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Sustainability Challenges and Urban Development
SGS Forum

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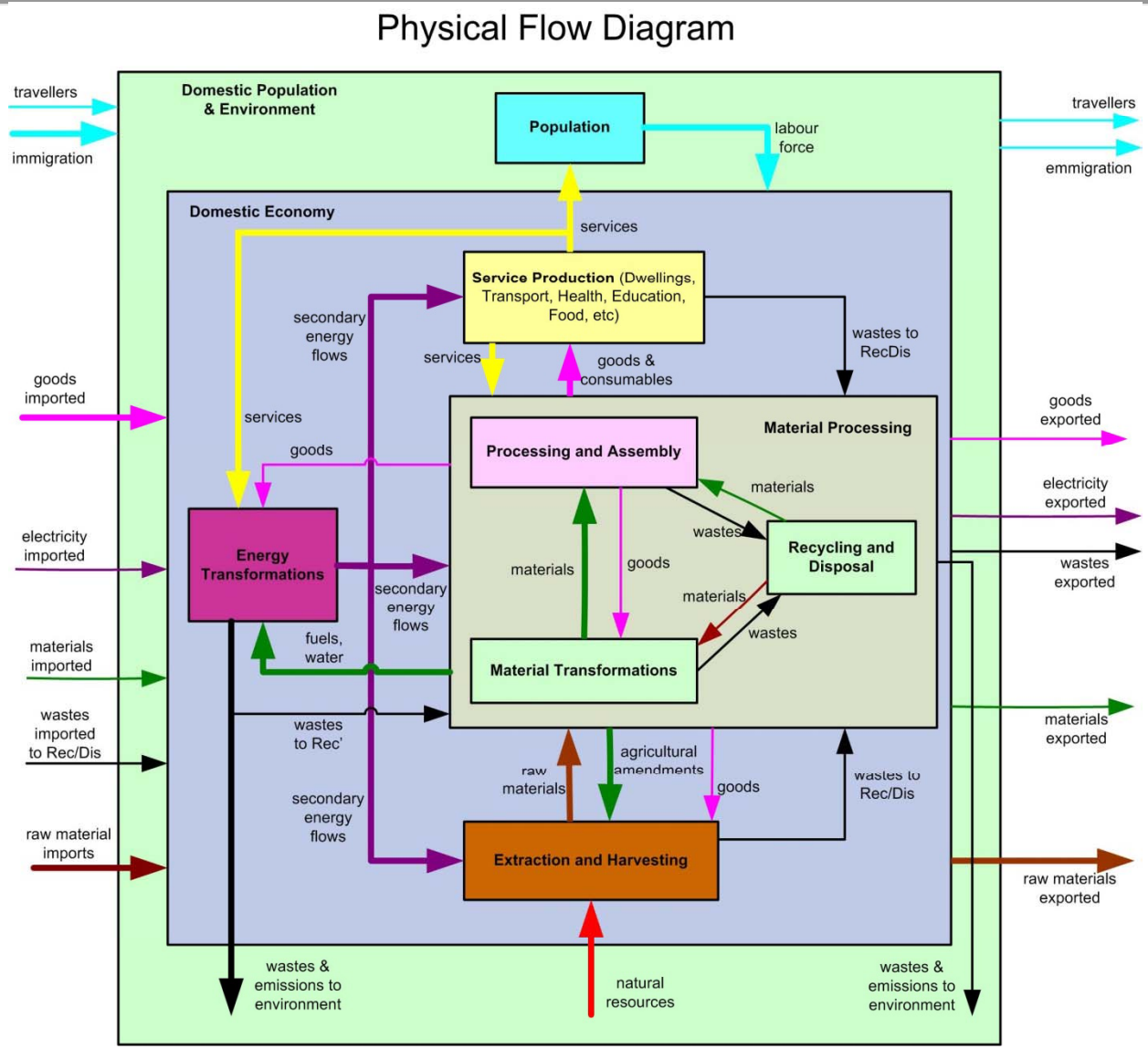
CSIRO

Outline and Messages

- Outline
  - National set of sustainability challenges
  - Urban form, water, and energy interactions
- Messages
  - The size of the sustainability challenges is immense
  - Solutions based on technology may make things worse
  - Compact urban form & technology may ease the pressures
    - but not avert large environmental impacts
    - and not be resilient to these impacts

Simulate the major bio-physical flows



Processes explicitly modelled for all physically significant activity in the whole economy

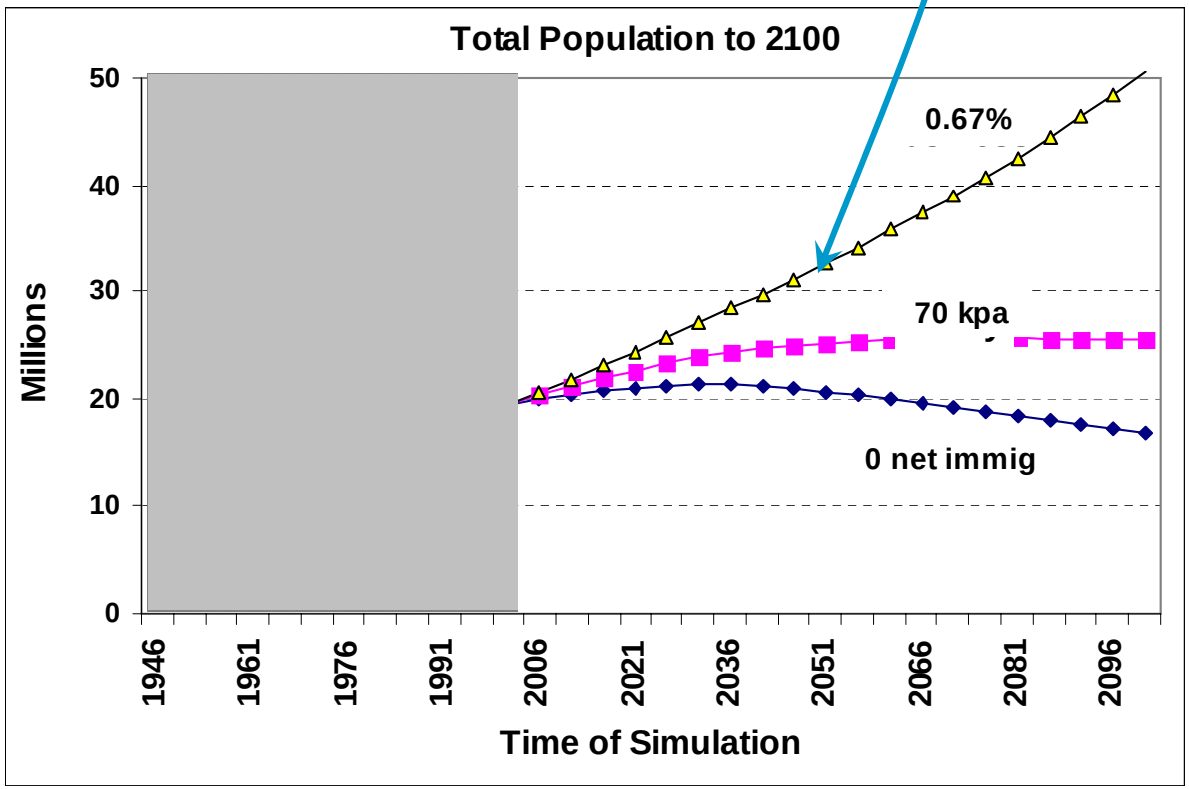
- Based on mass/energy conservation
- Grounded with historical data
- Transparent assumptions and data
- Cover all the economy
- Quantitative exploration of scenarios
- Free of ideology

