



A FUNDAMENTAL BREAKTHROUGH IN DETECTING ATMOSPHERIC RADICALS

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RADICAL



The RADICAL project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 899282.

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2020 - 2024

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16.06.2021

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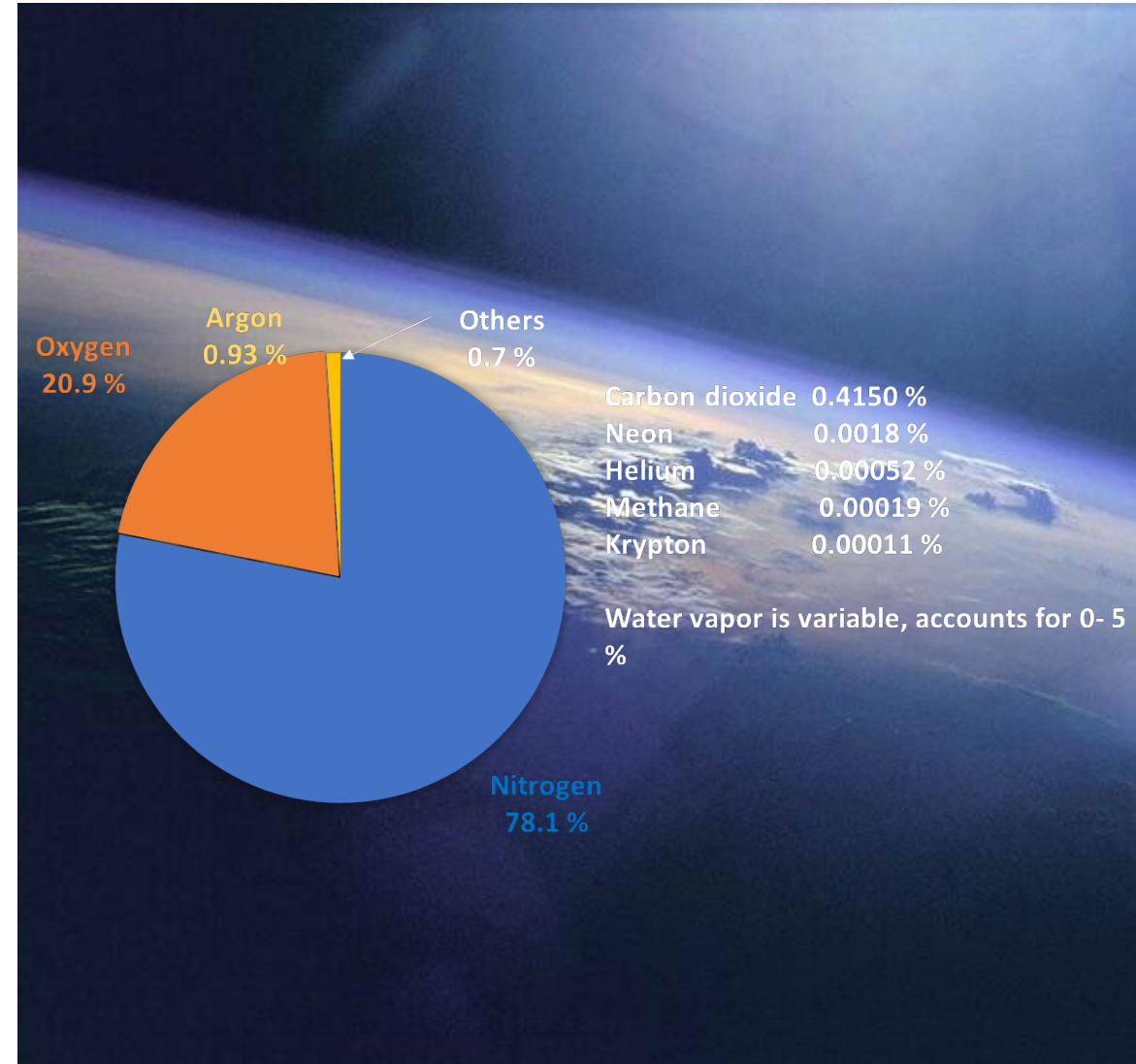
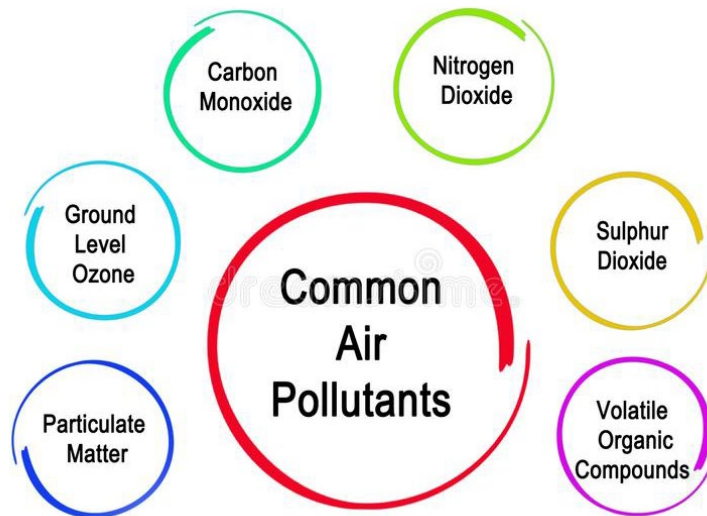


