

SEE 1003

Introduction to Sustainable Energy and Environmental Engineering

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**Module 6 – Advances in Environmental and Energy
Engineering**

March 28, 2022

| Week | Topics | Assignment issued | Key dates |
|---------|---|---|---|
| Week 1 | Course introduction; Climate Change and the Engineering approach | | Quiz 1 |
| Week 2 | MODULE I Introduction to Sustainability Energy, Natural Resources and pollution, Electromagnetic energy; Electrical energy – Lighting, Light pollution, Policy | Semester-long Project | |
| Week 3 | | Project deliverable 1.1 | |
| Week 4 | MODULE II Energy and Environmental Implications– Transportation Human-Environment Impacts | | |
| Week 5 | | Project deliverable 1.2 | Project deliverable 1.1 |
| Week 6 | MODULE III Noise Pollution in Urban Environment | Project deliverable 1.3 | Quiz2 |
| Week 7 | MODULE IV Urban Sustainability and Resilience | | Project deliverable 1.2 |
| Week 8 | MODULE V Tools: Systems Analysis for Sustainability Cost-Benefit Analysis | | |
| Week 9 | | | |
| Week 10 | Material Flow Analysis, Life Cycle Assessment | | Project deliverable 1.3; Quiz3 |
| Week 11 | MODULE VI Advances in Environmental and Energy Engineering MODULE VII Waste management and Waste-to-Energy | Project deliverable 1.4 | |
| Week 12 | MODULE VIII Economics and Policy of Energy and Environment | Project deliverable 1.5 (Now this is extra credit- BONUS!) | Quiz4 |
| Week 13 | Individual Presentations (5-mins) | | Final Project Report (merged with Project deliverable 1.4) |

Overview

- ESE/EVE Major Selection
- Advances in Environmental and Energy Engineering
- Activity and 1-on-1 advise
- Teaching and Learning Questionnaire (TLQ)
- Project deliverable 4

Two-Phase Process for Majors Allocation

Phase One Majors Allocation

- Top 20% of students in the School will be allocated their first choice major upon satisfying the selection criteria stipulated by the University

Phase Two Majors Allocation

- Remaining 80% of students will be allocated a major subject to availability of places and the selection criteria stipulated by the School

Phase One Majors Allocation

Top 20% of students in the School will be allocated their first choice major, irrespective of the intake plan number for individual majors (please note that once a major is allocated, no further changes to the choice of majors can be made for this allocation exercise):

- i. Cumulative GPA (CGPA) at the end of Semester B 2021/22;
- ii. No failed grades in any courses in Semesters A and B 2021/22; and
- iii. Completion of courses of at least 30 credit units in Semesters A and B 2021/22, which should include the required courses as specified below:
 - CHEM1200 Discovery in Biology
 - CHEM1300 Principles of General Chemistry
 - MA1200 Calculus and Basic Linear Algebra I
/ MA1300 Enhanced Calculus and Linear Algebra I
 - MA1201 Calculus and Basic Linear Algebra II
/ MA1301 Enhanced Calculus and Linear Algebra II
 - PHY1201 General Physics I
 - SEE1002 Introduction to Computing for Energy and Environment
 - SEE1003 Introduction to Sustainable Energy and Environmental Engineering

Phase Two Majors Allocation

- The Phase Two majors allocation exercise is arranged in the order of the student's choice of priority and School's prioritization, subject to availability of places for individual majors.
- The selection criteria adopted by SEE for prioritization of the remaining students are as follows:
 - i. CGPA on CHEM1200, CHEM1300, MA1200/MA1300, MA1201/MA1301, PHY1201, SEE1002, and SEE1003
 - ii. Choice of preference
 - iii. Interview (if necessary)

Procedures and Timeline

- Students are required to indicate or revise their choice of majors at AIMS.
- The system can be accessed via the following: AIMS → Study Plan → Declaring a Home Major → Indicate Choice of Majors.
- Please note the following time periods for indicating/revising choices:

| Date | Event | Applicable to: |
|---|---|----------------|
| Early June 2022 (exact period to be confirmed) | To indicate choice of majors after the release of Semester B 2021/22 course grades | All students |

