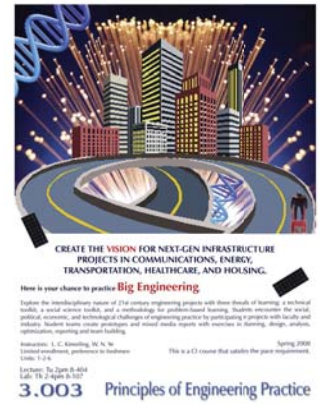

3.003
Principles of Engineering Practice

Engineering the Future of Solar Electricity

Project 1A,B

A: Solar Electricity Generation System Constraints

rate limiting factors

B: Materials Selection

Constraints, FOM analysis

University of Tokyo

- SolaLoco
  - Koseki vs. Salvucci
- *GridSol*
  - *Toriumi vs. Fitzgerald*

May 27-June 1

  - *Trip to Tokyo*

Project 1A,B,C,D Execution

- Each project status review will be presented by a team leader.
  - Take notes from meeting before
  - Manage delivery of commitments
  - Report results to the group (BIRAC format)
    - Goal
    - Progress
    - Next steps
- U Tokyo is part of your team
    - Post on new global website

Engineering Practice

1. Problem Definition (B)
2. Constraints (I)
3. Options (R)
4. Analysis (A)
5. Solution (C)

Engineering the Future of Solar Electricity

Problem

- What fraction of US/global power consumption?
- Timeline for deployment?
- Markets and applications?
- Roles of Government, Users, Investment, Performance, Sustainability?

Constraints

- Design-limiting attributes and specifications
  - Figures-of-Merit, estimates, rules-of-thumb

Project 1A: *due 4-6*
Electricity Generation System Constraints

Applications: FOM Comparisons

- Strengths
  - Attributes of solar electricity
  - Optimization plot
    - x vs. y with maximum for solar attributes
- Weaknesses
  - Barriers
    - Crossover point to solar advantage
- Competition
  - Local power
    - Gasoline: energy/unit volume

P1A: Social and Political Factors

- Solar technical language
- Solar benefits
  - Availability, security, reduced transmission losses, grid independent, grid load leveling
- Greenhouse reduction
- Jobs

Infrastructure Change Issues

- New technology requires changing multiple components.
- Multi-vendor interoperability must be considered.
- Expected rewards in one area are sometimes accompanied by risks of disruption in other more critical application areas.
- Capital cost of infrastructure upgrade vs. sunk cost of existing.
- Missing or incomplete backward compatibility leading to replacing more equipment than will benefit from the upgrade.
- Incomplete value-chain availability, particularly in early stages of new technology.
- New skills availability and adoption.
- Changes in Economic Marketplace.

P1B: Materials Factors

- Materials
  - Absorption: energy gap
  - Charge collection: p-n junction, diffusion length
  - Reflectance: AR coating, texture
  - Current extraction: contacts, shading
  - Light trapping: optics

P1C: Engineering Practice

- Module
  - Interconnection, shading, uniformity
- Manufacturing
  - Extraction of materials, process flow, thin film vs. wafer, throughput, yield
- Deployment
  - Reliability
  - Control circuits, compatibility
  - SWAP: size, weight and power
  - Safety, skill set

Engineering the Future of Solar Electricity
Teams: local power; grid connected power

- Project 1A: *due 4-6*
  - Electricity Generation System Constraints
- Project 1B: due *4-13*
  - Materials Selection
- Project 1C: *due 4-27*
  - Solar Cell Solar Cell Design
  - Module Manufacturing Platform
- Pentachart Summary Presentations: due *5-4*
- Project 1D: *due 5-6*
  - Final Report and Presentation

Project Planning

- Timeline
- Resources
- Problem Definition

The Solar Cell

1) Principles of operation
2) Relevant performance metrics
3) Design for performance
4) Design for manufacturing
5) Design for application
6) What scale of production is consistent with (6)?

Project Execution

- One Project assignment is given and divided into parts for concurrent engineering by teams.
- One solution will be submitted per team. All members of the team receive the same project grade.
- Teams will complete four project stages during the term.
  - Plan; Initial Findings; Solution Consistency among Teams; Final Presentation to Panel of Experts
- The final deliverables are:
  - 20 minute presentation (5-10 slides), during which all workgroup members must speak.
  - Two days later, edited slides and a final two-page report.