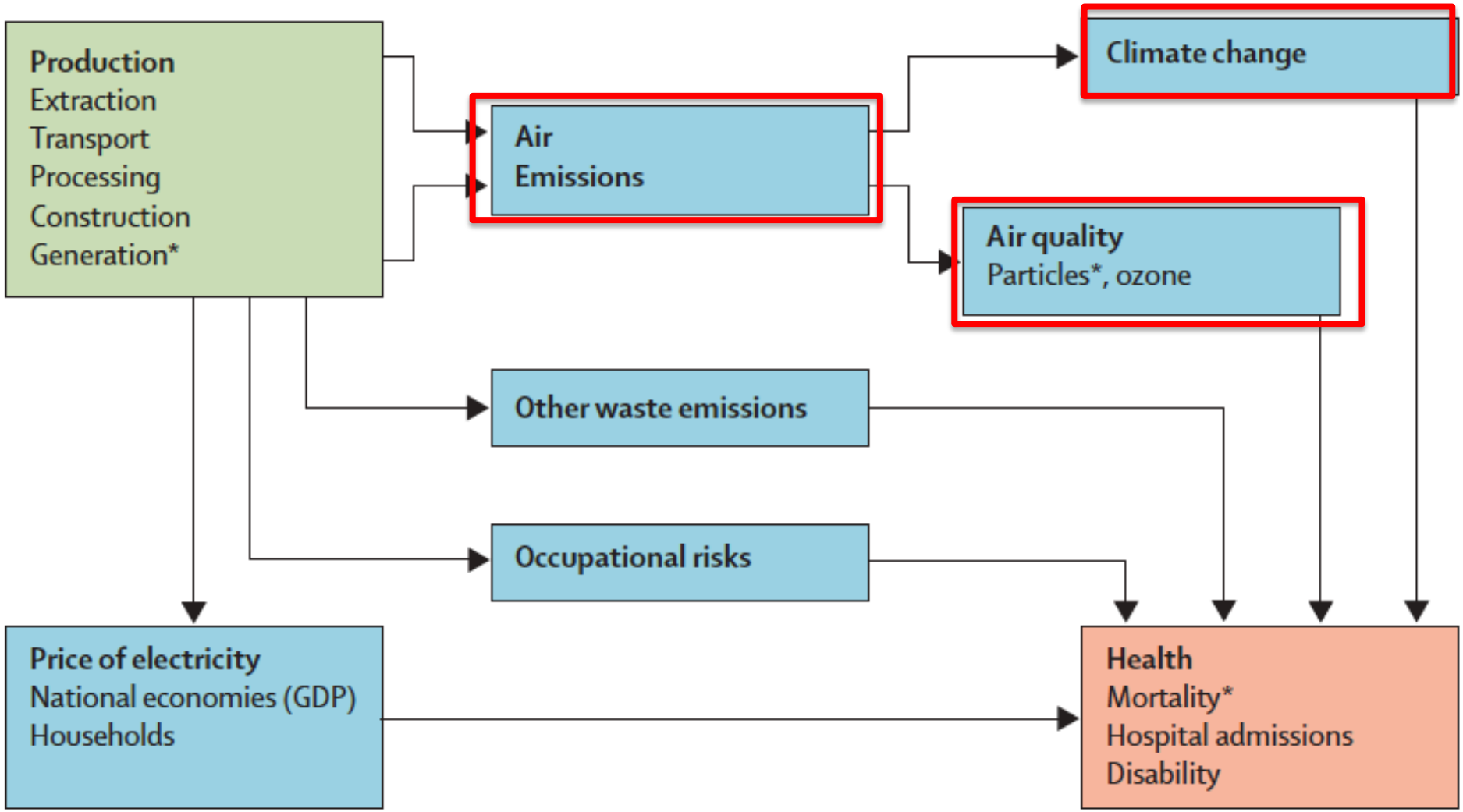
# The Role of Nuclear Energy to Address 3 E challenges and Public Health Concerns

Gerry Thomas, Imperial College London
gerry.thomas@imperial.ac.uk

# Health Effects and the 3 Es

- Environmental Protection
  - Direct effects on health from pollution and climate change
- Economics
  - Effects on household income – effects on health of poverty
- Energy Security
  - Potential effects on healthcare

# The Energy Pathway and Effects on Health




Markandya et al., The Lancet Vol 374 December 12, 2009

# Health effects of air pollution

- Coal fired power stations are a major source of PM
- Inhalation of PM causes respiratory and circulatory disease

Oil and Gas power stations produce lower levels of $PM_{2.5}$ compared with coal

Nuclear power plants produce negligible amounts of $PM_{2.5}$ and lower amounts of $SO_2$ and $NO_2$

