University Experiential Pedagogy to Advance Safety in Renewable Energy

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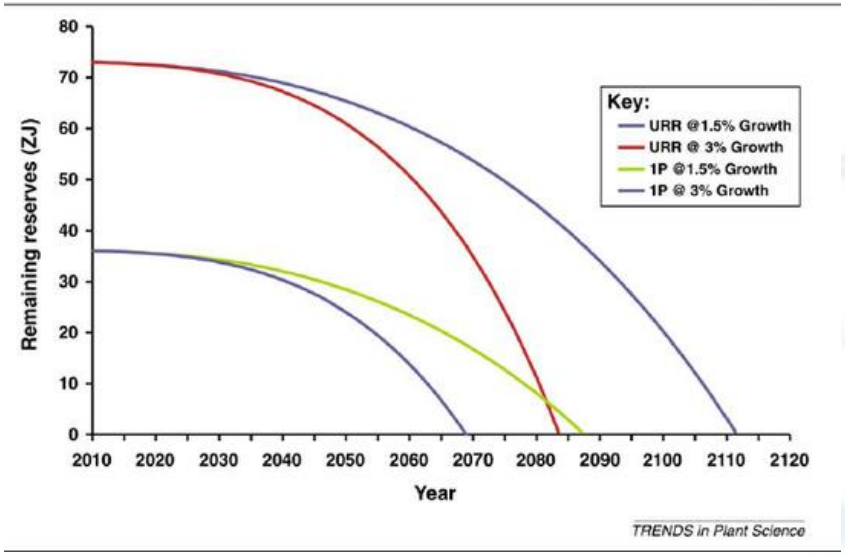
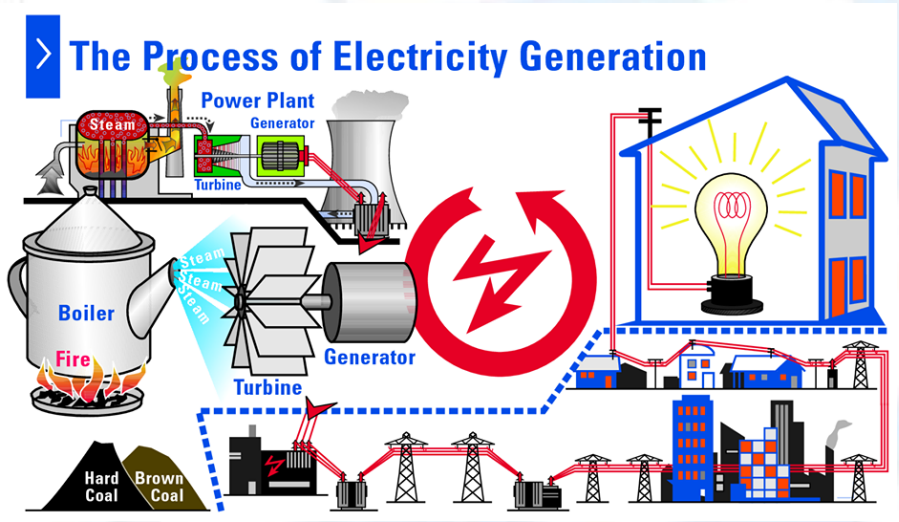
Introduction to Renewable Energy

- Nowadays, electrical energy form an indispensable part of every day activities
- Fossil Fuels form the main source of electrical generation
- Fossil Fuels depletion is inevitable[1]



