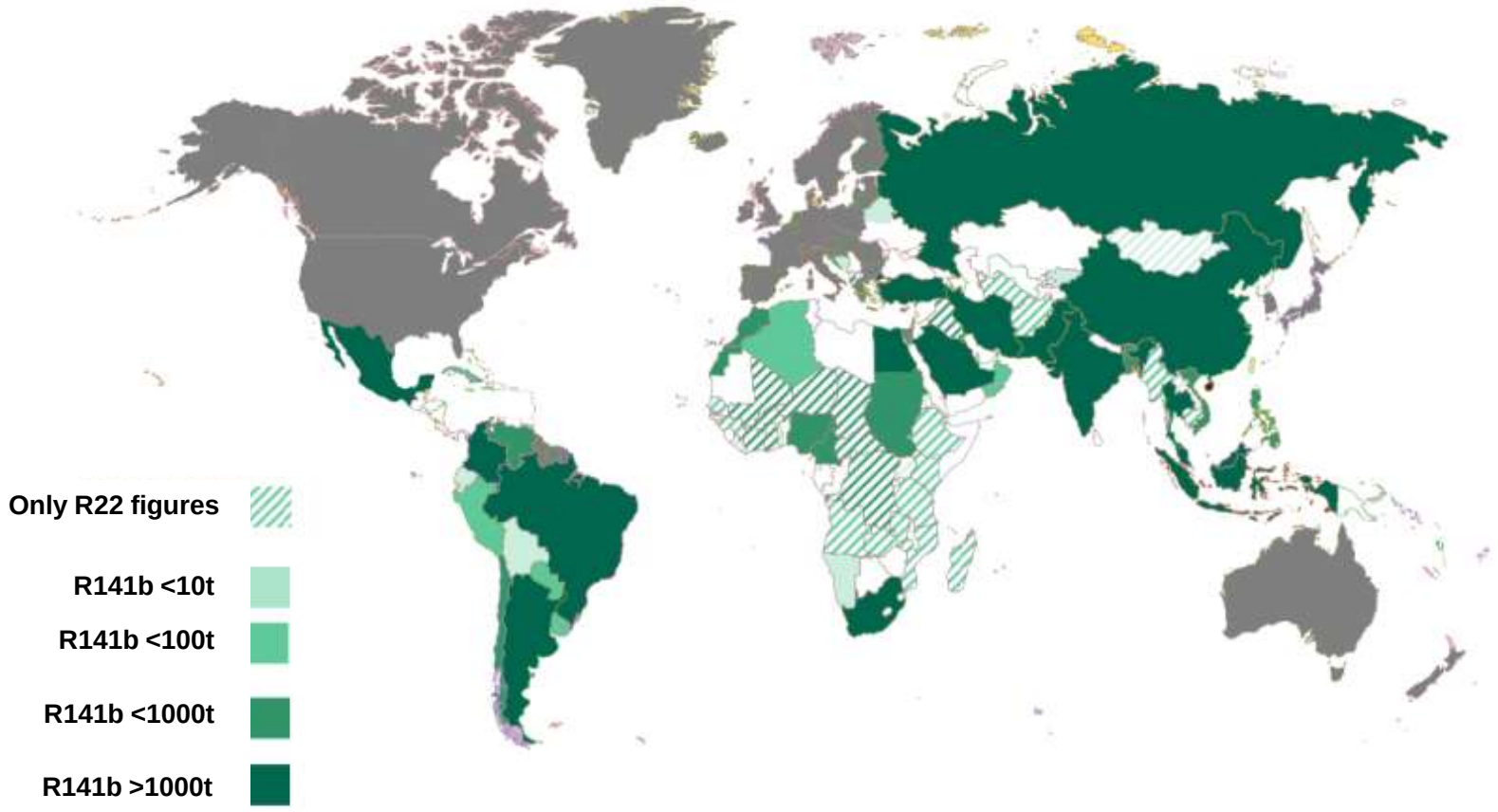
Countries Market Size >1kt

Country	Timeline	**R141b Market Size
China	2013	54011
India	2013	7868
Brazil	2013-2015	5902
Mexico	2015	5882
Saudi Arabia	2015	3100
Russia	2015	2842
Iran	2015	1971
Turkey	2013	1792
Thailand	2015	1483
Malaysia	2015	1477
South Africa	2016	1455
Pakistan	2015	1219
Colombia	2015	1203
Indonesia	2015	1186
Egypt	2015	1180
Argentina	2015	1111