Many sustainability issues that must be dealt with at the same time

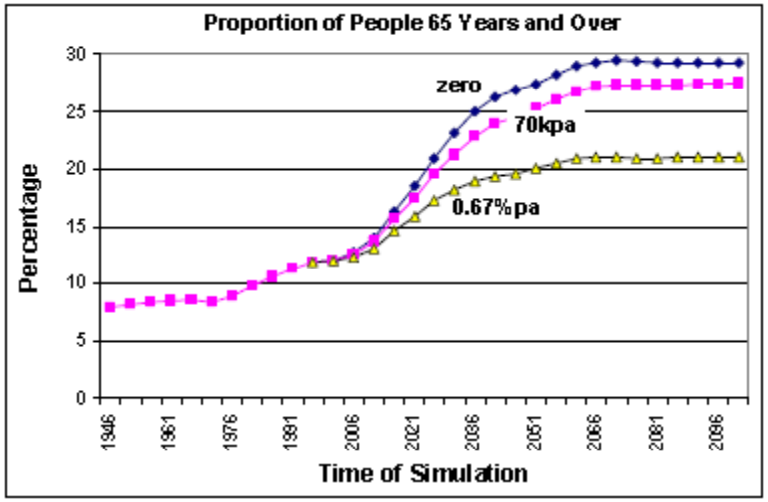
- Labour force
- Agricultural land
- Water resources
- Seafood
- Minerals
- Transport fuel
- Greenhouse gases
- Infrastructure

Population is growing strongly

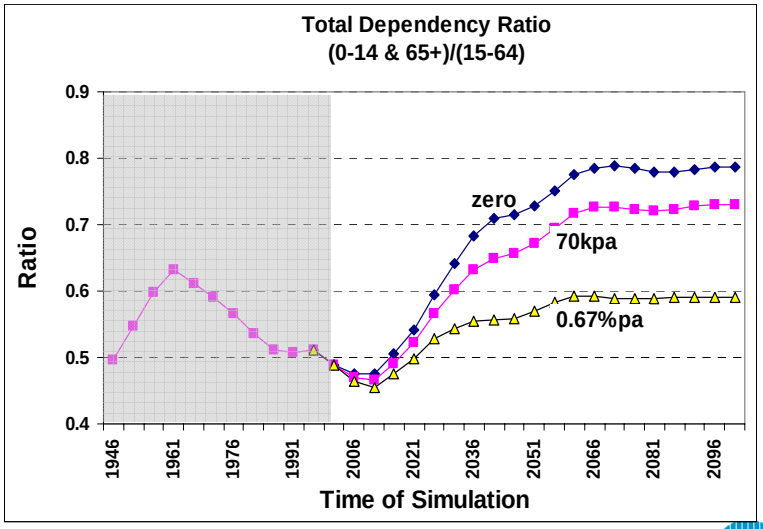
- likely to increase by 50% or
- 30+ million by 2050
- currently increasing by ~300,000 pa
- net immigration > natural increase
- **1 new Canberra each year**