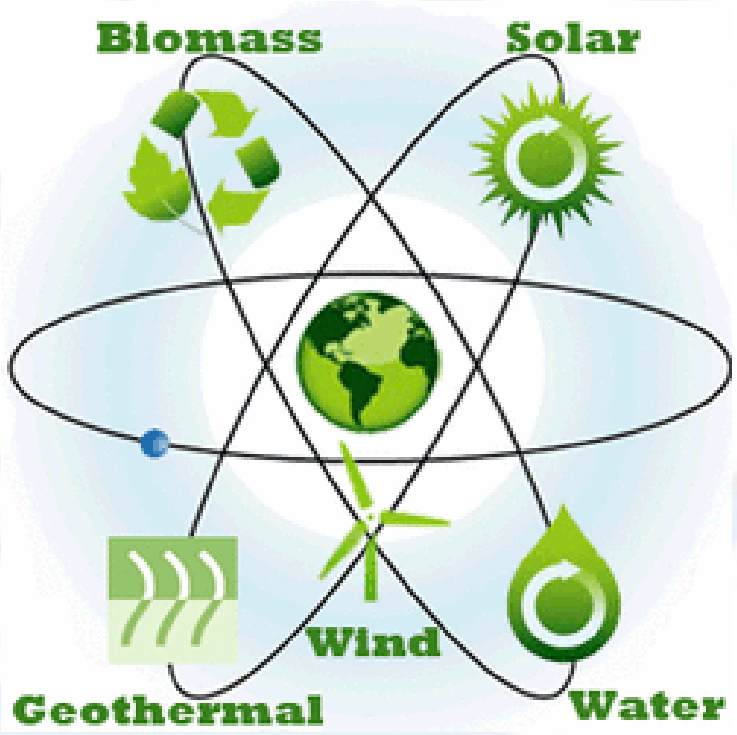


1 Stephens, Evan & Ross, Ian & H Mussgnug, Jan & Wagner, Liam & Borowitzka, Michael & Posten, Clemens & Kruse, Olaf & Hankamer, Ben. (2010). Future prospects of microalgal biofuel production systems. Trends in plant science. 15. 554-64. 10.1016/j.tplants.2010.06.003.

Introduction to Renewable Energy

- The search for renewable energy sources is a necessity to ensure sustainable supply of the required power demand

- Renewable Energy Sources
  - Solar
  - Wind
  - Biomass
  - Geothermal
  - Ocean Energy
  - Hydro Energy

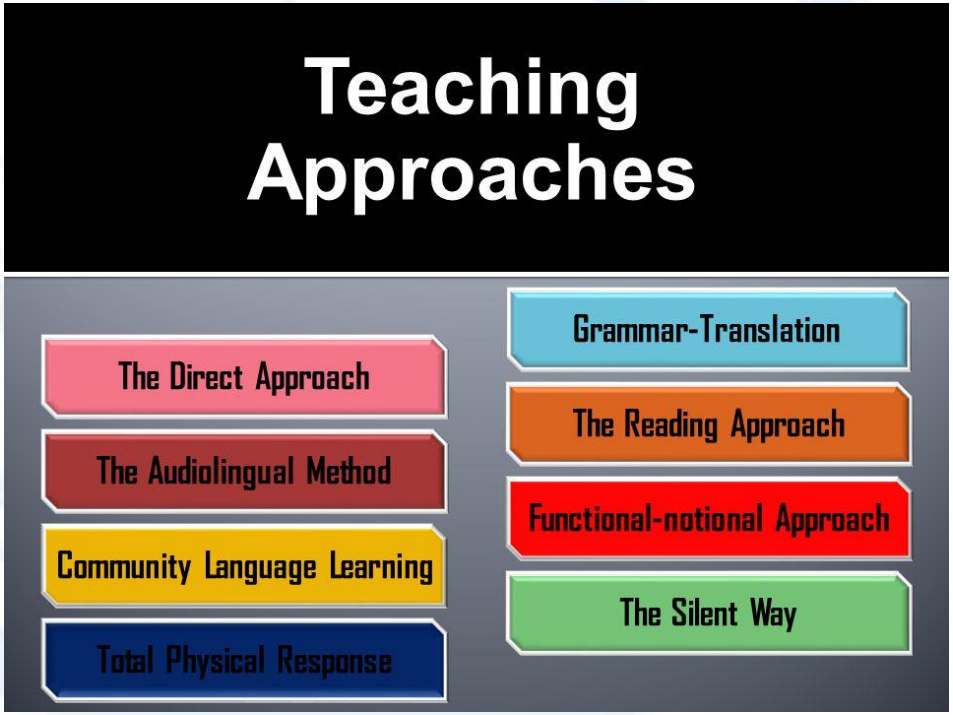


Introduction to Renewable Energy

- The work in this paper focuses on Photovoltaics and Wind Energy Systems

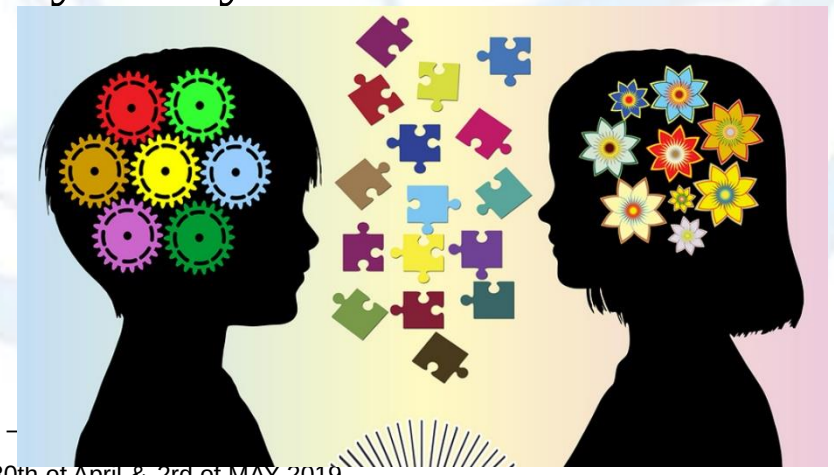
Introduction to Pedagogical System

- What is Pedagogical System?
  - Is it the approach to teaching and learning?
  - Is it how knowledge and skills are exchanged?



