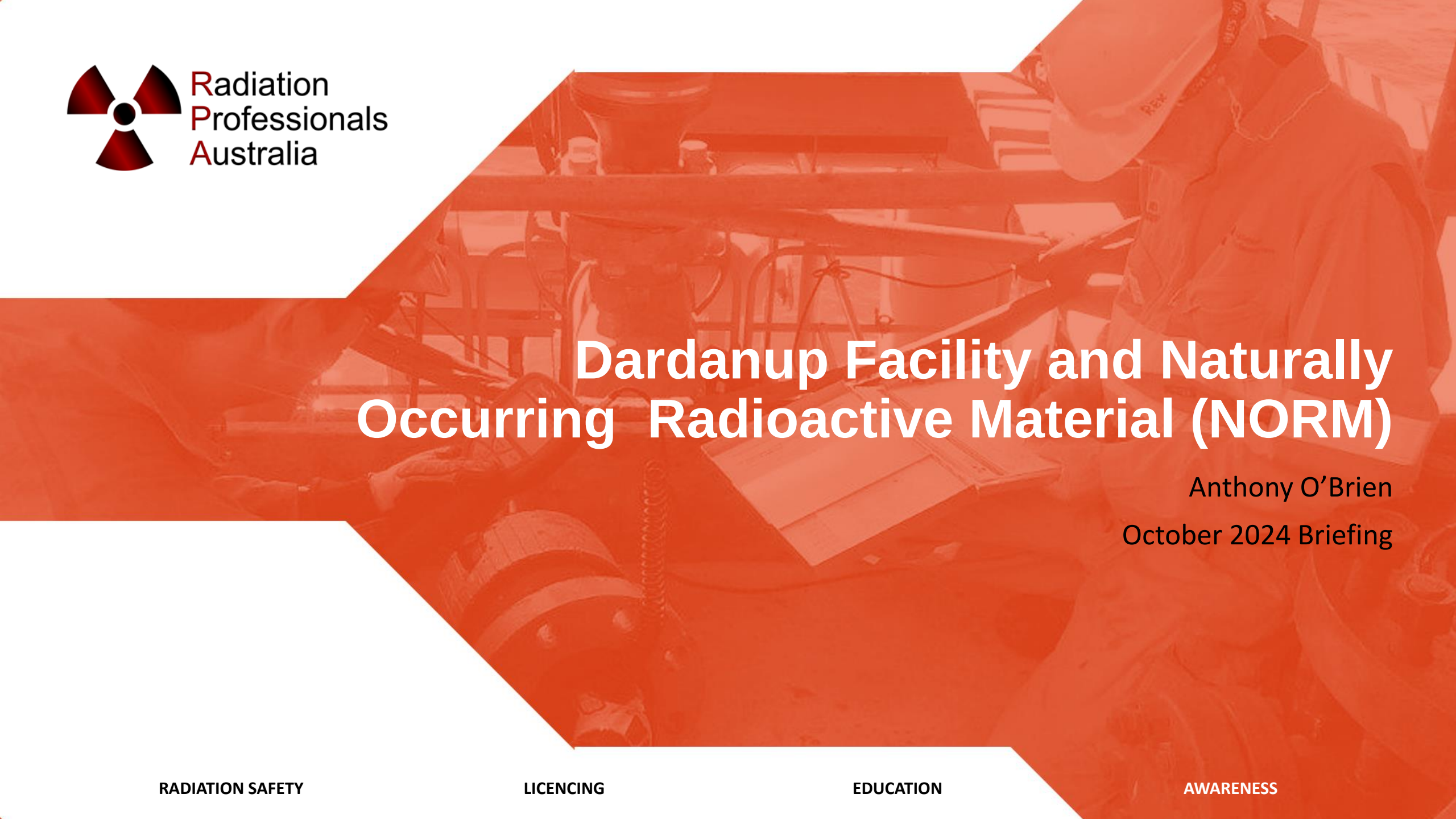
Radiation Professionals Australia



Dardanup Facility and Naturally Occurring Radioactive Material (NORM)

Anthony O'Brien

October 2024 Briefing

Agenda

- Why we register facilities such as this
- The regulatory framework
- What is radiation and NORM
- Monitoring of radiation
- Principals of protection
- Controls onsite
- Risk Perspective

Why are we registered under regulations?

- Residue from pigment production
- Residue contains some low level natural radioactive materials
- Residue disposal into lined cells

The Regulatory Framework

International guidance - provided by three major bodies:

The United Nations Scientific Committee on the Effects of Atomic Radiation

Committee established by the United Nations on 3 December 1955.
They study the effects of exposure to ionising radiation, following international incidents and documented exposures to various individuals and workers.

International Commission on Radiological Protection

The commission was established in 1928 to provide guidance on radiological principles.
They develop recommendations and standards for international radiation protection.

International Atomic Energy Agency

The IAEA is the international forum for radiological safety.
They produce guidelines and technical reports on radiological safety.

Federal guidance are provided by

arpansa

The Commonwealth Regulator

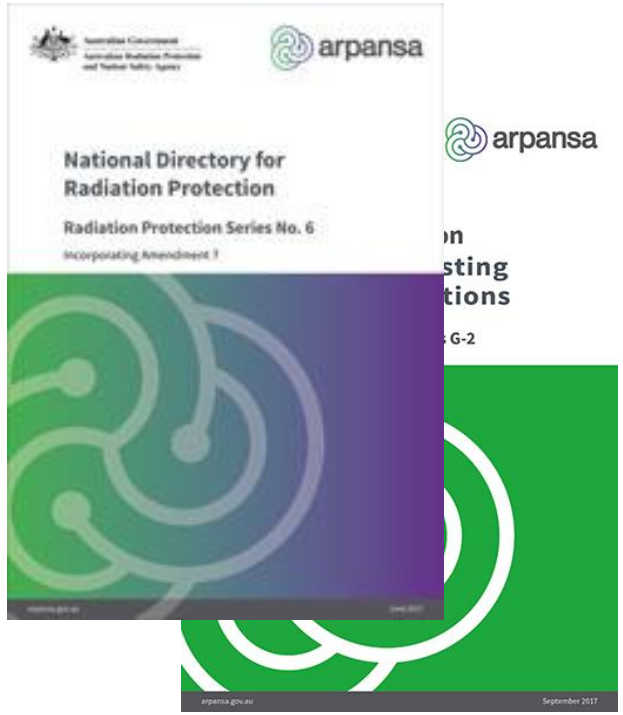
Provides national leadership and promotes a uniform regulatory framework.

Promote the use and implementation of international standards throughout Australia.

Works with state and territory regulators to promote national uniformity in radiation protection through the Radiation Health Committee (RHC)

Radiation Protection Series

Radiation Health Committee



State and Territory Regulators

WA

Government of Western Australia
Radiological Council

Government of Western Australia
Department of Mines, Industry Regulation and Safety