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The Earth's atmosphere

- A thin layer of air on Earth's surface
- Troposphere: ~0-10 Km, contains 90% of atmospheric mass
- **Air composition**
 N_2 , O_2 , Ar, trace gases (*mainly drives the chemistry in air*)



Impacts of Air Pollution

“Air pollution is the single greatest environmental health risk”

- World Health Organization

Environment:

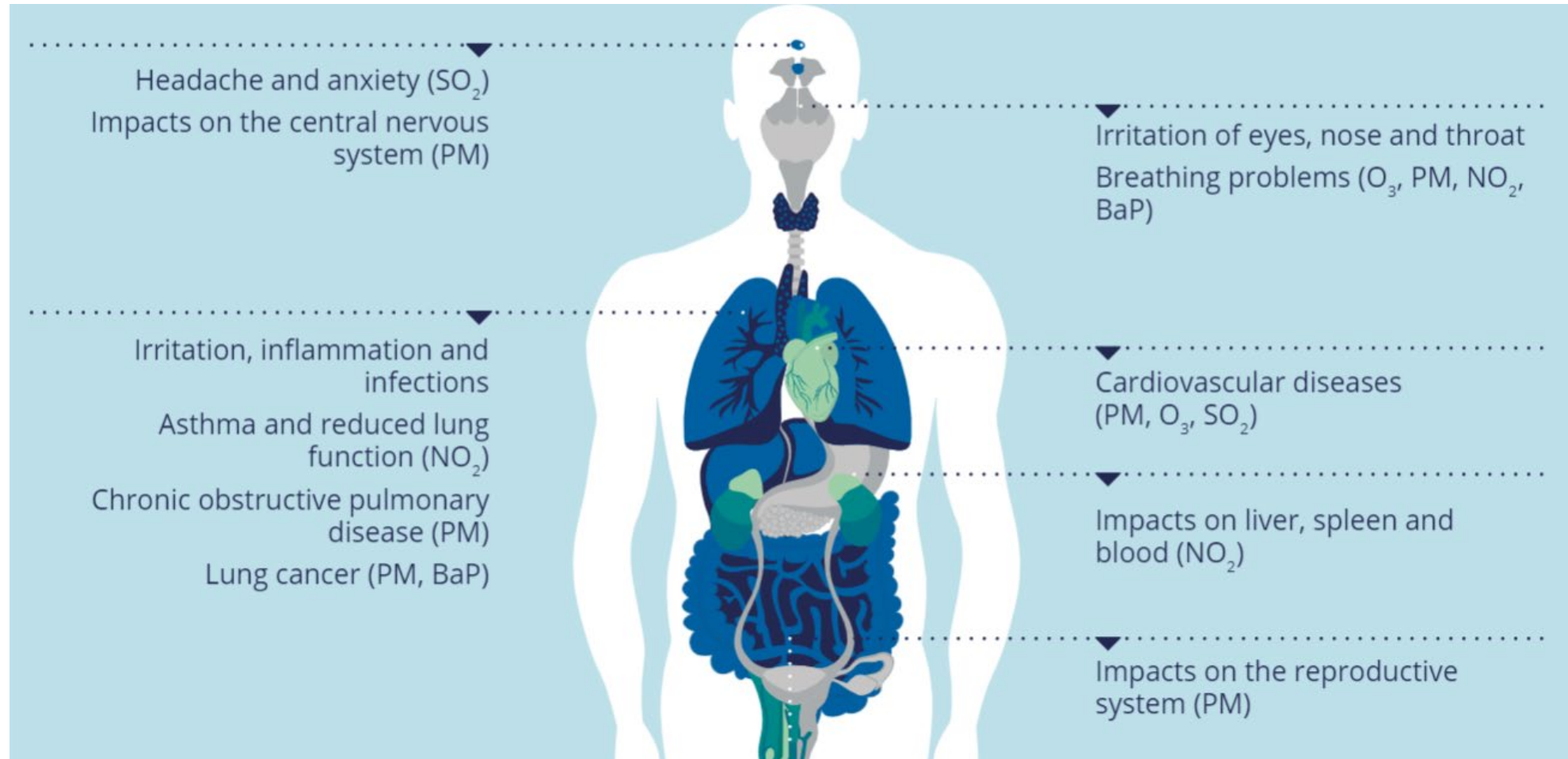
- Crop loss
- Acidification: Soil, Oceans
- Eutrophication

