



# Chapter 6

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## Future Challenges



# Expanding World Population

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- 1900-2000, world population climbs from 1.6 billion to 6 billion people
- Places new stress on use of resources
- Gives engineers new challenges to compensate for higher population relative to resources
- Land use, energy use, transportation/congestion, pollution, waste disposal become significant issues
- These issues have always been significant challenges



# Topic One: Population

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- Population growth drives most future engineering challenges and needs
- Futurists have long posited that human population is expanding exponentially (like bacteria)
- See, for instance, Harry Harrison's 1966 novel "Make room, make room" which was the basis for the 1973 movie "Soylent Green" ("Soylent green is people! It's people!") or Star Trek episode "The Mark of Gideon"



# Topic Two: Environmental Impact

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- Engineers concerned with management and the control of pollution, especially:
  - Air pollution
  - Water pollution and the depletion of freshwater resources
  - Management of solid waste
- US Clean Air Act has had significant ramifications in this regard



# Topic Three: Energy

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- Developing industrial countries have been increasing energy usage dramatically
- Stored sources of energy (fossil fuels, uranium) will eventually be depleted (when? 10 years? 50 years? 1000 years?)
- Engineers can improve efficiency of energy usage and develop alternative energy sources (renewable energy, fusion)
- Renewable energy refers to transforming the direct and indirect effects of sun's incident energy



# Topic Four: Transportation

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- Types of transportation systems (automobile, air transport, rail transport)
- Infrastructure (highways, rail systems, airports and air corridors)
- Congestion, travel times, delays
- Cost of transportation – who pays?
- Roads and bridges - safety



# Topic Five: Infrastructure

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- Entities designed to support human activity such as roads, bridges, airports, public service facilities, buildings
- Deteriorating infrastructure in the US
- US grade in 2001 was a D+
- Dropped to D in 2005 but held at D in 2009
- NOTE: ASCE gave the grade. Who benefits from increased public infrastructure spending? American Society of Civil Engineers



# Topic Six: Space, the Final Frontier (Aerospace)

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- Cancellation of Space Shuttle Program may be similar to the demonopolization of “Ma Bell” in 1982 which gave birth to the telecommunications industry.
- Will there be a Space Industry to put stuff into near earth orbit?
- How might that industry develop?
- What opportunities might be present for engineers?





# Topic Seven: US Competitiveness

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- Successful STEM education is closely coupled to technological competitiveness
- US has been slipping (or has it?) in STEM education
- World Economic Forum ranked US below Switzerland in 2009-2010 in its Global Competitiveness Report (really, Switzerland?)
- How technologically competitive is the US? What can be done to improve this?



# Topic Eight: Climate Change

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- Climate change (formerly Global Warming) rocketed to the top of the US political agenda in the mid-2000s.
- Good science or bad science? Man-made or cyclical?
- Causes (CO2 emissions, deforestation, entropy)?
- Solutions (carbon exchanges, atmosphere factories, artificial sun-screen)? Engineering challenges?
- It might be helpful to review the history of the environmental movement to see how far back some of these trends extend (for instance, see “Northern Exposure” in the 1990s, long before “Global Warming Science” was established)



# Topic Nine: Aging Population

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- The US population is living longer
- Many new challenges in assisted living for the elderly
- Smart homes? Wearable computer?
- Robotic assisted devices?
- Pharmaceuticals and smart drug delivery?