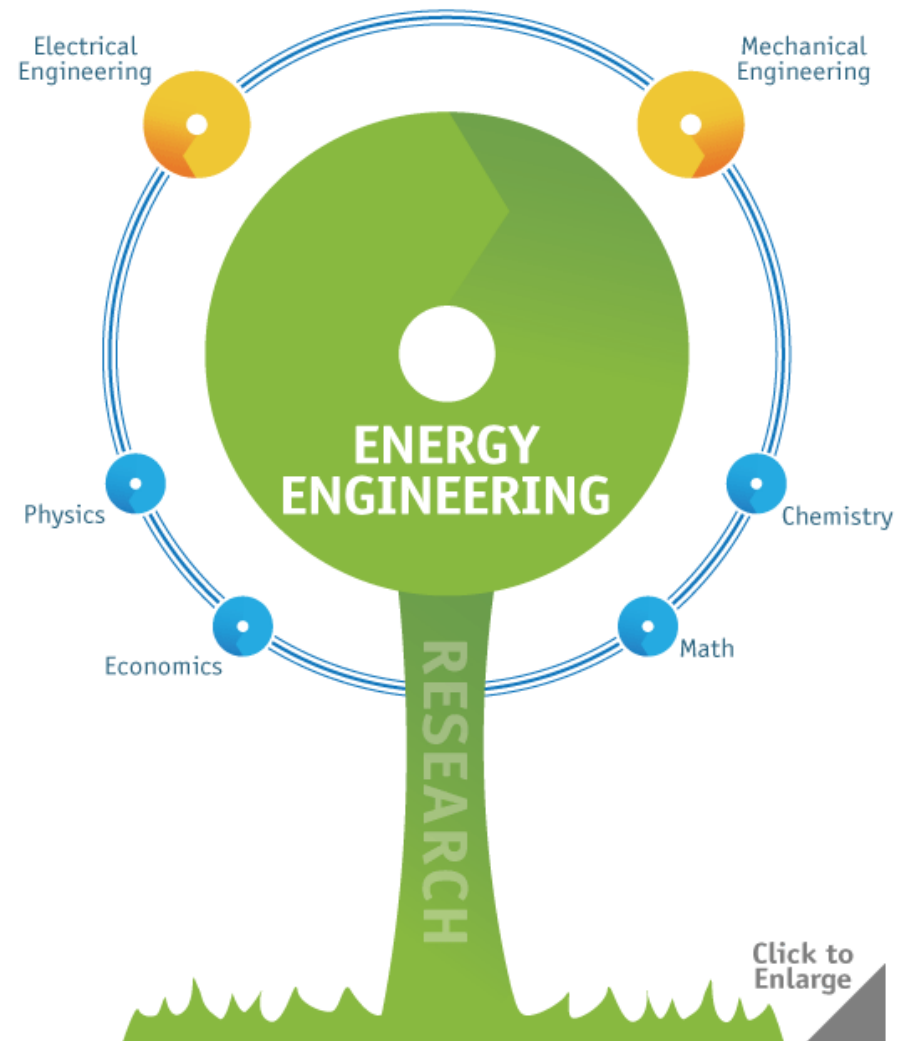
What is Energy Engineering?

- What is the problem that needs to be solved?

People use energy.

- How to provide sustainable energy supply for future use?

Energy engineers are tasked with the overall reduction of existing energy consumption and the improvement and development of technologies to produce energy more efficiently.



Click to
Enlarge

Future in Energy Engineering

- Global energy landscape is set to change drastically in the next decade.
- Today every major country in the world is investing massively into solar, wind and geothermal power.
 - Mainly due to rapidly **falling prices and increased scalability of renewable technology**.
 - Price of solar power is **set to drop by as much as 25% by 2022**.
- Shift in the energy landscape creates an opportunity for the aspiring energy engineer as **new jobs are being created** in order to drive this revolution.
- An energy engineer is an optimizer and problem solver by nature.

Sub-fields of Energy Engineering

- Energy engineers are not only utilized in the energy generation sphere but also within manufacturing environments where they are used to reduce overall energy consumption by analysing and optimising existing systems.
- Regardless of the technology used to generate and store energy, there is a growing need to create systems that make efficient use of energy and as such an energy engineer will always be in demand.
- Topics:
 - Energy efficiency
 - Energy services
 - Facility management
 - Energy supply
 - Alternative energy technologies
- Etc.

Renewable Energy Engineer

Aim:

- Design of renewable energy systems such as solar and wind plants.
 - Optimisation of existing energy systems.
 - Research and design of new renewable technologies and methods.
-
- Employment opportunities in the **‘green economy’** are on the increase in the design, development, testing production, storage and maintenance of renewable and sustainable sources of energy.
 - There is growing development in wind energy; tidal energy; biomass and solar power.





What about other types of Energy Sources?

Energy Systems Engineer

Aim:

- Analysing existing energy plants and systems to determine their efficiency and recommend ways to improve it.
- Evaluate the economic and environmental impact of new energy installations.



- Energy system engineer's (ESE) focus is on the **bigger picture in terms of energy use**.
- An ESE is tasked with improving **energy storage systems**, managing **energy distribution**, analysing **the effect of energy practices on the local environment**, and understating the **effects of energy-related activities on the economy**.
- An ESE needs to have a broad knowledge of **basic engineering all the way to the economics of energy systems**.

Green Building Engineer

Aim

- Analyse energy usage of existing buildings and recommend ways to improve energy efficiency.
 - Design buildings that make use of passive methods to cool and heat themselves.
-
- Infrastructure developers are constantly looking at **building structures that make the most effective use of energy.**
 - This means that every **single aspect of the construction and design needs to be analysed** from an energy efficiency perspective.

