Περιβαλλοντικά και Επαγγελματικά Αίτια Καρκινογένεσης

Λαμπρινή Στουρνάρα

Πνευμονολόγος

Επιστημονική Συνεργάτης

Ογκολογικής Μονάδας Γ΄ Πανεπιστημιακής Παθολογικής Κλινικής και Ομώνυμου Εργαστηρίου

Carcinogenesis

- Cancer is caused by changes to certain genes that alter the way our cells function
- Some of these genetic changes occur naturally when DNA is replicated during the process of cell division
- Others are the result of environmental exposures that damage DNA

Risk Factors

What is a carcinogen?

- A carcinogen is a substance, mixture or agent that can cause cancer or it increases the risk of developing cancer. Known carcinogens include viruses (Hepatitis B), hormones (estrogens), chemicals (benzene), naturally occurring minerals (asbestos), alcohol, and solar radiation (ultraviolet radiation)

International Agency for Research on Cancer

World Health Organization

Environmental health

- Clean air, stable climate, adequate water, sanitation and hygiene, safe use of chemicals, protection from radiation, healthy and safe workplaces, sound agricultural practices, health-supportive cities and built environments, and a preserved nature are all prerequisites for good health.

International Agency for Research on Cancer

World Health Organization

Epidemiology

- 13.7 million of deaths per year in 2016, amounting to 24% of the global deaths, are due to modifiable environmental risks
- One in five people worldwide develop cancer during their lifetime. Prevention of cancer has become one of the most significant public health challenges of the 21st century
- Based on current scientific evidence, at least 40% of all cancer cases could be prevented with effective primary prevention measures, and further mortality can be reduced through early detection of tumors

PAHO Pan American Health Organization World Health Organization Americas

PAHO 120th ANNIVERSARY

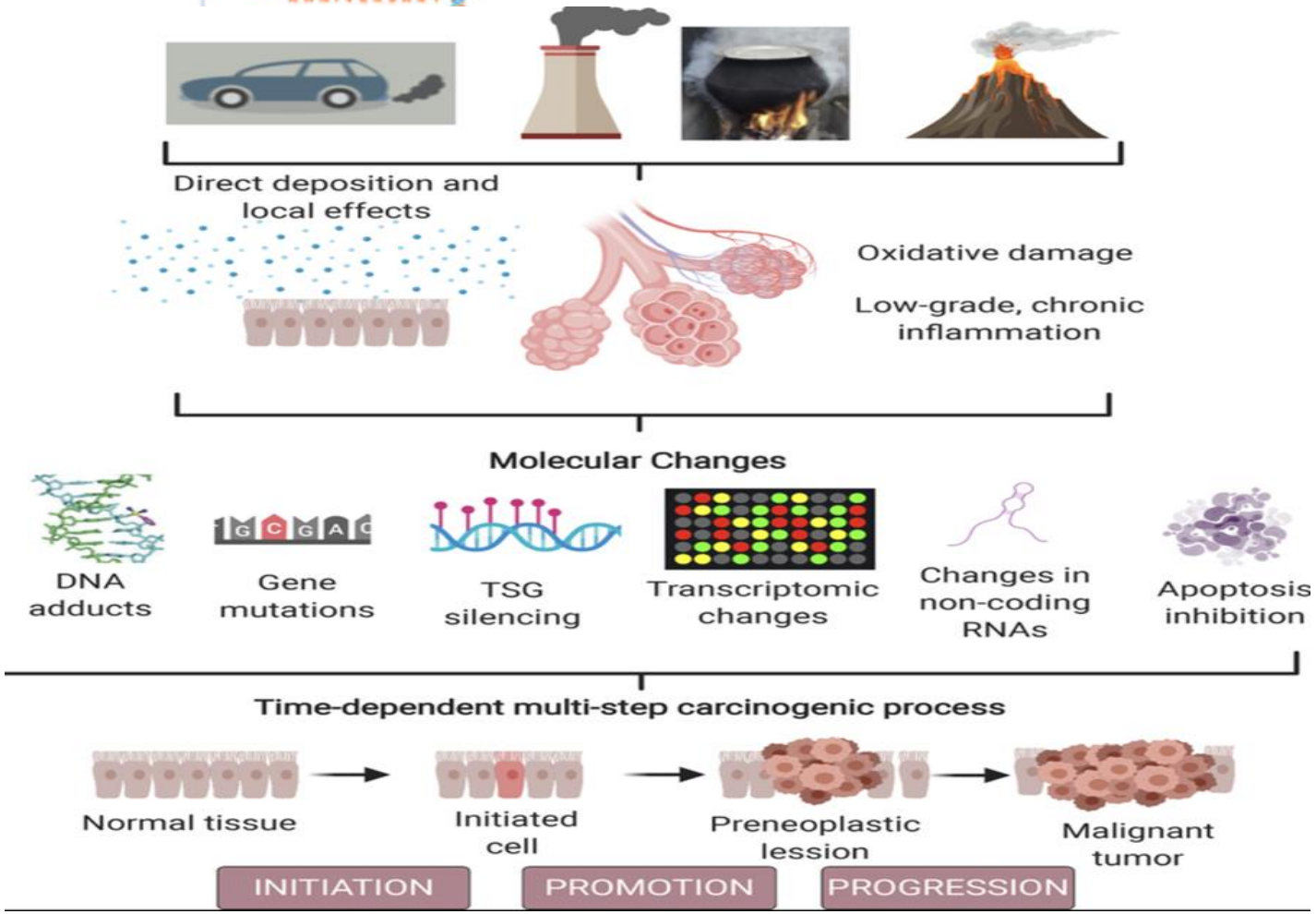
13% of deaths in the Americas attributed to environmental risks **847,000** deaths per year

320,000 deaths in the Americas attributed to **air pollution**

15.6 million still practice open defecation

1.55 million deaths attributed to **chemical exposures**

More tan **80 million** people use **polluting household fuels**



A healthy environment is vital to “ensure healthy lives and promote well-being for all at all ages.”

Air pollution

- A complex mixture of **solid particles**, **liquid droplets**, as well as **gases**. It can come from many sources for example: household fuel burning, industrial chimneys, traffic exhausts, power generation, open burning of waste, agricultural practices, desert dust and many other sources
- In 2019, 99% of the world's population was living in places where the WHO air quality guidelines levels were not met
- The combined effects of ambient air pollution and household air pollution are associated with 6.7 million premature deaths annually
- WHO estimates that in 2019, some 11% of **outdoor** air pollution-related premature deaths were due to cancer within the respiratory tract

Over 3.2 million people

a year die prematurely from household air pollution (2019). Household air pollution is mostly created by using kerosene and solid fuels such as wood with polluting stoves, open fires and lamps.

