PMI SCIENCE
PHILIP MORRIS INTERNATIONAL

SEE THE SCIENCE FOR YOURSELF

Delivering a smoke-free future

OUR PRODUCT **TECHNOLOGIES**

Our goal at Philip Morris International (PMI) is to offer smoke-free alternatives that have the potential to reduce the risk of developing smoking-related diseases as compared with continued smoking. Recent advances in science and technology have made it possible to develop innovative products that current adult smokers accept and that are less harmful alternatives.

THE TECHNOLOGIES BEHIND OUR SMOKE-FREE PRODUCTS

Heat-not-burn or heated tobacco products

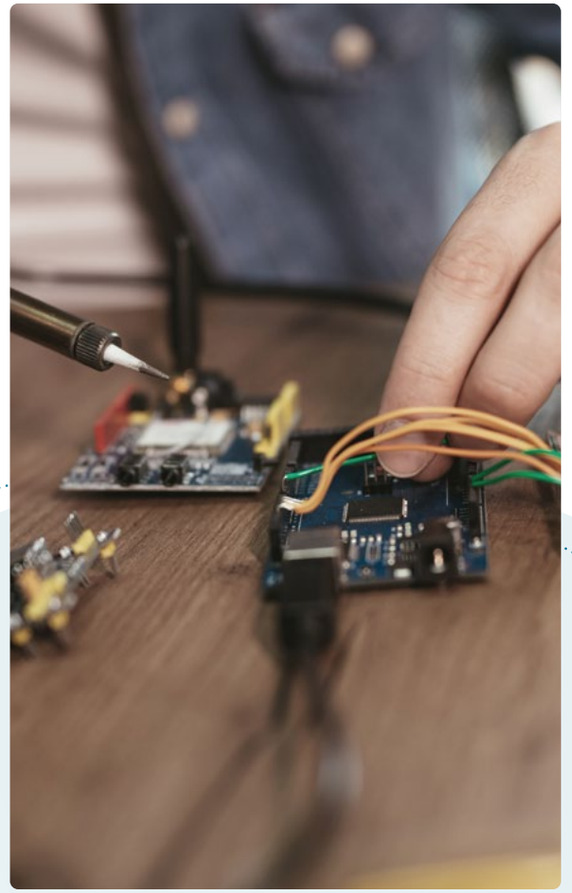
Our heated tobacco products (HTPs), also known as heat-not-burn (HnB) products, electrically heat tobacco or a nicotine substrate, using either inductive or resistive heating, just enough to release a nicotine-containing aerosol without burning.

E-vapor products

E-vapor products are battery-powered devices, commonly known as e-cigarettes, that vaporize a liquid solution containing nicotine and flavors to create an inhalable aerosol. While traditional e-vapor products come with rechargeable batteries and replaceable or refillable cartridges, disposable e-vapor products are single-use devices that come prefilled with e-liquid.

Oral products

The oral smokeless category does not involve a device, heating, or the inhalation of an aerosol. Instead, oral products contain either tobacco or purified nicotine that is wrapped in a cellulose pouch and they are placed between the gum and the cheek or upper lip, with nicotine absorbed into the bloodstream mainly via the mucous membranes in the mouth.



THE TECHNOLOGIES
BEHIND OUR SMOKE-FREE PRODUCTS

INHALED PRODUCTS

HEAT-NOT-BURN OR HEATED TOBACCO PRODUCTS

HYBRID PRODUCTS

AEROSOL HEATING TECHNOLOGY

AEROSOL HEATING SYSTEM (AHS)
- Developed by KT&G*
- Uses a tobacco stick and an e-liquid with nicotine
- Internal heating

EXTERNAL RESISTIVE HEATING

OVEN HEATING SYSTEM (OHS)
- Uses a tobacco stick
- Resistive heating
- Employs a heating chamber

INTERNAL RESISTIVE HEATING

TOBACCO HEATING SYSTEM 2.2 (THS 2.2)
- Uses a tobacco stick
- Resistive heating
- Employs a heating blade