Health:

- ~7 M premature deaths across globe
- Respiratory and cardiovascular issues
- Reduce in birthweight



Health Impacts of Air Pollution



Source: EEA, "Healthy environment, healthy lives," 2019

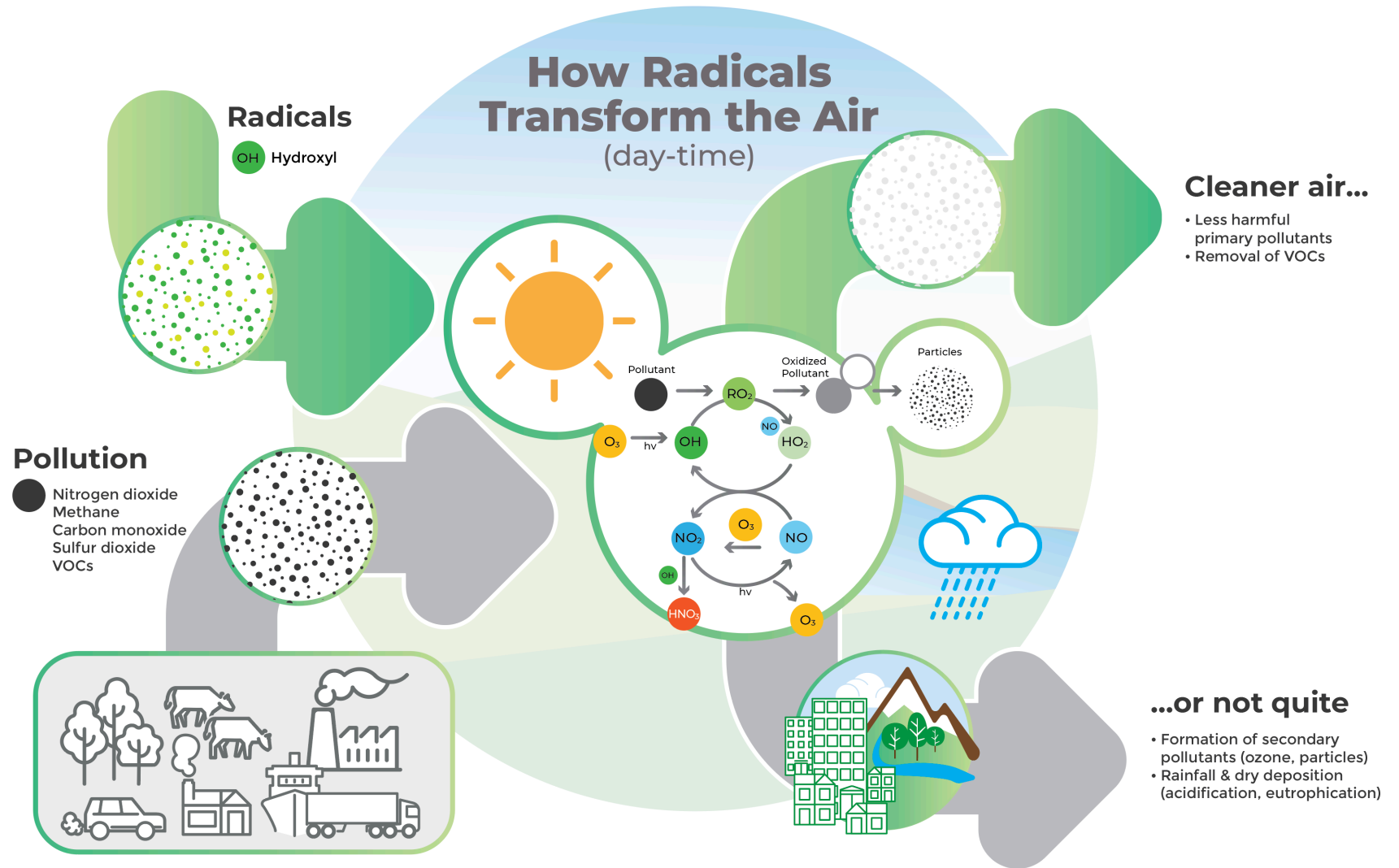
Air Pollution in Ireland

- About **1300 Premature deaths** each year
- Major pollution sources in Ireland: **Transport** (NO₂) and **domestic solid fuel burning** (PM)
- Not too bad in summer, but for winters; peat, coal or wood burning leads to **Winter Smog**.