23%
from stroke

32%
from ischaemic heart disease

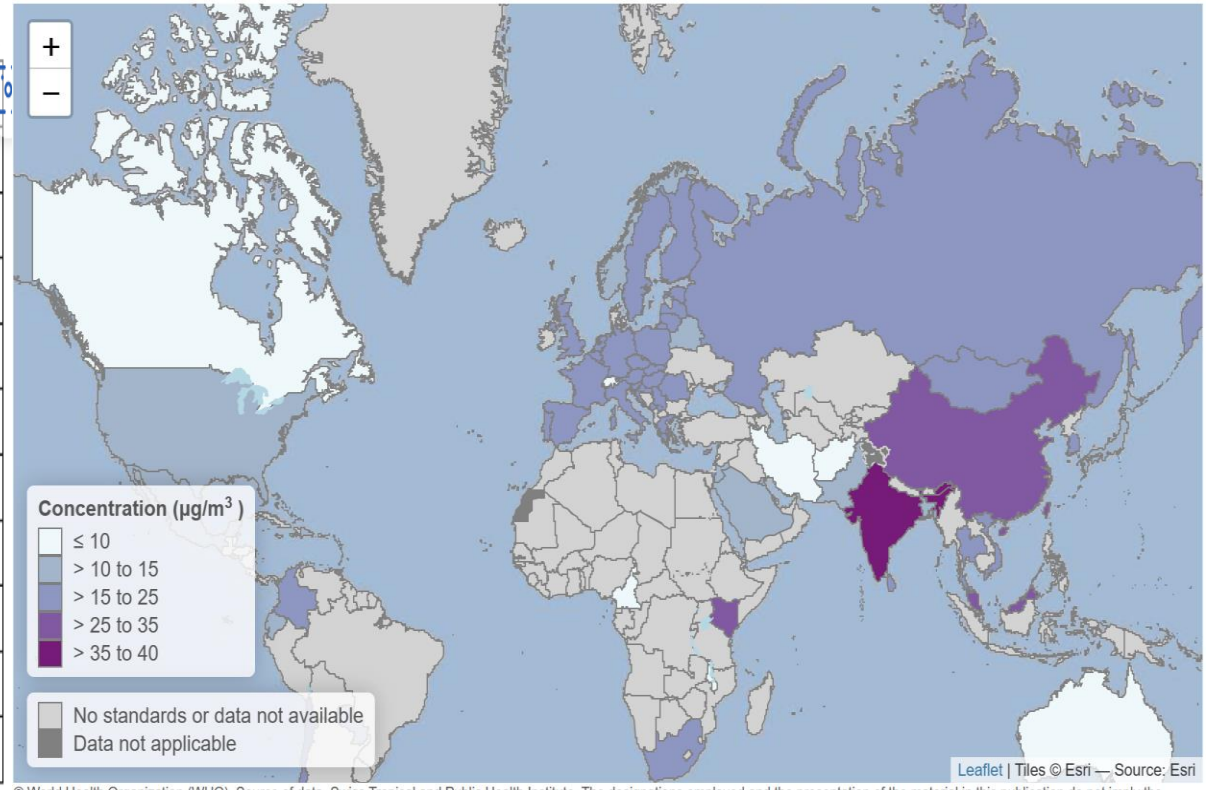
19%
from chronic obstructive pulmonary disease (COPD)

6%
from lung cancer

21%
are due to lower respiratory infections

Recommended 2021 AQG levels compared to 2005 air quality guidelines

Pollutant	Averaging Time	2005 AQGs	2021 AQGs
$PM_{2.5}$, $\mu g/m^3$	Annual	10	5
	24-hour[a]	25	15
PM_{10}, $\mu g/m^3$	Annual	20	15
	24-hour[a]	50	45
O_3, $\mu g/m^3$	Peak season[b]	-	60
	8-hour[a]	100	100
NO_2, $\mu g/m^3$	Annual	40	10
	24-hour[a]	-	25
SO_2, $\mu g/m^3$	24-hour[a]	20	40
CO, mg/m^3	24-hour[a]	-	4



Which country had the worst air quality in 2022?

#	COUNTRY	POPULATION	AVG. US
1	Chad	17,179,740	169
2	Iraq	43,533,592	164
3	Pakistan	231,402,117	159
4	Bahrain	1,463,265	157
5	Bangladesh	169,356,251	156
6	Burkina Faso	22,100,683	155
7	Kuwait	4,250,114	151
8	India	1,407,563,842	144
9	Egypt	109,262,178	128
10	Tajikistan	9,750,064	127
50	Greece	10,641,221	65

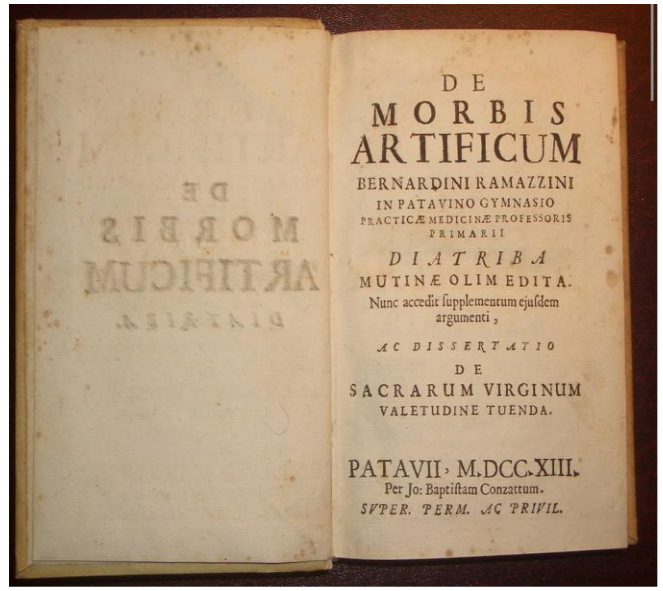
PM2.5 stands for particulate matter that is 2.5 micrometers or less in diameter, going down to sizes as small as 0.001 microns across. Due to its incredibly small size as well as chemical composition depending on the material, it has the ability to cause considerable harm when respired, and as such is used as a major component for calculating the overall AQI, or air quality index