**Data published in 2009, 2010, 2011, 2012

HCFC 141b phase-out …a need for change

Into Phase-out Consumption



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Solkane® Insulation Products Offered

Blowing Agents

SOLKANE®

Solkane® Insulation

Third Generation HFC

Solkane® 365mfc Solkane® 365/227 Solkane® 365/227	Pentafluorobutane 7 % (Foam producer) 13 % (System Houses)

Second Generation HFC

Solkane® 141b

Reactive Flame Retardant
Brominated Polyetherpolyols

IXOL® B 251
IXOL® M 125

Why SOLKANE® – Best Choice!

Easy & Safe Handling

- **A non-flammable, true liquid**
  - The boiling point is above standard processing temperatures in the range of 68 F.
  - In hot weather climates the vapor pressure is low.
- **Polyol system optimization**
  - Polyol systems can be optimized to show no flashpoint behavior
- **Packaging of Solkane 365 in standard drums (non hazardous for the 365/227 blends)**
  - 245fa ships in pressurized gas containers

Why SOLKANES® – Best Choice!

Best performance

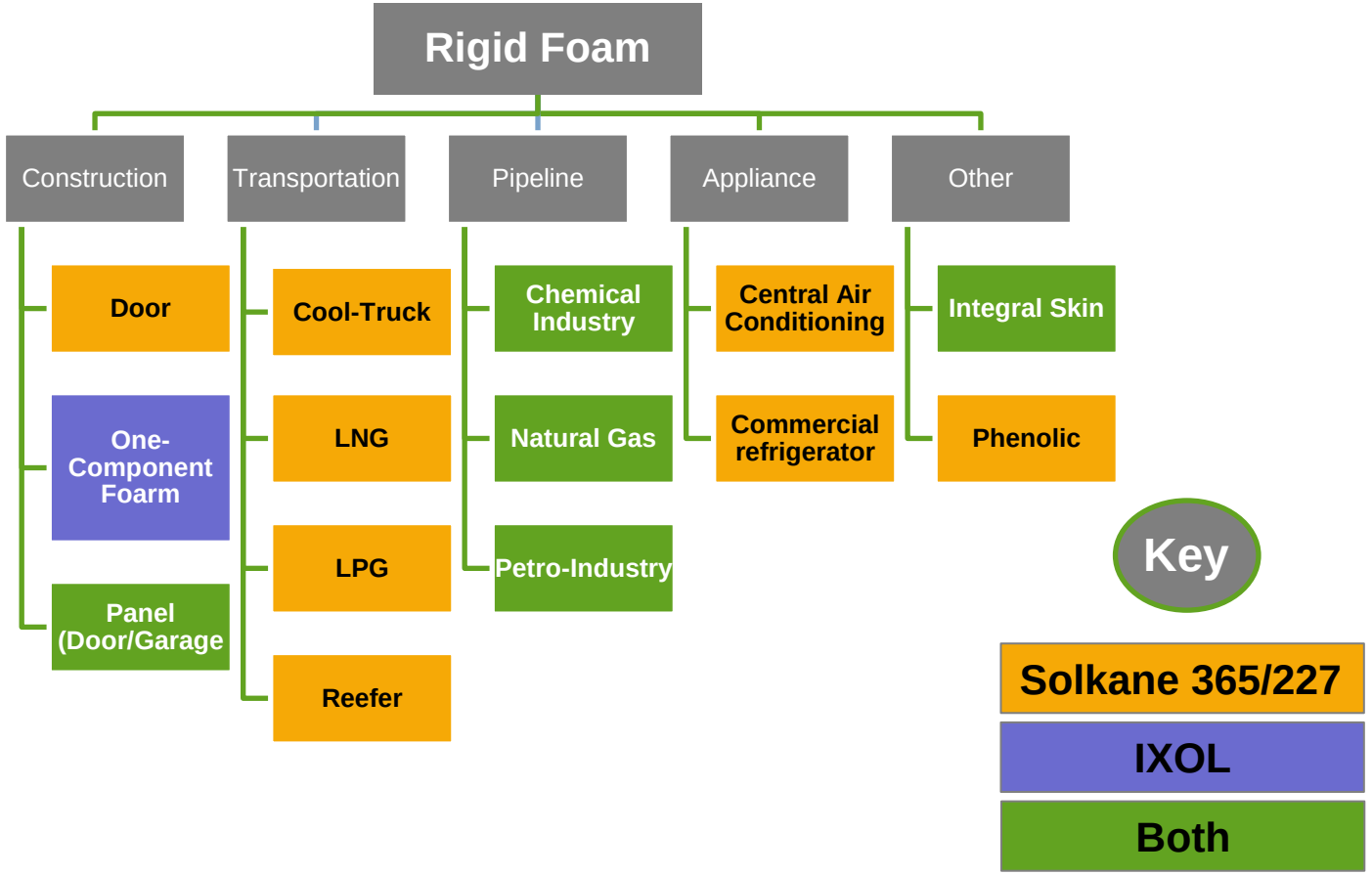
- **Best fire behaviour results**
  - Compared to pentanes, SOLKANE 365 blends are significantly better due to the fluorine content in the molecule.
- **Best insulation value**
  - Based on Standard aged time values and beyond
  - Less energy needed to heat & cool buildings, appliances – resulting in direct environmental CO2 savings
- **Very easy conversion of 141b systems**
- **Closest match to 141b of available replacements**
- **365 is in industrial use in variety of PUR applications since 2003**

