



Fluor & Energy
Materials

Navigating the F-Gas Regulation and transition to Low GWP propellants

October 27th



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Orbia Company
Overview

Global Imprint and Impact

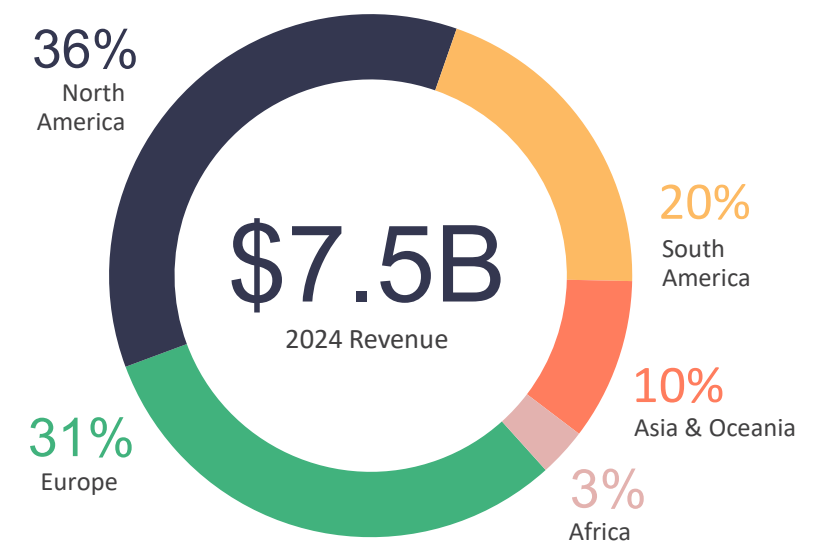
1953 Founded 23,000+ Employees \$7.5B Revenue \$1.19B Adjusted EBITDA¹ 15.8% Adjusted EBITDA Margin¹ 100+ countries Commercial Footprint 50+ countries Operations Footprint

Diversified Global Footprint



1. As of 12/31/24

Revenue¹ by Region



Leading Positions Across All Business Groups



Polymer Solutions

#1 Global specialty PVC producer¹

#6 Global general PVC producer²



Advantaged player in PVC and specialty PVC, serving infrastructure, health and well-being & other industries.

Building & Infrastructure

#1 in Europe³



Leading global provider of innovative water management solutions for resilient construction.

Precision Agriculture

#1 Globally³



Global market leader in precision irrigation and other solutions that enable the world's farmers to grow more with less.

Connectivity Solutions

#1 in the U.S.⁴



Market leader in data network solutions, including conduit and accessories designed to bring connectivity to all.

Fluor & Energy Materials

#1

Global fluorspar mine⁵



One of the world's largest global fluorspar providers for fluorine-based products with applications from medicine to refrigeration to energy storage.

1. IHS Markit (PVC – Capacity to produce by Process). 2. IHS Markit (PVC – Capacity to produce by Shareholder) 3. Company estimates
4. Dun & Bradstreet interview with Data Communications sales teams & experts (Mar 2022). 5. S&P Global Fluorspar and Inorganic Fluorine Products report 2024

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Orbia Fluor & Energy
Materials Business