High immigration does not halt aging

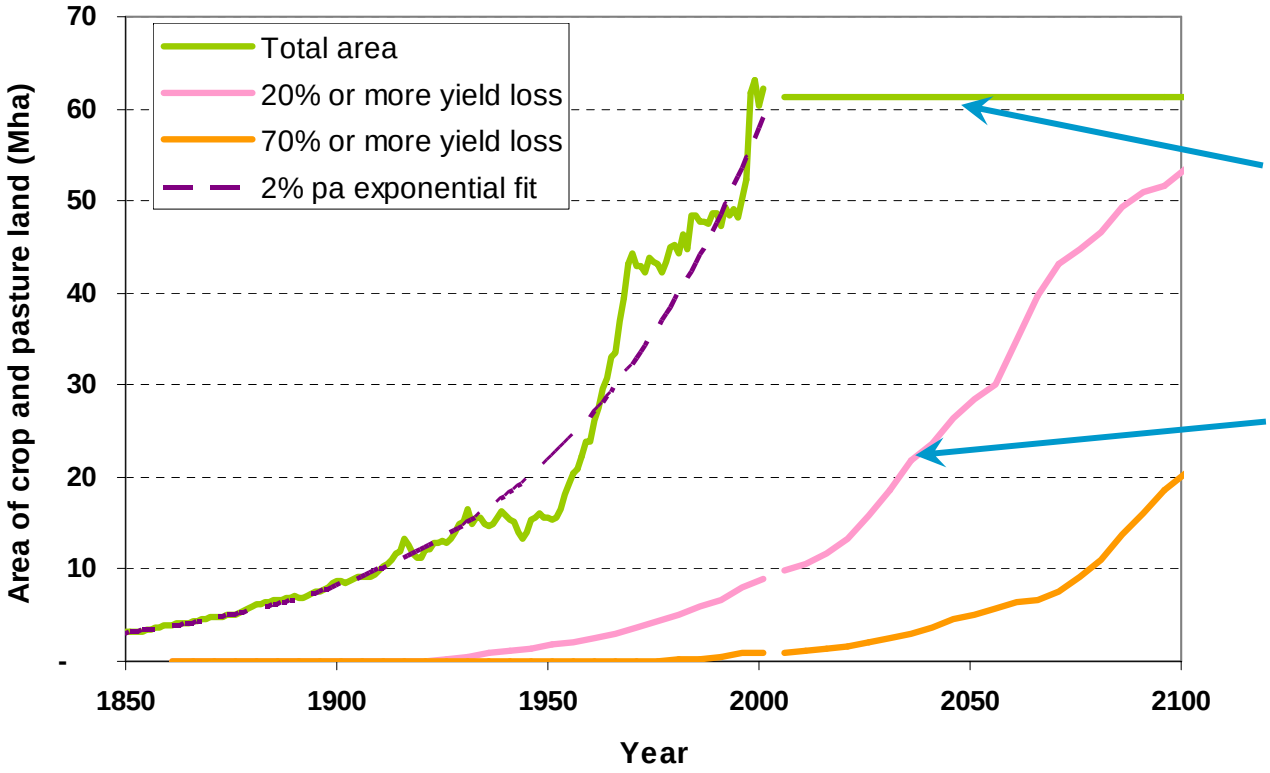


- effective labour force may decrease by 20-30%



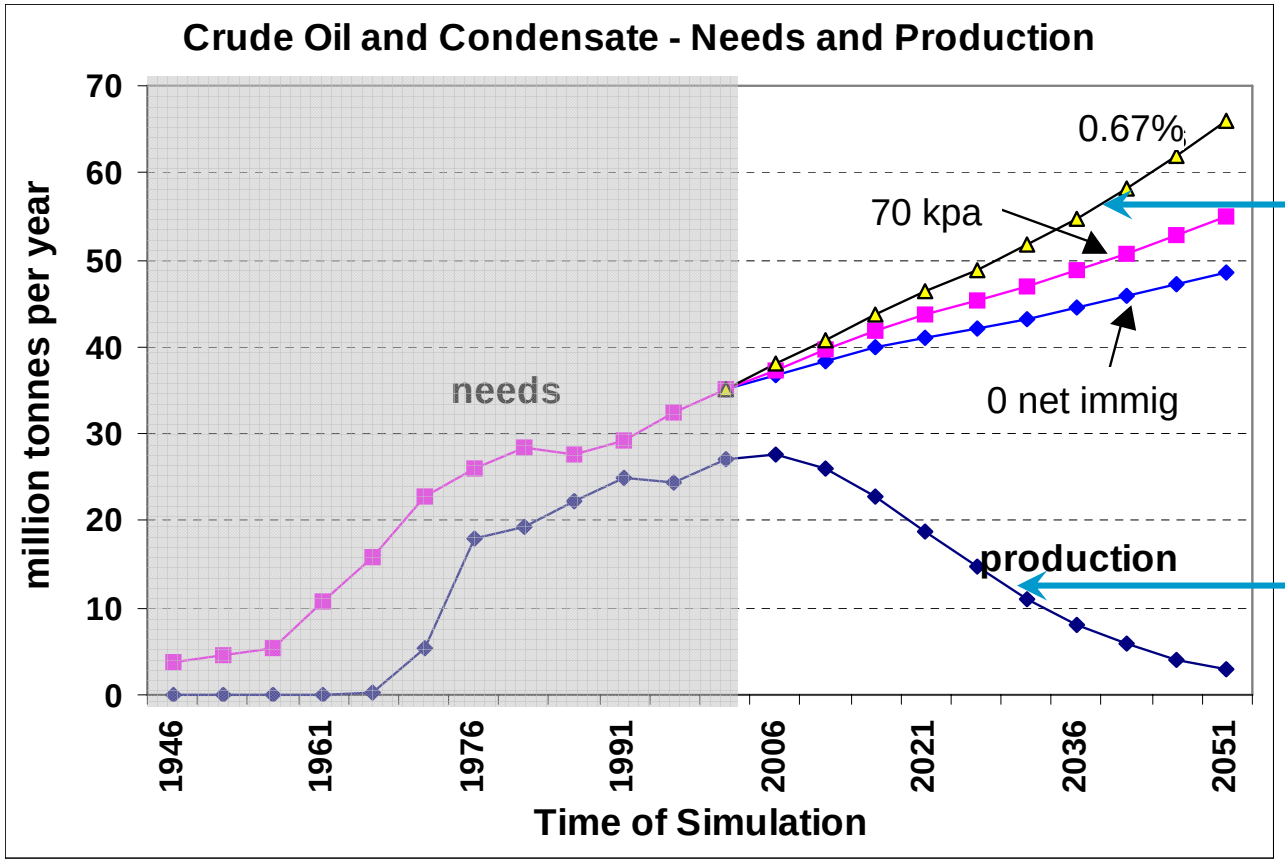
Food production faces challenges

- adding new land has masked degradation of older land
- past 2% pa growth unlikely to continue
  - doubling every 3 decades would require ½ Australian land area before 2100
- no change to land area may mean all degraded in 4-6 decades