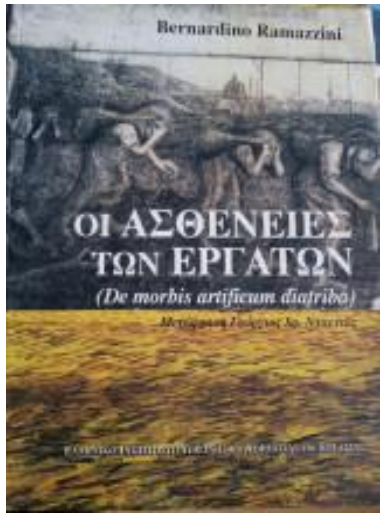
2022 average PM2.5 concentration in Greece: 3.8 times the WHO annual air quality guideline value

2022 Greece cleanest city	Corfu , Ionian Islands	10
2022 Greece most polluted city	Vasilika , Central Macedonia	76

The Father of Occupational Medicine

- Bernardino Ramazzini
- Born in Carpi, Italy, in 1633
- Ramazzini focused on workers' health problems in a systematic and scholarly way
- De Morbis Artificum Diatriba [Diseases of Workers]; the first edition was printed in Modena in 1700





- With cancer accounting for an estimated 53 % of all work-related deaths in the EU and other developed countries, reliable data on workplace exposures to cancer risk factors are essential for both the safety and health of workers and a productive and sustainable economy

What is occupational cancer?

- Occupational cancer is cancer that is caused wholly or partly by exposure to a carcinogen at work
- The most common types of occupational cancer are lung cancer, bladder cancer and mesothelioma

Type of Cancer	Related to Occupational Exposure Estimated % (USA)
Lung	6.3-13%
Bladder	3-19%
Mesothelioma	85-90% (men); 23-90% (women*)
Leukemia	0.8-2.8%
Laryngeal	1-20% (men)
Skin Cancer (non-melanoma)	1.5-6% (men)
Sinonasal and nasopharyngeal	31-43% (men)
Kidney	0-2.3%
Liver	0.4-1.1 (vinyl chloride only; men)

Dying for work: the magnitude of US mortality from selected causes of death associated with occupation. K. Steenland, et al. American Journal of Occupational Medicine. Vol. 43 (2003). p. 461-482

Definitions

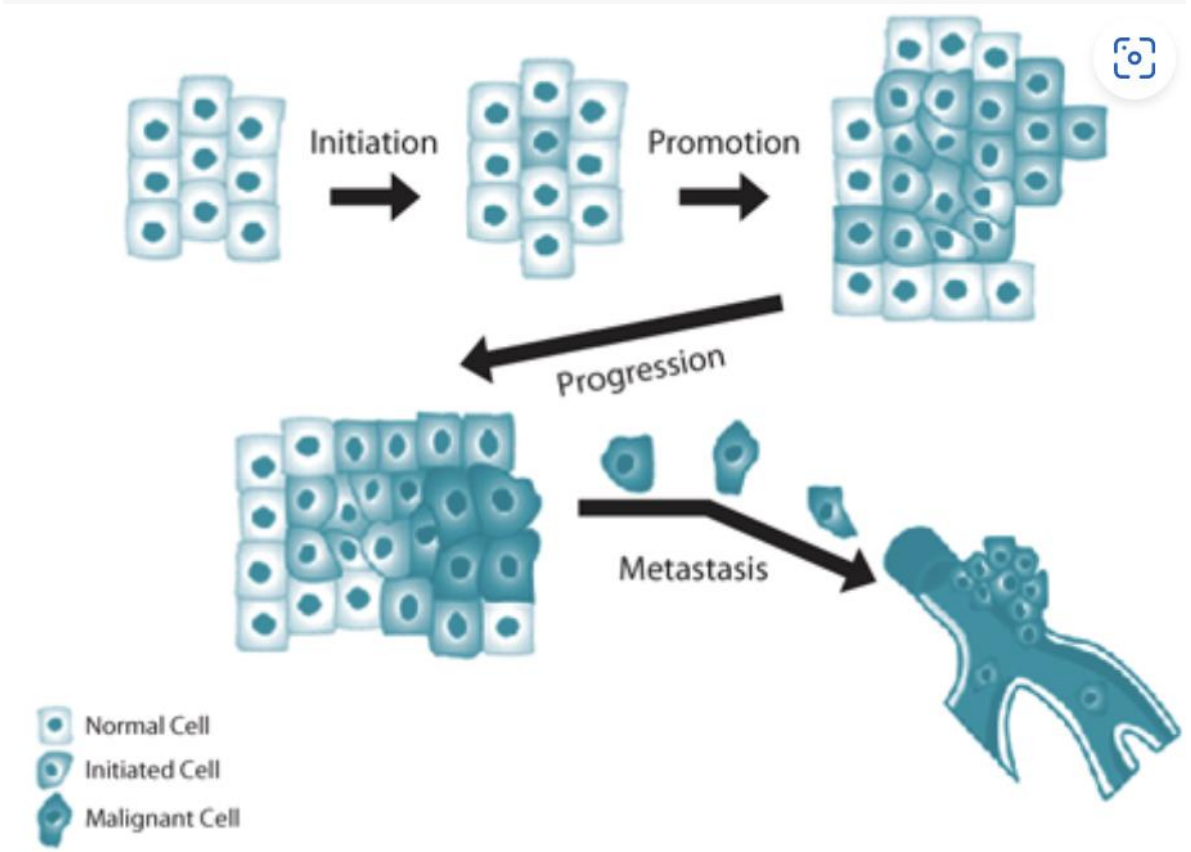
The agent is a defined substance, a mixture, or a type or source of radiation

The agent is classified in IARC Group 1 with ‘sufficient evidence of carcinogenicity’ in humans (to ensure that observed exposure-disease associations are causal).