Orbia F&EM supplies fluorine-based materials to many industries



Infrastructure

Fluorspar is critical to cement, steel and aluminum industries



Cooling & Refrigeration

Fluorine is used in refrigerants for air conditioning and food storage



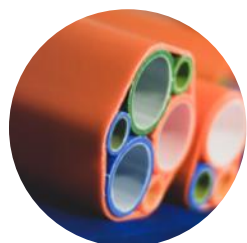
Medical Propellants

Fluorinated medical gas ensures drug stability and efficacious delivery



Pharmaceuticals

Fluorine plays a key role in life-changing drugs and anesthetics



Telecommunications

Fluorine is used in fluoropolymers and coatings for data communications



Semiconductors

High-purity fluorine is used in chips and displays



Renewables

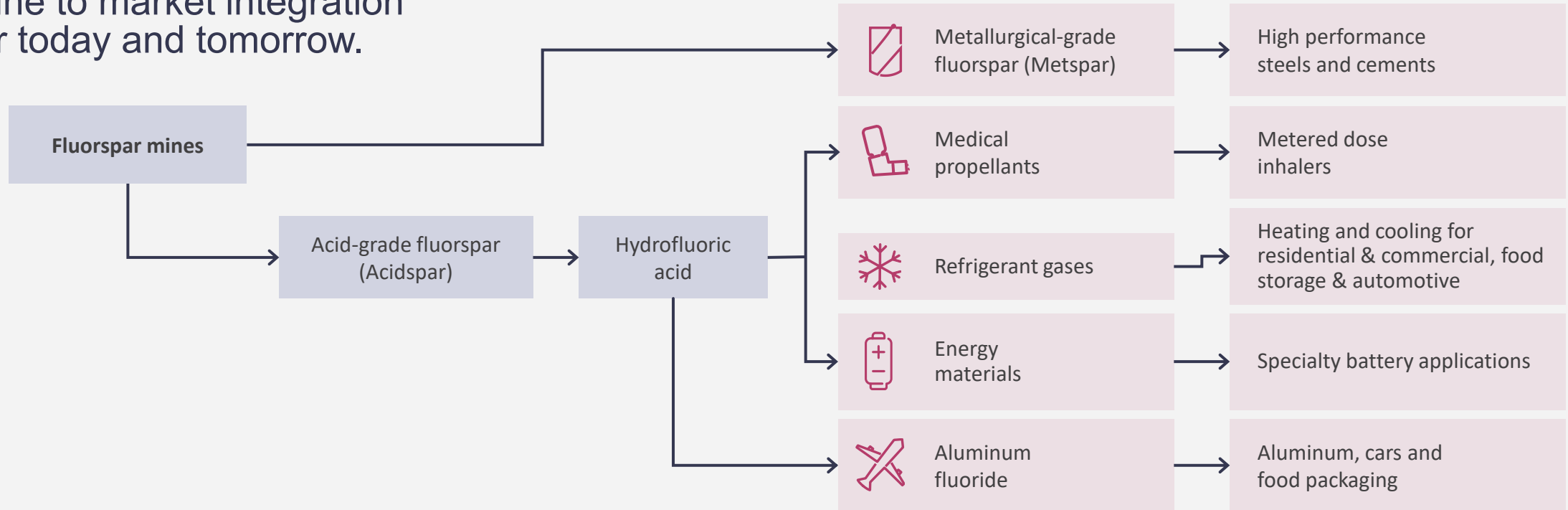
Fluorine protects solar panels from moisture



Energy Storage

Fluorine enables lithium-ion batteries to work

Mine to market integration for today and tomorrow.



Zephex®

World Leader in Medical Propellants

Zephex®

We are one of the world leaders in the manufacture and supply of **HFA medical propellants**.

Produced to the most demanding industry standards at dedicated facilities, **Zephex®** propellants are used in:



+67%

of the world's metered dose inhalers (MDIs).

=

~100 Million

people with respiratory diseases, such as asthma every year.



Zephex Products

Zephex 134a

- Relied upon by leading manufacturers for over thirty years
- By far the most widely used medical propellant in the world

Zephex 227ea

- Produced to our exacting, industry-leading standards
- Offers performance characteristics complementary to Zephex® 134a

Zephex 152a

- A new, sustainable medical propellant that has been under development by Orbia for over a decade for use in metered dose inhalers (MDIs)
- Used for the treatment of respiratory disorders such as asthma and COPD
- Representative scale available since 2022, first commercialized pMDI product expected in 2026

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The Zephex® 152a story

Technical properties & timeline: The transition to Low GWP propellants

The Story of Zephex® 152a Part 1

Initial Formulations Studies

Initial screening of more sustainable fluorocarbons driven by anticipated environmental regulatory pressure