Why SOLKANES® – Best Choice!

Economic Advantage

- **Improved dimensional stability performance**
  - Range is improved over 2nd generation blowing agents, providing cost savings.
  - Low density material with full performance.

Typical Applications for Insulation Products
Blowing Agents



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Solkane® Insulation Products Properties

Blowing Agents

Comparative Physical properties

	HCFC-141b	HFC-365mfc	HFC-365/227 93:7	HFC-365/227 87:13	HFC-245fa	c-pentane
Structure	CCl_2F-CH_3	CF_3-CH_2-CF_2-CH_3	CF_3-CH_2-CF_2-CH_3 CF_3-CHF-CF_3	CF_3-CH_2-CF_2-CH_3 CF_3-CHF-CF_3	CF_3-CH_2-CF_2H	
Mol.-Weight	116.9	148.1	149.5	150.9	134	70
Boiling Point [°C]	31.7	40.2	30	24	15.3	49.5
Vapour pressure at 20 °C [bar]	0.6	0.4	0.7	0.9	1.2	0.35
Lambda [gas at 25 °C]	9.5	10.6	10.7	10.7	12.2	12.0
Flash point [°C]	none	-27	none	none	none	-37
Flammability limits [% by volume]	7.4 - 17.7	3.6 - 13.3	3.6 - 13.3*	3.6 - 13.3*	none	1.4 - 8.3
MIE [mJ]	20 000	10.4	>> 1000	>> 1000	-	0.54