Introduction to Pedagogical System

- Engages the students and ensures that graduates have advanced Critical Thinking abilities that
  - reflect positively on safety, environment and cost
- Most importantly, making sure that students are enjoying the proposed program concentration, which
  - ensures additional awareness of the graduates in their individual fields
- Provides a learning platform for early safety awareness



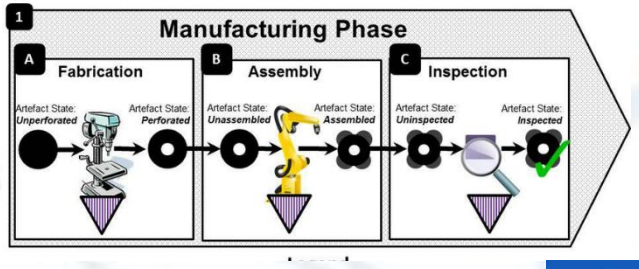
https://www.shutterstock.com/search/college+students+enjoying?search_source=base_related_searches

https://www.gettingsmart.com/2017/08/creating-change-agents-the-intersection-of-critical-thinking-and-student-agency/

Safety in Renewable Energy

- Safety in Renewable Energy Systems
- The presentation divided the safety awareness into the following four sections:

  - Design Phase
  - Manufacturing Phase



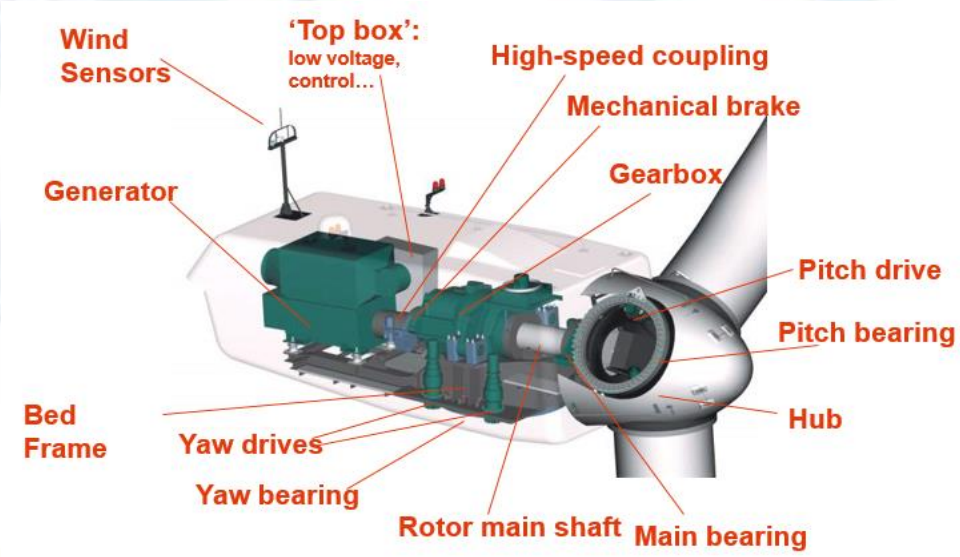
  - Installation & Commissioning Phase

  - Maintenance Phase

Wind Energy System: Safety Consideration

Design & Manufacturing Phases

- Structure Safety
  - Weight
  - Access
- Mechanical Safety
  - Equipment ratings for speed
  - Gearings
- Electrical Safety
  - Equipment ratings for power generation
  - Earthing system for fault, system malfunction and lightning
  - Electrical Protections