Victoria

VICTORIA
State Government

ACT

ACT Government
Health

South Australia

EPA

Tasmania

Tasmanian Government

Northern Territory

NORTHERN TERRITORY GOVERNMENT

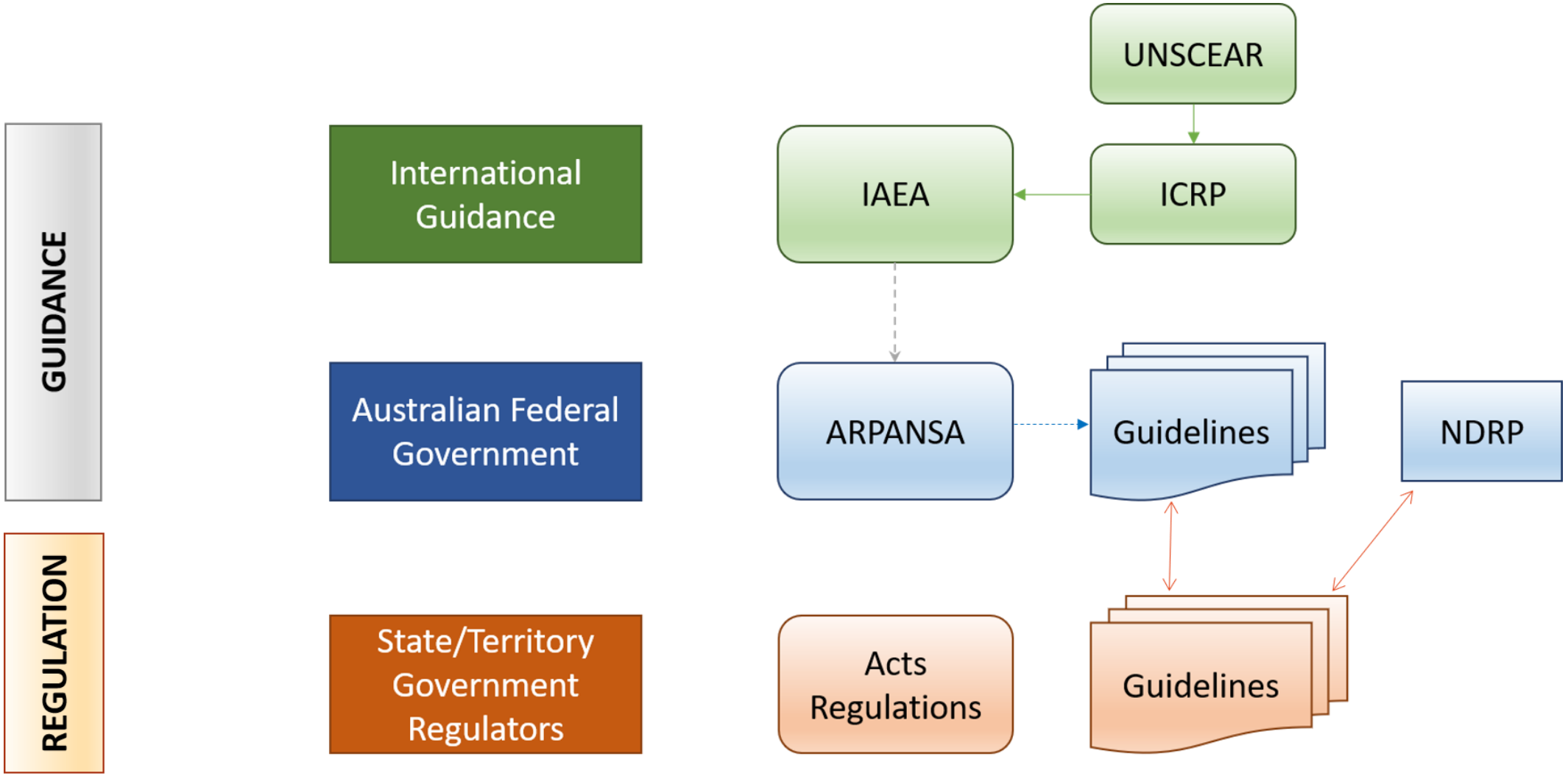
New South Wales

NSW EPA

Queensland

Queensland Government
Queensland Health

How it all goes together

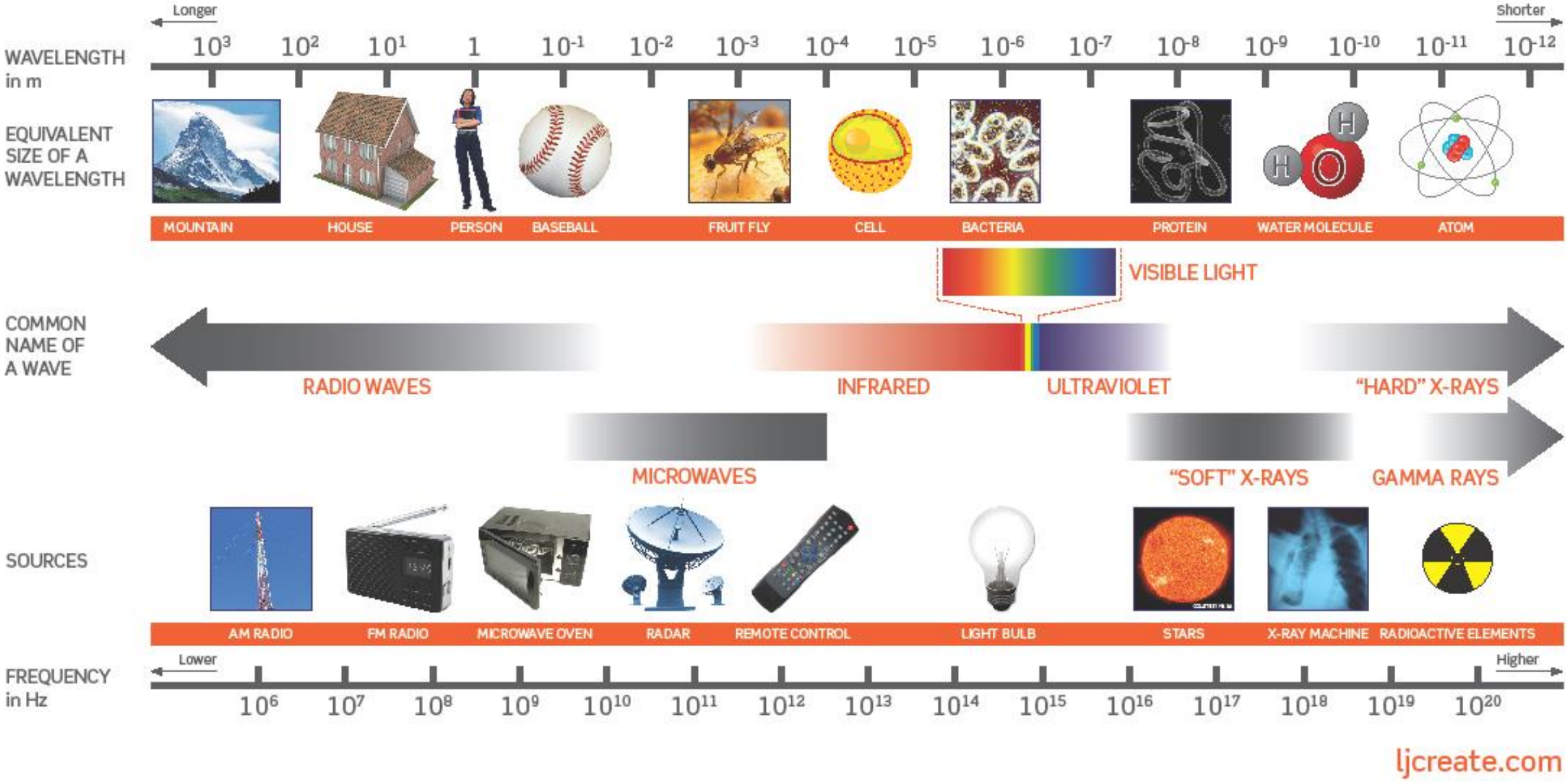


Radiation Dose Limits

	Occupational / Designated Radiation Workers #	Radiation Workers (NOT designated)	Non-radiation workers	Public
Definition	A radiation worker who has the potential to exceed 1 mSv/y. Personal radiation dose monitoring must be performed.	A person who may be exposed to radiation arising from their direct involvement with sources of radiation in the course of their work	Persons exposed to radiation in their workplace that do not have direct involvement with radiation sources during the course of their work	Persons exposed to radiation from a workplace in which they are not working.
Effective Dose Limits*	20 mSv/y 20,000 µSv/y	1 mSv/y	1 mSv/y	1 mSv/y 1,000 µSv/y
Single year max dose	50 mSv/y	5 mSv/y	5 mSv/y	5 mSv/y