BEAM Plus assessment is the Hong Kong's leading initiative to offer independent assessments of building sustainability



Energy Consultants in Finance Sector

Aim:

- Energy consultants are well versed in energy rules and regulations that apply to the venues where their clients do business.
- Gathering and analysing data using technical modelling software, and keeping accurate records.
 - Engineering background a positive.

- Must be a talented writer
- Compile detailed reports outlining your recommendations
- Confident to present to an audience



Example of reports provided by Energy Consultants

Opportunities Across Major Industries

- Sustainable energy engineering graduates are working in all sectors of industry, including,
 - food industry,
 - transport sectors,
 - Pharmaceuticals,
 - biopharmaceutical,
 - biomedical devices,
 - energy supply utilities, and
 - manufacturers of energy systems

These are just a few examples... list is extremely long.

What is Environmental Engineering?

Engineering:

“application of *fundamental scientific principles* to the development and implementation of technologies needed to *satisfy human needs*”

Environmental Engineering

“human needs” = Environmental protection for present and future needs

“fundamental scientific principle” = Environmental Science; other science and engineering fields

What do Environmental Engineers do?

Engineers design and build things to solve specific problems

So what do Environmental Engineers do?



Sub-fields in Environmental Engineering

“Environmental engineering is concerned with

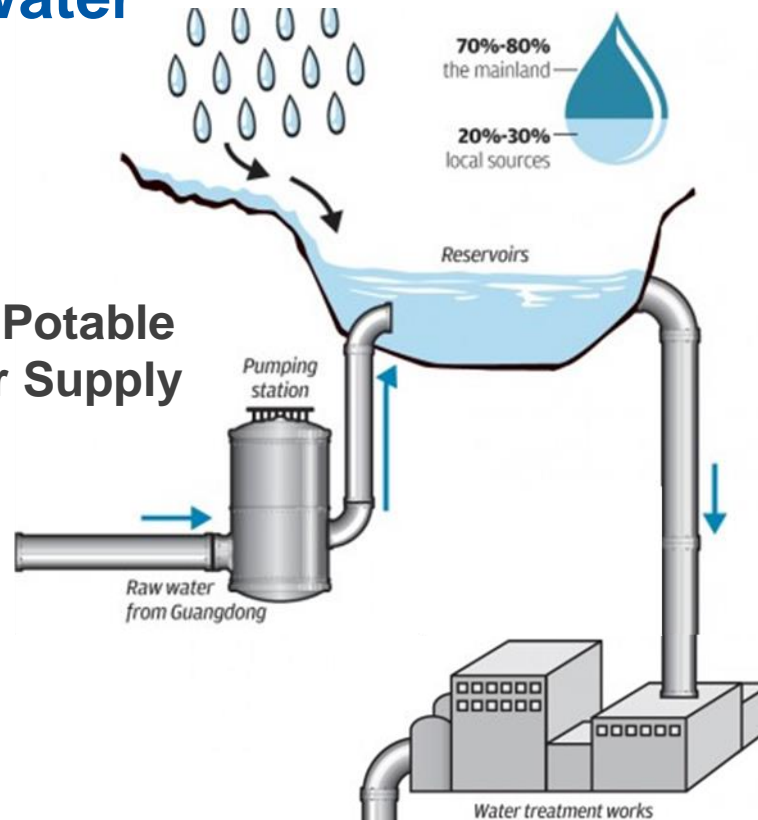
- ***water and waste water treatment and environmental management*** (including application of re-use and recycling),
- **waste management** (including eco-efficiency and cleaner production concepts, and life cycle assessment),
- **surface and ground water system environmental management** (including water quality management),
- **contaminated land assessment and remediation,**
- **natural resource management,**
- **environment protection,**
- **management and pollution control, environmental management system design** (including environmental management planning and auditing),
- **environmental impact assessment and environmental management planning,**
- **environmental information systems, natural system accounting** (including economic evaluation),
- **social impact analysis,**
- **community consultation and dispute resolution,**
- **sustainable energy planning and design, greenhouse gas mitigation and management,**
- **environmental risk assessment and management, and**
- **environmental policy formulation”**

—Institution of Engineers Australia (IEAust)

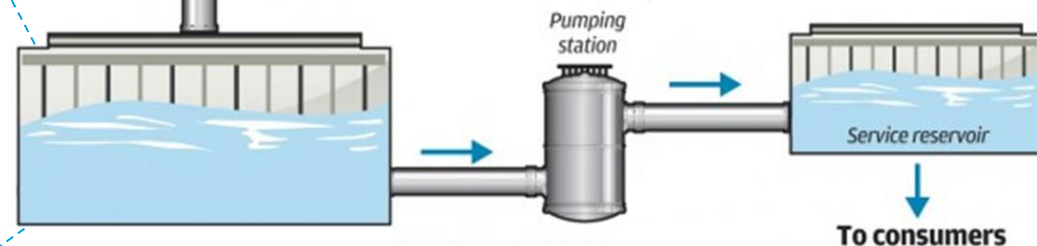
Water and Wastewater Treatment and Environmental Management