Wind Energy System: Safety Consideration

Installation & Commissioning Phase

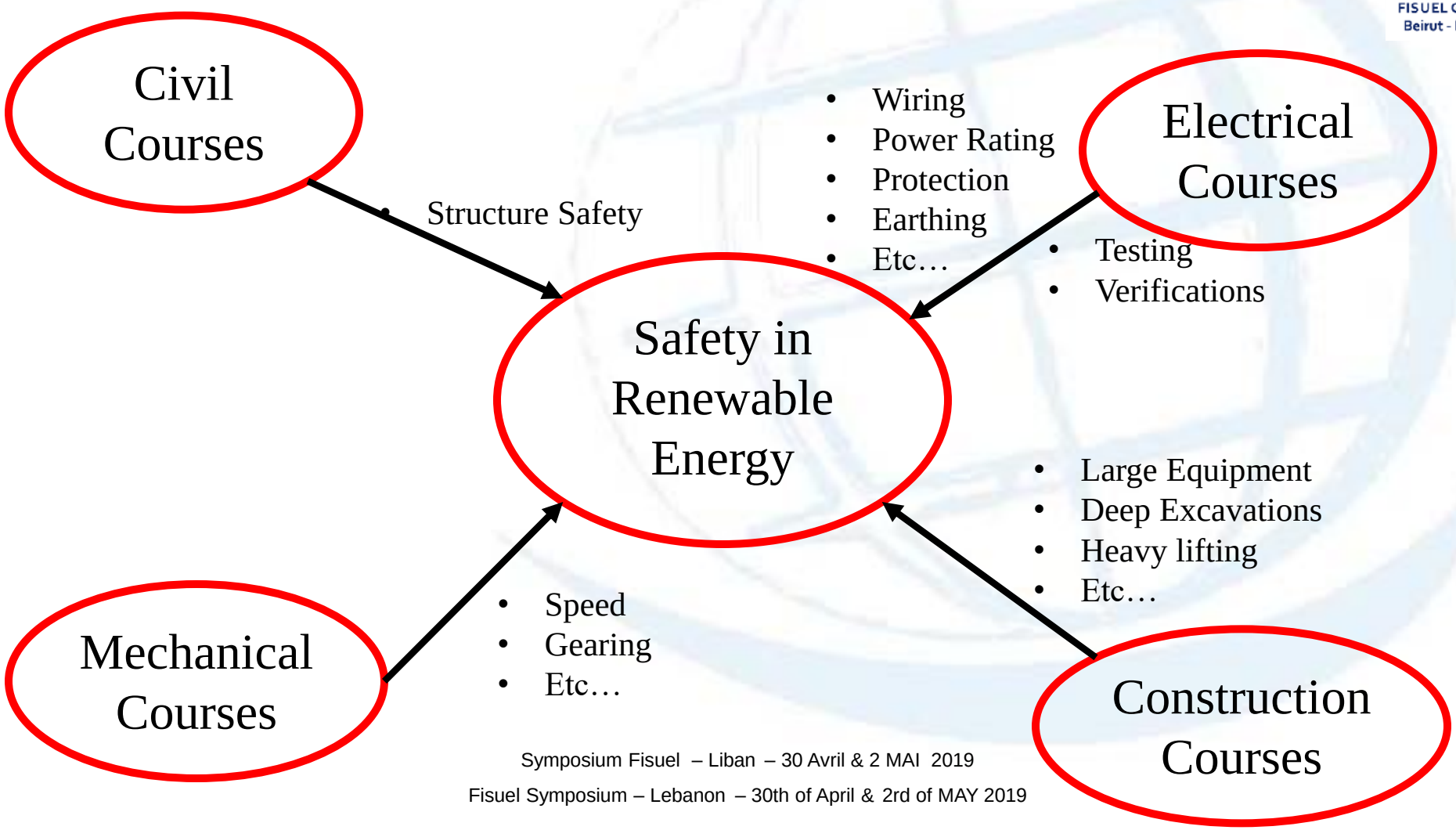
- Civil Works
  - Working with Machines
  - Heavy equipment
- Mechanical works
  - Adequate fixing
  - Adequate torque
- Electrical Installation
  - Adequate wiring system
  - Proper jointing and insulation
  - Temporary earthing for lightning strike
  - Temporary Electrical Protections during construction
  - Testing

Wind Energy System: Safety Consideration

Maintenance Phase

- Access
- Routine inspection
- Routine testing

Experiential Pedagogical System and Safety in Renewable Energy (1/3)



Experiential Pedagogical System and Safety in Renewable Energy (2/3)

Main steps:

- Course syllabus captures the latest technologies
- Teaching style to engage students and capture their interests
- Faculty members with wealthy practical experiences

https://www.literacyplanet.com/au/news/engage-7-types-learners-classroom/

https://medium.com/@samarthmathur/impact-of-latest-technology-on-our-lives-da93cc9ef781

Experiential Pedagogical System and Safety in Renewable Energy (3/3)

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Beirut - Lebanon

Main steps:

- Course projects related to the industries
- Learning materials capture the safety requirements of the system
- Highlights the advanced benefits of safety compliance for the human wellbeing, environments and cost
- Engage speakers from the market

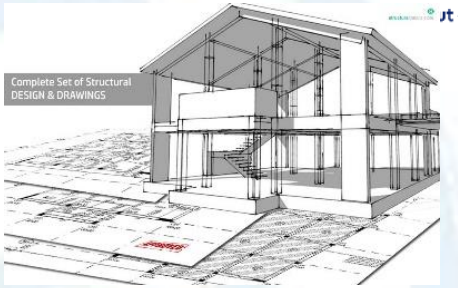
https://www.fcslearningsolutions.com/compliance-and-safety

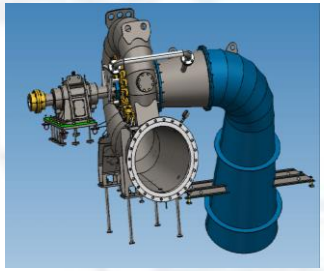
https://en.wikipedia.org/wiki/Environmental_chemistry

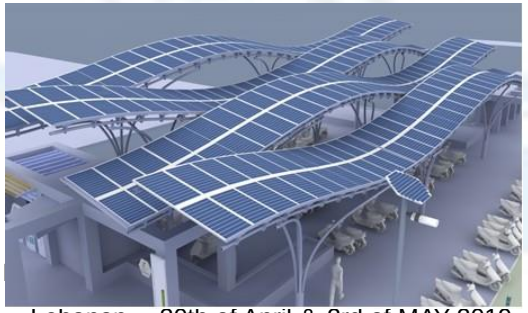
Case Study (1/7)

Student Project & Scope of Works

- Building net zero house in Dubai
- The scope of the student work includes
  - Structure and Civil
  - Mechanical
  - Electrical wiring
  - Photovoltaic System
  - Energy Storage