ORAL PRODUCTS

SNUS

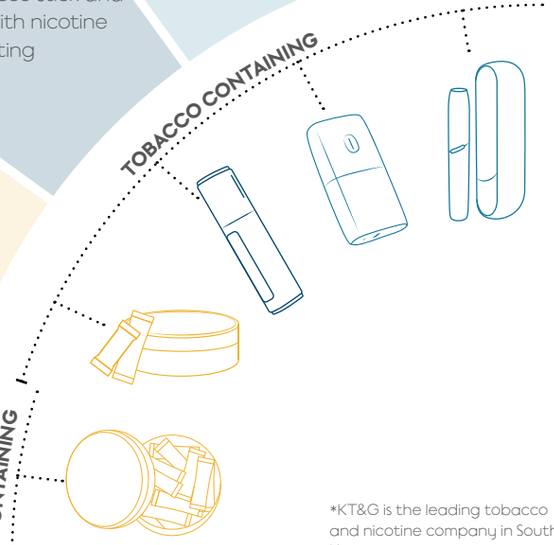
TOBACCO POUCH
- Uses real tobacco
- Nicotine released into saliva

NICOTINE POUCH

TOBACCO-FREE POUCH
- Uses no tobacco
- Contains nicotine
- Nicotine released into saliva

TOBACCO CONTAINING

NONTOBACCO CONTAINING



*KT&G is the leading tobacco and nicotine company in South Korea.

HEAT-NOT-BURN OR HEATED TOBACCO PRODUCTS

INTERNAL RESISTIVE HEATING

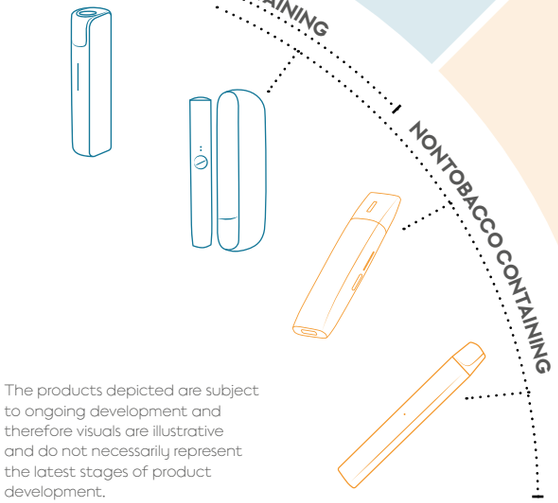
PIN-BASED HEATING SYSTEM (PHS)
- Developed by KT&G*
- Uses a tobacco stick
- Resistive heating
- Employs a heating pin

INTERNAL INDUCTION HEATING

TOBACCO HEATING SYSTEM 3.0 (THS 3.0)
- Uses a tobacco or tobacco-free stick
- Induction heating
- Employs a magnetic field

TOBACCO CONTAINING

NONTOBACCO CONTAINING



The products depicted are subject to ongoing development and therefore visuals are illustrative and do not necessarily represent the latest stages of product development.

EVAPOR PRODUCTS

CERAMIC VAPING TECHNOLOGY

CERAMIC VAPING SYSTEM (CVS)
- Uses no tobacco
- Contains e-liquid with nicotine
- Employs ceramic heater technology

WICK AND COIL TECHNOLOGY

DISPOSABLE VAPING SYSTEM (DVS)
- Uses no tobacco
- Contains e-liquid with nicotine
- Employs wick and coil technology

KEY FINDINGS

For a deep dive into each section of our assessment program and the references supporting our statements, please consult our PMI Science Booklet, available at PMIscience.com.

Our smoke-free products are in various stages of development, scientific assessment, and commercialization; all designed to offer better alternatives for adult smokers than continuing to smoke. All newly developed products undergo rigorous testing. This leaflet summarizes the key scientific results of our leading HTP, the tobacco heating system (THS).

THERE IS NO BURNING IN THS

Scientific data show that the primary cause of smoking-related disease is the high levels of Harmful and Potentially Harmful Constituents (HPHCs) in smoke formed during the combustion of tobacco.