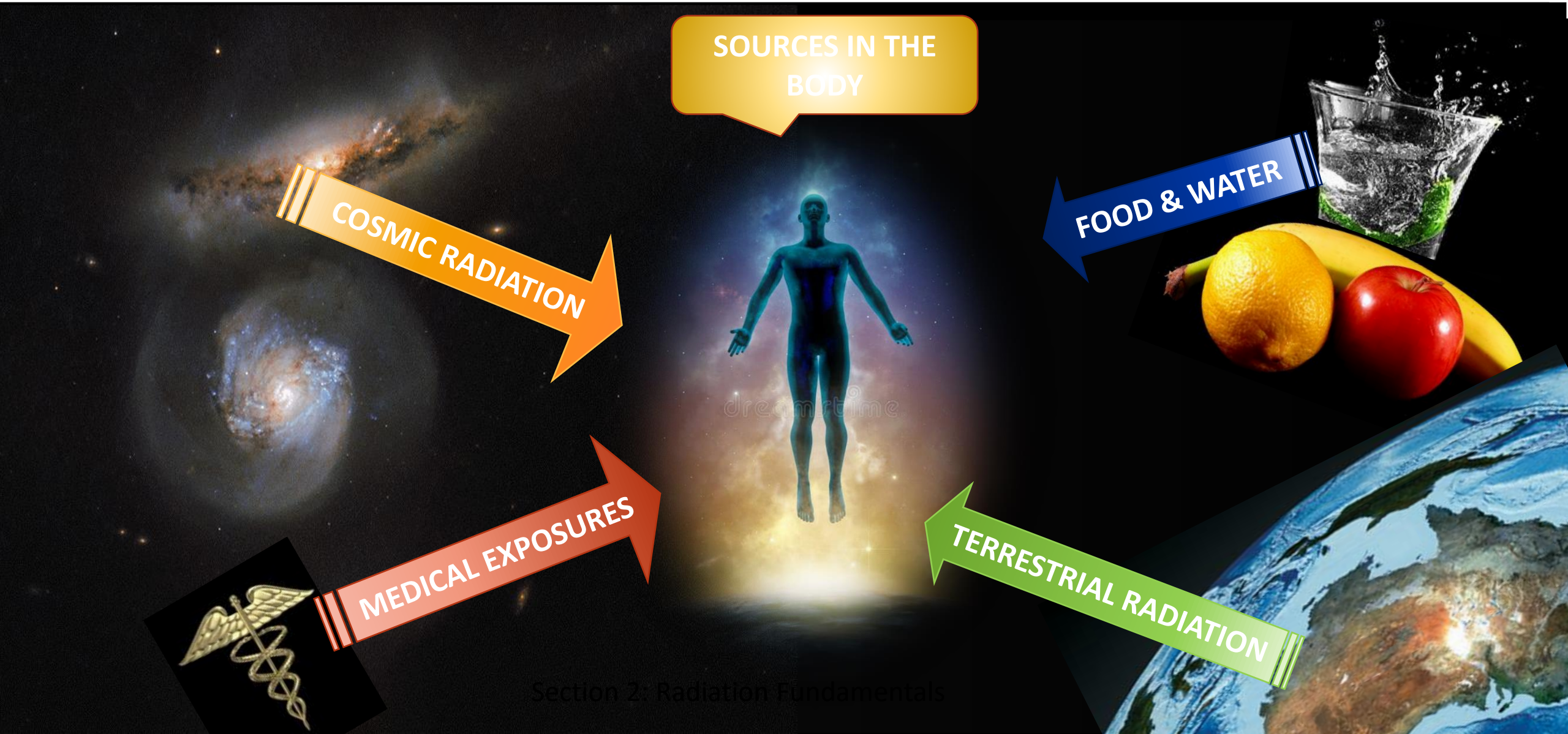
What is radiation and radioactivity?

What is Ionising Radiation?



ljcreate.com

Radiation - It is all around us…



Annual Radiation Dose in Australia

Background exposure
Medical treatments
- X-rays
- Radioisotopes

Radioactive fall out
- Nuclear weapons testing

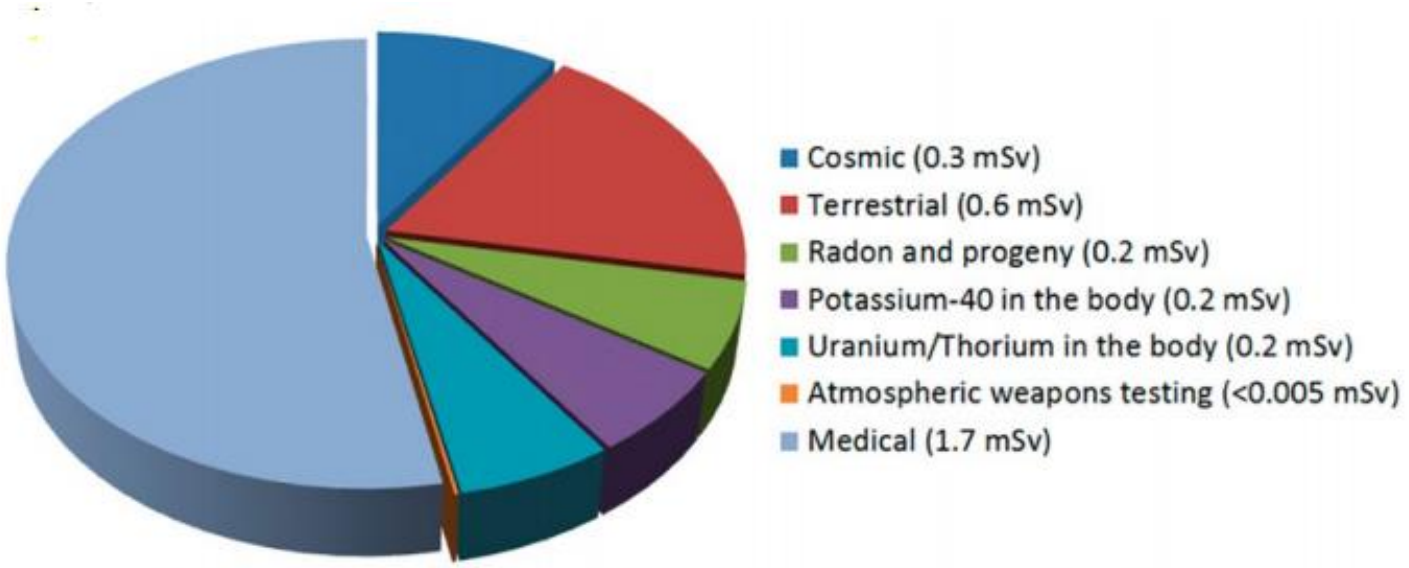


Figure 1: Average yearly radiation exposure in Australia

Australians are exposed to 1.5 mSv each year from natural sources* (Does not include Occupational exposures)

Annual Terrestrial Radiation Dose Worldwide

- Uranium, Thorium and daughters in earth
- Radon daughters may settle in your lungs