* based on pure Solkane® 365mfc

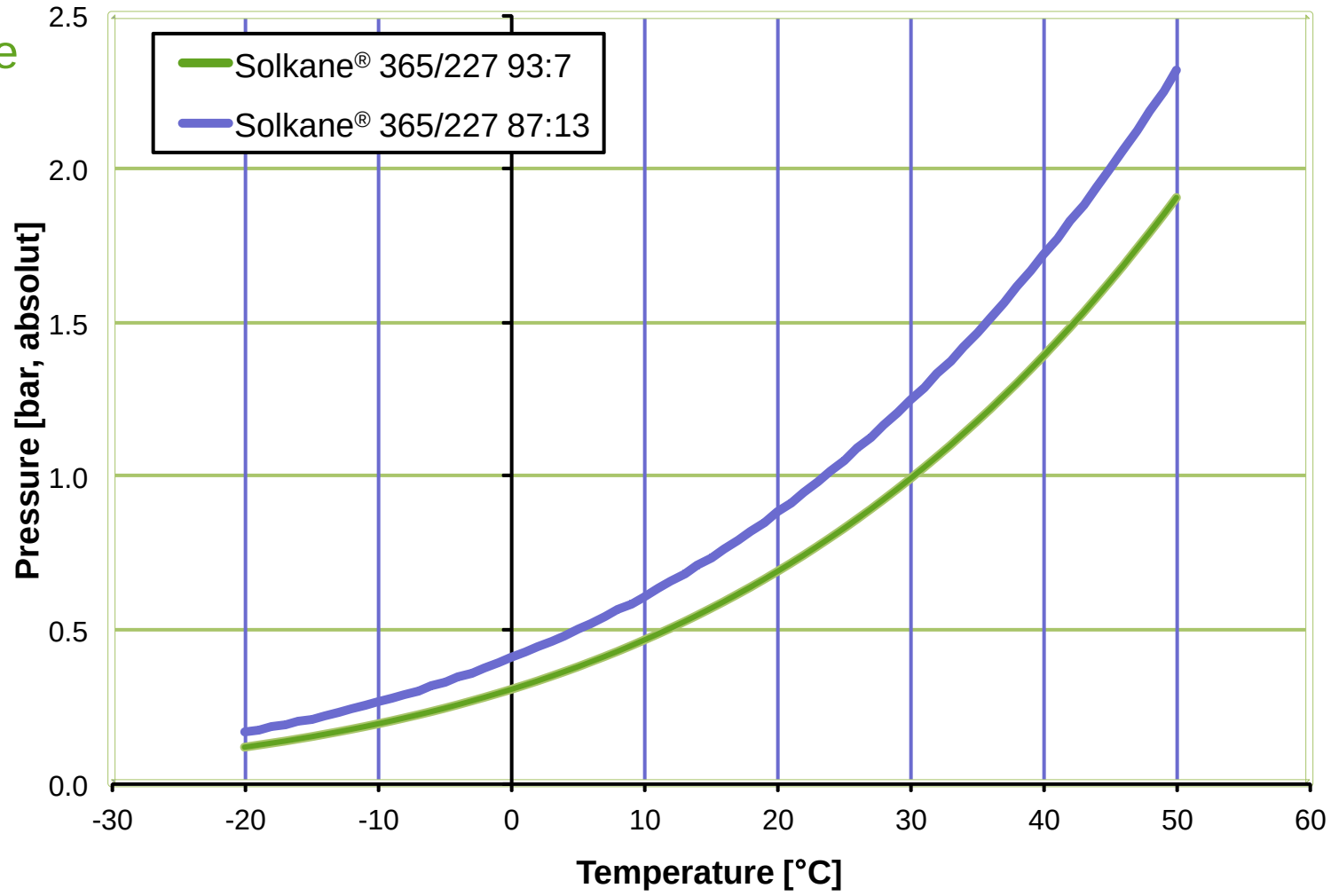
Comparative Physical properties
Eco-toxicology

	HCFC-141b	HFC-365mfc	HFC-365/227 93:7	HFC-365/227 87:13	HFC-245fa	c-Pentane	
Boiling Point	31.7	40.2	30	24	15.3	49.5	[°C]
Mol.-Weight	116.9	148.1	149.5	150.9	134	70	
Atm. Lifetime	9.3	8.6	8.6*	8.6*	7.6	“few days”	[years, IPCC 4, 2007]
ODP	0.11	0	0	0	0	0	
GWP	725	794	964	1109	1030	11	[IPCC 4, 2007]
VOC	no	no	no	no	no	yes	