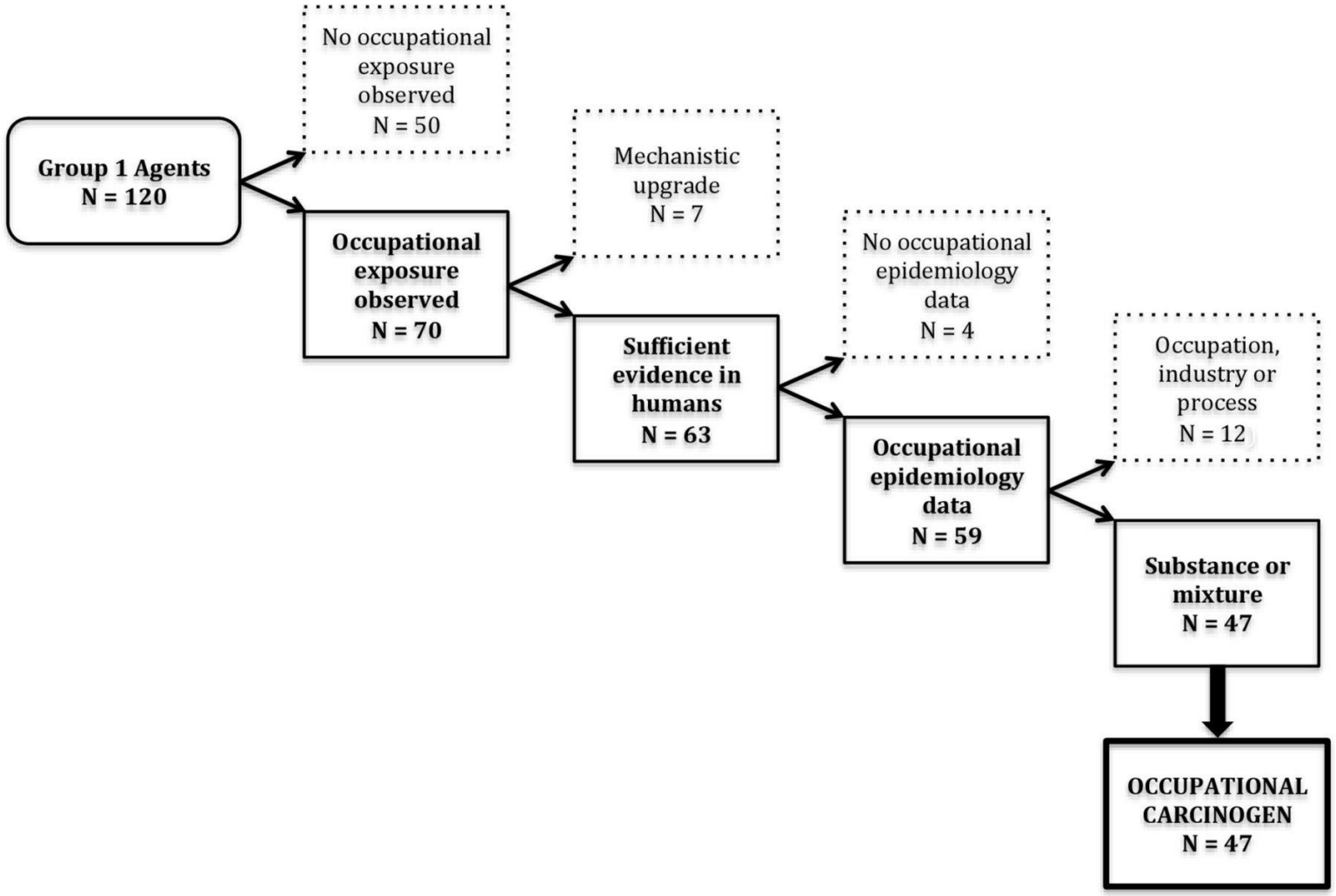
‘Sufficient evidence of carcinogenicity’ in humans is obtained entirely or in part from epidemiologic studies of exposed workers (to ensure that the carcinogen has documented occupational exposure); the occurrence of exposure in workers is documented in the pertinent monograph.

Carcinogenic chemicals are divided into 3 categories:

- known to cause cancer to humans (category 1A);
- presumed to cause cancer to humans (category 1B);
- suspected of causing cancer to humans (category 2)

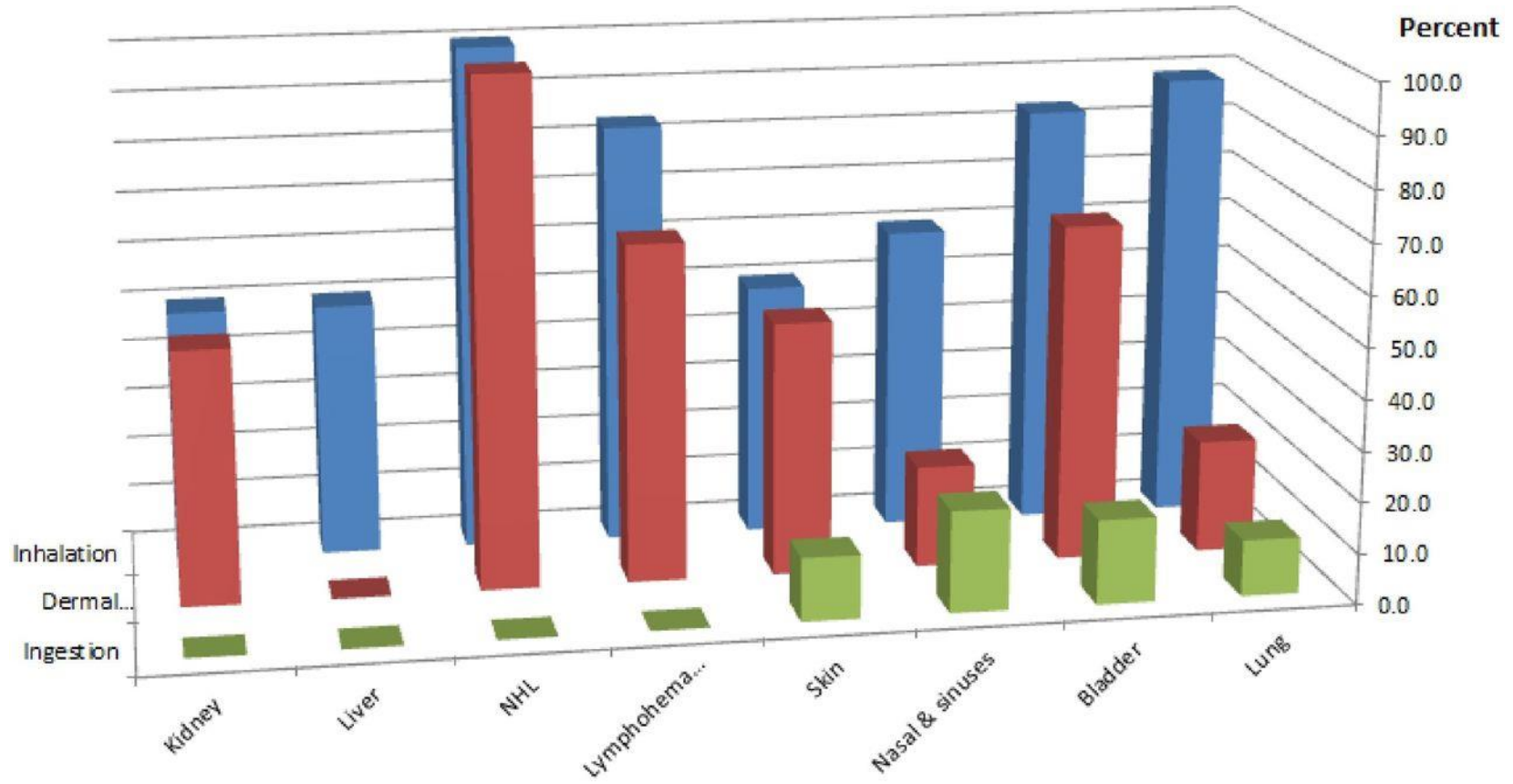


Defining occupational carcinogens from the International Agency for Research on Cancer (IARC) Monographs (1971–2017).