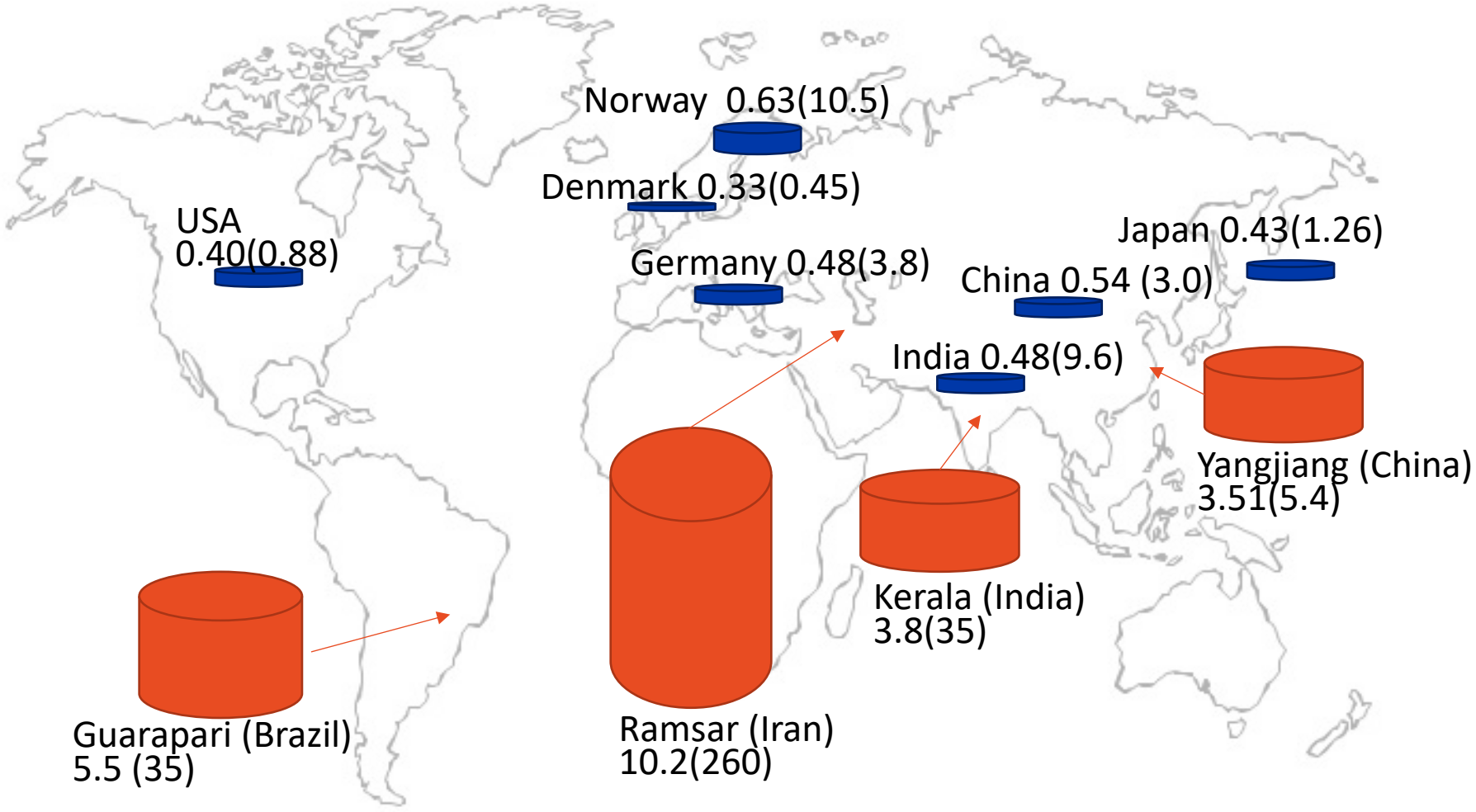
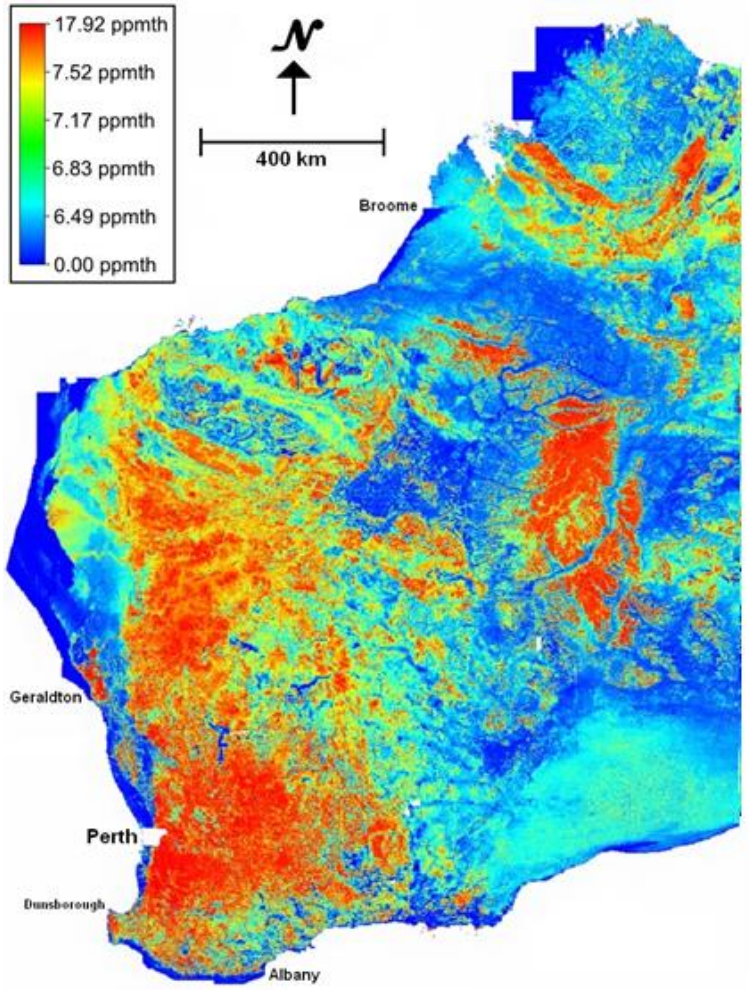


Figure adapted from Health Research Foundation, Kyoto, Japan

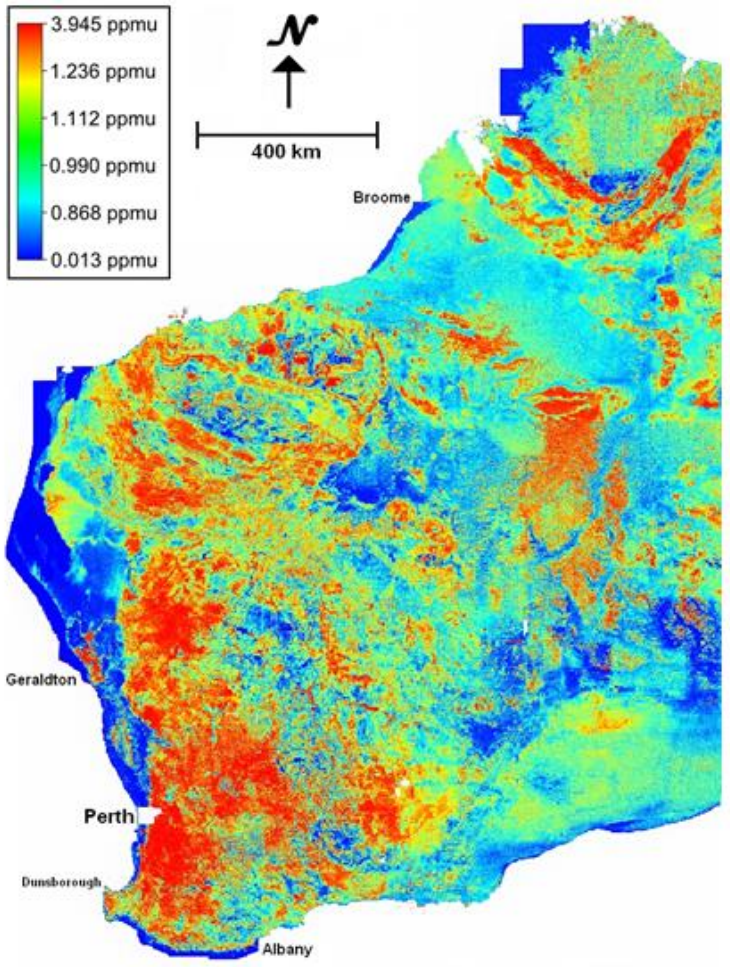
Annual Radiation Dose in WA

Varies

- Coastal plains
  - 1.2 mSv
  - 1,200 µSv
- Kalamunda
  - 3.5 mSv
  - 3,500 µSv
- Southwest
  - 5.0 mSv
  - 5,000 µSv



Thorium



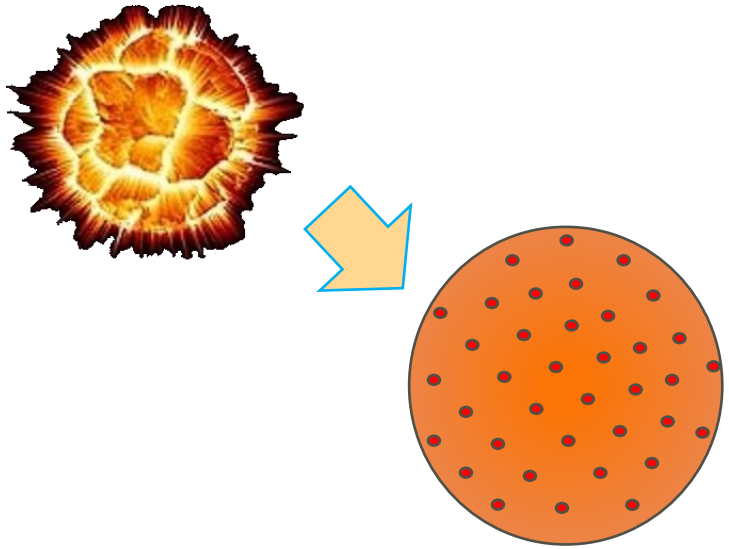
Uranium

https://www.intechopen.com/chapters/49620

NORM

What is NORM?