Goal: Provide adequate Potable Water Supply

- Storage
- Treatment
- Distribution Systems

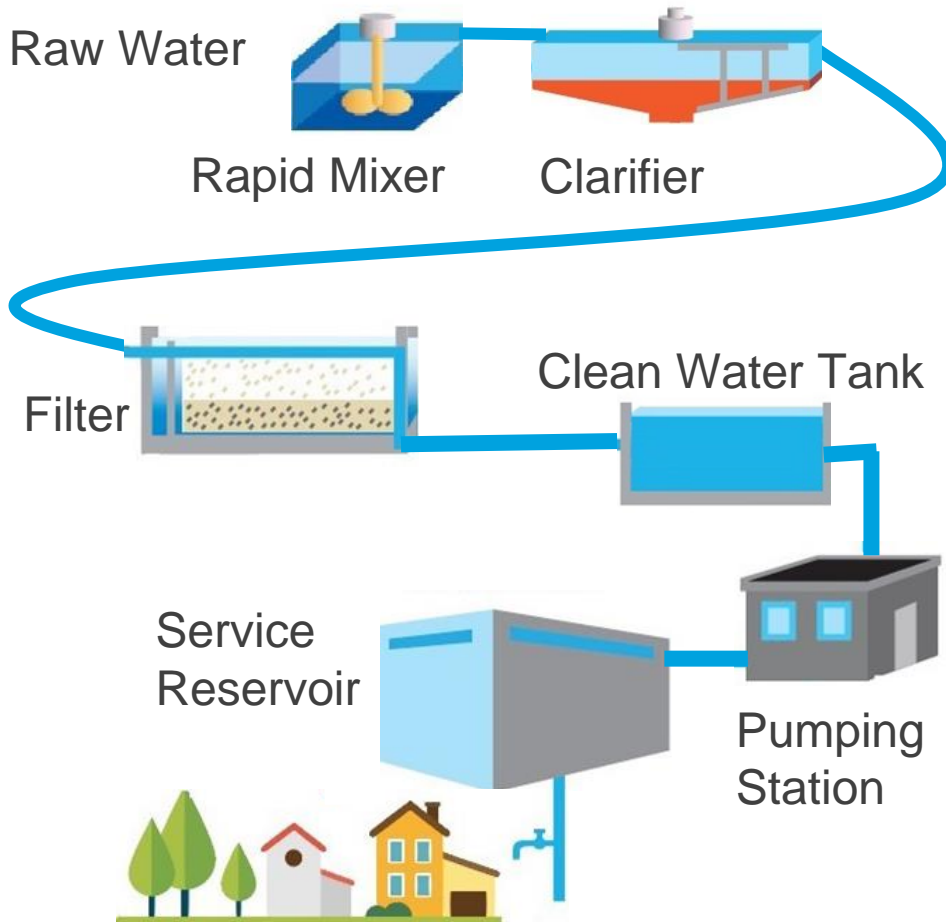


Treatment steps include **purification**, **disinfection** through chlorination and **fluoridation**

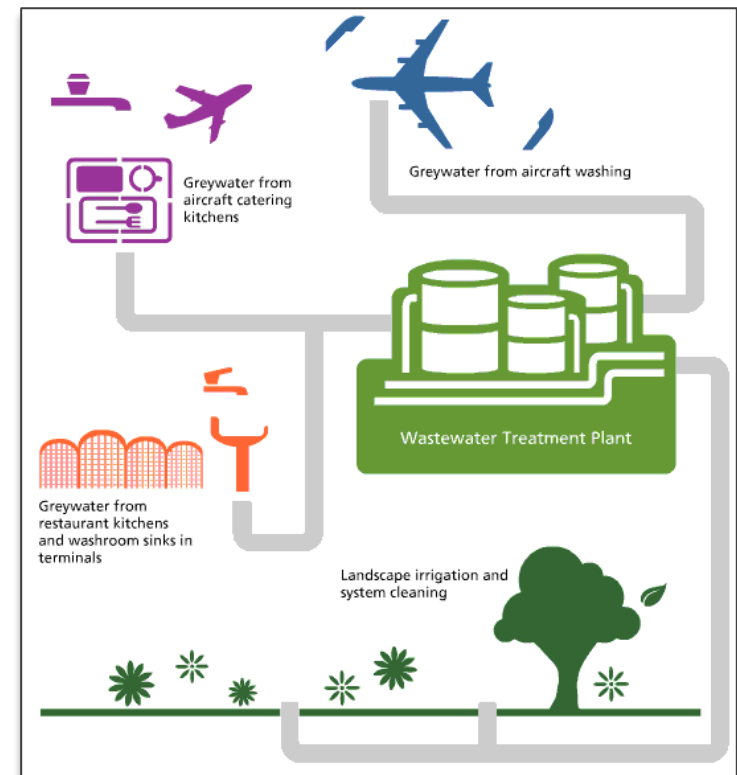


Wastewater Treatment and Environmental Management

Aim: Disposal of human and industrial effluents without danger to human health or unacceptable damage to the natural environment