Dana Loomis et al. Occup Environ Med 2018;75:593-603

Route of exposure to occupational carcinogens and the cancers they cause (ionising radiation not included due to the diversity of exposure routes and cancer types). NHL, non-Hodgkin lymphoma.



Dana Loomis et al. Occup Environ Med 2018;75:593-603

List of classifications by cancer sites with sufficient or limited evidence in humans, IARC Monographs

Cancer site	Carcinogenic agents with *sufficient evidence* in humans	Agents with *limited evidence* in humans
Lip, oral cavity, and pharynx		
Lip		Hydrochlorothiazide Solar radiation
Oral cavity	Acetaldehyde associated with consumption of alcoholic beverages Alcoholic beverages Betel quid with tobacco Betel quid without tobacco Human papillomavirus type 16 Tobacco, smokeless Tobacco smoking	Bitumens, occupational exposure to hard bitumens and their emissions during mastic asphalt work Bitumens, occupational exposure to oxidized bitumens and their emissions during roofing Human papillomavirus type 18
Salivary gland	Acetaldehyde associated with consumption of alcoholic beverages X- and Gamma-radiation	Radioiodines, including iodine-131
Pharynx: oropharynx [b]	Human papillomavirus type 16	
Pharynx: tonsil [b]	Human papillomavirus type 16	
Pharynx: nasopharynx [b]	Epstein–Barr virus Formaldehyde Salted fish, Chinese-style Wood dust	Pickled vegetables (traditional Asian)
Pharynx: all combined	Acetaldehyde associated with consumption of alcoholic beverages Alcoholic beverages Betel quid with tobacco Tobacco smoking	Asbestos (all forms) Bitumens, occupational exposure to hard bitumens and their emissions during mastic asphalt work Bitumens, occupational exposure to oxidized bitumens and their emissions during roofing Opium consumption Tobacco smoke, secondhand
Oesophagus	Acetaldehyde associated with consumption of alcoholic beverages Alcoholic beverages Betel quid with tobacco Betel quid without tobacco Tobacco, smokeless Tobacco smoking X- and Gamma-radiation	Bitumens, occupational exposure to hard bitumens and their emissions during mastic asphalt work Bitumens, occupational exposure to oxidized bitumens and their emissions during roofing Dry cleaning Opium consumption Pickled vegetables (traditional Asian) Rubber manufacturing industry Very hot beverages (squamous cell carcinoma)
Stomach	*Helicobacter pylori* (infection with) Rubber manufacturing industry Tobacco smoking X- and Gamma-radiation	Art glass, glass containers and pressed ware (manufacture of) Asbestos (all forms) Epstein–Barr virus Lead compounds, inorganic Nitrate or nitrite (ingested) under conditions that result in endogenous nitrosation Opium consumption Pickled vegetables (traditional Asian) Processed meat (consumption of) Salted fish, Chinese-style
Colon	Alcoholic beverages Processed meat (consumption of) Tobacco smoking X- and Gamma-radiation	Asbestos (all forms) Firefighter (occupational exposure as a) Night shift work Red meat (consumption of) *Schistosoma japonicum* (infection with)

List of classifications by cancer sites with sufficient or limited evidence in humans, IARC Monographs

Cancer site	Carcinogenic agents with *sufficient evidence* in humans	Agents with *limited evidence* in humans
Rectum	Alcoholic beverages Processed meat (consumption of) Tobacco smoking	Asbestos (all forms) Night shift work Red meat (consumption of) *Schistosoma japonicum* (infection with) X- and Gamma-radiation
Anus	Human immunodeficiency virus type 1 (infection with) Human papillomavirus type 16	Human papillomavirus types 18 and 33
Liver	Aflatoxins Alcoholic beverages Estrogen–progestogen oral contraceptives (combined) Hepatitis B virus (chronic infection with) Hepatitis C virus (chronic infection with) Plutonium Thorium-232 and its decay products Tobacco smoking (in smokers and in smokers' children) Vinyl chloride	Androgenic (anabolic) steroids Arsenic and inorganic arsenic compounds Betel quid without tobacco DDT (4,4'-dichlorodiphenyl-trichloroethane) Human immunodeficiency virus type 1 (infection with) *Schistosoma japonicum* (infection with) Trichloroethylene X- and Gamma-radiation
Bile duct	*Clonorchis sinensis* (infection with) 1,2-Dichloropropane *Opisthorchis viverrini* (infection with) Plutonium Thorium-232 and its decay products Tobacco smoking (in smokers)	Androgenic (anabolic) steroids Arsenic and inorganic arsenic compounds Betel quid without tobacco DDT (4,4'-dichlorodiphenyl-trichloroethane) Dichloromethane (methylene chloride) Hepatitis B virus (chronic infection with) Hepatitis C virus (chronic infection with) *Schistosoma japonicum* (infection
Pancreas	Tobacco, smokeless Tobacco smoking	Alcoholic beverages Opium consumption Red meat (consumption of) Thorium-232 and its decay products X- and Gamma-radiation
Digestive tract, unspecified		Radioiodines, including iodine-131
Respiratory and intrathoracic organs		
Nasal cavity and paranasal sinus	Isopropyl alcohol manufacture using strong acids Leather dust Nickel compounds Radium-226 and its decay products Radium-228 and its decay products Tobacco smoking Wood dust	Carpentry and joinery Chromium(VI) compounds Formaldehyde Textile manufacturing industry (work in)
Larynx	Acetaldehyde associated with consumption of alcoholic beverages Acid mists, strong inorganic Alcoholic beverages Asbestos (all forms) Opium consumption Tobacco smoking	Bitumens, occupational exposure to hard bitumens and their emissions during mastic asphalt work Bitumens, occupational exposure to oxidized bitumens and their emissions during roofing Human papillomavirus types 16 and 18 Rubber manufacturing industry Sulfur mustard Tobacco smoke, secondhand
Lung	Acheson process, occupational exposure associated with Aluminium production Arsenic and inorganic arsenic compounds Asbestos (all forms) Beryllium and beryllium compounds Bis(chloromethyl)ether; chloromethyl	Acid mists, strong inorganic Art glass, glass containers and pressed ware (manufacture of) Benzene Biomass fuel (primarily wood), indoor emissions from household combustion of