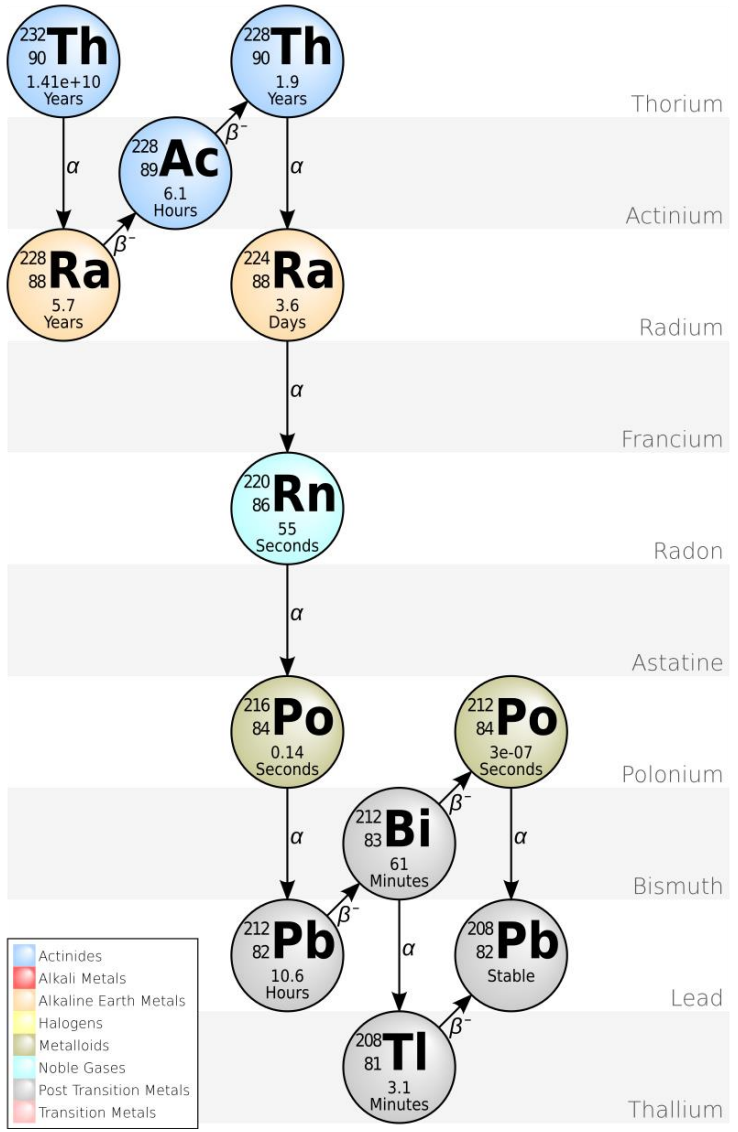
Naturally
Occurring
Radioactive
Material



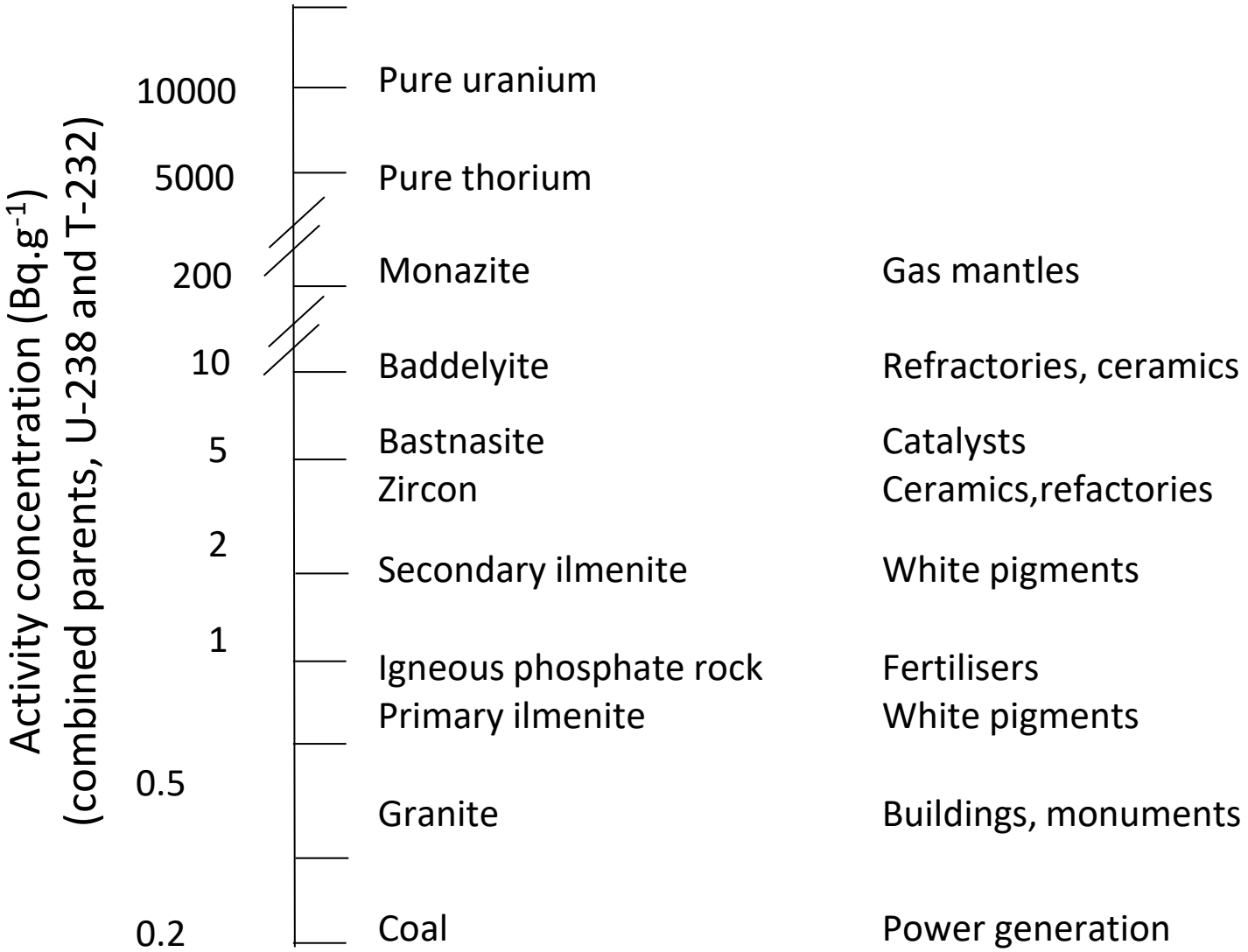
All minerals contain some natural radioactivity

Some have above average concentrations eg:

- Uranium ore
- Mineral sands – zircon, monazite, ilmenite
- NORM scale, sands, sludge in petroleum facilities