HKIA Wastewater Treatment Plant

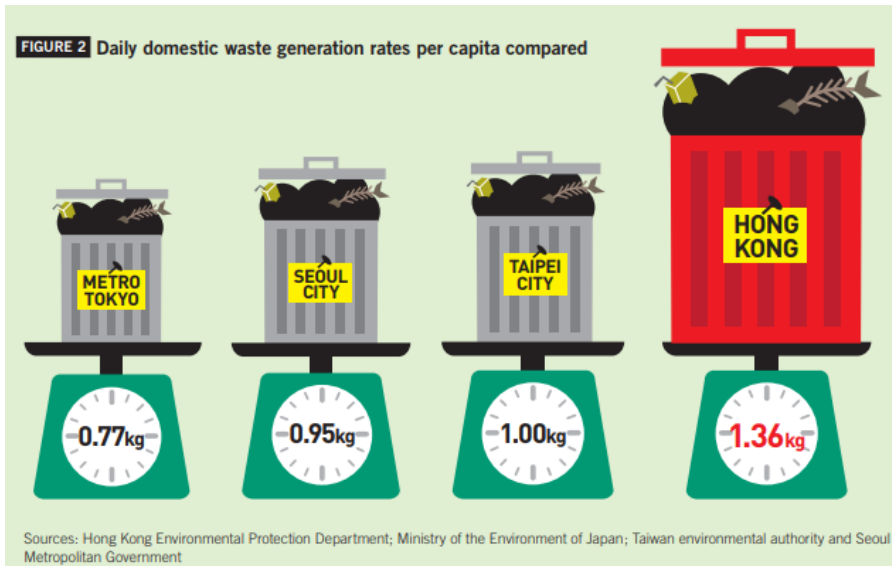


Waste Management

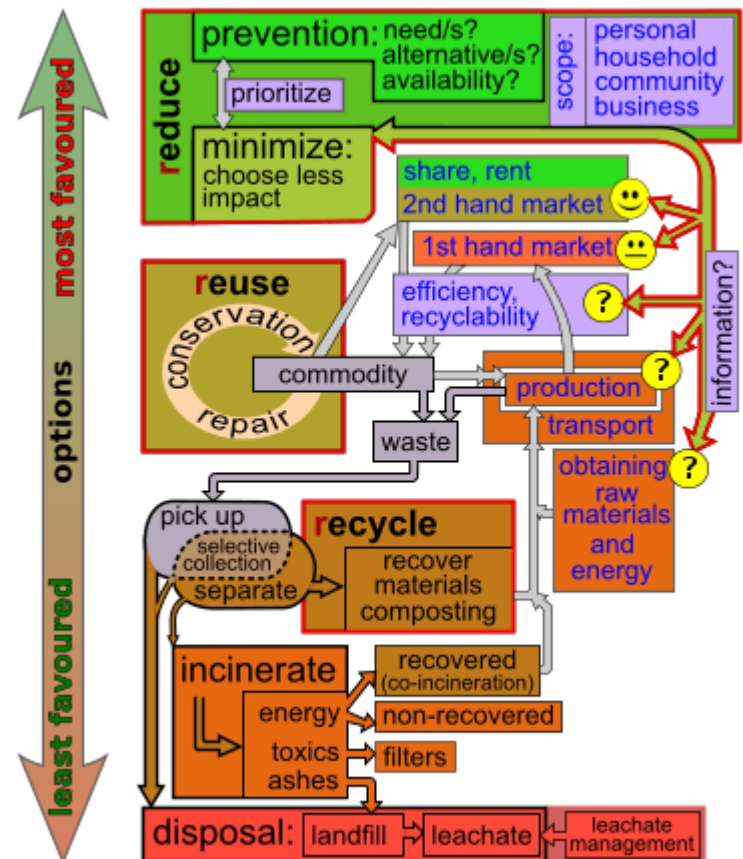
Aim: Manage waste from its inception to its disposal. This includes amongst other things collection, transport, treatment and disposal of waste together with monitoring and regulation.