# Health effects of energy production

Deaths and illness expressed as per TW (W x $10^{12}$)/hr for different sources of energy

| | Deaths from accidents | | Air pollution-related effects | | |
|---|---|---|---|---|---|
| | Among the public | Occupational | Deaths* | Serious illness† | Minor illness‡ |
| Lignite[30] | 0·02 (0·005–0·08) | 0·10 (0·025–0·4) | 32·6 (8·2–130) | 298 (74·6–1193) | 17 676 (4419–70 704) |
| Coal[31] | 0·02 (0·005–0·08) | 0·10 (0·025–0·4) | 24·5 (6·1–98·0) | 225 (56·2–899) | 13 288 (3322–53 150) |
| Gas[31] | 0·02 (0·005–0·08) | 0·001 (0·0003–0·004) | 2·8 (0·70–11·2) | 30 (7·48–120) | 703 (176–2813) |
| Oil[31] | 0·03 (0·008–0·12) | .. | 18·4 (4·6–73·6) | 161 (40·4–645·6) | 9551 (2388–38 204) |
| Biomass[31] | .. | .. | 4·63 (1·16–18·5) | 43 (10·8–172·6) | 2276 (569–9104) |
| Nuclear[31,32] | 0·003 | 0·019 | 0·052 | 0·22 | .. |

Markandya and Wilkinson, Lancet (2007) 370: 979-90

# Attributable deaths

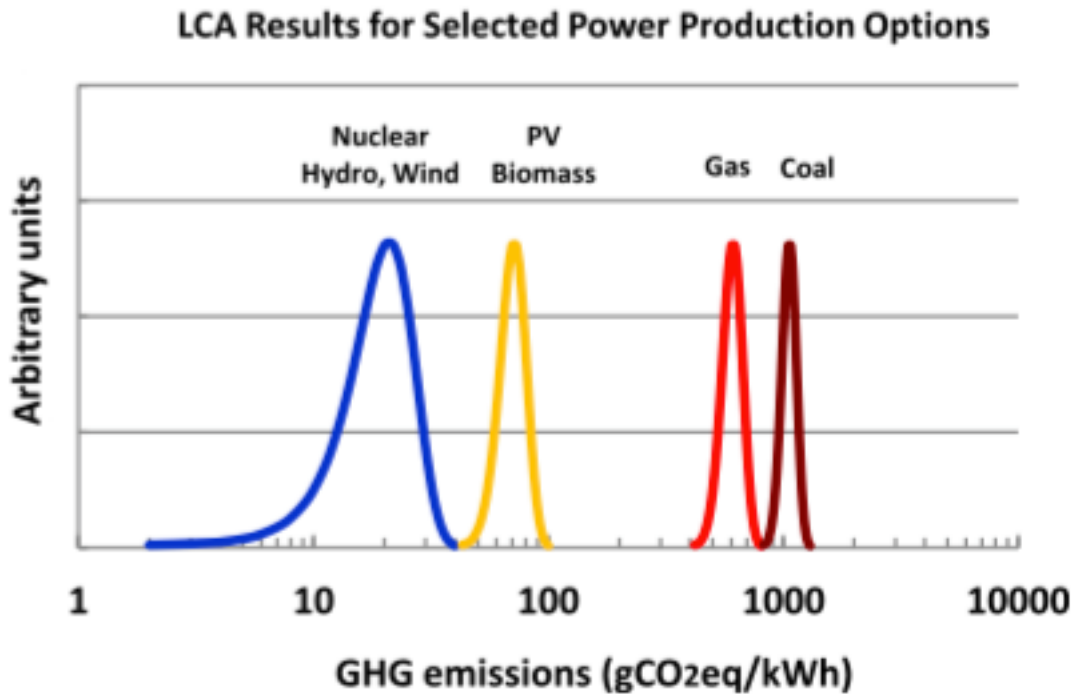
Worldwide deaths (per year)

| | |
|---|---|
| Residential Radon | 99,000 |
| Air pollution, ambient particulate PM2.5 | 3,200,000 |
| Tobacco smoking | 6,300,000 |

Nuclear accidents* approx 200-12500

* Total deaths, not per year as a direct result of radiation: Chernobyl 28 from ARS, 160 deaths from thyroid cancer, 12,500 from other cancers (?)

# Life Cycles and Greenhouse Gas Emissions




Van der Zwaan Energy Strategy Reviews 1 (2013) 296e301

# Climate Change and Health

- Effects of climate change expected to cause approx 250,000 additional deaths per year between 2030-2050 (malnutrition, malaria, diarrhoea and heat stress)
- The direct damage costs to health (i.e. excluding costs in health-determining sectors such as agriculture and water and sanitation), is estimated to be between US$ 2-4 billion/year by 2030.
- Areas with weak health infrastructure will be most affected – e.g. Africa and South East Asia
- Reducing emissions of greenhouse gases through better transport, food **and energy-use choices** can result in improved health, particularly through reduced air pollution

http://www.who.int/mediacentre/factsheets/fs266/en/

# Nuclear Power and Health Concerns

- Nuclear power produces negligible PMs, leading to cleaner air
- The number of deaths associated with nuclear power accidents are much lower than from environmental radiation (e.g. radon)
- An energy mix that favours nuclear and renewables over carbon based technologies will reduce the health consequences of climate change
- Excluding nuclear will increase the economic burden of healthcare in the future

# Life is a balancing act


"We've considered every potential risk, except the risks of avoiding all risks"

**We all need energy – but nothing is risk free**