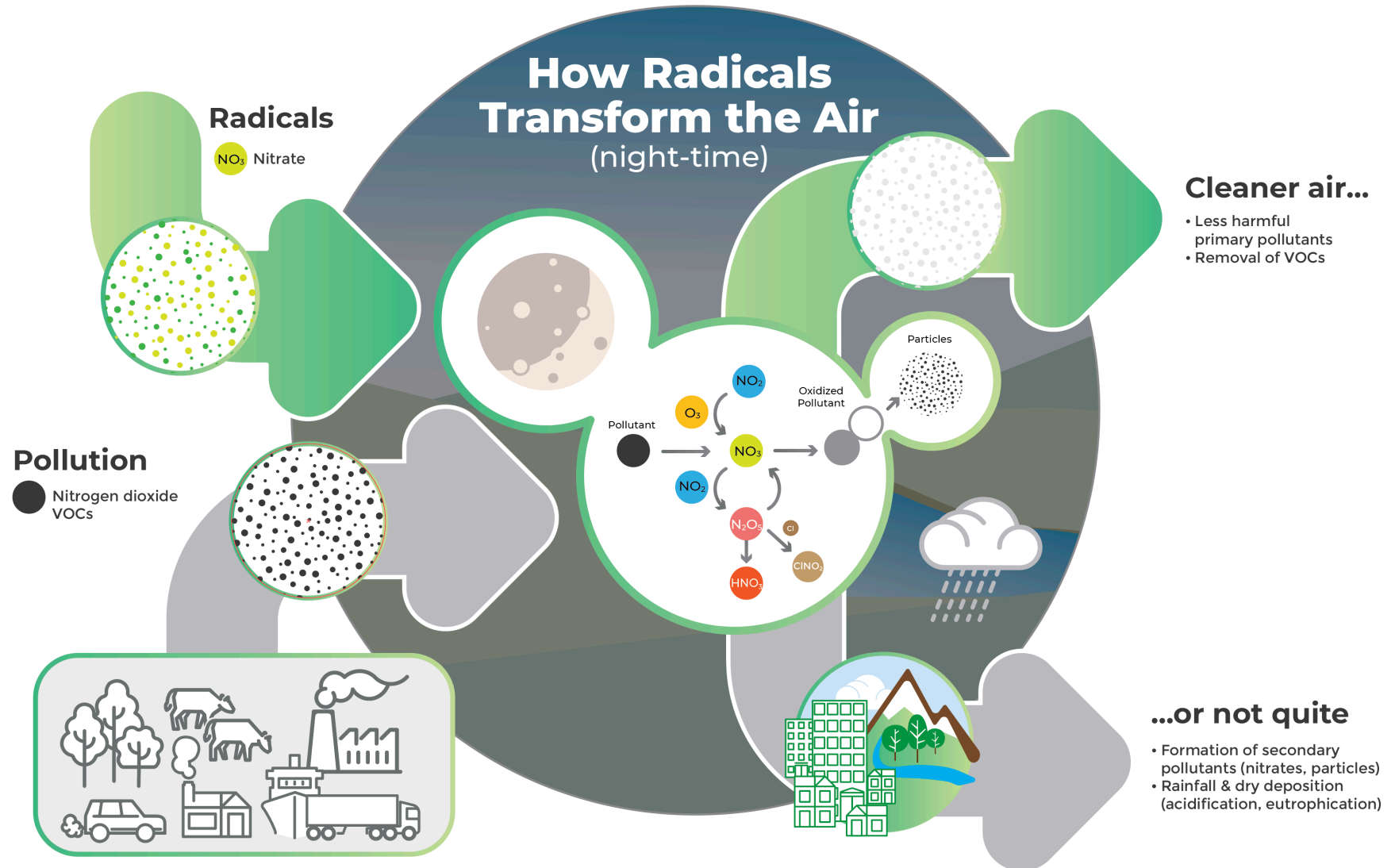
IRELAND'S ENVIRONMENT



Why are radicals important for the atmosphere?



Why are radicals important for the atmosphere?



Challenges of detecting radicals

Challenges

- Low mixing ratios (pptv)
- Short lifetime (1s for OH)
- Surface losses during sampling

NOW

- Detecting radicals is complex, cumbersome and expensive
- Only a few labs worldwide can detect radicals

FUTURE

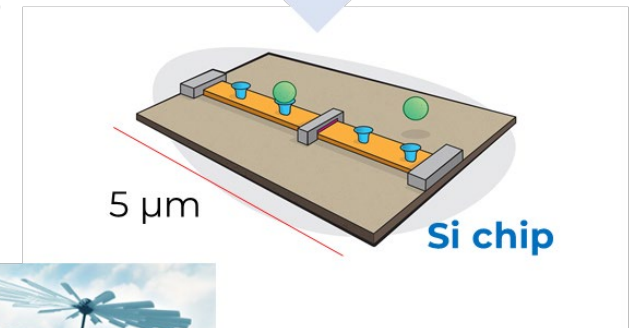
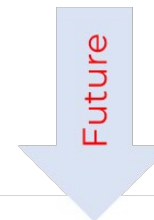
Breakthrough way of radical detection:

- Smart electronic sensors
- Easy to use and cheap to produce
- potential for global deployment