Challenges in Hong Kong:

1. Large waste load
2. Overflowing Landfills
3. Public Distrust
4. Lack of Infrastructure



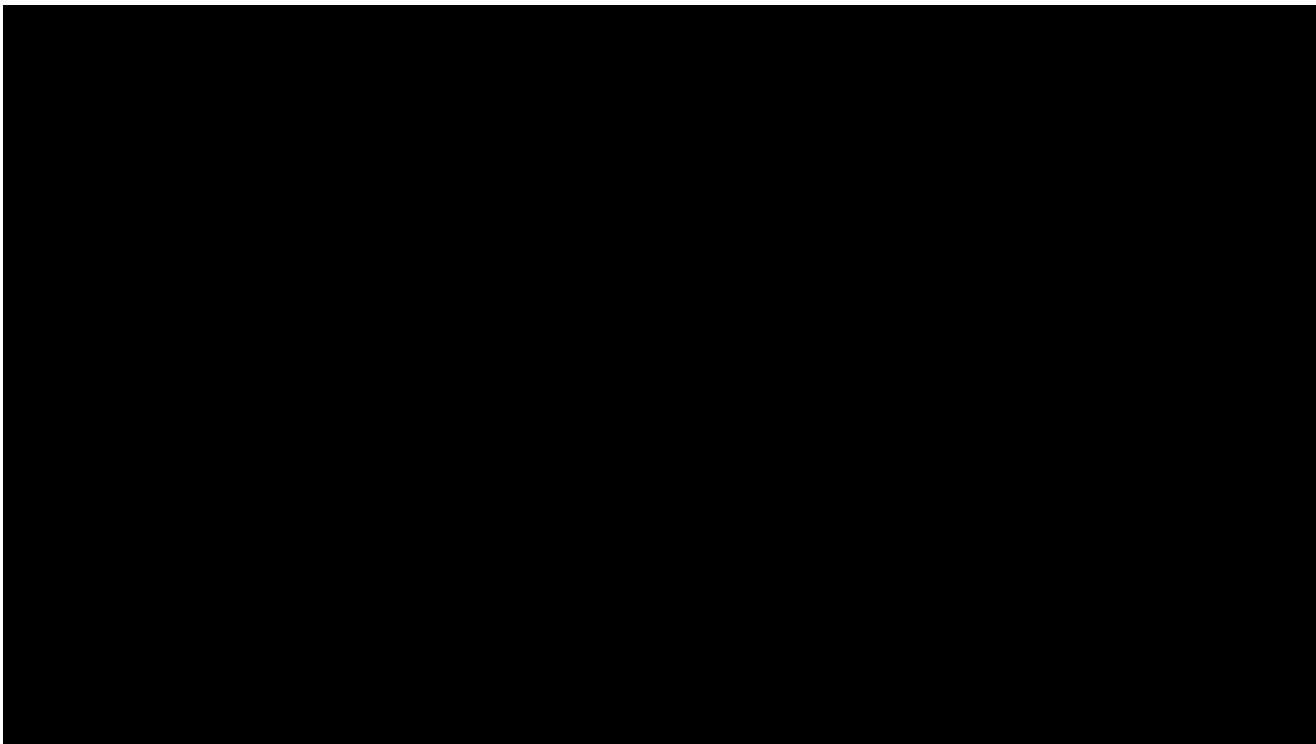
Waste Management Hierarchy



Contaminated land assessment and remediation

Aim: Determine the extent of contamination and remediate site before re-development to prevent unacceptable risks

