Sustainable Energy System (ENES801002) - 6 Credits

Instructors

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Course description

Motivated by the desire to design future energy systems and create a sustainable and clean environment, there is gradual shifting from the use of fossil fuels to more clean and sustainable energy resources. Fossil fuels which are currently most used to meet energy demand, are now being depleted. Currently, Indonesia is also facing the transition from fossil energy exporter to oil importer. One thing is very true that achieving future sustainable energy system requires more role of renewable energy and holistic policy approaches by taking into account economic, environmental and social dimensions. The purpose of this course is to provide an overview of current energy status and the transition to future energy systems, especially energy resources (fossil and renewables), conversion, transportation, storage and end-used technologies as well as its linkage to other systems (economic, social and environment). The class will explore the current issues of energy and understand the challenges in sustainable energy technologies and policy in fulfilling world and national energy needs in a sustainable manner.

Course objective

Students who complete this course will be able to:

1 Explains the principles of energy system.
2 Distinguish the concept of sustainability and sustainable energy.
3 Distinguish the relationships of energy system to economic, society and environment systems.
4 Interpret geopolitical and global aspects of energy related to their supply-demand chains.
5 Analyze technical, economic, and environment attributes of sustainable energy systems from resource, conversion, transportation, storage, and users.
6 Analyze the energy demand, energy efficiency and how to reduce it, include consumer behaviour.
7 Understand sustainable energy policy and international commitment.

Course content

Week/Instructor /Date	Topic	Reading	Assignments
1 WWP Wed, 28 August	Concept of energy system, sustainability and sustainable energy	JT Ch.1, GB Ch. 1, MK I.1, F&S Ch.1	
2 ST 4 September	Global climate change, mitigation and cleaner fossil energy systems	JT Ch.4, 7, GB Ch. 5, 7, 13,14	
3 WWP 11 September	Energy System Transition	IEA	
4 HP 18 September	Renewable Energy II: Bioenergy	JT Ch.10, F&S Ch.4	HW 1
5 ST 25 September	Renewable Energy II: Hydropower System	JT Ch.12, MK I, III	HW 2
6 ST 2 October	Renewable Energy III: Ocean Energy	JT Ch.14, MK I	
7 HP 9 October	Renewable Energy IV: Geothermal Energy *(Guest Lecture)*		
8 ST 16 October	Mid Exam		

Week/Instructor /Date	Topic	Reading	Assignments
9 ST 30 October	Renewable Energy IV: VRE – Wind Energy	TB Ch.2-3, JT Ch.15	HW 3
10 ST 6 November	Renewable Energy V: VRE – Solar Energy (PV and thermal)	JT Ch.13, MK I, III	
11 WWP 13 November	New Energy: Hydrogen+Fuel and Fuel Cell, Nuclear Energy	JT Ch.9, 16	
12 ST 20 November	Energy Storage and Power Flexibility (PtX)	JT Ch.17, F&S Ch. 10, IRENA	HW 4
13 WWP 27 November	Energy Demand Systems; Energy Efficiency; and conservation	JT Ch.17,18,19,20, F&S Ch.12	
14 WWP 4 December	Sustainable Energy Policy and Energy Economic	SCB Ch. 11	
15 HP 11 December	Class Project Presentation		
16 HP 18 December	Final Exam		

Grading System (4 credits)

HW	= 10%
Class Project	= 15%
Paper/Presentation	= 15%
Mid Exam	= 30%
Final Exam	= 30%

Required Books

1. Jefferson W. Tester, et al., Sustainable Energy: Choosing Among Options, MIT Press, 2005 (**JT**)
2. Godfrey Boyle, et al. Energy Systems and Sustainability: Power for a Sustainable Future, Oxford University Press, 2003. (**GB**)
3. Mac Kay, D.J.C., Sustainable Energy –without hot air, UIT Cambridge, 2008, free online (**MK**)
4. Dincer, Ibrahim**,** Zamfirescu**,** Calin, Sustainable Energy Systems and Applications, Springer, 2012 (**D&Z**)
5. Hendrik Lund, Renewable Energy Systems. A Smart Energy Systems Approach to the Choice and Modeling of 100% Renewable Solutions, 2nd Edition, Elsevier, 2014 (**HL**)
6. Frank Kreith, Susan Krumdieck, Principles of Sustainable Energy System, 2014, CRC Press, (**F&S**)
7. Amritanshu Shukla and Atul Sharma, Energy Security and Sustainability, 2017, CRC Press (**A&A**)
8. Bhattacharyya. Energy Economics. Springer 2011 **(SCB)**
9. Tony, L Burton. et al. Wind Energy Handbook. Available from: VitalSource Bookshelf, (3rd Edition). Wiley Professional, Reference & Trade (Wiley K&L), 2021 **(TB)**

Other useful references

10. Website of related institution: Sustainable energy for all- UN (Sustainable Energy for All | Sustainable Energy for All (seforall.org)), IRENA (IRENA – International Renewable Energy Agency)
11. Course web sites: Sustainable Energy – MIT (https://ocw.mit.edu/courses/nuclearengineering/22-081j-introduction-to-sustainable-energy-fall-2010/index.htm)
12. IRENA Power Flexibility (https://www.irena.org/publications/2018/Nov/Power-systemflexibility-for-the-energy-transition) (IRENA)
13. Net Zero by 2050 IEA (https://www.iea.org/reports/net-zero-by-2050) (IEA)