Current Spectroscopy



1.5 m



Wide-spread network

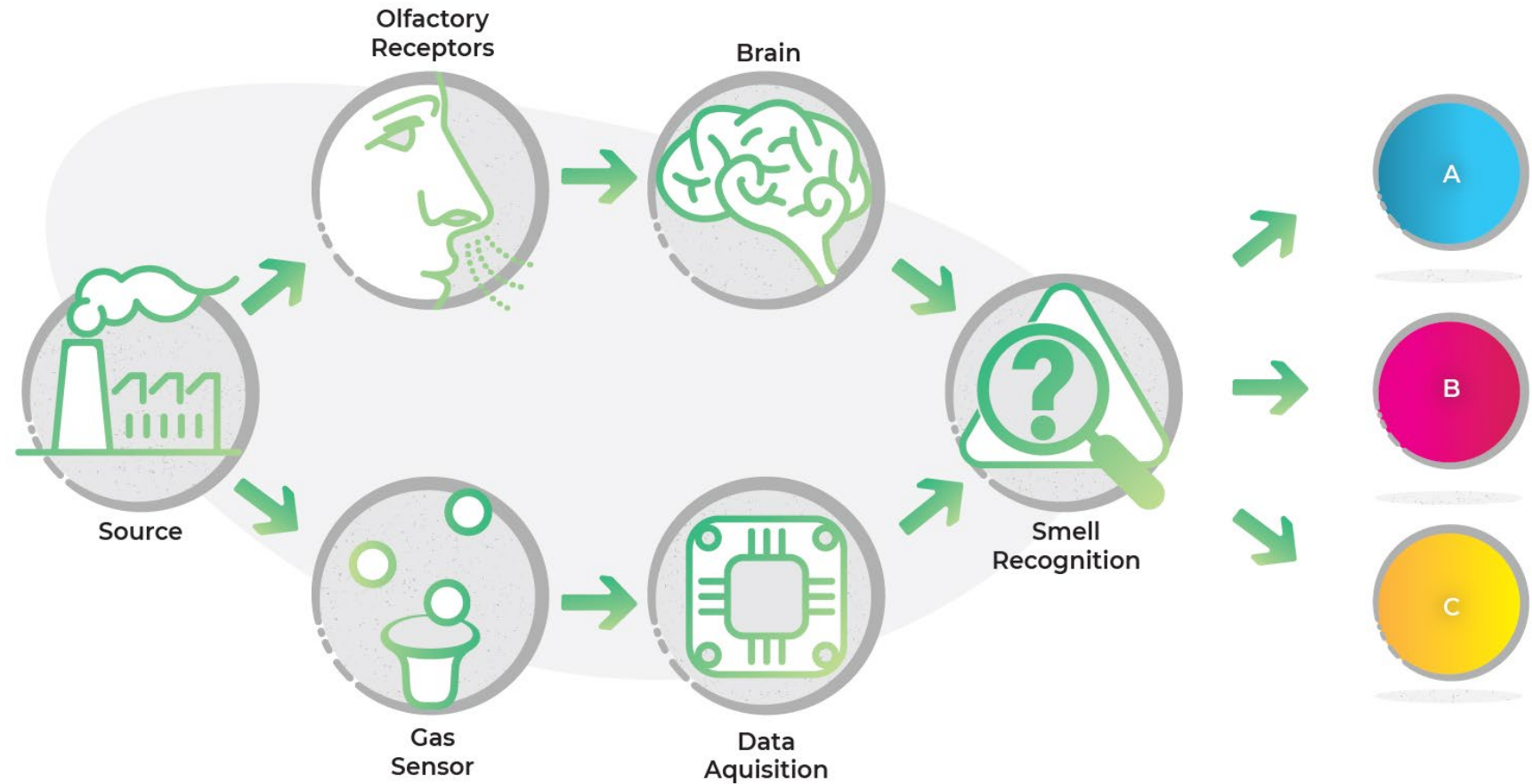
Building an electronic nose

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