E.g. Years of toxic waste contamination from a previous chemical factory

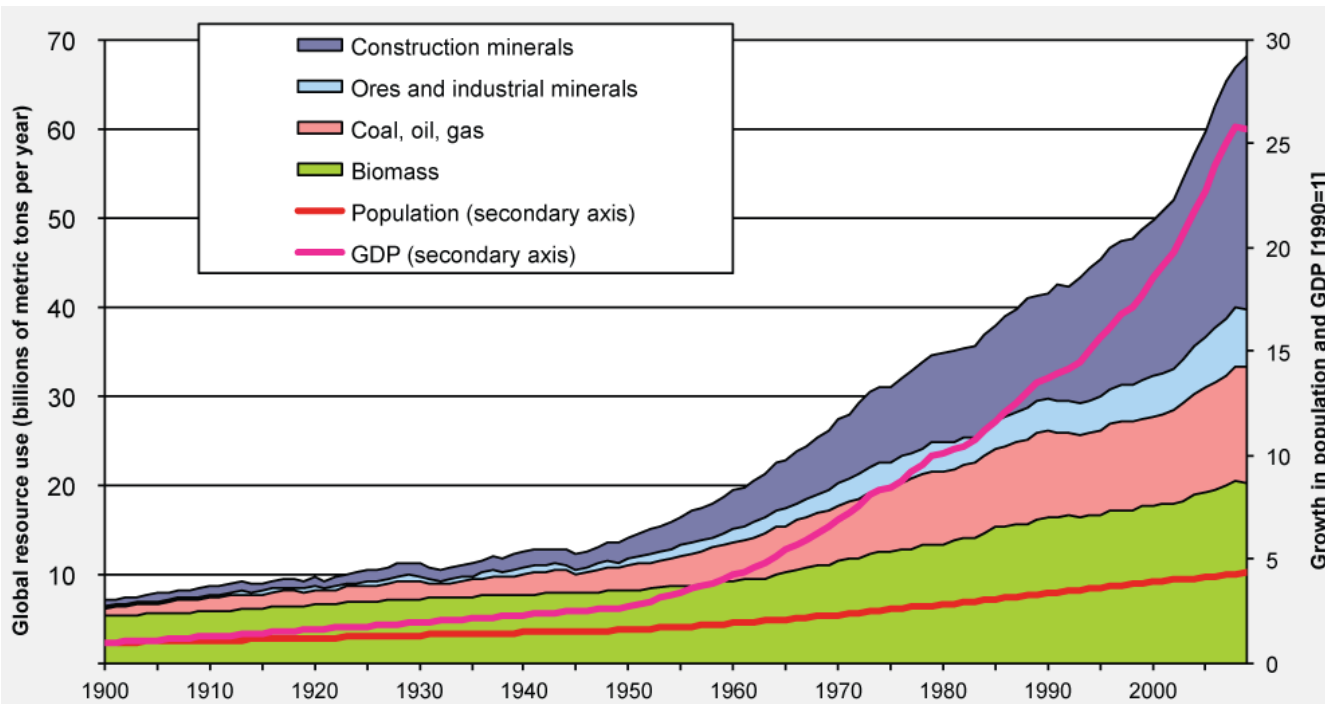


Natural resource management

Aim: Manage the supply of or access to natural resources necessary for survival and development.

Non-renewable Natural Resources: minerals (metals, rare earth elements, etc.), petroleum, and other fuels like coal, uranium.

Renewable Natural Resources: land, water, forests, fish, biodiversity, wildlife, and other ecosystem services.



Major Driver of Global Resource Consumption:

Industrialization!

CityU Strategy: **The 5Rs**
(Reuse, Rethink, Restore, Reduce, Recycle)

Environment protection

Aim: Protection of the natural environment at the governmental level by formulating and implementing policies for the benefit of both the environment and humans



Environmental Protection Department

The Government of the Hong Kong
Special Administrative Region

“The EPD is responsible for developing policies covering

- ❖ **environmental protection, nature conservation;**
- ❖ **enforcing environmental legislation;**
- ❖ **monitoring environmental quality;**
- ❖ **providing collection, transfer, treatment and disposal facilities for various types of waste;**
- ❖ **advising on the environmental implications of town planning and new policies; handling pollution complaints and incidents; and**
- ❖ **raising awareness and support in the community for environmental initiatives”**

Management and pollution control, environmental management system design

Aim: Management of an organization's environmental programs in a comprehensive, systematic, planned and documented manner

6 CHALLENGES TOWARD 2050

TOYOTA ENVIRONMENTAL CHALLENGE 2050



ISO 14001:2015 sets out the criteria for an environmental management system and can be certified to.

| CHALLENGE 1 | CHALLENGE 2 | CHALLENGE 3 | CHALLENGE 4 | CHALLENGE 5 | CHALLENGE 6 |
|--|---|--|--|---|---|
| New vehicle Zero CO ₂ Emissions Challenge | Life Cycle Zero CO ₂ Emissions Challenge | Plant Zero CO ₂ Emissions Challenge | Challenge of Minimizing and Optimizing Water Usage | Challenge of Establishing a Recycling-based Society and Systems | Challenge of Establishing a Future Society in Harmony with Nature |