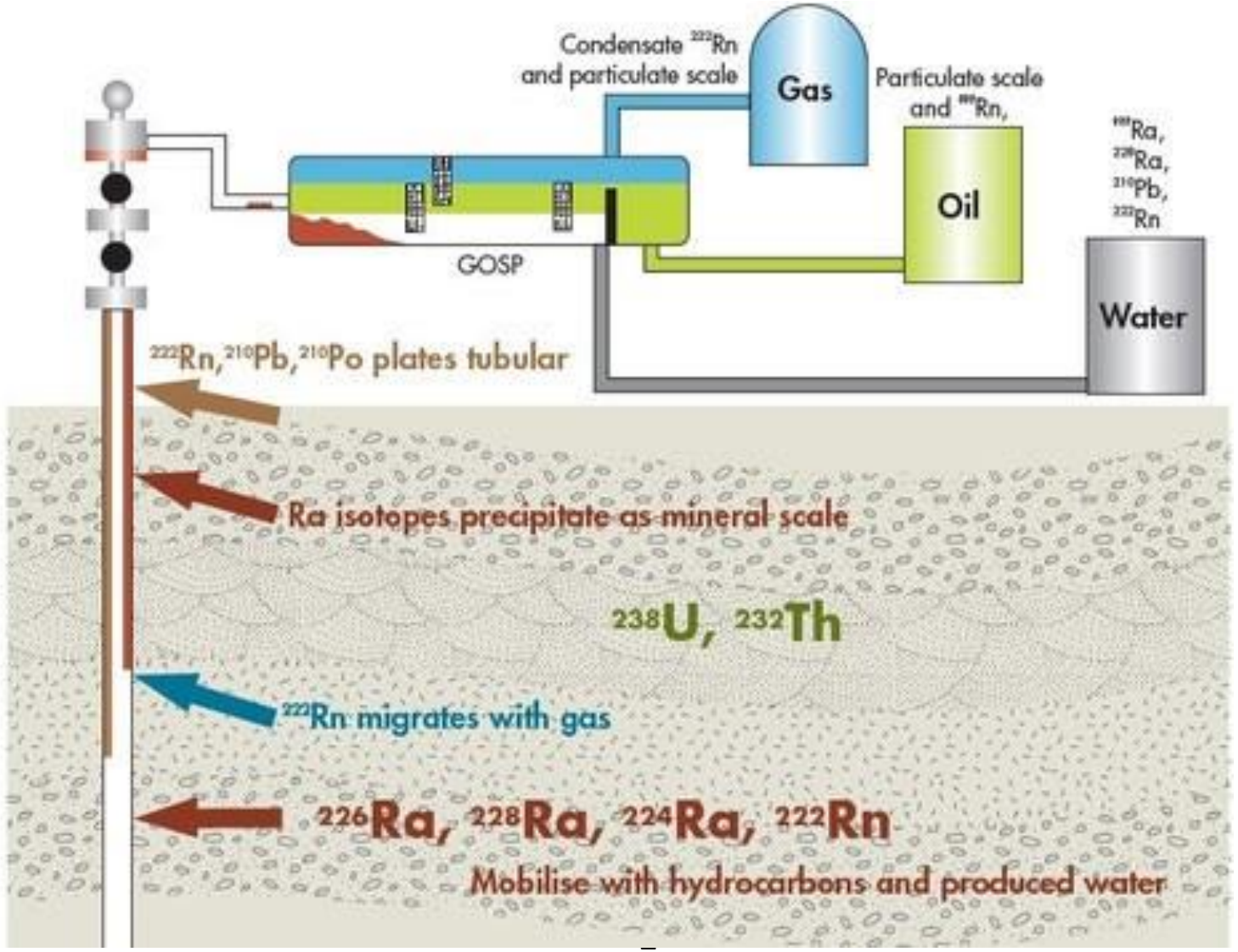


NORM in mining related industries



Where does it come from?

- NORM concentration in most natural substances is low
- Becomes concentrated due to extraction and processing of material from the earth



Monitoring

Monitoring equipment

NORM Monitor

PED or Badge worn by workers as required

Monitoring equipment

Survey instruments are used to measure immediate radiation levels

Gamma radiation monitoring

- PED monitors – this does not protect you from radiation
- Area monitors – establish background levels

Contamination monitoring

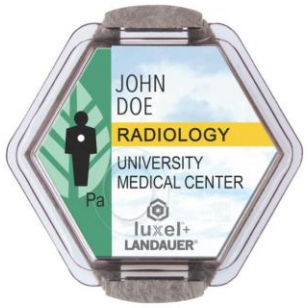
- GM pancake probe or similar
- Wipe tests

Personal Radiation Monitors

Passive badges

TLD (thermo-luminescent dosimeter)

OSL (optically stimulated by laser)



Luxel

Direct readout monitoring

Integrating personal electronic dosimeter (PED)