Ίνες αμιάντου

- Chrysotile
- Amphibole asbestos

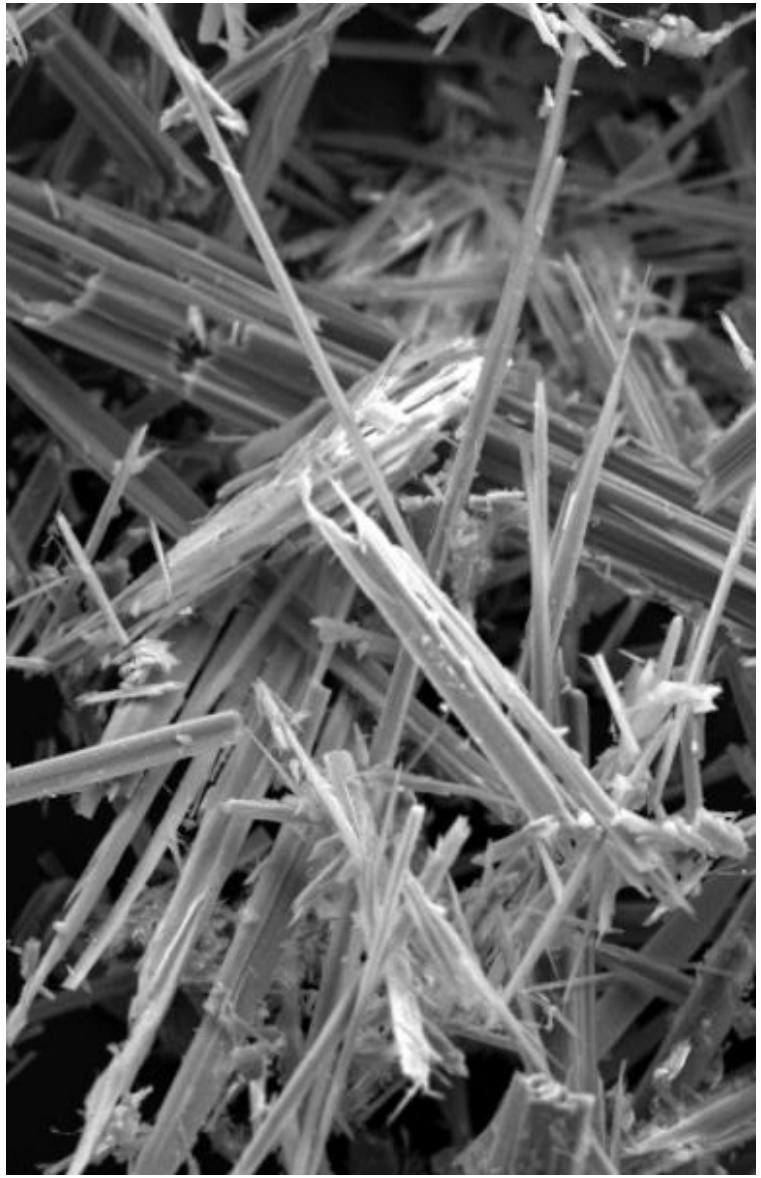
i. Crocidolite (blue) asbestos

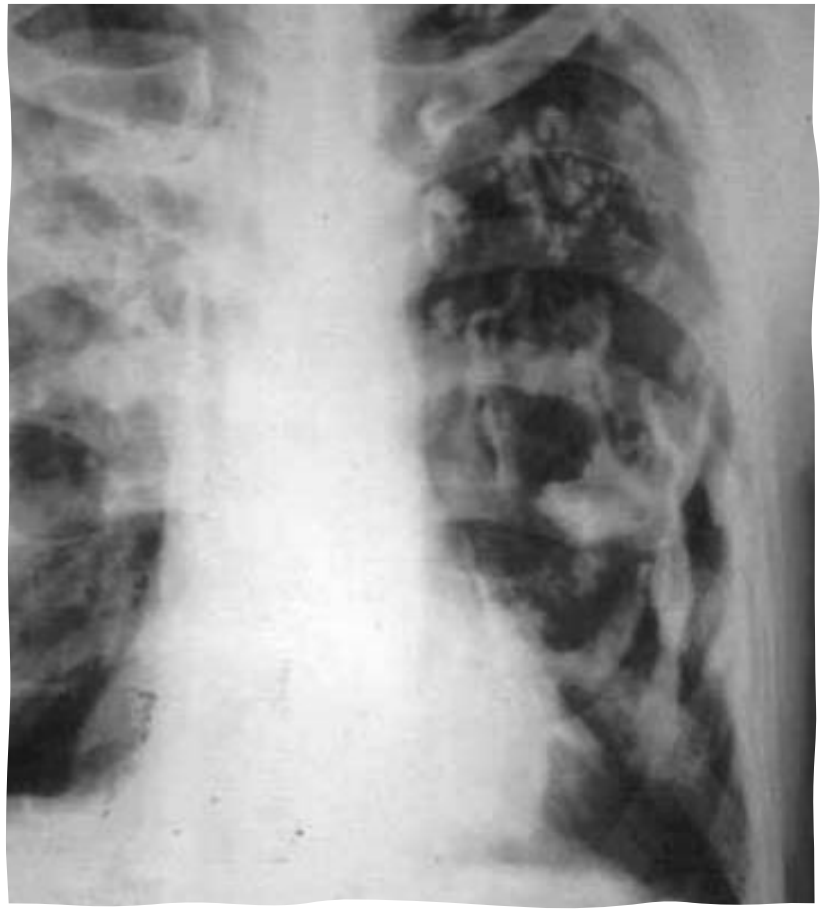
ii. Amosite (brown) asbestos

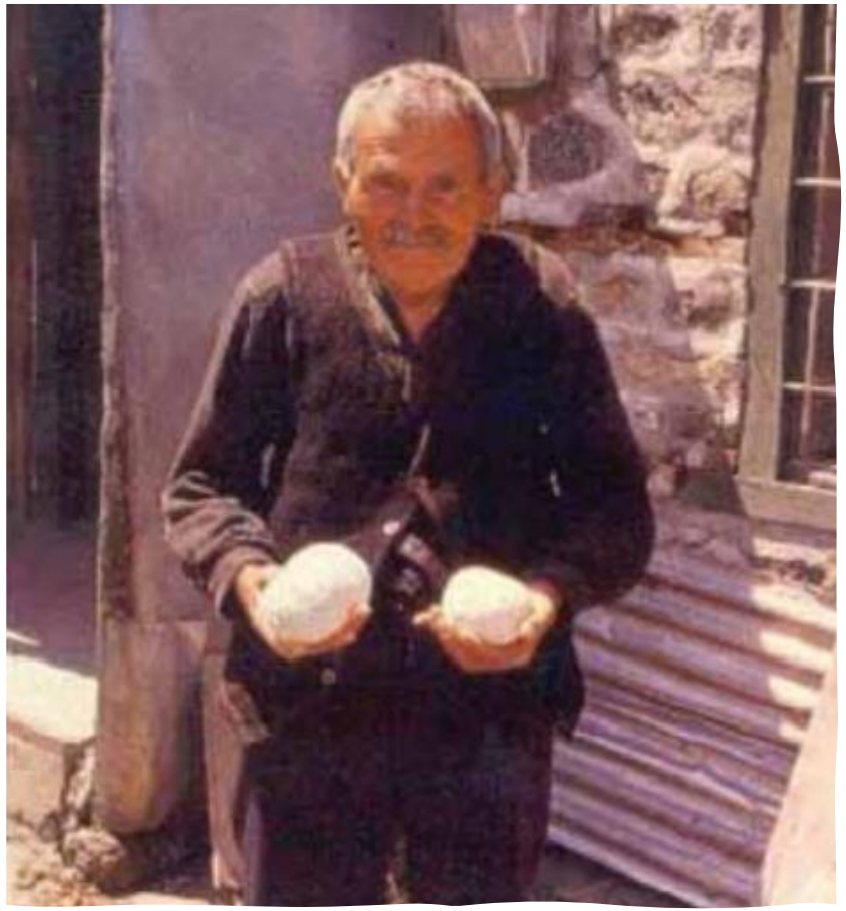
iii. Anthophyllite

iv. Actinolite

v. Tremolite



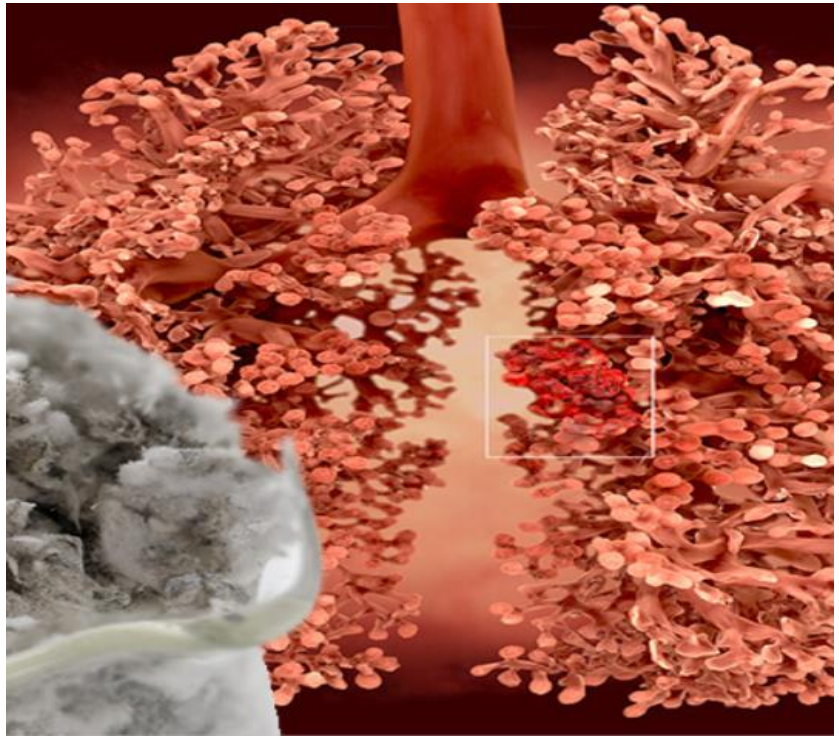




Metsovo Lung

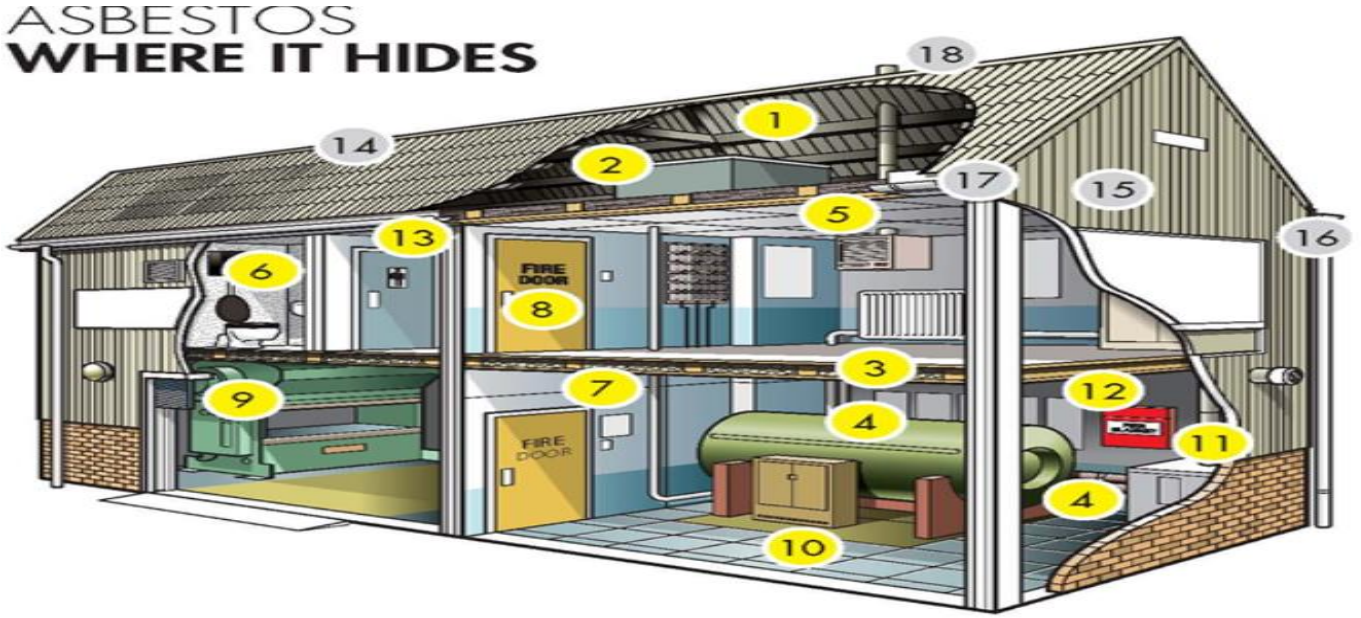
Κακοήθες Μεσοθηλίωμα

- Mesothelioma is a rare but fatal form of thoracic cancer that is diagnosed in more than 30,000 people per year and kills over 25,000
- Over 80% of cases arise from exposure to asbestos fibres which cause long term inflammation in the mesothelial cells of the lung, slowly leading to cancerous changes 20-50 years later
- The incidence of mesothelioma has fallen in Australia, the USA and Western Europe, where asbestos or strict regulations were introduced in the 1970s and 1980s
- Approximately 3000 incident cases of mesothelioma are registered each year in the United States