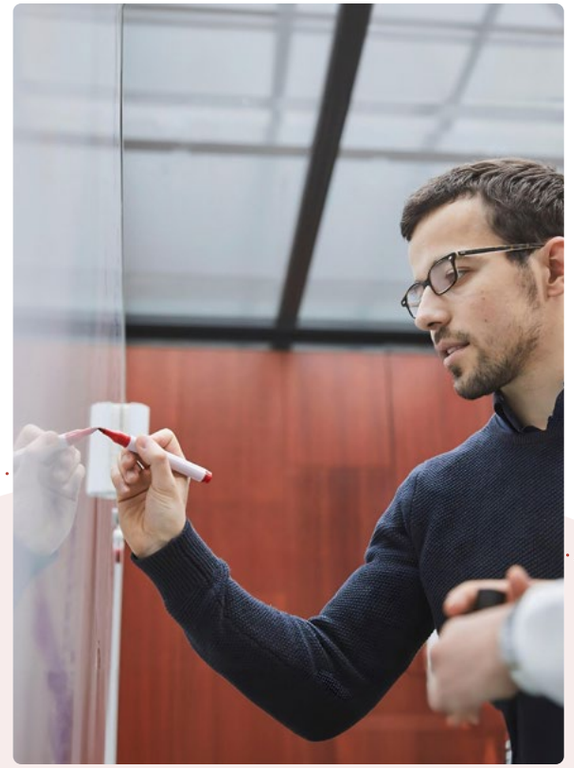
We have conducted several studies to demonstrate the absence of combustion in THS, including temperature measurements, experiments demonstrating the absence of net exothermic processes, and measurements of constituents that represent typical markers of combustion.

Our studies also support that the aerosol of THS does not contain solid particles that are produced when tobacco is burned. In addition, since burning requires oxygen, we have tested THS in an oxygen-free atmosphere. The results showed that oxygen does not play a major role in the thermochemical degradation of the THS tobacco or the aerosol formation. Combustion does not occur during THS use.

MAJORITY OF THS USERS NO LONGER SMOKE CIGARETTES AND USE THS EXCLUSIVELY

Our repeated post-market cross-sectional surveys show that the majority of THS users no longer smoke cigarettes and use THS exclusively.

These studies also show very low to non-existing tobacco or nicotine-containing products (TNP) initiation with THS among never TNP users (<0.1%). More than 99% of current THS users have a history of TNP use before switching to THS, and only 1% to 2% of current THS users relapsed or re-initiated tobacco use with THS.



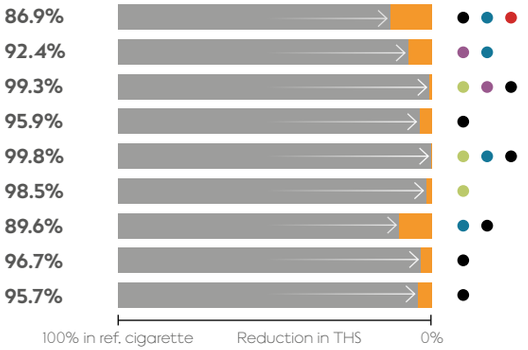
KEY FINDINGS

REDUCED EMISSIONS OF HARMFUL CHEMICALS

By eliminating combustion, the levels of HPHCs are reduced on average by 95% in the aerosol of THS compared with those in cigarette smoke.*

This figure illustrates the reductions of HPHCs, as listed in the WHO 9 list, present in the THS aerosol compared with cigarette smoke.

HPHCs	Ref. cigarette mean (per stick)	THS mean (per stick)	Reduction in THS versus ref. cigarette (per stick)
Acetaldehyde	1641 µg	215 µg	**86.9%**
Acrolein	156 µg	11.8 µg	**92.4%**
Benzene	81.1 µg	0.533 µg	**99.3%**
Benzo[a]pyrene	15 ng	0.621 ng	**95.9%**
1,3-butadiene	98.5 µg	0.233 µg	**99.8%**
Carbon monoxide	30.2 mg	0.447 mg	**98.5%**
Formaldehyde	85.2 µg	8.89 µg	**89.6%**
NNK**	264 ng	8.72 ng	**96.7%**
NNN***	283 ng	12.3 ng	**95.7%**



*Based on the WHO 9 list.