2008

HFA-152a formulation research began

2010

2011

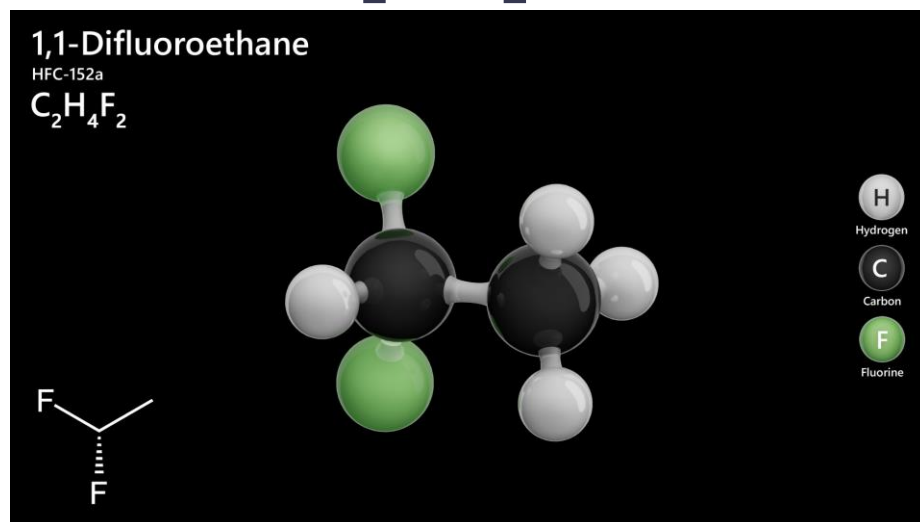
Focus on HFA-152a as an alternative due to promising potential

First HFA-152a reports produced and patents filed



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HFA-152a has some unique properties when compared to current propellants



Great potential with respect to boiling point, vapour pressure, >90% lower global warming potential and apparent low toxicity but

- Needed to determine flammability had no impact on patient safety
- Non-toxicity needed to be fully proven for human use
- Needed to fully understand the impact on formulation potential of:
 - Lower molecular weight
 - Lower liquid density
 - Higher affinity for moisture

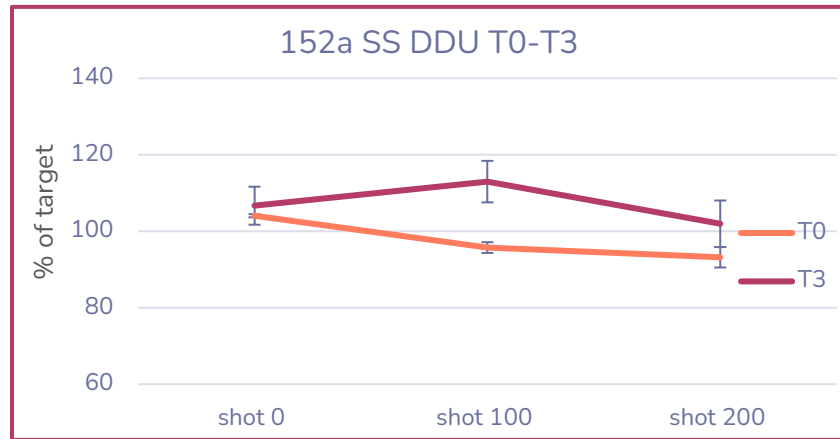
Property	134a	227ea	152a
MW	102.03	170.03	66.05
BP (°C)	-26.2	17.1	-24.7
Vap. Press (barg, 25°C)	5.65	2.89	4.95
Liq. Density (g/cc, 25°C)	1.22	1.41	0.90
Liq. Viscosity (cP)	0.21	0.26	0.24
Lower Flammable limit in Air (%vol, 1atm)	-	-	3.7
Dipole moment (Debye)	2.06	1.46	2.26
Moisture solubility (25°C, %w/w)	0.11	0.06	0.22
GWP	1430	3220	124