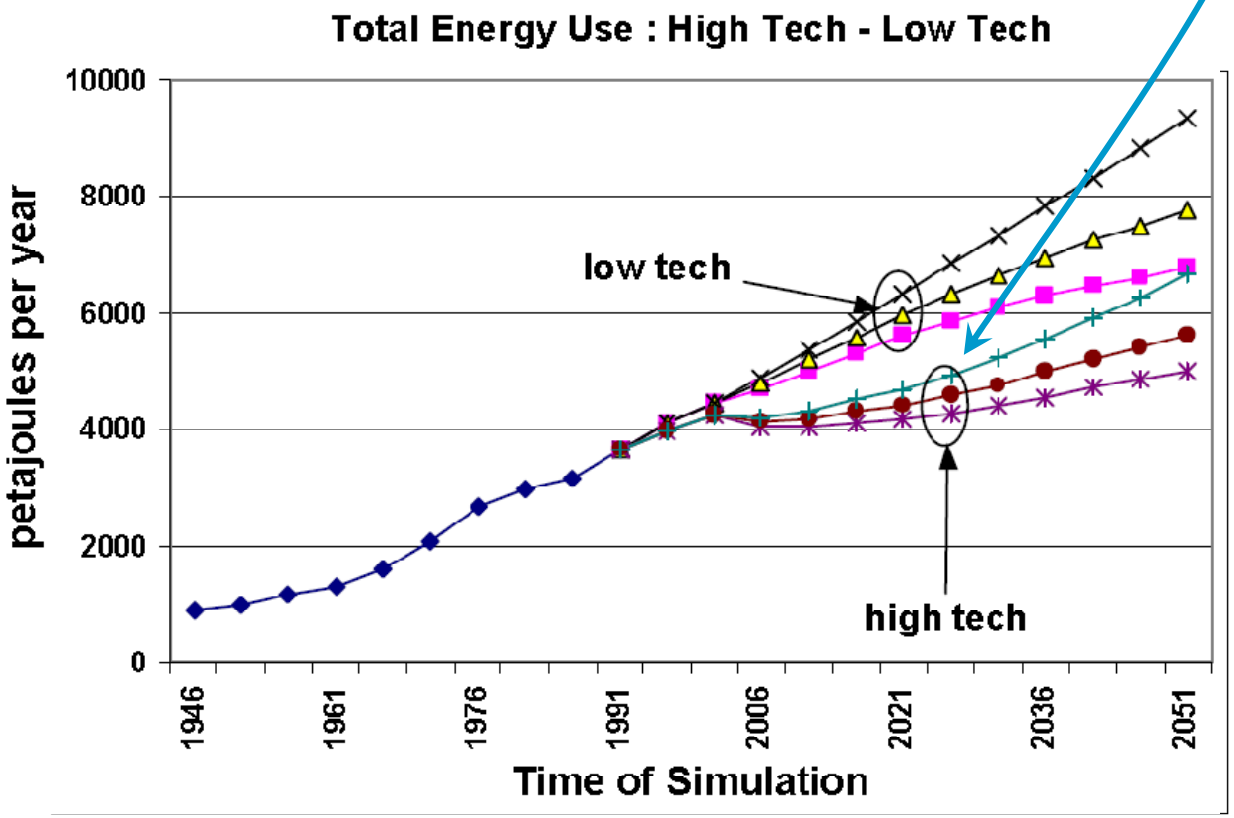
Transport fuel is uncertain

- growing domestic oil deficit
- importing 80% by 2030?



Energy use & emissions are likely to grow

- substantial efficiency improvements have temporary effects
  - buildings 50% more efficient by 2020
  - electricity generation at maximum thermal efficiency
  - cars at 3 L/100km by 2020
  - no rebound effect assumed



Population effects

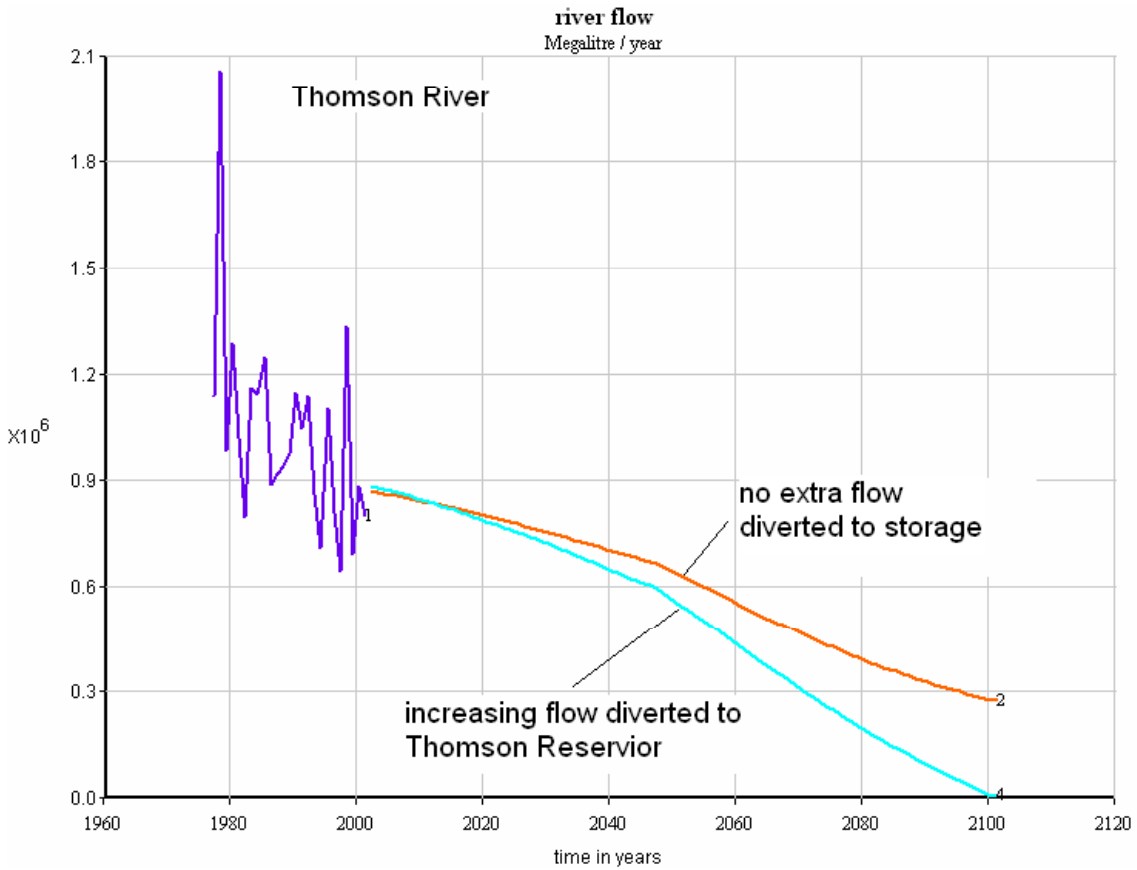
- A population of 35m (or so) in 2050 means
  - Greenhouse gas emissions could approximately double (if emissions are not curbed)
  - Australia may become almost entirely dependent on foreign oil over coming decades.
    - There is no guarantee that there will be enough foreign oil.
  - Provision of water for capital cities looks increasingly more complex.
  - Australia could become increasingly reliant on imports from overseas of food and agricultural inputs (fertilisers).

