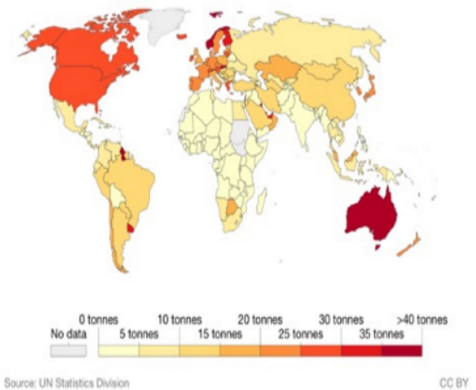# Lesson 1 Drivers

September 5, 2019   4:49 PM

Material footprint per capita, 2010
The total material footprint (MF) is the sum of the material footprint for biomass, fossil fuels, metal ores and non-metal ores, measured in tonnes per person per year.

Context
- 1810 - Life expectancy < 40%
- China, bangladesh, india etc. still stuck in pauverty
- overall, lifespan has increased, though still inequalities in wealth
- 200 years of progress

World population growth
- total human population is increasing, high rate of growth
- population around 10 billion by end of working career

Increasing per capita consumption
- consume earth's resources to live
- canada among countries with highest per-person consumption rates of materials in world
- sum of extracted material req by the per person consumption habits in countries = per capita material footprint
- total material footprint = sum of material footprints of biomass, fossil fuels, metal ores, non-metal ores

Impacts
- increases in global population/ per-person material consumption rates = significant societal, biophysical, and economic changes
- IPAT eqn: IMPACT = POPULATION * AFFLUANCE * TECHNOLOGY
- Describe env impacts and social
- deg of impact on people andd ecosystems is function of population size, wealth, and technologies
  - Infant mortality dec
  - GHG emissions inc
  - biodiversity loss
  - air and water quality dec
  - education rates inc

Primary Drivers:
- Increasing global population growth
- Increasing global per-person material consumption rate

Lesson 2 Concepts & Definitions

September 6, 2019   8:41 AM

Intro
- 1987 - United nation - idea of **sustainable development**
  - ==development that meets the needs of the present without compromising the needs of future generations to meet their own needs==

SDGs
- 2015 UN created 17 sustainability goals (SDGs)
- targets aimed at guiding national sustainable development strategies
- each target associated with 1+ indicators to measure progress
  https://sustainabledevelopment.un.org/sdgs
- **Final project:** connecting several SDGs to an engineering activity (ex. green/sustainable technology of choice)

1. No poverty
2. Zero hunger
3. Good health and well-being
4. Quality education
5. Gender equality
6. Clean water and sanitation
   - ensure availability and sustainable management of water and sanitation for all
   - 2019 - billions still lack safe water, sanitation and handwashing facilities. Achieving universal access to basic sanitation service by 2030 require doubling current annual rate of progress. Most countries unlikely to reach full implementation of integrated water resources management.
   - 758 million people still lack basic drinking water service
   - increased from 28- 43% 2000-2015 and to 45% in 2017
   - 1/3 countries have medium/high levels of water stress (North africa, west asia central south asia)
7. Affordable and clean energy
   - Ensure access to affordable reliable sustainable and modern energy for all
   - access to electricity in poor country accelerating. 800 million remain without electricity.
   - global electrification rate rose 83-87% in 2010-2015 but 840 million still without access
   - renewable energy share of total final energy consumption increased 16.6-17.5% from 2010-2016 but faster change required to meet climate goals
8. Decent work and economic growth
9. Industry innovation and infrastructure
   - Build resilient infrastrucure, promote inclusive and sutainable industrialization
   - countries laggin behind face serkous challenges in doubling manufacturing industry's share of GDP by 2030, investment in scientific research and innovation remains below global average
   - efficient transportation services are key drivers of economic development, more than 80% of world merchandise trade by volume transported by sea
10. Reduced inequalities
11. Sustainable cities and communities
    - Make cities and human settlement
    - reducing proportion of global urban populaiton living in slums, more than 1 billion still living in situations
    - urban resident breathing poor quality air and limited access to transport and open public spaces

- ○ areas occupied growing faster than populaitons
12. Responsible consumption and production
13. Climate action
14. Life below water
15. Life on land
16. Peace, justice and strong institutions
17. Partnerships for the goals

- **Relation to engineering**

      Goals 6, 7, 9, and 11 have obvious connections to engineering. The choice of which of the remaining 13 goals relate most to engineering is open-ended