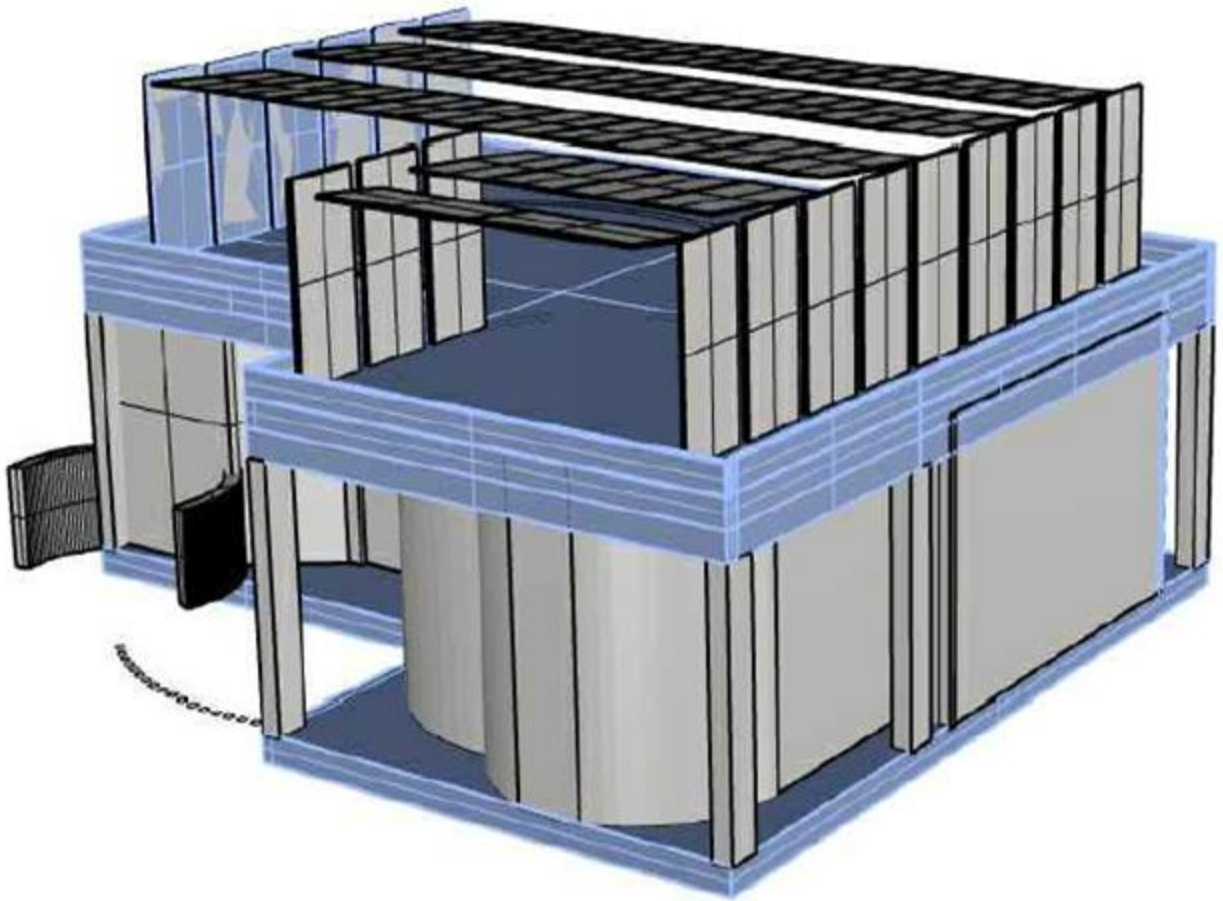






Case Study (2/7)

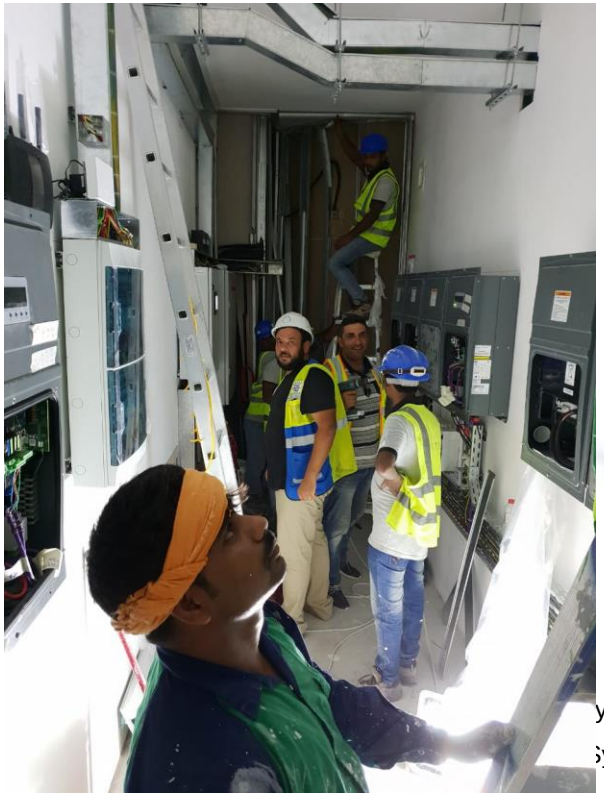
- Designed house by AUD Students



Case Study (3/8)

Group projects offers all students (Civil, Mechanical, Electrical and Computer) an eye on safety:

- Working with heavy structure (in conjunction with leading company from the industry HSBC)
- Working with PV system (Working with light DC source during sunlight) (in conjunction with leading companies from the industry, ASU and ABB)



Case Study (4/7)

Group projects offers all students (Civil, Mechanical, Electrical and Computer) an eye on safety:

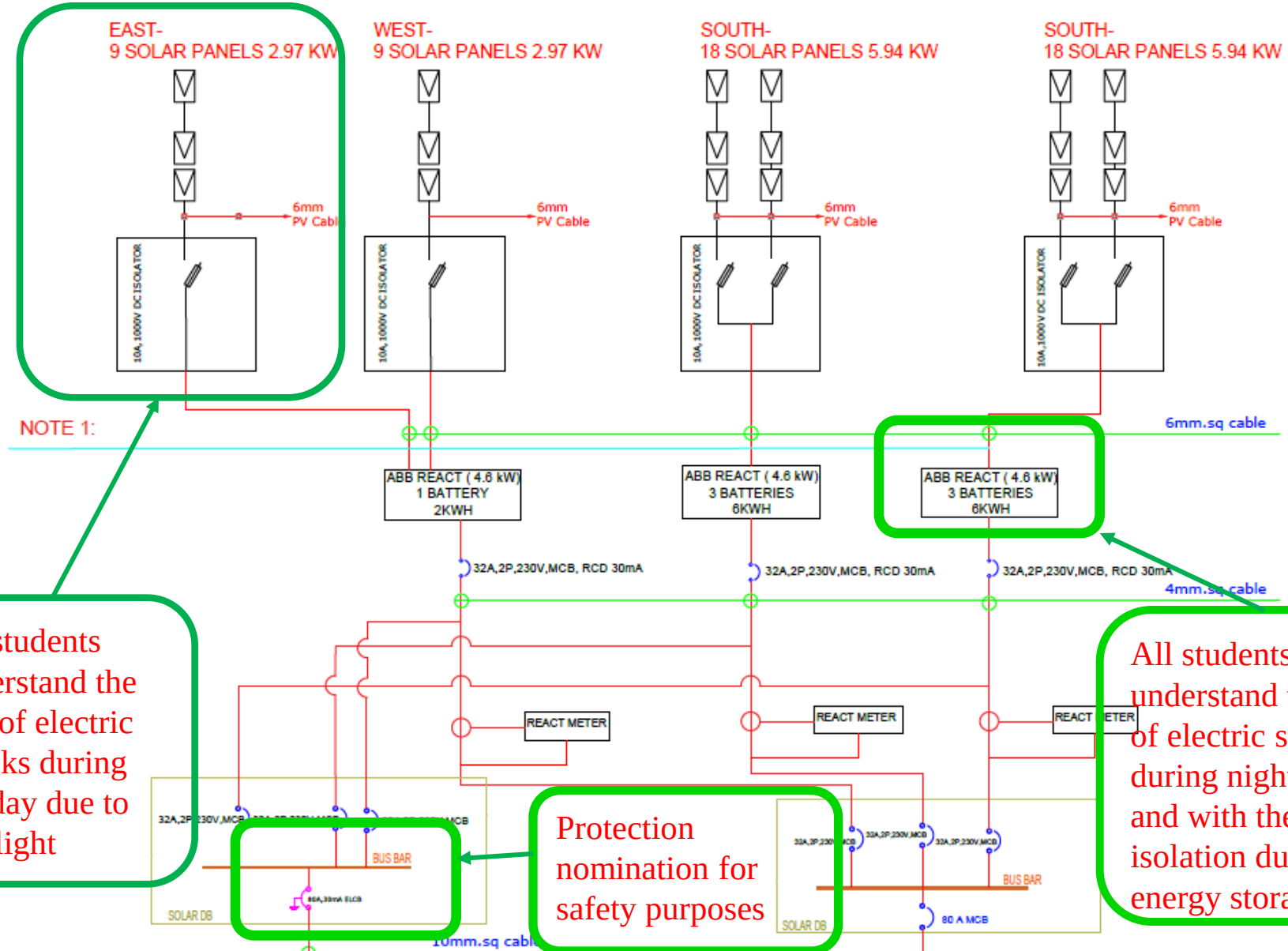
- Working with energy storage (Always be aware that you are working with the energy source) (in conjunction with leading companies from the industry, ASU and ABB)
- Extra care shall be taking when wiring the PV panels as it has DC power due to sunlight (in conjunction with ASU, Canadian Solar and ABB)

Case Study (5/7)

Group projects offers all students an eye on safety:

- Place the wires away from obstacles that could cause damages which has the potential of electric shocks (in conjunction with ASU and ABB)
- Design the system for clear access for testing and maintenance purposes (In conjunction with ASGC and ABB)

Case Study (6/7)



All students understand the risk of electric shocks during the day due to sun light

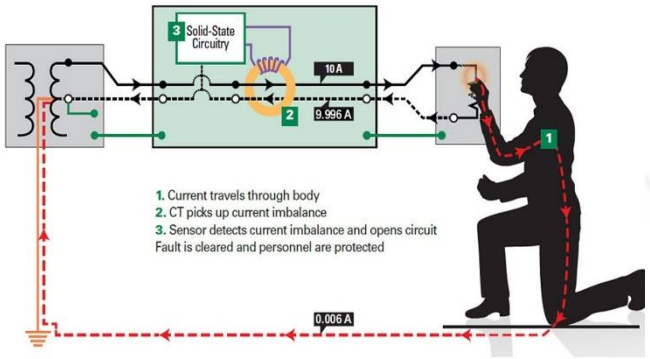
Protection nomination for safety purposes

All students understand the risk of electric shocks during night time and with the grid isolation due to energy storage

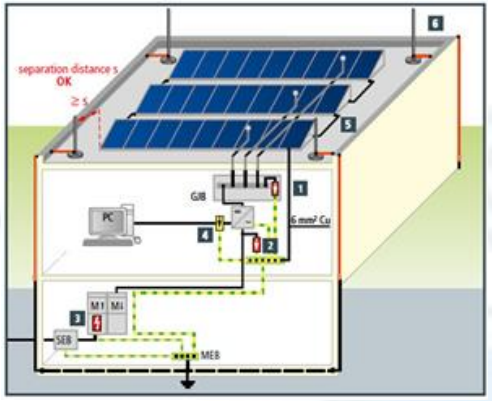
Case Study (7/7)