- Lower populations (including stabilised populations) ease the environmental pressures, but they are not eliminated.

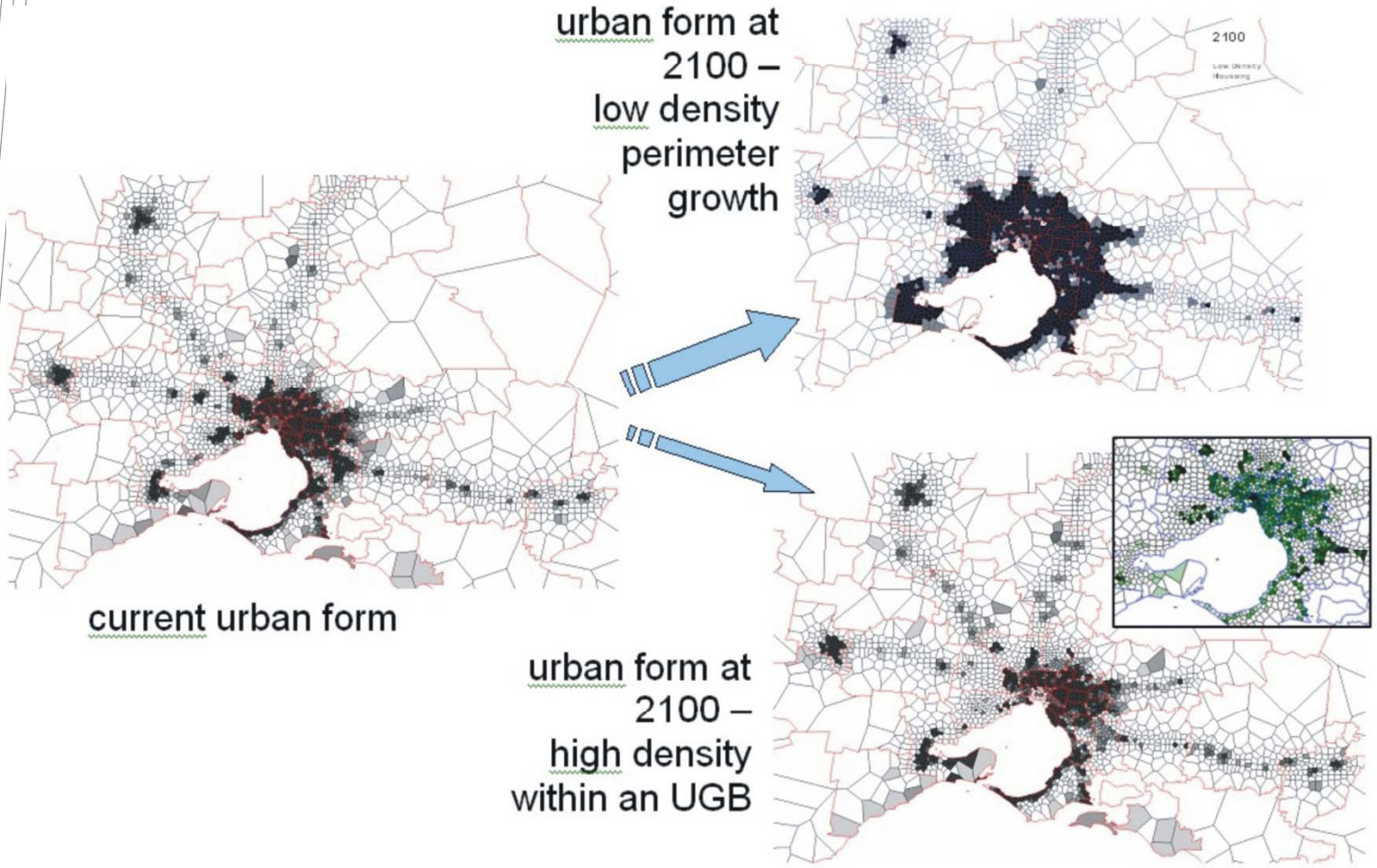
More detailed work applied to Victoria, and now developing for Australia

Melbourne catchment supply is threatened by climate change

- “high” climate change scenario (2.2 °C change in temp by 2050)
- river flow decreases dramatically