Carrying capacity
- num of people who can be supported over very long period of time by natural, social human and built capital
- Depends on:
    - ○ resources available in ecosystem
    - ○ resources consumed by each individual within population
- Biocapacity
    - ○ productivity of land areas including forests, pastures, cropland and fisheries
    - ○ if left unharvested can absorb waste generated by humans, absorb carbon
    - ○ 2010 - biocapacity = 1.7 hectares/person

Eco footprint
- EF = measurement of current humand emand on earth's ecosystems. provides estimate of area biologically productive land and sea needed to sustainably support human activities (area/year)
- ecological deficit calculated as difference b/w total ecological footpring tof its population and its biocapacity of the area available to that population
    - ○ 86% of humanity lives in a country that is in ecological deficit
- **Per-capita ecological footprints**
      http://www.footprintcalculator.org
    - ○ (estimate personal EF)
    - ○ avg ecological footprint per person = 2.6 global hectares
    - ○ earth cannot sustain current human activities over long run
- about 4 global hectares reduction in EF necessary for avg canadian to live within planet's biosphere

Natural Capital
- NC = land, air, water, living organisms and all formations of earth's biosphere that provide us with ecosystem goods and services imperative for survival and well-being. basis for all human economic activity = financial capital
- most secure environmental position is to use natural resources in way as to ensure abundance maintained or even increased over long-term

Quiz
- global avg per-capita EF decreased from 2014 to 2018

Lesson 3 Climate Change

September 22, 2019   9:15 PM

Backgrounder
- Need to be familiar with understanding of climate change and effect on
    - atmospheric CO2 emissions
    - global average surface temp
    - annual minimum area of arctic sea ice
    - area of land ice
    - sea levels
- Understand greehouse effect and connections to indicators of climate changes above

Paris
- Paris Agreement
- NDC = Nationally Determined Contributions
- COP21 in 2015 Dec 12 Paris agreement, 195 countries agreed
    - limit average surface global temp increase to below 2deg above pre industrial levels and limit increase to no more than 1.5 deg
    - establish binding commitments by all parties to make nationally determined contributions NDCs to pursue domestic measures aimed at achieving them
    - commit to regularly reporting national emissions and pregress made in achieving their NDCs
    - extend current goal of mobilizing 100 billion a year in support to poorer countries by 2020 through 2025 with new higher goal to be set for period 2025
    - call for new mechanism enabling emissions reducitons in one country to be counted towards another countrys NDCs

Global Warming Potentials
- GHG = any gas in atmosphere absorbs and re emits heat and keeps atmosphere warmer than should be
- /kg of GHG

Greenhouse Gas	Global Warming Potential (GWP)
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
Hydrofluorocarbons (HFCs)	$124 - 14,800$
Perfluorocarbons (PFCs)	$7,390 - 12,200$
Sulfur hexafluoride (SF_6)	22,800
Nitrogen trifluoride (NF_3)	17,200

Carbon Footprint Calculations
- contribution to global warming of human activity
- Tonnes of atmospheric GHG emitted in atmosphere - Tonnes CO2e
- ex. 34kg of atmospheric CH_4 = 21*34=714 kg of atmospheric CO_2

Notes
- need to explain carbon footprint as above
- perform simplified carbon footprint calculation

Lesson 4 Biodiversity & Loss

September 22, 2019   9:23 PM

Backgrounder
- <mark>Biological diversity (biodiversity)</mark>
  - <mark>variety of species and ecosys on earth and ecological processes of which they are a part</mark>
  - 3 componenets
    - ecosystems diversity
    - species diversity
    - genetic diversity
- <mark>Biodiversity Loss occurs naturally</mark>

Causes
- climate change
- poaching/hunting
- razing wild lands

Impacts
- <mark>reduces healthy function of eosystems</mark>

Ecosystem Services
- <mark>ecosystem suport to humans</mark>
  - <mark>Air and water purification;</mark>
  - <mark>Waste decompostion;</mark>
  - <mark>Soil and nutrient cycling (this is more important than you may think!);</mark>
  - <mark>Climate and radiation regulating;</mark>
  - <mark>Habitat Preservation (we won't have crops if pollinators don't have habitat)</mark>
  - <mark>Noise Reduction;</mark>
  - <mark>Aesthetic and culture;</mark>
  - <mark>Raw materials and products</mark>