Tobacco-specific nitrosamines:
**NNK: 4-(Methylnitrosamino)-1-(3-pyridyl)-1-butanone
***NNN: N-Nitrosonornicotine

Yields are obtained under the Health Canada Intense Testing regime.

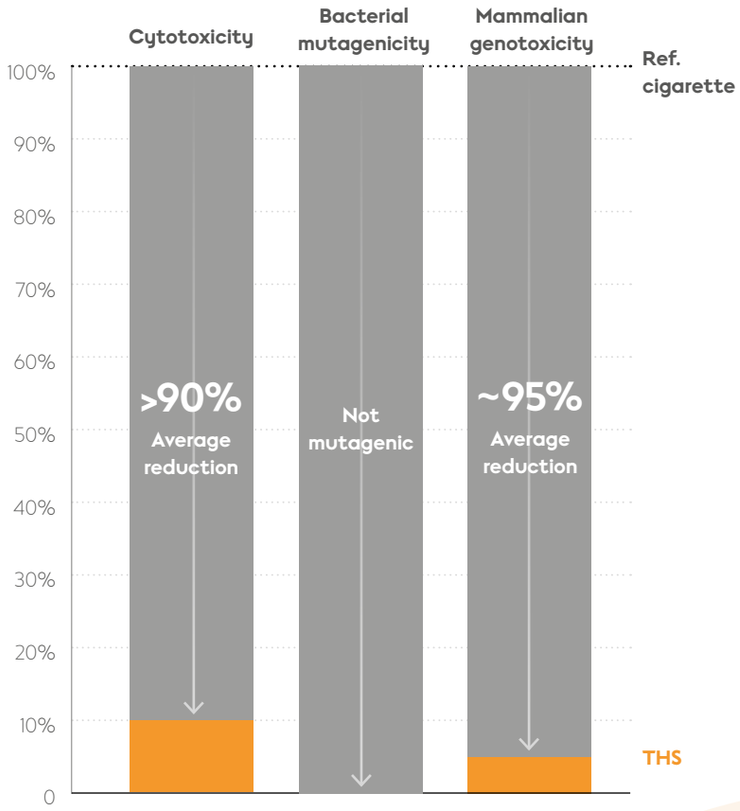
Toxicants classification based on the established U.S. Food and Drug Administration (FDA) list.

- Carcinogen
- Respiratory toxicant
- Cardiovascular toxicant
- Reproductive or developmental toxicant
- Addictive

REDUCED TOXICITY

Our studies show a substantial reduction in toxicity of the THS aerosol compared with cigarette smoke.

The chart shows our findings concerning the relative *in vitro* toxicity of THS aerosol compared with the smoke from the 3R4F reference cigarette using three *in vitro* assays commonly used to assess cytotoxicity and genotoxicity.

