KAIST Business School, 2017 Spring
GG551: Green IT & Smart Grid

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W, 16:00 – 18:50, Room: 000

for MS in Green Business & Policy Program and Green MBS Programs

Version 1.0

1. Course Overview

This course explores a set of emerging concepts, technologies, applications and business models, and the related trade-off decisions involved in transforming the nation's half-century old, centralized power grid into a climate and renewable energy-friendly "Smart Grid."

The use of communication and information technology is essential to shift energy paradigm from supply to demand. The smart grid will use these technologies to deliver electricity reliably and efficiently, and it has the potential to radically change the electricity sector in the same way that new technologies changed the telecommunications sector.

Many visionaries informed about the world of energy policy believe that this emerging "Internet for Energy" will enable individual and business to participate in generating and storing energy from multiple sources. The Smart Grid will integrate generation from both directions – home/business and central station plant – and move it as needed to meet load while incorporating solar panels, wind farms, fuel cells, plug-in hybrid electric vehicles, and other energy sources.

This intelligent electric network will manage load shape and will achieve greater utilization than today. Its full value will be achieved when it is combined with an emerging participatory network model that enables consumers to actively manage their electricity consumption and sell back to the grid the surplus power they generate. This course will examine not just the smart grid technologies, but the transformational impacts of the smart grid on the industry.

2. Objectives

Upon completion of this course, students are expected to understand the following subjects.

1) The various aspects of the smart grid, including
   - Technologies, Components, Architectures, Applications

2) How a smart grid can be designed to meet the needs of a utility, including
   - Meeting a utility's objectives
   - Helping to adopt new technologies into the grid
3) Why ICT is essential to change energy paradigm from supply to demand, including
   - Smart energy platform : E-IoT, Cloud Computing, E-Big Date
4) Practice with the cases of the smart grid industries such as
   - xEMS (Energy Management System) : BEMS, CEMS, FEMS
   - Energy IoT : LTE-based AMI vs PLC (Power Line Comm.)
   - Renewable Energy : the next PV generation
   - Electric vehicle & EV charging strategy, and so forth
5) The issues and challenges that remain to be solved

3. Textbook and References

Primary Readings

1. Peter Fox-Penner, Smart Power: Climate Change, the Smart Grid and the Future of Electric Utilities, Island Press, 2014
2. Tony Seba, Clean Disruption of Energy and Transportation, 2014 (번역본 : 에너지혁명 2030, 교보문고)
3. Fereidoon P. Sioshansi (editor), Smart Grid: Integrating Renewable, Distributed & Efficient Energy, Academic Press, 2012
4. 스마트그리드 ,스마트그리드의 기본 개념과 최근 동향, 최동배, 인포더북스, 2016

References

1. L.T. Berger and K. Iniewski, Smart Grid: Applications, Communications, and Security, Wiley, 2012
2. A. Keyhani, M. N. Marwali, and M. Dai, Integration of Green and Renewable Energy in Electric Power Systems, Wiley, 2010
3. P. Schavemaker and L. van der Sluis, Electrical Power System Essentials, Wiley, 2008
4. Energy for future Presidents, Richard A. Muller, W.W. Norton & Company, 2012 (번역본 : 대통령을 위한 에너지 강의),

4. Contact

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5. Teaching Framework

5.1 Interactive Lecture and Discussion

- Reading assignment and lecture note will be posted in advance for preview study
- Discussion questions and preview questions will be given one or two weeks in advance for student's own preview and preparation for possible discussion
- Lecture will explain the key points of lecture objectives and discuss the issues assigned in advance

5.2 Case Discussion and Analysis

- Smart energy business cases will be discussed in class. Students should prepare for the active participation of case discussion
- Student may be invited to prepare for the presentation about case analysis

5.3 Term Project

- Term project may be performed by a team of at most two or by individual
- Term project will be guided throughout the five steps:
  1) Post Self Introduction with Interesting Topics
  2) Team Building and Pre-proposal
  3) Proposal
  4) Team Presentation with PPT

6. Assessment Summary

6.1 Class Activity (20%)

- Read the assigned articles and cases before the class hour. Preview questions will be given in advance on the class folder to guide the reading.
- Post self-introduction by the 2nd week of the semester including interesting areas. Self-introduction will help in finding your project partners with common interest. You may update your interesting area as it develops.
- Class Participation is a MUST. Absence will be penalized by 2% point; late appearance or leaving the class early by 1% point. Please check your presence in the class roster for each class.
- Case and Role Discussion and Presentations are encouraged. Active contribution will get extra credit.
- Join the evaluation of term project presentations of other teams, and suggest constructive critiques for them.