Countries with a National Ban on Asbestos, 2018
Countries with a National Ban on Asbestos, 2018
National Asbestos Ban
Asbestos.com
Brought to you by The Mesothelioma Center


ASBESTOS
BANNED


ASBESTOS
WHERE IT HIDES
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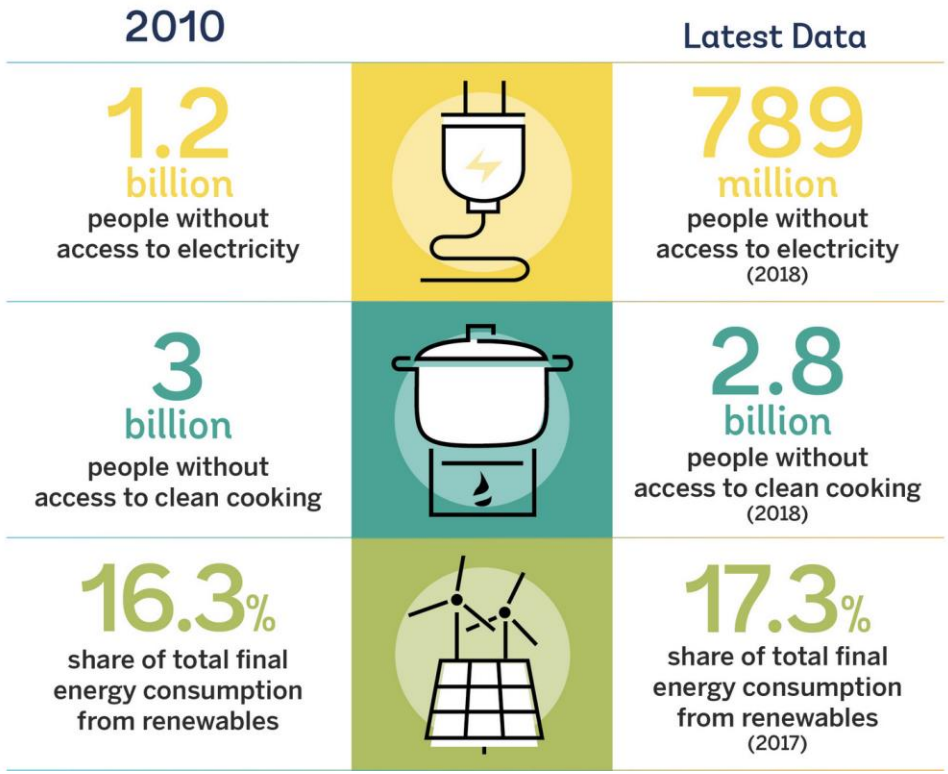
FIRE DOOR
FIRE DOOR

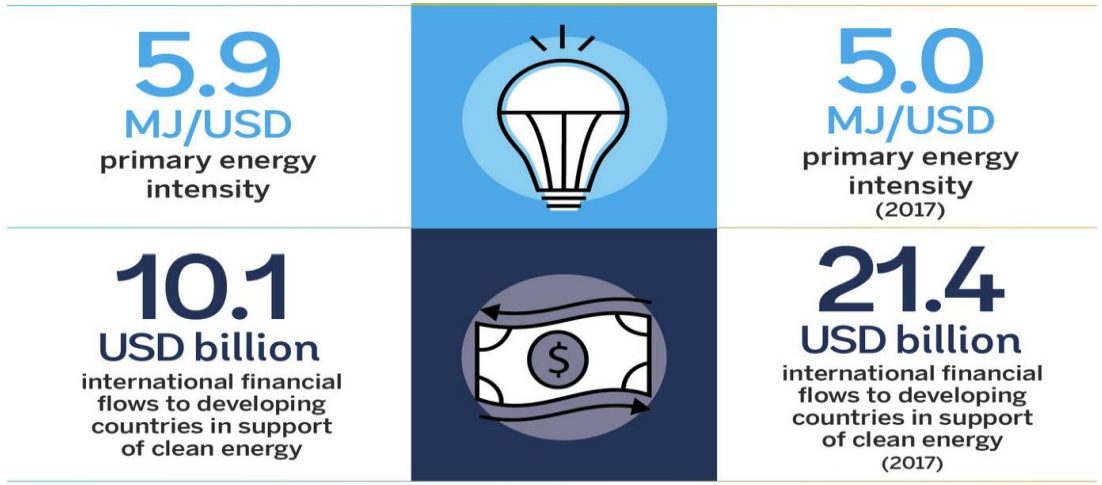
- Data compiled from the IARC Monographs from its initiation in 1971 through 2017 indicate that the number of recognized occupational carcinogens has increased progressively in recent decades
- Despite notable progress, there continues to be a need for research on the causes of work-related cancer. Epidemiologic evidence is inadequate or entirely lacking for the majority of the over 1000 agents evaluated by IARC; many more agents present in workplaces have never been evaluated for carcinogenicity

Solutions


INVEST IN ENERGY-EFFICIENT POWER GENERATION.
IMPROVE DOMESTIC, INDUSTRY AND MUNICIPAL WASTE MANAGEMENT.
REDUCE AGRICULTURAL WASTE INCINERATION, FOREST FIRES AND CERTAIN AGRO-FORESTRY ACTIVITIES.
MAKE GREENER AND MORE COMPACT CITIES WITH ENERGY-EFFICIENT BUILDINGS.
PROVIDE UNIVERSAL ACCESS TO CLEAN, AFFORDABLE FUELS AND TECHNOLOGIES FOR COOKING, HEATING AND LIGHTING.
BUILD SAFE AND AFFORDABLE PUBLIC TRANSPORT SYSTEMS AND PEDESTRIAN- AND CYCLE-FRIENDLY NETWORKS.
WHO Air Quality Guidelines set goals to protect millions of lives from air pollution.

Energy Progress Report for 2020





ευχαριστώ


Air pollution kills 13 people every minute
World Health Organization
due to lung cancer, heart disease and strokes.
Stop burning fossil fuels like oil, coal and natural gas.