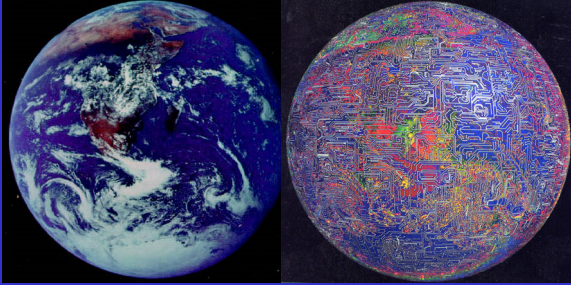


SCIENCE

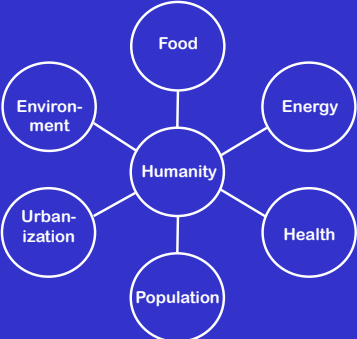
BIG Issues in Science



Prof Peter O'Donoghue

1

What are BIG issues facing humanity?



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POPULATION

Global population P ~ 7,000,000,000 people (and growing!)

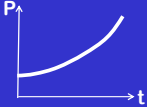


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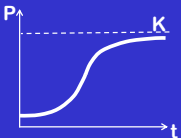
POPULATION (growth)

Global population P ~ 7,000,000,000 people (and growing!)

Exponential growth (unconstrained)
 $P' = r \cdot P$



Logistic growth (constrained)
 $P' = r \cdot P \cdot [(K-P)/P]$




growth rate = r = birth rate – death rate

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POPULATION (births)

Birth rate changes due to:

- infant care
- longevity
- family planning
 - ZPG, 1cf
 - IVF
 - contraception
 - sterilization





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POPULATION (deaths)

Death rate changes due to:

- natural disasters
- war/revolt
- famine
- disease
- health care
- nutrition
- education

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ENERGY (looming crisis?)

Problems with:

- over-reliance on fossil fuels
- diminishing reserves
- increased consumption
- alternative sources
- storage



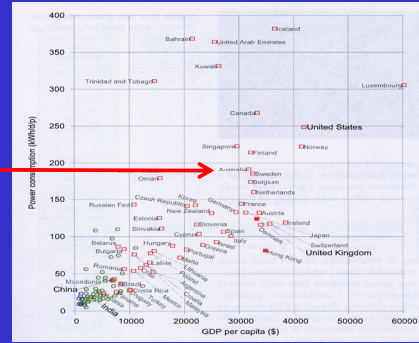
Units (currency):

Energy (amount) kWh

Power (rate) kWh/d

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Power consumption (per capita)



Australia: 190 kWh/d/p

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ENERGY (Australian consumption)

| | kWh/d/p |
|-----------------|------------|
| Cars | 40 |
| Planes | 27 |
| Household | 36 |
| Lighting | 5 |
| Appliances | 5 |
| Food/farming | 13 |
| Manufacturing | 60 |
| Public services | 4 |
| TOTAL | 190 |



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ENERGY (Australian production)

| SOURCE | kWh/d/p |
|------------------|------------|
| Fossil fuels | 6 |
| Wind - onshore | 20 |
| - coastal | 15 |
| - offshore | 30 |
| Solar - thermal | 12 |
| - photovoltaic | 5 |
| - biomass | 33 |
| Hydroelectricity | 11 |
| Wave | 5 |
| Tide | 15 |
| Geothermal | 2 |
| TOTAL | 154 |



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Power deficit

| | |
|-------------------------|-------------|
| Total power consumption | 190 kWh/d/p |
| Total power production | 154 kWh/d/p |
| Deficit | 36 kWh/d/p |

Where will it come from?
What sources are left?

Nuclear energy: <420 kWh/d/p



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FOOD (sustainable)

Sources:

- from wild
- from farms

40% population farm
33% land (1/3 arable)

Australia: 1% farmers, 50% land

Issues:

- production
- distribution
- consumption



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FOOD (production)

Produce:


- plants (pastures, cereals, vegetables, fruit..)
- animals (meat, milk, fibre, power)

Production cost / benefit

- selective breeding
- genetically-modified (GMF)

Food security

- guarantee supply
- guarantee safety



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FOOD (utilization)

Gate to plate:

- harvest
- processing
- storage
- distribution
- sale
 - pricing
 - global economy




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ENVIRONMENT (protection)

Conservation

- ecological
- ethical
- economic
- aesthetic



Matter is recycled, energy flows through

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ENVIRONMENT (conservation)

Natural resources

- earth
- water
- atmosphere
- biota

Biodiversity

- species richness
- relative abundance

Evolution through competition

Evolution through collaboration




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ENVIRONMENT (degradation)

Pollution

- physical
 - (temperature)
 - (pH)
- chemical
 - (organics)
 - (inorganics)
- biological
 - (pests)
 - (parasites)



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URBANIZATION

Transition

- nomads (hunter-gatherers) survival
- farmers (homesteads) sustenance
- townies (villages) commerce
- urbanites (cities) culture

> 55% people live in urban communities (and it is growing)!

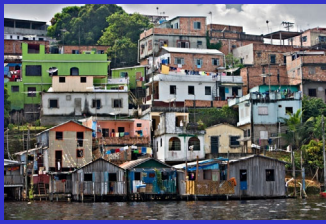


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URBANIZATION (standards)

Crowding effect

- sociological
- psychological
- biological



Town planning

- infrastructure (residence, sanitation, transport..)
- life-style (work, home, play..)
- safety (mind and body)

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URBANIZATION (psychology)

Associated with:

- mental disorders
- crime / civil unrest
- sedentary diseases

Move to:

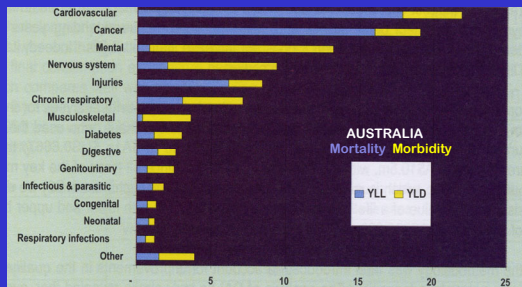
- green cities
- active living
- healthy mind & body



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HEALTH (prioritization)

life span, standard of living, technology
(sanitation, hygiene, medicines, education)



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HEALTH (diseases)

Disease diagnosis:

- V vascular
- I infectious/inflammatory
- N neoplastic
- D degenerative
- I intoxication/iatrogenic
- C congenital/genetic
- A allergic/autoimmune
- T traumatic
- E endocrine/metabolic



- P psychological
- E ethico-legal
- C clinical
- S society/population



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HEALTH (management)

Treatment

- pharmacological
- surgical
- psychological



Prevention

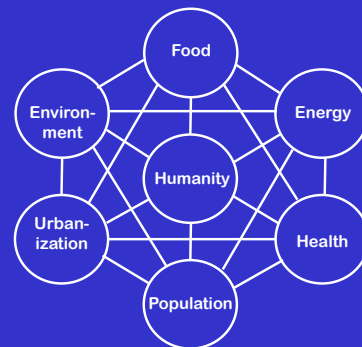
- pharmacological
- immunological
- psychological



Hardest thing to change is human behaviour!

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BIG issues!



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It is all about EDUCATION!



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