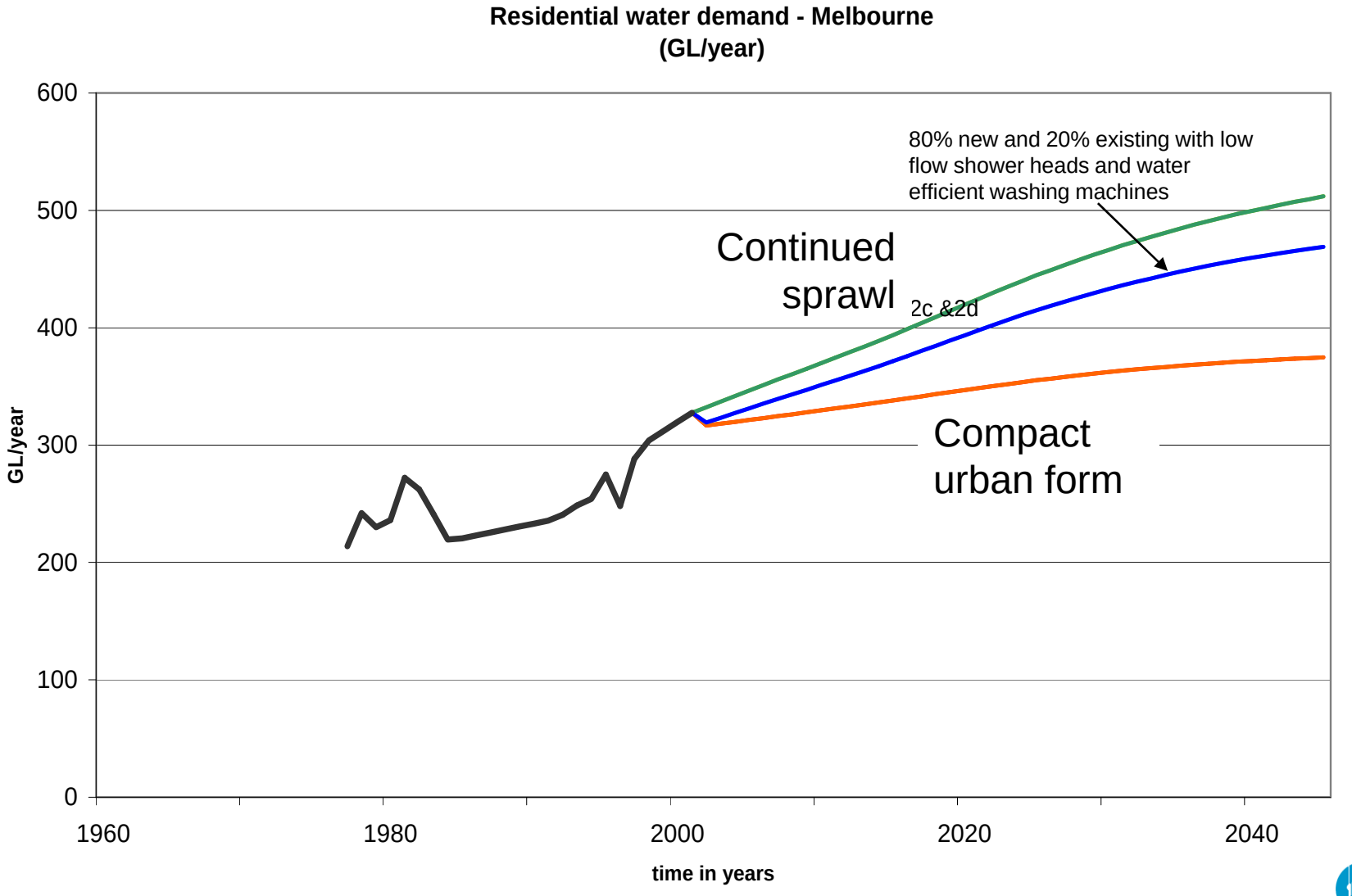
Urban form scenarios



(2a,b,c,d)

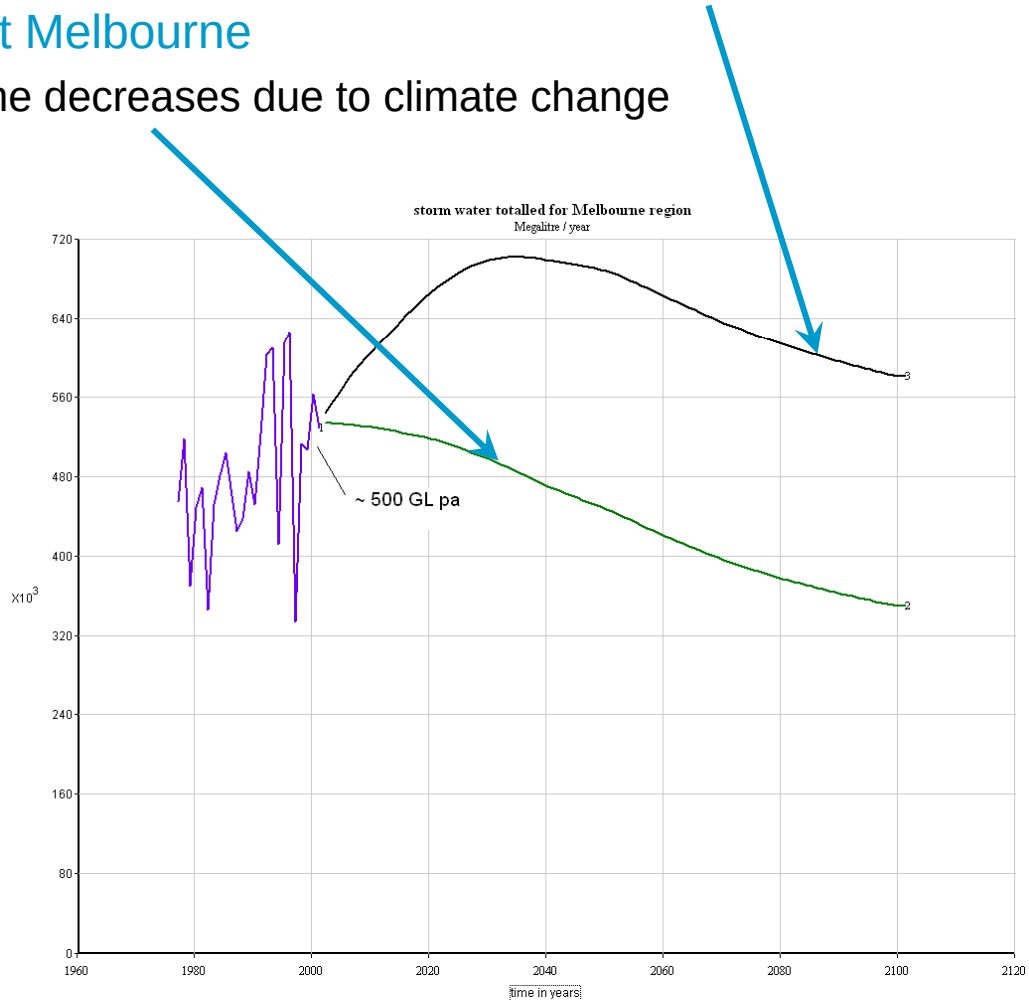
(1a,b)