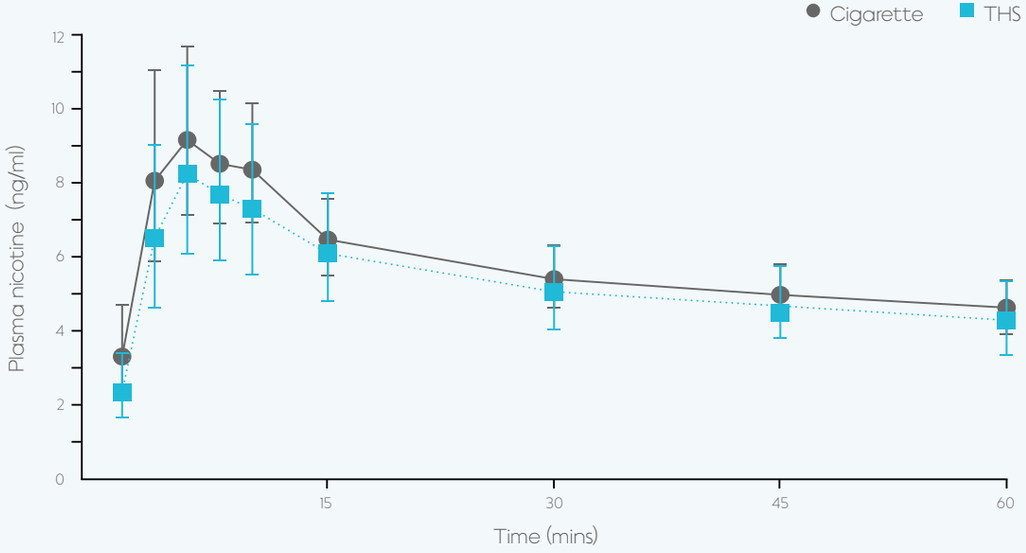


KEY FINDINGS

NICOTINE UPTAKE

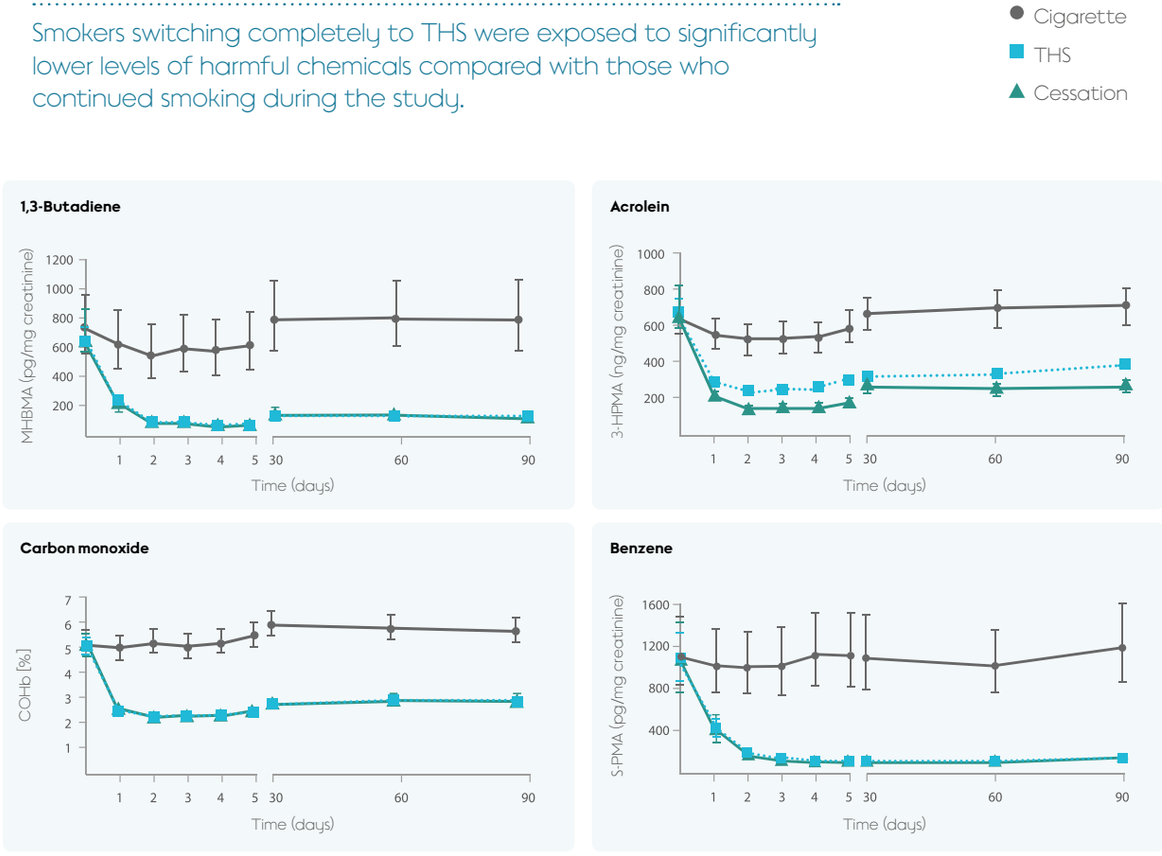
When switching to THS, the nicotine uptake and urge-to-smoke scores were comparable to those measured in subjects who continued smoking.