Other Monitoring Equipment

Baseline Measurements

Dust Sampling

- Personal Dust sampling pump

Radon monitoring

- Dust Pumps (different methods)
- RAD7 Monitor
- Electret (E-Perm) Ion Chamber

Principals of protection

Fundamental Principal

As

Low

As

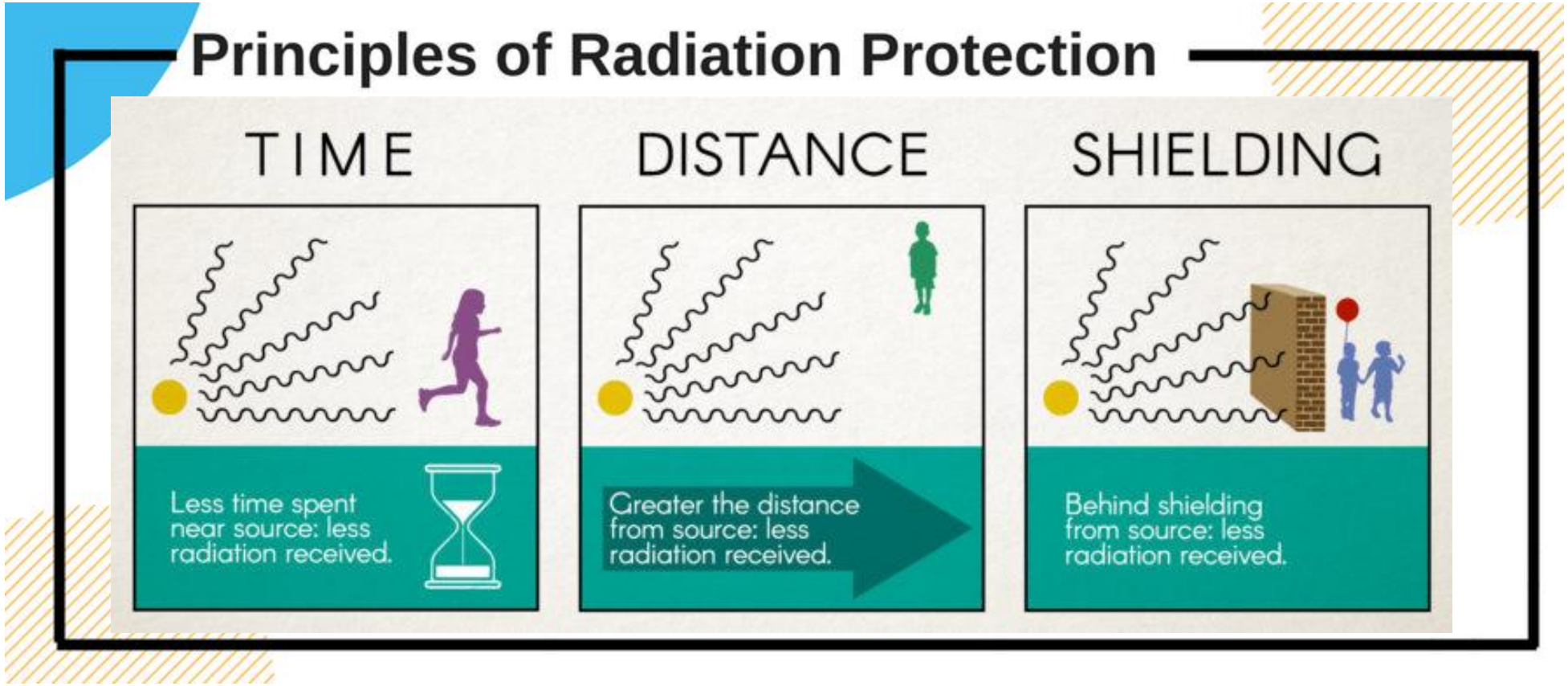
Reasonably

Achievable

A L A R A

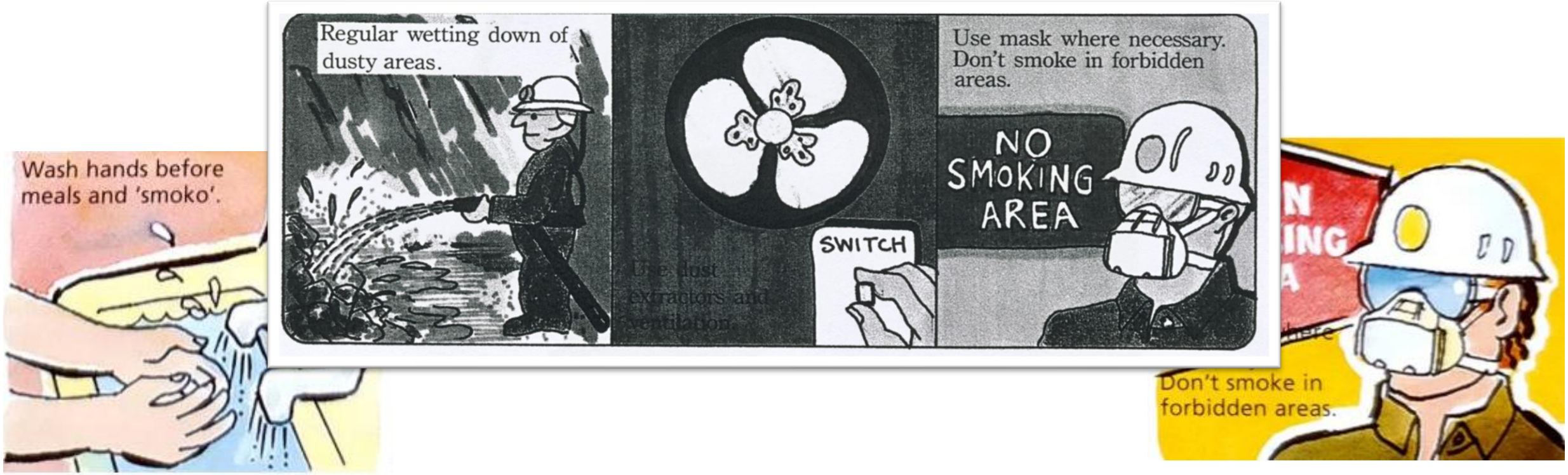
‘Reasonably’ means with economic and social factors considered

Controlling External Hazards



Controlling Internal Hazards

Inhalation exposure is reduced by minimising dust and practicing good ventilation to avoid accumulation of radon gas



Courtesy of Radiation Workers Handbook

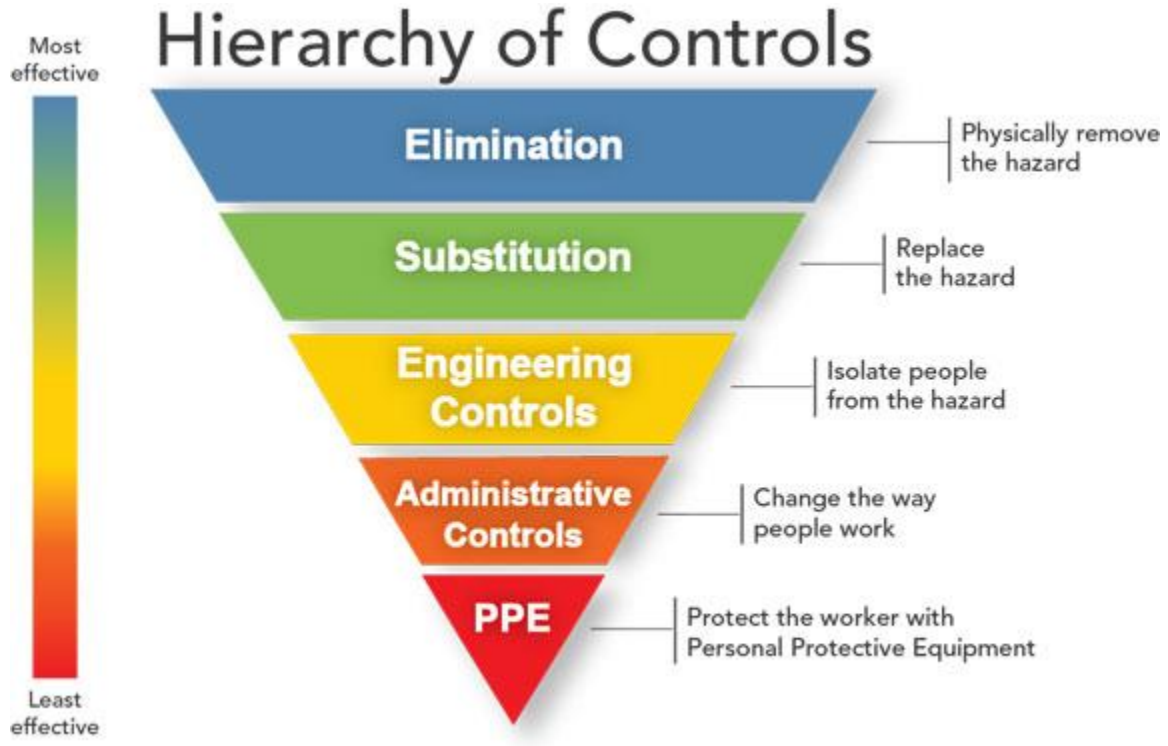
Controls

The Hierarchy of Control

The purpose of control is to minimise exposure to workplace hazards

Top 4 – minimise likelihood

PPE – minimise the effect



Source: US CDC

Controls on the site

- Separation – remote location
- RMP sets out the requirements
  - Engineered, lined Cells to contain – leachate recovery
  - Closed system transfer
  - Maintain wet residue – dust suppression
  - Restricted access to site
  - Signage
- Monitoring confirms efficacy of controls