6.2 Homework Assignments (20%)

- Every lecture start with summary presentation of the previous lecture by student (3~5page ppt., 5minutes, 1 lecture/1 student, order will be given)

- Benchmark report of leading company (1 different item per student)

6.3Mid-term Exam (30%)

- In class Mid-term : March 22th

6.4 Term Project (30%)

- **Project Team**:
  - A project may be conducted by a team of two members at most or individually
  - Each member should contribute equally to the team.
- **Project Subjects**: Research topic development, Case development, or Business plan development with justifications.

7. Lecture Schedule Outline

Week 1. Overview: Course Objectives and Syllabus

1-1. Course Introduction

- Objectives of Green IT & Smart Grid
- Scope of Smart Grid Research
- Course structure
- Impact of Climate Change on Energy Industry

1-2. Green Big Bang occurs when ICT converges with energy system

- New trend and Innovation in energy industry
- The 3rd industrial revolution and the 6th wave
- Response of private & public company

Week 2 . Energy New Industry

- What is Energy New Industry? & Why?
- Scope and Component of Energy New Industry
- Winning strategy for Global penetration

[Case Discussion] Utility Company Case

Week 3-1. Smart Energy Platform (1/2) : Energy IoT (Internet of Things)

- What is Energy IoT?
- Is Energy IoT inevitable?
- Energy IoT control elements : smart meter, communications, sensors
- Technologies behind the IoT : RFID + NFC, Wireless networks + WSN

Week 3-2. Smart Energy Platform (2/2) : Cloud Computing & Big Data

- The benefit of cloud computing
- The scope of energy big data
- How much increase the energy efficiency of consumption and generation
- Emerging Players : EnerNoc, Opower, Nest

[Case Discussion] Telecom Company Case

Week 4. Introduction to Smart Grid System

- Concept and Definition of Smart Grid
- Benefits of Smart Grid over conventional grid
- Smart Grid Architecture and components
- Communication for Smart Grid

[Case Discussion] Jeju Smart Grid project Case

Week 5. Smart Grid expansion (Business models)

- Background of Smart Grid expansion strategy
- Key Business Models
- Key market drivers & market projection

[Case Discussion] KT proposal Case

Week 6. K-MEG : Korea Micro Energy Grid

- What is K-MEG?
- K-MEG business model analysis
- New business opportunity : Smart Green City

[Case Discussion] Guro G-valley Case

Week 7. Mid-Term Exam (30%)

- In class Mid-term : March 22th

Week 8. Advanced Metering Infrastructure

- Key characteristics of AMI
- Communication trend in AMI
- Privacy and Security Issues
- Key market drivers & market projection

Week 9. xEMS : Energy Management System

- Key characteristics of EMS
- BEMS, CEMS, FEMS
- New opportunity and Major player
- Key market drivers & market projection

[Case Discussion] Building & Factory Case

Week 10-1. Renewable Generation (1/2) : PV (Photo Voltaic)

- Major component of solar palm
- Technology trend in solar panel
- EPC and O&M (Operation / Maintenance)
- New trend in solar generation
- Key market drivers & market projection

- **Guest Speaker - Specialist (TBD) : Global Case**

Week 10-2. Renewable Generation (2/2) : Wind Power

- Major component of wind power
- Technology trend in wind power
- Issues when wind power is connecting to Grid

Week 11. Energy Storage System

- Key characteristics of ESS
- Various type of ESS : Li-Ion, Redox-flow, Flywheel, Compressed Air, Fuel cell
- Emerging business opportunity
- Key market drivers & market projection

Week 12. Electric Vehicle Outlook

- Key characteristics of EV
- Various type of EV : Hybrid, PHEV, BEV
- New business opportunity : V2H, V2G
- Key market drivers & market projection

Week 13. Electric Vehicle Charging Platform

- Key characteristics of EV-Charging
- Various type of EV-C : Slow, Quick, Mobile
- New business opportunity : Charging Platform
- Global case : Hubject, Nippon Charging System, Charge Point, Unisys

Week 14. Environmental friendly Eco Island

- Key characteristics of Zero-energy Island
- Issues to build Zero-energy Island
- New export model : Island country and isolated grid

[Case Discussion] Deokjeok Island Case

Week 15. Term Project: Team Presentations (30%)

- 13 minutes presentation and 5 minutes discussion
- All students participate in the comments and scoring