This suggests that switchers do not seek to use THS more frequently than smokers seek to use cigarettes and that switchers can find THS acceptable and satisfying.



REDUCED EXPOSURE TO HARMFUL CHEMICALS

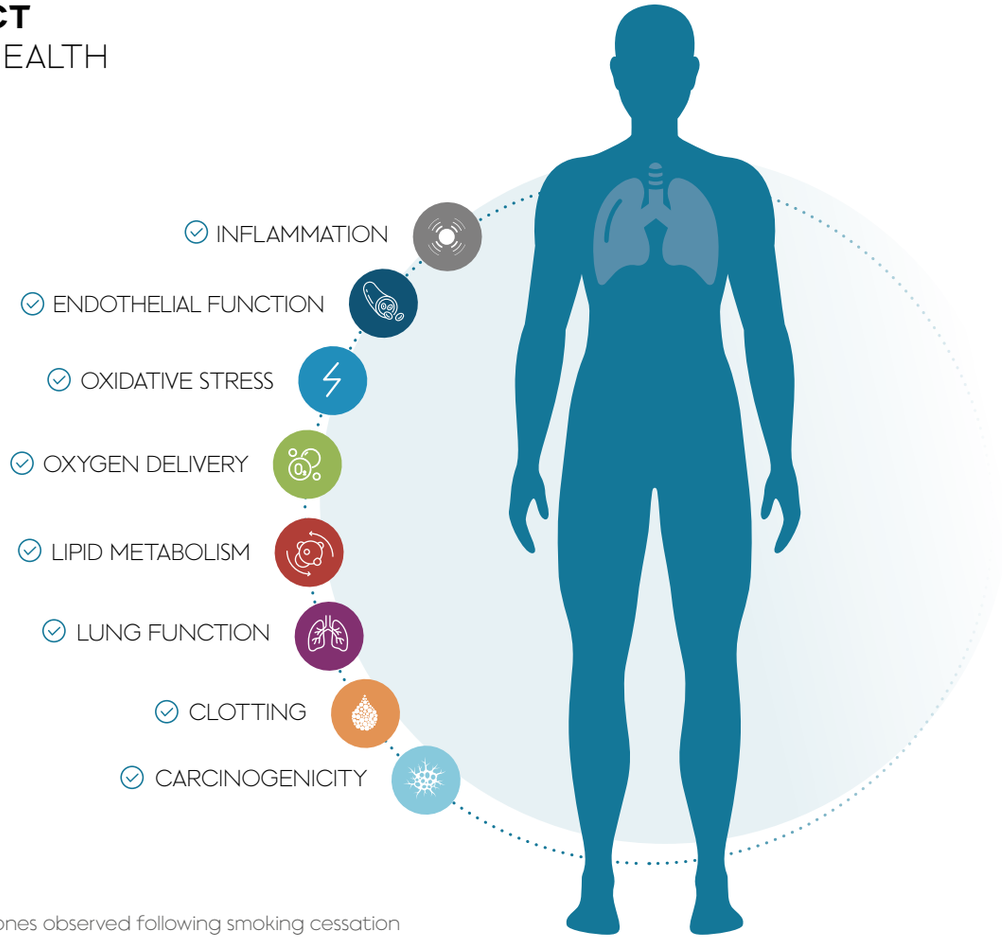
Smokers switching completely to THS were exposed to significantly lower levels of harmful chemicals compared with those who continued smoking during the study.



KEY FINDINGS

POSITIVE IMPACT
ON SMOKERS' HEALTH

Our 1-year exposure response study showed that smokers who switched from cigarettes to THS for 12 months had favorable changes in all eight measured biomarkers of potential harm, in the same direction as upon smoking cessation.