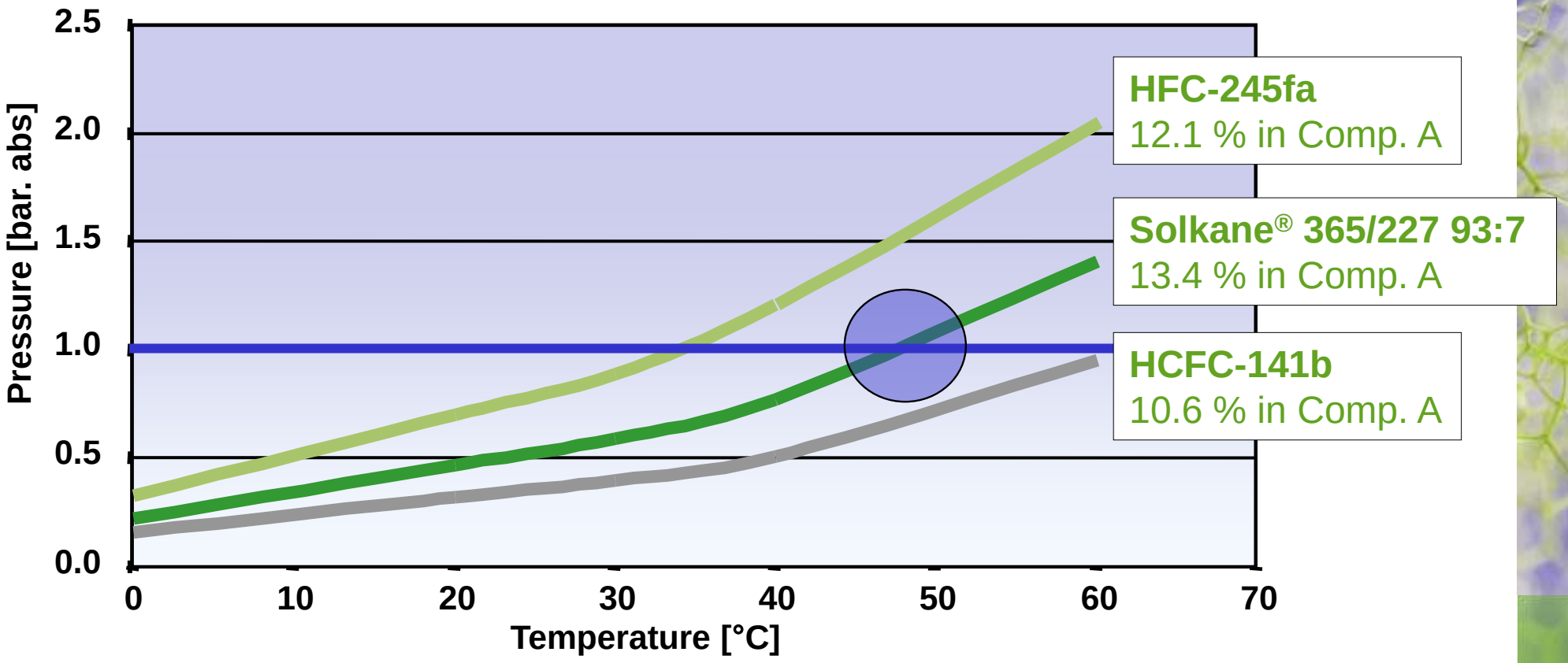
* based on pure Solkane 365mfc

Vapour pressure of Blends

Vapour pressure vs Temperature



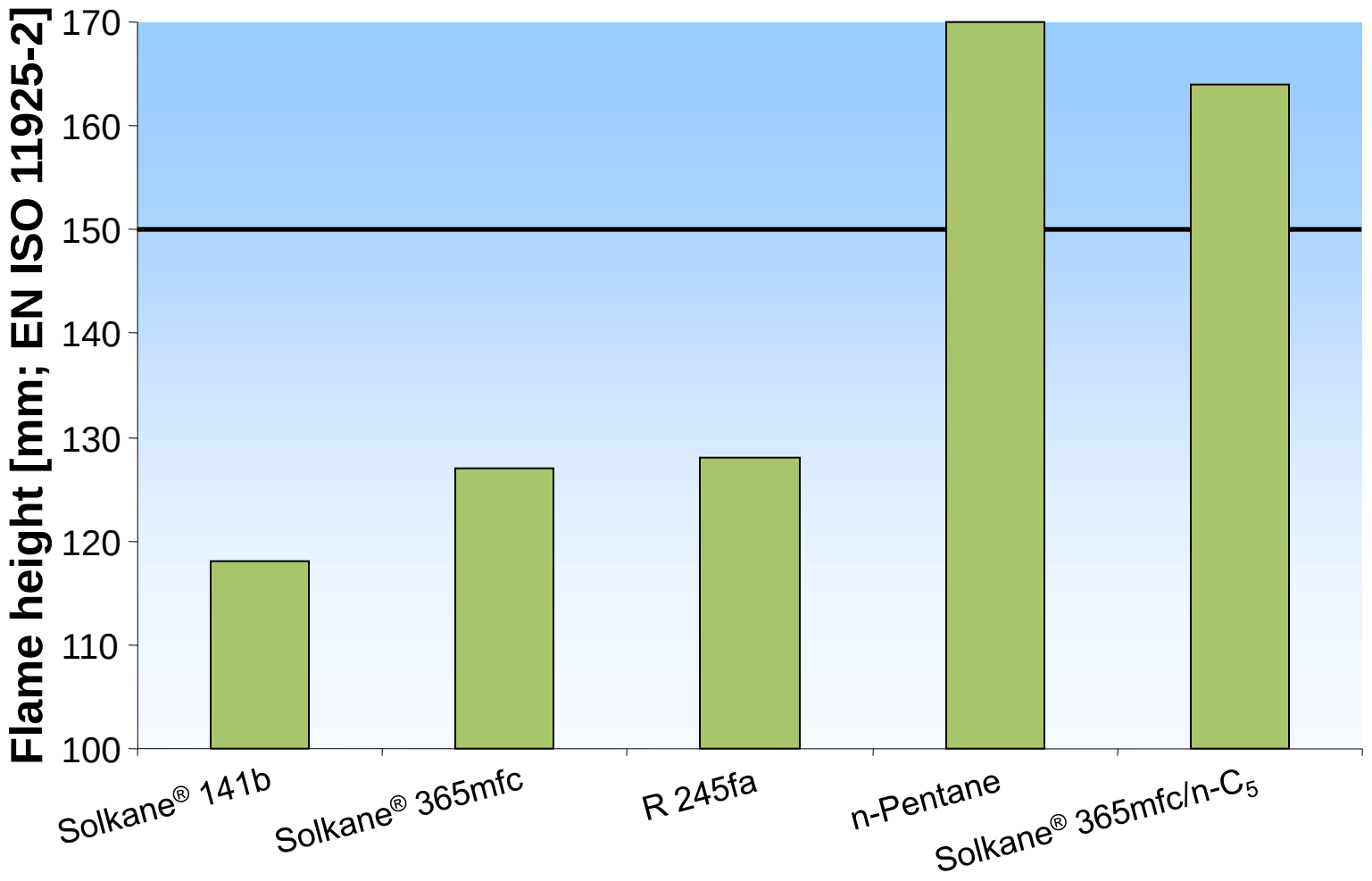
Vapour Pressure of Pre-Formulated PU Systems



Favorable handling – also in hot Climates!

Comparative Flammability in Foams

EN ISO 11925-2 – Ignitability Test (B2)



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Summary

Blowing Agents

SOLKANE®

Why Solkanes® - Best Choice!

Easy & Safe to Handle

- Non-flammable, true liquid
- Polyol system optimized with no flashpoint
- Package in standard drums (no need for pressurized gas containers)

Best Performance in Use

- Best fire behavior results
- Best insulation value
- Easy conversion of 141b systems

Economic Advantage

- Improved dimensional stability performance = Cost Savings!

www.solkane.com