In addition to the previous slide, electrical students grasp the following skills:

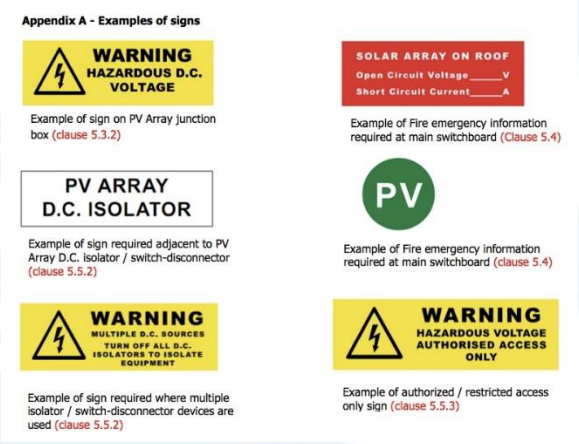
- Design **isolations for the DC system** to ensure safety requirements
- Design and install **warning signs due to DC system**
- Design the **surge arrestors** for lightning and overvoltage protection
- Design **safety protection (RCD)** to ensure system safety compliance
- System **testing and commissioning**



https://www.youtube.com/watch?v=CL1zIVWvr9g



https://www.electricalreview.co.uk/advertorials/10363-lightning-and-surge-protection-for-photovoltaic-pv-systems



https://www.solarchoice.net.au/blog/changes-to-as-nzs-5033-solar-pv-installation-standard-2012/

Conclusions

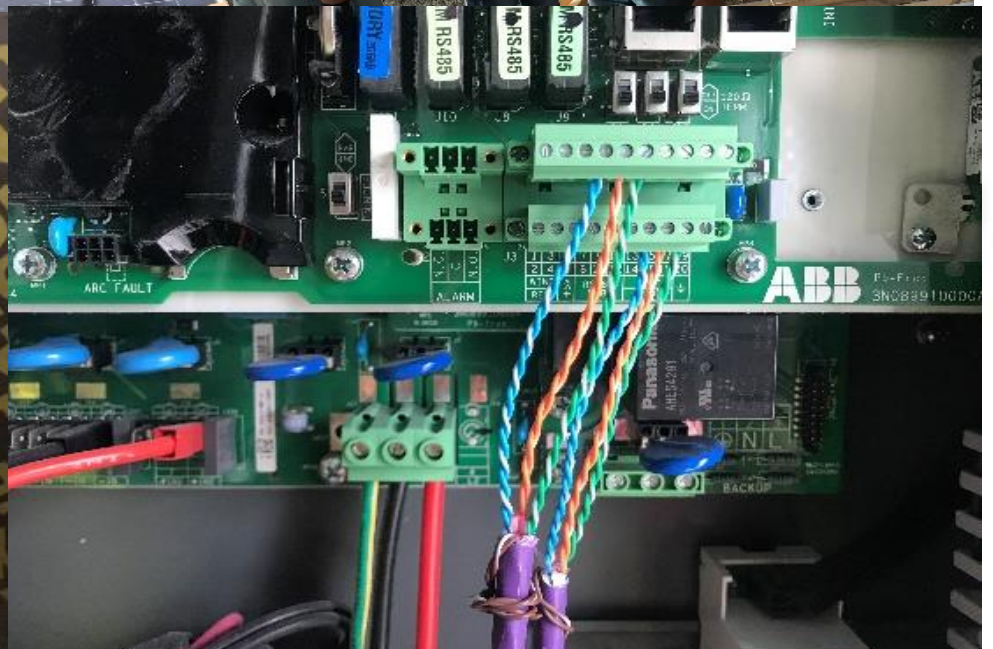
- The pedagogical system should be designed not only to capture the theoretical aspect of the courses.
- Also to capture the industrial requirements from safety and installation points of views
- The implemented system showed the upper hand of AUD students when working with professional from the market
- The project was assessed by the government safety division, which they were very satisfied

Students from different departments were exposed to the safety awareness of different design elements. This increase the safety awareness not only for the specialist designers, also for the general manpower.

In addition, this advance the safety awareness of renewable energy within the public, which they are the owner, operator and maintainer of the system

Pictures-AUD Senior Design-2018

Pictures-AUD Senior Design-2018



Pictures-AUD Senior Design-2019

Pictures-AUD Senior Design-2019

Symposium Fisuel – Liban – 30 Avril & 2 MAI 2019

Fisuel Symposium – Lebanon – 30th of April & 2rd of MAY 2019

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