Table 1 - Physical properties table of medical propellants 152a, 134a and 227ea

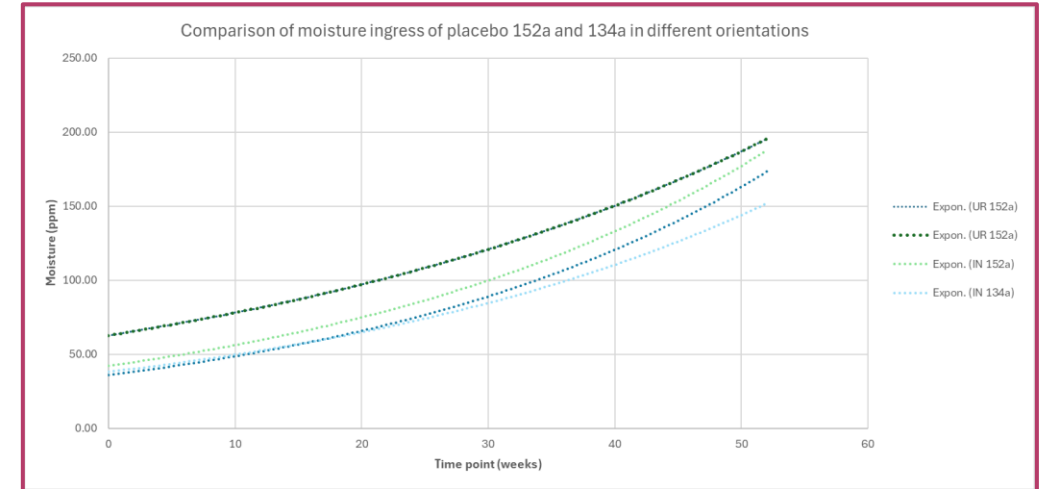
Despite the lower density and moisture affinity you can obtain good suspension stability and dose delivery through life



Figure 1 – Salbutamol suspensions of HFA-152a and HFA-134a
(At 30 secs post shaking)



Graph 1– Delivered dose at T0 and 3 months stability at 40°C/75%RH of salbutamol suspensions of HFA-152a.



Graph 2– Moisture Ingress results of HFA-152a and HFA-134a propellant only cans stored at 40°C/75%RH in inverted and upright orientations

- Salbutamol sulphate formulations show comparable sedimentation rates and subsequent delivered dose is consistent throughout the can and post stability.
- Moisture levels at start of life can be higher (when orientated upright) than current propellants, but through optimisation of the valve gasket seal material it can stay almost equivalent to current propellants throughout shelf-life. The same effect can be seen for leak rate due to the low molecular weight.
- 152a's moisture affinity and higher polarity can potentially mitigate the density effect by aiding dispersion and providing some suspension stabilisation through Van der Waals interactions between propellant and API.

Increased solvent power shows great solution formulation potential of HFA-152a

Active ingredient	227ea (µg/g)	134a (µg/g)	152a (µg/g)
Salbutamol Sulphate (SS)	X	0.00	0.00
Fluticasone Propionate (FP)	x	9.90	49.50
Ipratropium Bromide (IPB)	x	0.01	0.01
Formoterol Fumarate Dihydrate (FFD)	0.00	0.00	0.15
Beclomethasone Dipropionate (BDP)	x	31.20	130.00
Budesonide (BUD)	16.76	17.09	68.10
Salmeterol Xinafoate (SX)	x	15.70	2.30

Table 2 – Solubility data of typical pMDI APIs in 152a, 134a and 227ea

Surfactant	134a	152a
Oleic Acid	<0.05%	<2.5%
Lecithin	<0.01%	<0.05%
PVP	<0.01%	<0.01%
PEG 400	<0.02%	<0.05%
Sorb. Monooleate	<0.03%	<0.05%
Sorb. Trioleate	<0.05%	<0.05%

Table 3 – Solubility data of typical pMDI surfactants in 152a and 134a

- In general, APIs and common excipients have better solubility in 152a than 134a or 227ea, this increases its solution formulation potential over current propellants and reduces the reliance on co-solvents such as ethanol in both suspensions and solutions.

Solutions can exhibit increased chemical stability over time, providing shelf-life flexibility

Propellant	Ethanol w/w %	% Total Imps at 40°C/75RH			134a/152a imp ratio
		T0	1 month	3 months	
HFA-134a	5	0.89	1.58	2.08	5.94
HFA-152a	5	0.08	0.16	0.35	
HFA-134a	10	1.16	1.82	2.21	5.26
HFA-152a	10	0.21	0.35	0.42	
HFA-134a	15	1.08	2.35	4.21	3.79
HFA-152a	15	0.56	0.89	1.11	

Table 3 – Chemical stability data comparing total impurities in HFA-134a and 152a BDP solution formulations with varying ethanol levels stored at 40°C/75%RH

- Chemical stability of a typical solution formulation (BDP) can show a considerable reduction in total impurity formation over time when compared against HFA-134a.
- This provides potential flexibility around product shelf-life and stabiliser use
- This is due to HFA-152a's more stable molecular structure with less intense electron withdrawal (absence of the CF₃ group), better resonance stabilisation (more hydrogens) and lower steric hindrance.