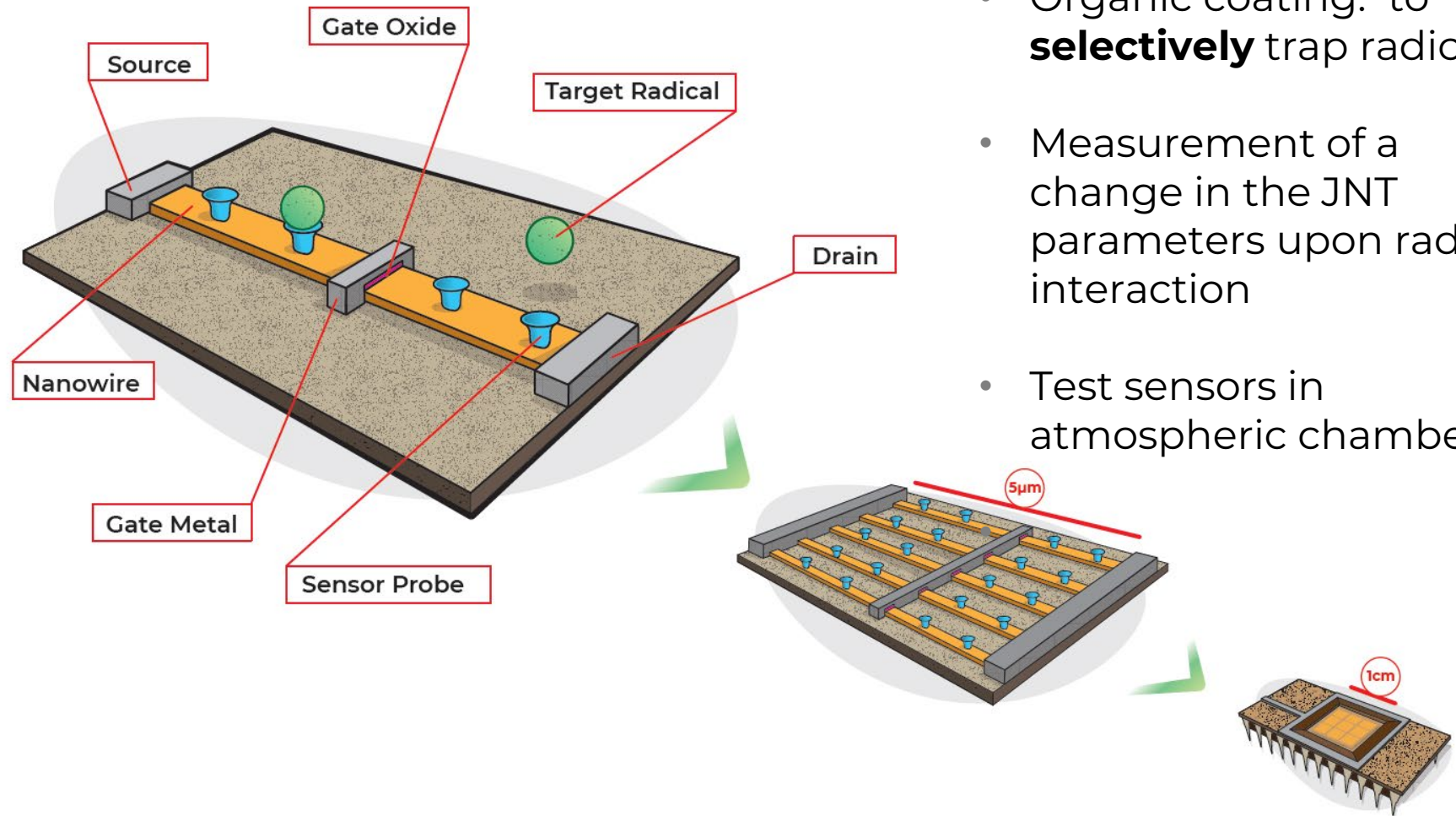
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Future radical sensor

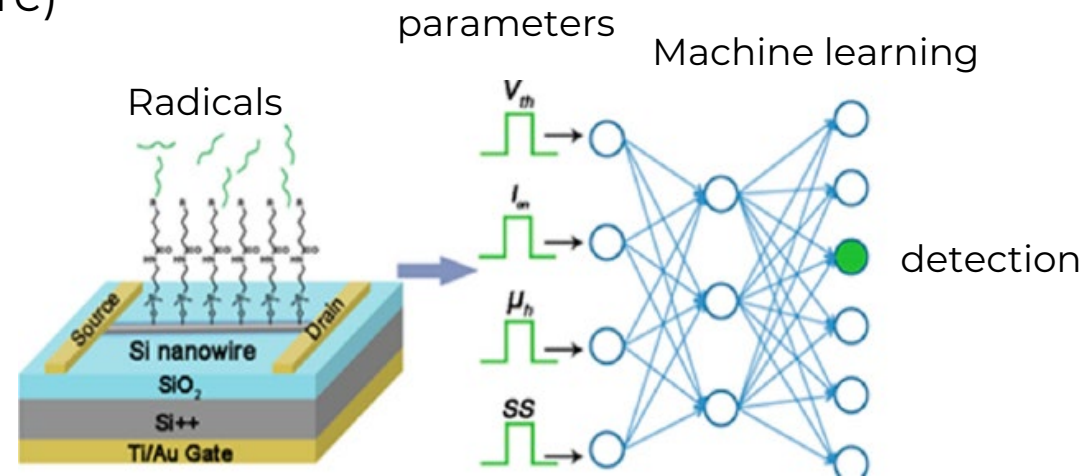
How we will achieve this:



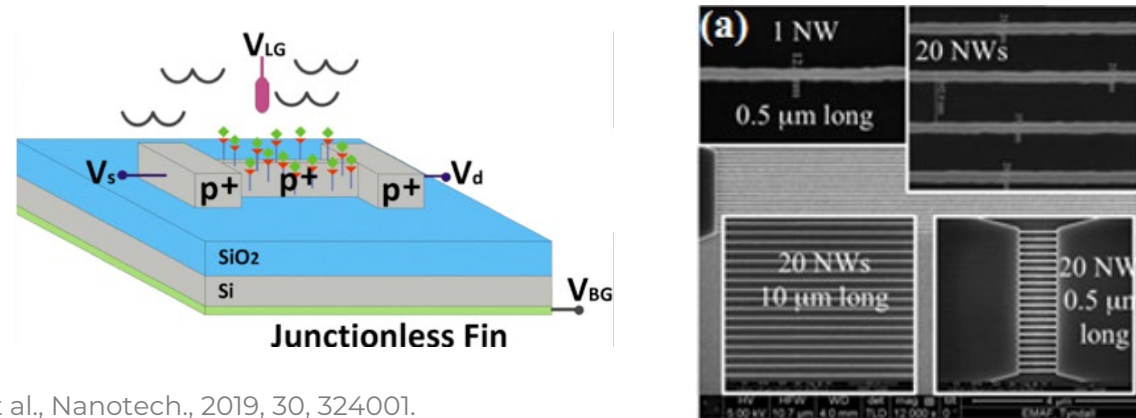
- Si Nanowire junctionless transistor (JNT) as sensor platform
- Organic coating: to **selectively** trap radicals
- Measurement of a change in the JNT parameters upon radical interaction
- Test sensors in atmospheric chambers

Sensing with Si Nanowire JNTs

Our goal: Si nanowire JNT sensors to detect **radicals** in **gas phase** (the atmosphere)



Prior Knowledge: Si nanowire JNT sensors to detect protein streptavidin in **liquids**.