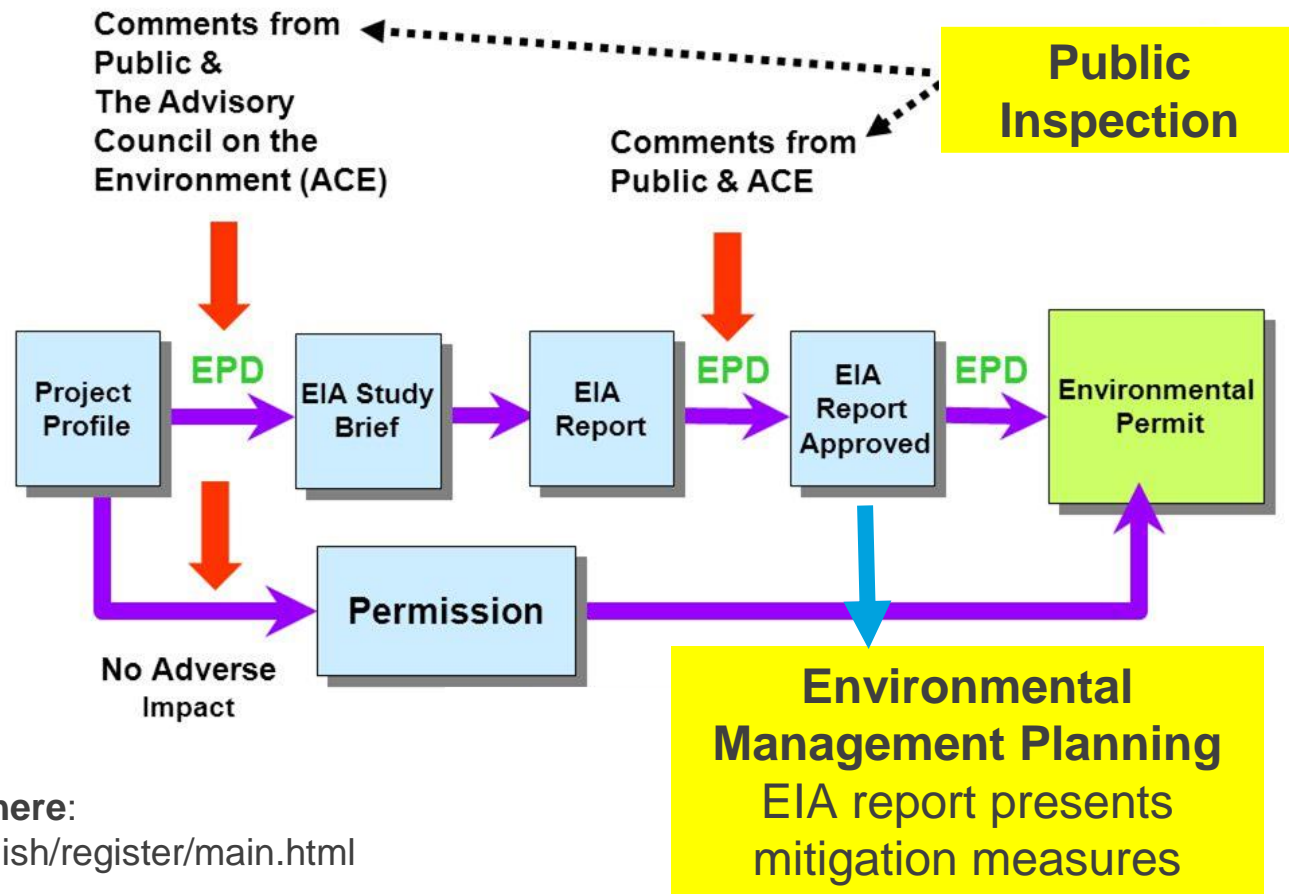
Environmental Impact Assessment and Environmental Management Planning

Aim: Ensure effective environmental management outcomes for development projects

EIA report includes assessment of:

- ❖ Air Quality
- ❖ Water Quality
- ❖ Noise Pollution
- ❖ Waste Management
- ❖ Land Contamination
- ❖ Ecological Impacts
- ❖ Visual Appearance
- ❖ Cultural heritage
- ❖ Public health risks

Hong Kong EPD is responsible for EIA



Read EIA reports from EPD here:

<http://www.epd.gov.hk/eia/english/register/main.html>

Environmental, Social and Governance (ESG)

- “Informed market” calls for disclosure of all information that might have a significant impact on the company or its business
- Hong Kong Stock Exchange (HKEX) mandates all listed companies to produce an Environmental, Social and Governance (ESG) Reports
 - ESG guide introduced in 2013 to encourage listed companies
 - In 2016, ESG reporting moved from voluntary to recommended
 - From 2017, ESG reporting is a requirement
- Potential area for employment for all of you

Summary

- Energy and Environmental Engineers are not too different, focus on sustainability common
 - Will study similar courses and have options to pick common electives
- Job Opportunities Numerous in the Future
 - Both are jobs that cannot be automated completely
- Passion for Physics and Mathematics essential for Energy Engineers
 - Should love numbers
- Passion to solve environmental crisis both globally and locally very important
 - Strong interest in interdisciplinary studies and data sciences
 - Have to be good writer and confident speaker
- Entrepreneurship opportunities plenty

Career Activity

1. Log in to [Glassdoor.com.hk](https://www.glassdoor.com.hk) and click on Jobs. You may register to see Salaries as well.
 - In the Keyword Search box, enter “Energy Engineering” and click Search.
2. Identify 5 different jobs and note them down.
3. Before reading more about the job, write down three things you think you would like about each of them. (e.g., on-the-job activities, work environment, or other interesting aspects)
4. Now read the job requirements for each of the jobs and identify the qualifications (e.g. degree, experience, skills, certificates, etc.)
5. Read the job description, and compare them with your answer for question 3.
6. Answer the question:
 - How did the job match up with your interests and expectations? Do you still think it is a good job option for you? Why or why not?
7. Repeat Step 1 with “Environmental Engineering” as the keyword.