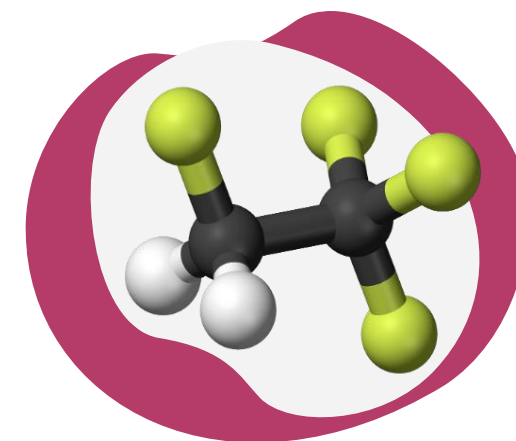


Figure 2– Chemical structure of HFA-134a

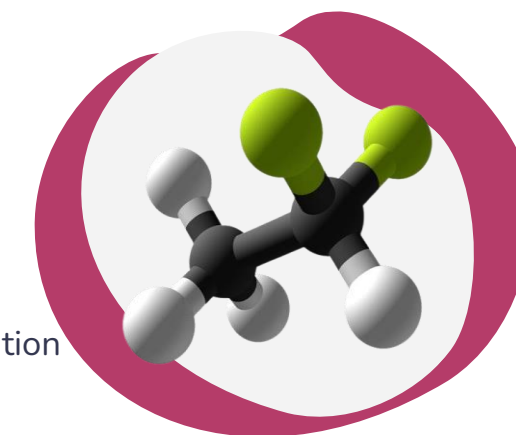


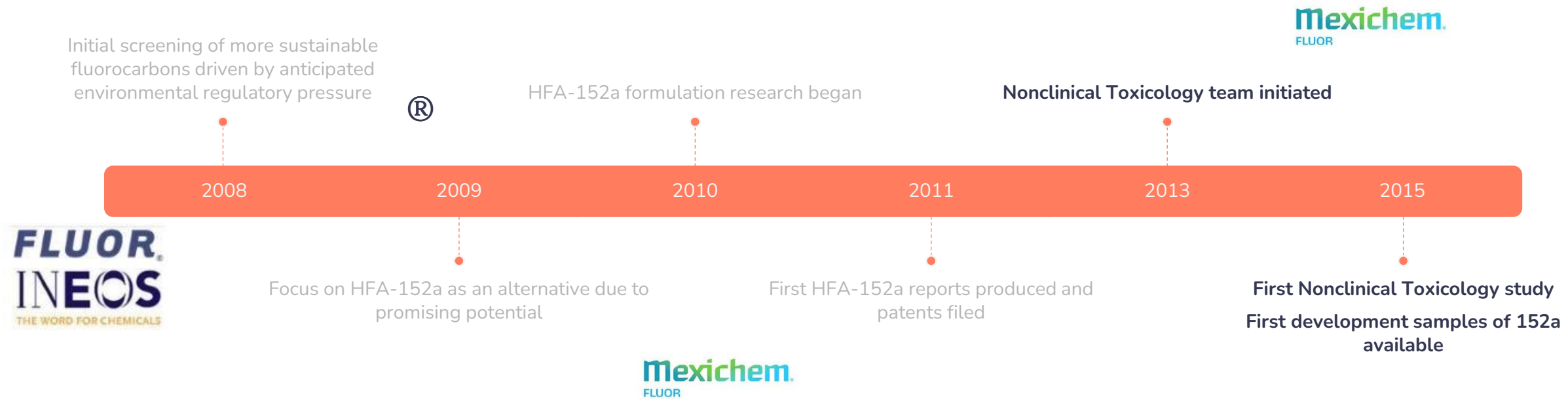
Figure 3– Chemical structure of HFA-152a

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The Zephex® 152a story: Non-Clinical Studies