Compact city uses 100 GL/a less by 2045



Stormwater harvesting is uncertain

- Sprawling Melbourne:
  - volume increases for several decades, but then decreases due to climate change
- Compact Melbourne
  - volume decreases due to climate change



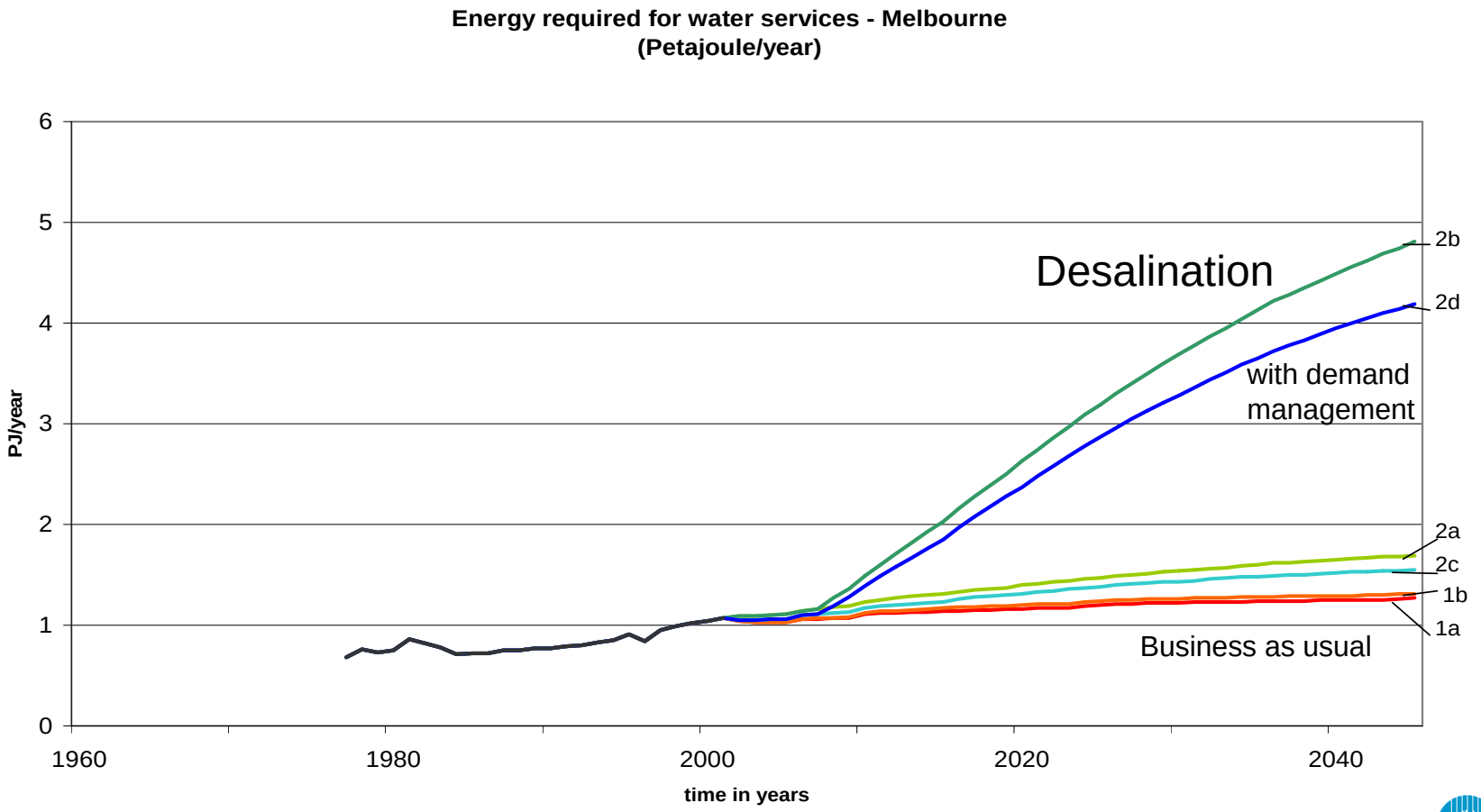
Technological solutions can have negative interactions

- Employing technological solutions to a particular issue can stress another area, creating a vicious cycle.