Changes similar to the ones observed following smoking cessation

INTENTION TO USE
AND USE BEHAVIOR

Our pre-market perception and behavior studies showed that substantial proportions of current adult smokers expressed intention to use THS and that low proportions of nonsmokers expressed intention to use THS.

Furthermore, the studies showed that smokers correctly understand that switching to THS presents less risk of harm than continued cigarette smoking.

Our actual use perception and behavior studies showed that a sizeable proportion of smokers were likely to switch from cigarettes to THS exclusive or predominant use.

KEY FINDINGS

PERCEIVED RISK

We examined the impact of risk-related perceptions of THS on smokers' behavior and its impact on exclusive and stable use over time, highlighting the importance of factual and nonmisleading product information capable of enabling informed decision making.

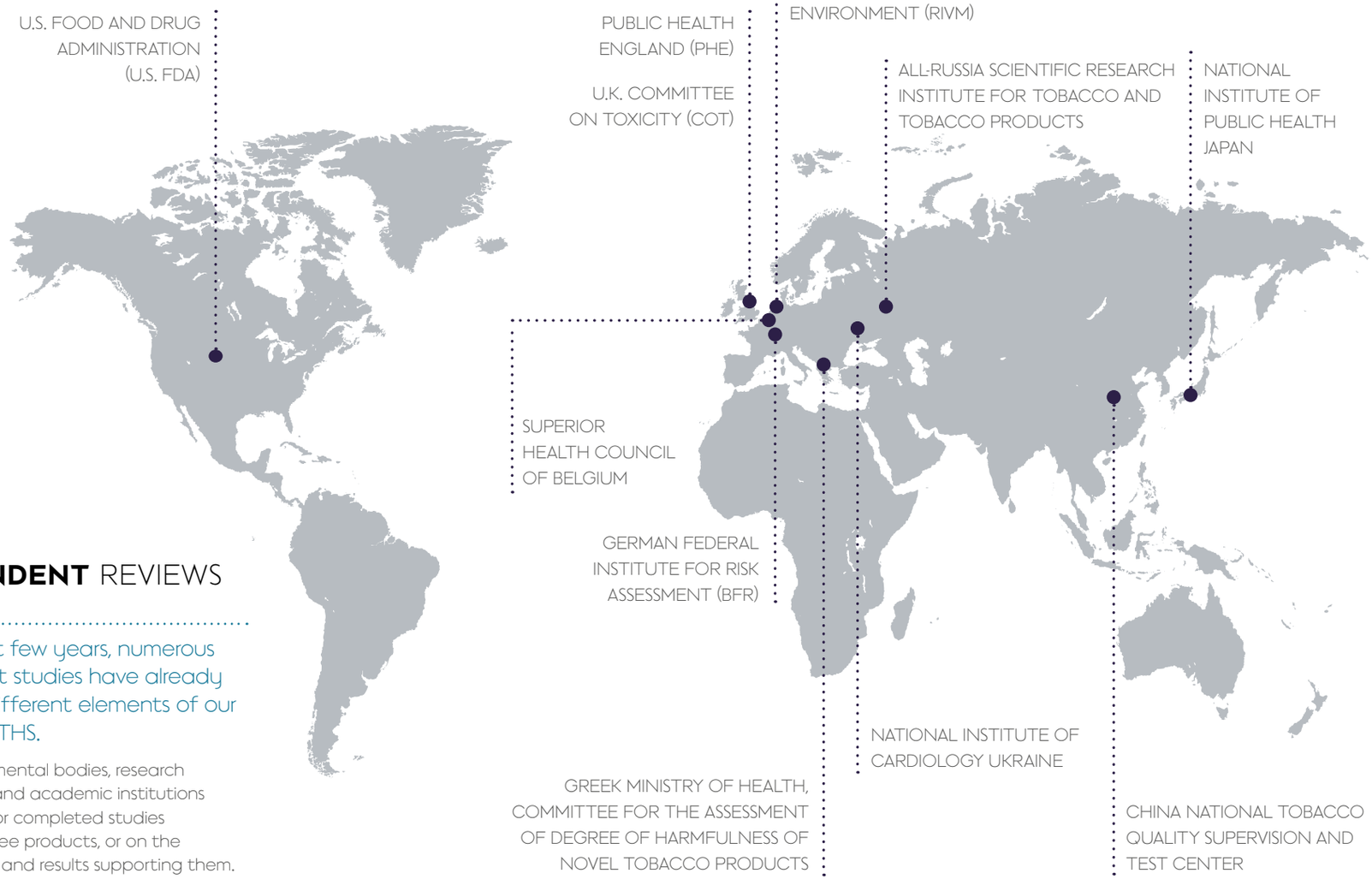
The results showed that individuals who identified perceived reduced formation of harmful chemicals or perceived reduced risk of harm as reasons for using THS were more likely to switch exclusively and did so more quickly than those who did not.