The story of Zephex® 152a Part 2

Nonclinical Safety



Nonclinical Safety Program

Excipient Safety

- Excipient safety program must adequately address the risk of the most sensitive population and extreme use
- MDIs used chronically in paediatric and patients with respiratory conditions

Program Philosophy

- HFA-152a should have comparable safety to HFA-134a
- Conduct highest risk studies first
 - Respiratory sensitization
 - Cardiac sensitization

Guidance for Industry Nonclinical Studies for the Safety Evaluation of Pharmaceutical Excipients

Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and Marketing Authorization for Pharmaceuticals

U.S. Department of Health and Human Services
Food and Drug Administration
Center for Drug Evaluation and Research (CDER)
Center for Biologics Evaluation and Research (CBER)

May 2005
Pharmacology/Toxicology

U.S. Department of Health and Human Services
Food and Drug Administration
Center for Drug Evaluation and Research (CDER)
Center for Biologics Evaluation and Research (CBER)

January 2010
ICH

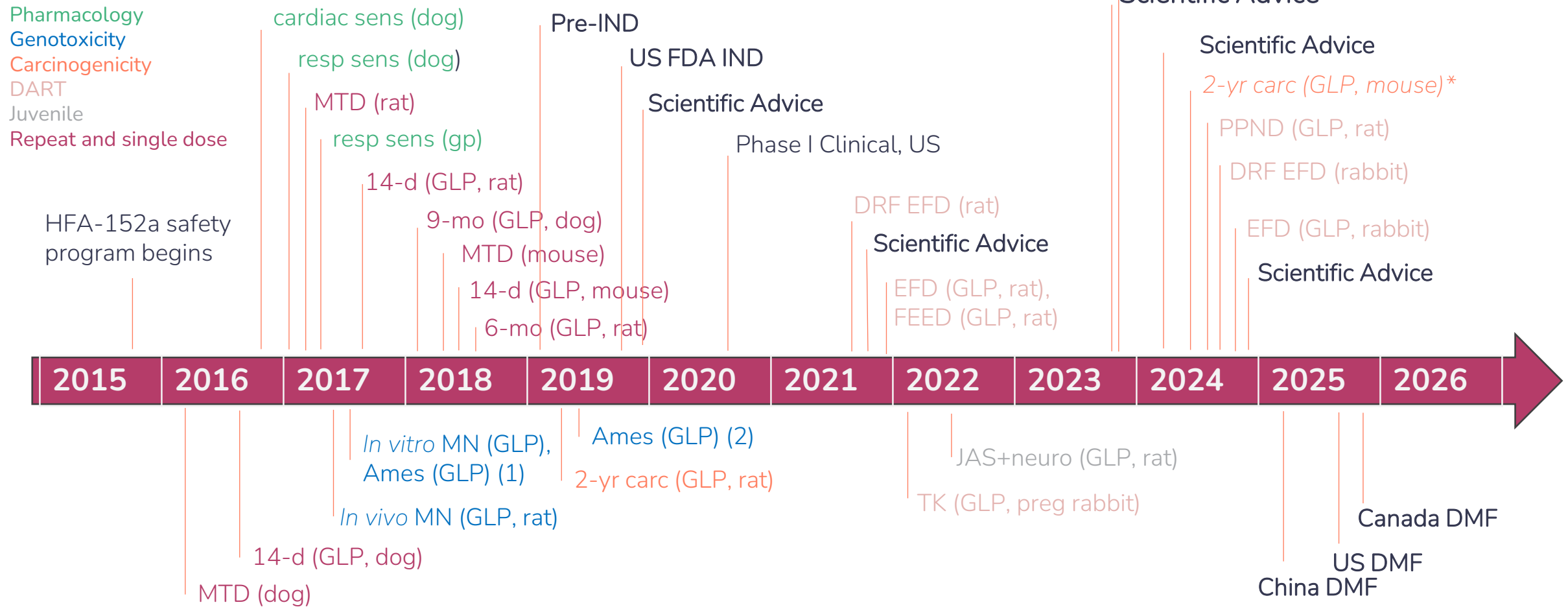
Revision 1



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Reference: I Mohar, T Lewandowski, S Johnson, S Corr and C Leach: Safety Overview of Zephex® 152a as a Low Global Warming Potential Medical Propellant. RDD Europe 2025

Nonclinical Safety Program Timeline



carc, carcinogenicity; d, day; DRF, dose range-finding; EFD, embryofoetal; FEED, fertility / early embryonic development; GLP, good laboratory practice; JAS, juvenile animal study; MN, micronucleus; mo, month; MTD, maximum tolerated dose; neuro, neurobehavior; PPND, pre-/post-natal development; preg, pregnant; resp, respiratory; sens, sensitization; TK = toxicokinetic, yr, year. *on-going study.