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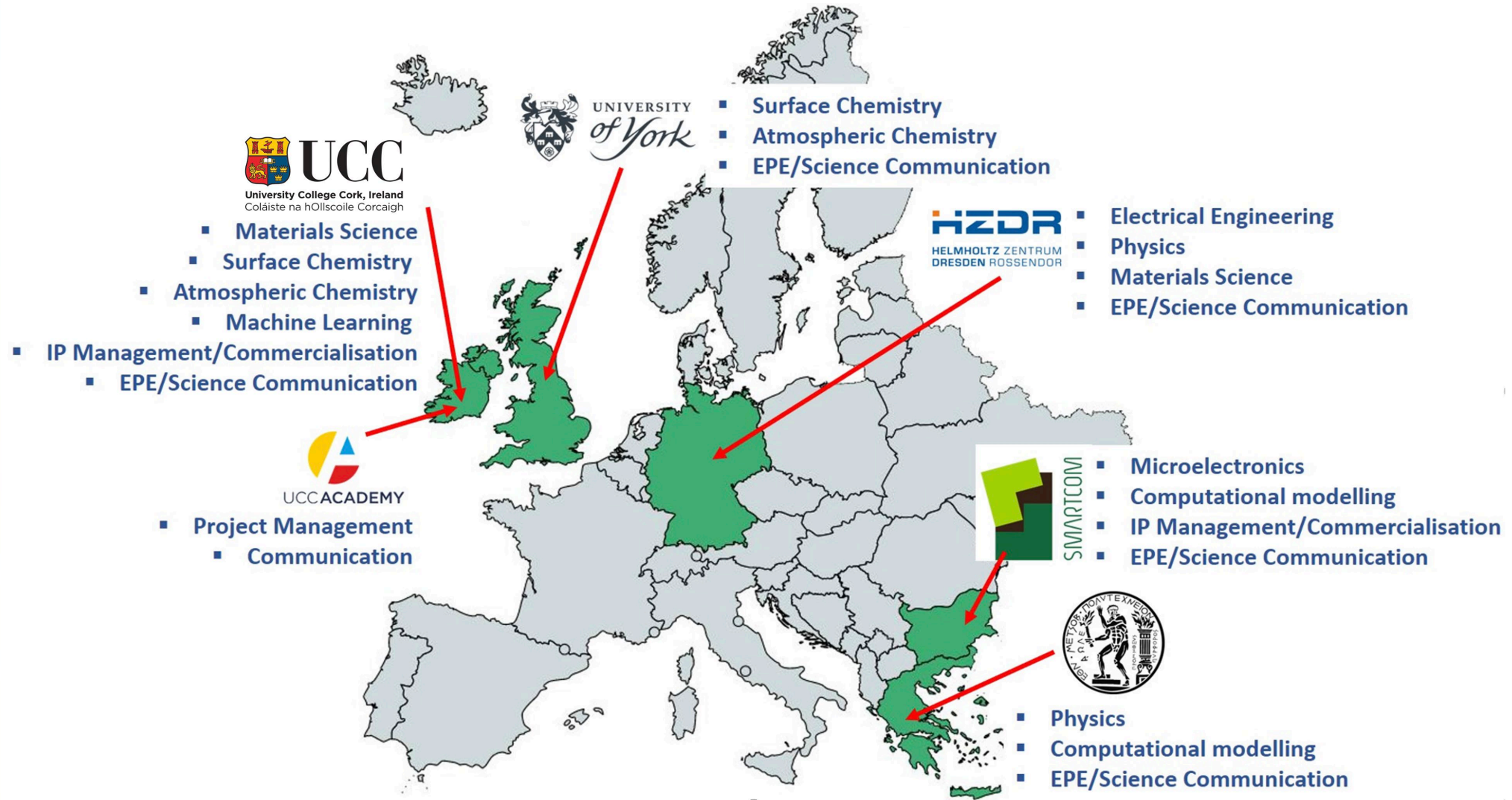
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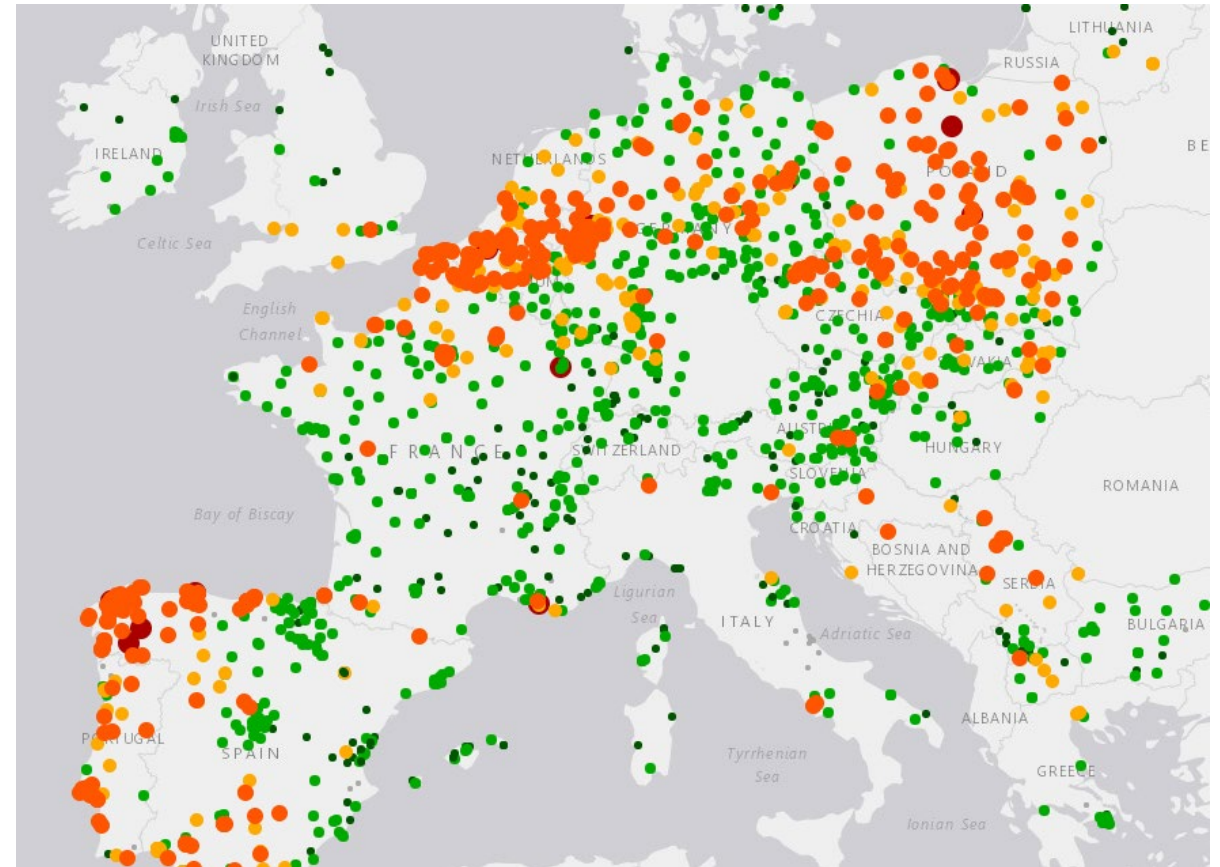
The RADICAL team



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- **Breakthrough** in atmospheric monitoring
- **Transform the way we measure air quality;** Sensors to be used globally
- **Improved human health and beneficial for citizens**
- Spin-off applications for low-cost gas sensors



Air quality map from the European Environment Agency

- Extended into other areas:
- *Other environmental pollutants – ammonia, NO₂, SO₂*
- *e-health applications - monitoring radicals in the human body*
- *Food security & surveillance*

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*In the search of such world, where we can
make our planet more breathable, pollution-
free and a healthier place to live!!*



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RAD:CAL



Coláiste na hOllscoile Corcaigh