- Examples include:
  - Desalination
  - Bio-fuels
  - Electric cars

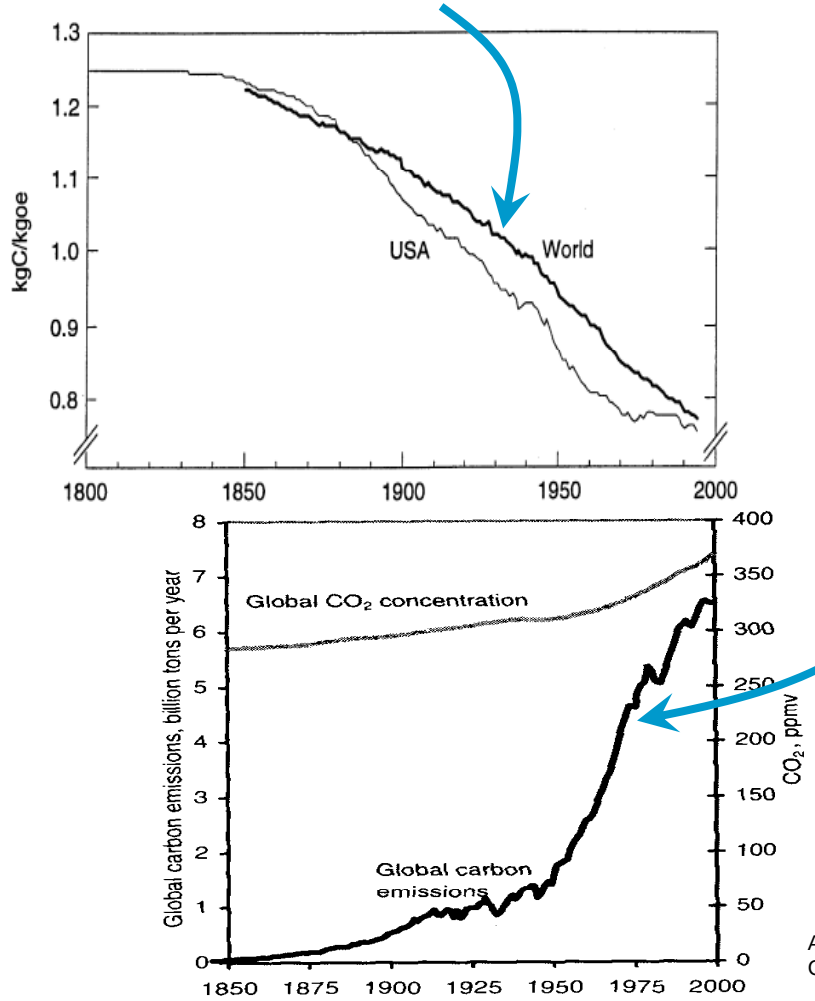
Energy use for water provision

- Water system energy use could increase from 50% to over 300% over baseline



Technological efficiency does not equal environmental improvements

- Substantial empirical and theoretical evidence
  - e.g., carbon intensity (decreasing) but carbon emissions (increasing)



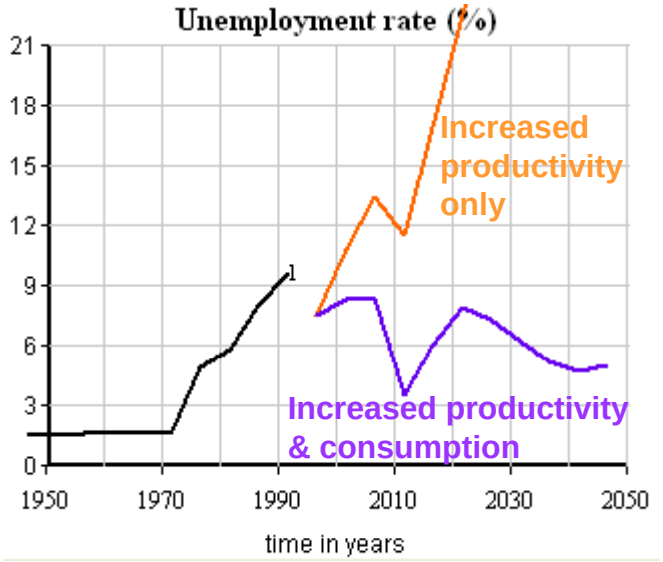
Arnulf Grübler, Technology and Global Change, Cambridge University Press, 1998

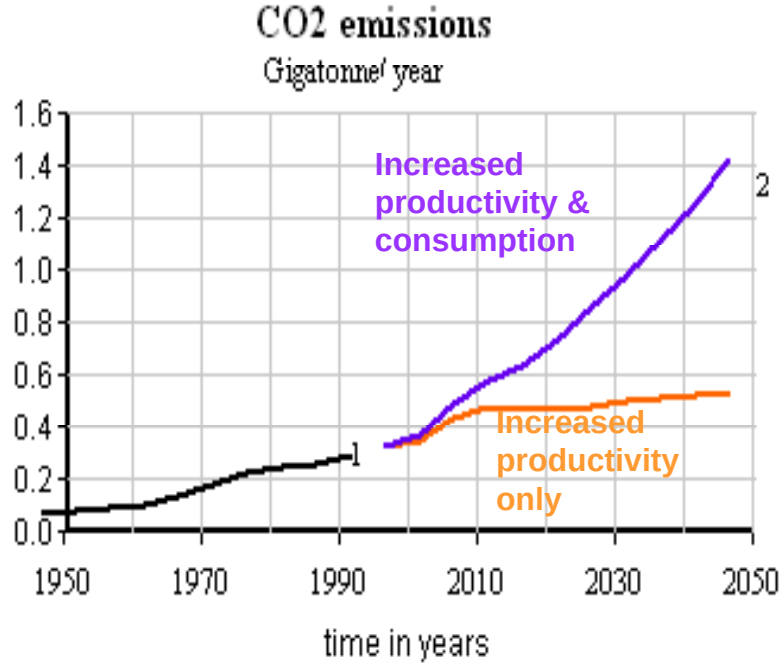
Rebound effects and growth reduce technological benefits

- Increasing efficiency and using technology does not relieve the environmental pressures.
  - Being more efficient initially reduces environmental impacts
  - And ~1% pa increase in labour productivity and efficiencies without economic growth can create mass unemployment (up to 50% by 2050)
    - because you need less people to produce less goods (and associated services)
  - But growth in consumption and the economy provides jobs for the unemployed.
    - 3-4% economic growth accounts for both population and technological growth
  - This continual economic growth uses up most of the environmental savings.

National simulation of the rebound effect

- Increased productivity (without economic growth) leads to high unemployment
- Economic growth and increased consumption stabilises unemployment
- but results in growing greenhouse gas emissions





Summary of key issues

- Larger population makes the environmental & resource challenges worse (but they exist for all population levels)
  - Transport fuels
  - Greenhouse gas emissions and climate change impacts
  - Water security
  - Food production
- Technological & engineering solutions can make other challenges worse
  - e.g., desalination
- Increased efficiency & productivity can make environmental challenges worse when combined with economic growth
  - Efficiency is a driver of growth

Urban design metrics depend on the objective

- The size of our changes (and challenges) is very critical
  - marginal, or
  - substantial?
- Are we attempting to
  - avert the impacts (e.g., mitigation), or
  - survive the impacts (e.g., extreme adaptation)?
- Denser cities may (marginally) ease environmental pressures, but potentially be more susceptible to impacts
- Local self-sufficiency may be less “efficient” but more resilient

Sustainable Ecosystems
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