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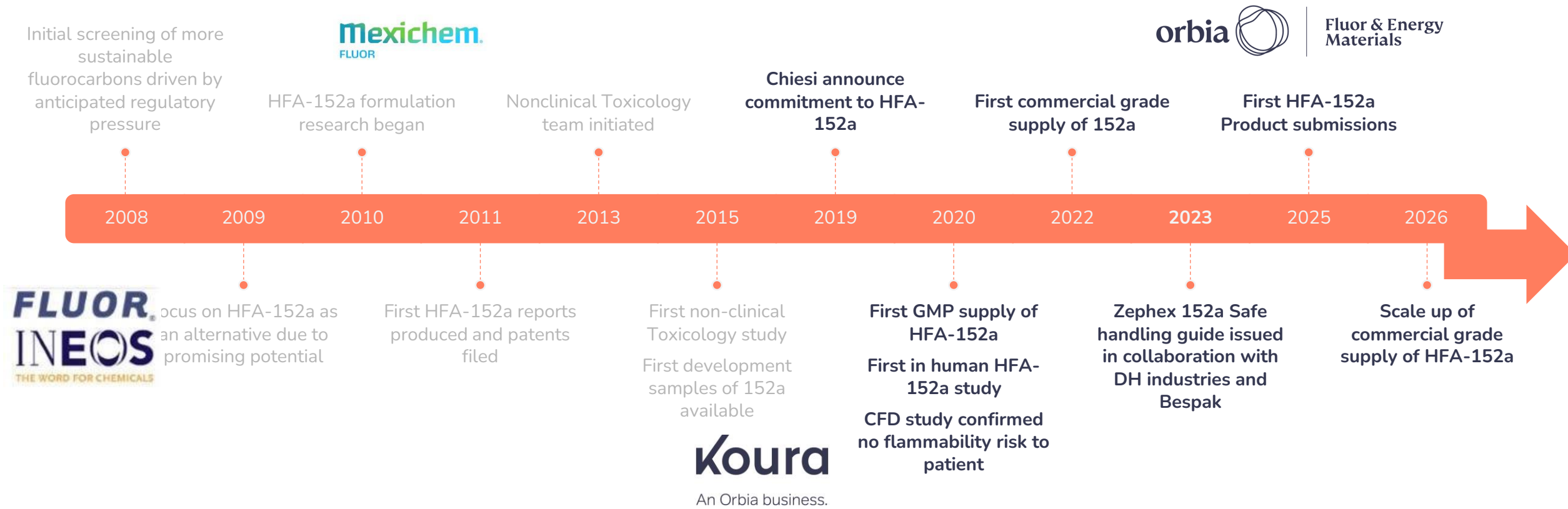
Reference: I Mohar, T Lewandowski, S Johnson, S Corr and C Leach: Safety Overview of Zephex® 152a as a Low Global Warming Potential Medical Propellant. RDD Europe 2025

Nonclinical Safety Program: Conclusions



The story of Zephex® 152a Part 3

Commercialisation



Overall Summary



Zephex® 152a is highly adaptable to both suspension and solution pMDI formulations



Zephex® 152a has been proven safe for use as a medical propellant



Zephex® 152a's commercialisation is aligned to support the industry's transition to NGP



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Keen to learn more?

Reach out to us [here](#), via email and we will be in touch with you.



Fluor & Energy Materials

To support modern, efficient living, Orbia's Fluor & Energy Materials business group provides fluorine and downstream intermediates, battery materials, refrigerants and propellants used in industries from automotive to infrastructure, pharmaceuticals to energy storage, computing to telecommunications applications.