POPULATION HEALTH IMPACT MODEL

We developed an epidemiological model relying on mathematical simulations using publicly available data, the Population Health Impact Model (PHIM), with the aim to estimate, in the absence of epidemiological data, the potential effects of introducing a smoke-free product on the public health of a whole population.

We have conducted several studies using our PHIM for various countries and while the PHIM has several important limitations, these simulations seem to suggest that the introduction of a smoke-free product as modeled has the possibility to substantially reduce smoking-related deaths.

INDEPENDENT STUDIES AND REVIEWS



INDEPENDENT REVIEWS

Over the last few years, numerous independent studies have already confirmed different elements of our research on THS.

Several governmental bodies, research organizations, and academic institutions have initiated or completed studies on our smoke-free products, or on the methodologies and results supporting them.

FACTS
AND FIGURES

The totality of evidence gathered so far demonstrates that THS is a better choice for adult smokers who would otherwise continue smoking cigarettes and that switching completely to THS presents less risk of harm than continued smoking. Smoke-free products are not risk free and contain nicotine, which is addictive. The best choice any smoker can make is to quit tobacco and nicotine altogether.

OUR CONTRIBUTION
SO FAR

Our comprehensive body of scientific evidence for our leading smoke-free product THS has been submitted to regulatory bodies in several countries.

We submitted Modified Risk Tobacco Applications (MRTPAs) in December 2016 and Premarket Tobacco Product Applications (PMTAs) in March 2017 to the U.S. FDA. We also submitted technical and scientific dossiers to regulatory authorities in several EU member states. In April 2019, following a rigorous science-based review through the PMTA pathway, the U.S. FDA determined that authorizing THS for the U.S. market is appropriate for the protection of the public health.

In July 2020, the U.S. FDA authorized the marketing of the THS as a modified risk tobacco product with reduced exposure information. The agency found that the issuance of the modified risk tobacco product orders with reduced exposure information would be "appropriate to promote the public health and is expected to benefit the health of the population as a whole."

1,586
scientists, engineers, technicians, and support staff working in PMI R&D in 2023.*

USD 120 million
invested in construction of the Cube, PMI's remarkable R&D facility in Neuchâtel (Switzerland).

532
scientific publications by PMI from 2008 to 2023 - most open access.

USD 12.5 billion
invested by PMI to develop, scientifically substantiate, and commercialize smoke-free products since 2008.**

USD 709 million
total R&D expenditure in 2023.

30
scientific and engineering disciplines including: materials science, consumer electronics, clinical science, and systems toxicology.

99%
of total R&D expenditure was dedicated to smoke-free products in 2023.

~3,720
patents granted for smoke-free technologies by the five largest intellectual property offices in the world (IP5, cumulative from 2015 to 2023).***

* Data includes employees of Swedish Match and Vectura Fertin Pharma.
** Investments reflect research, product and commercial development, production capacity, scientific substantiation, and studies on adult smoker understanding. Figure does not include Swedish Match and Vectura Fertin Pharma.
*** IP5 jurisdictions are Europe (patents granted by the European Patent Office), China, South Korea, Japan, and the U.S.

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Edition 2.0, May 2024

You can find more about our science on PMIScience.com

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The purpose of the site and leaflet is not advertising or marketing.

It is not intended for consumers.

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