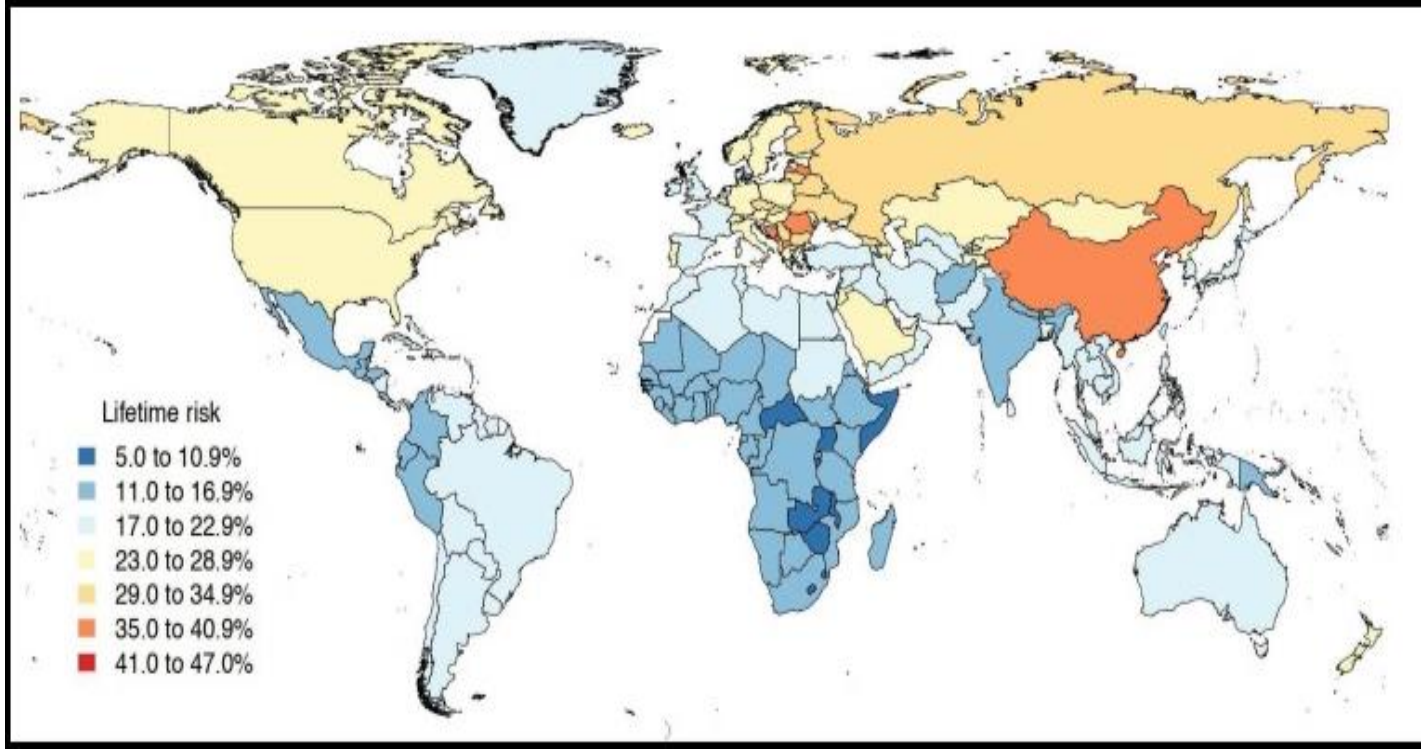
Monitoring on the site

- Gamma – OSL, surveys of site boundary and cell walls
  - Site BG 0.18 µSv/h (0.09 – 0.20)
  - Cell boundary 0.16-0.19 µSv/h
- Dust – positional and deposition
  - Gravitational slightly elevated
  - Radioactivity results <mdl
  - Why is that?
  - Disposal of wet slurry, maintained wet
  - Even when clay appears dry, can maintain 40-60% water
- Radon/Thoron – passive monitors
  - levels are typical for area
- Radionuclides in slurry, residue, leachate
- Radionuclides in water
- Total levels
  - Not measurable above normal BG outside site
  - <0.6mSv for workers (based on conservative dust and Rn/Thn)

Putting the risk in perspective

Relative risk

- Western Australia
  - Lifetime cancer risk due to being alive
    - 41.6%, or roughly 1 in 2
  - Road fatalities in WA
    - 1 in 16,500



- No measurable detriment below 100mSv (or 100,000 uSv)
  - If all workers at 0.6 mSv = 600 uSv
  - 1 in 33,000 excess cancer
- As public dose is negligible risk is also negligible

Relative Risk - NORM

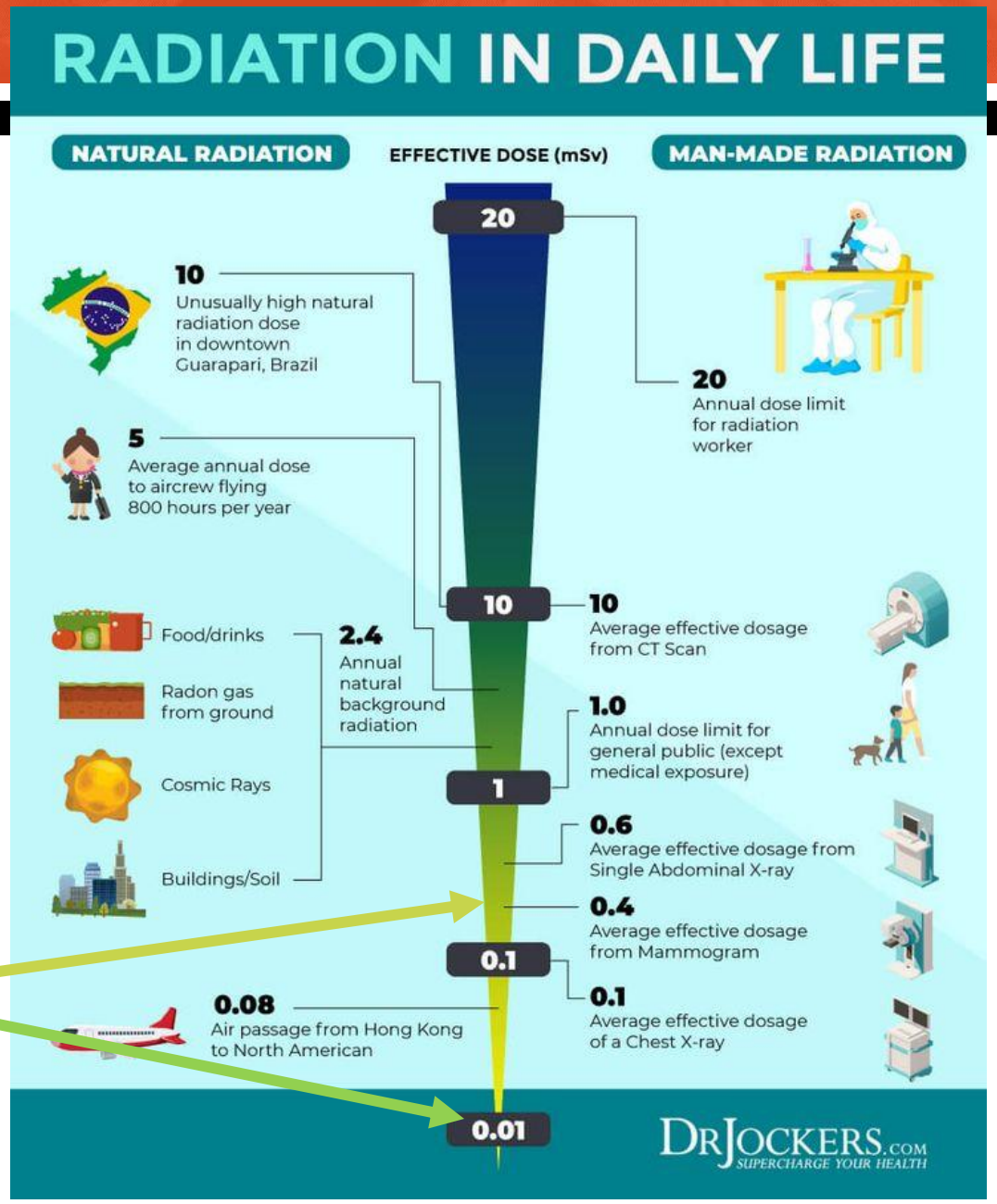
Natural Sources

- Natural background radiation comes from three main sources: cosmic, terrestrial and radiation inside the body.

Artificial Sources

- NDT & borehole logging Sources
- Density, MPFM gauges
- Baggage X-Rays
- Radiotherapy treatments

Where we are working at



Relative Risk - NORM

1,000,000 µSv	**Single Dose -** that will cause acute radiation sickness
100,000 µSv	**Single Dose -** that will increase risk of cancer
20,000 µSv	**Annual Occupational Dose – Radiation Worker** average over 5 year
5,000 µSv	**Single Dose** from a CT scan to the chest
2,000 µSv	**Airline Pilots** Cosmic Radiation of domectic pilots **average per year**
1,500 - 2000 µSv	**Average Annual Dose** from all sources (background, occupational, medical, ect)
1,000 µSv	**Non-Radiation Worker** average annual over 5 years
1,000 µSv	**Australian Uranium Mining Workers 1 year**
110 µSv	**Air Travel** 1 return flight from Melbourne to London
15 - 30 µSv	**Single Dose** from a chest x-ray
8 -10 µSv	**Dental Xray**
0.11 -0.20 µSv	Average background Perth Metropolitan area **– 1hr**

SMOKERS!! ~500 µSv

Where we are working at

Source:www.arpansa.gov.au/understanding-radiationdiation-sources/more-radiation-sources**/ionising-radiation-and-health**

Questions?

Thanks for your time