21st Century National Energy and Transportation Infrastructures: Balancing Sustainability, Costs, & Resiliency (NETSCORE-21)

Project Group Meeting
December 17, 2008
A 4-year, $2 million dollar project to accomplish the following

1. Provide national blueprint & modeling process: energy policy for state & federal research & investment for next 40 yrs.

2: Identify optimal infrastructure designs in terms of future power generation technologies, energy carriers and storage, and hybrid-electric transportation systems, with balance in sustainability, costs, resiliency.

3: Characterize interdependencies within and between energy resource portfolio & energy/vehicular transportation systems.
• Each faculty and corresponding PhD student is expected to **drive** (compel, force, or urge relentlessly) a major part of the project to facilitate deliverables.

• Deliverables are
  - Modeling approach
  - Application software
  - Identification/characterization of interdependencies
  - 40 year National & State (Iowa) plans to provide good tradeoff solutions between costs/sustainability/resiliency for social dialogue

• We need to **manage** (achieve a goal; be in charge of, act on, oversee, direct, coordinate) a large number of people to succeed.
Project Management

• Management/mentoring structure
  • Weekly meetings to supervise G & U students
  • Monthly meetings between faculty pairs

• Participation:
  • 6 faculty, 7 PhD students
  • Several other graduate students
  • 3 senior design teams/year (48 undergrad students)
  • 4 McNair scholars
  • 2 high school teachers
  • 10 faculty/students from Iowa Lakes Comm. College
  • 25 project advisors

• Communication:
  • Monthly meetings
  • Bimonthly teleseminars
  • Quarterly 1 hour conference calls with PAB
  • Make visits to industry advisors
  • Website

• Reporting:
  • Monthly to McCalley from faculty/PhDs and faculty/SD teams
  • Yearly to PAB, where each PAB grades 1 page summary of 1 task for progress/innovation/value

Fig. 1: Management/mentoring structure
# What does this look like?

## MONTHLY

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F, 01/02/08:</td>
<td>Faculty meets with PhD student</td>
</tr>
<tr>
<td>M, 01/05/08:</td>
<td>Faculty, PhD student meet with SD group</td>
</tr>
<tr>
<td>F, 01/09/08:</td>
<td>Faculty meets with Faculty</td>
</tr>
<tr>
<td>M, 01/12/08:</td>
<td>PhD student meets with SD group</td>
</tr>
<tr>
<td>F, 01/16/08:</td>
<td>Faculty meets with PhD student</td>
</tr>
<tr>
<td>M, 01/19/08:</td>
<td>Faculty, PhD student meet with SD group</td>
</tr>
<tr>
<td>F, 01/23/08:</td>
<td></td>
</tr>
<tr>
<td>M, 01/26/08:</td>
<td>PhD student meets with SD team</td>
</tr>
<tr>
<td>Th, 01/29/08, 5pm:</td>
<td>Monthly meetings, everyone attends.</td>
</tr>
<tr>
<td>Th, 01/29/08, 5pm:</td>
<td>PhD students work with faculty and SD teams to send 1 page progress report to McCalley, monthly report published on web</td>
</tr>
<tr>
<td>M, 02/02/08:</td>
<td>Faculty, PhD student meet with SD group</td>
</tr>
<tr>
<td>F, 02/06/08:</td>
<td>Faculty meets with PhD student</td>
</tr>
</tbody>
</table>

## YEARLY

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
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</thead>
<tbody>
<tr>
<td>10/30/08:</td>
<td>Kickoff meeting</td>
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<tr>
<td>03/02/09:</td>
<td>1 hr PAB conf call</td>
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<tr>
<td>07/02/09:</td>
<td>1 hr PAB conf call</td>
</tr>
<tr>
<td>6/08-9/09:</td>
<td>Industry visits</td>
</tr>
<tr>
<td>10/30/09:</td>
<td>1 hr PAB conf call &amp; annual reporting</td>
</tr>
</tbody>
</table>
Management: faculty responsibilities

• Recruit PhD student no later than fall 09
• Supervise at least 2 senior design teams over 4 year period. We should have at least 3 going at any one time (at least 3 by 1/09)
• Plan one monthly meeting
• Participate in bimonthly seminar
• Identify at least one PAB member to visit
• Prepare for PAB annual reporting duties
• Sequence of 10 one-credit minicourses to address energy de novo infrastructures – more on this later
Management: faculty assignments

• Oversee website: ?
• Start 2 McNair scholars in next 8 months: JM/AS
• Coordinate with Ames High for RET: LW/JM
• Coordinate REU activities: RB/DA/AS
• Coord, design interaction w/ Iowa Lakes: DA/JM
• Specialized educational programs for ISU:
  • 2 grad-level courses in planning electric infrstructure, w/ MISO engineers: JM
  • railroad engineering program to address fuel transportation, diesel locomotive hybridization, & electrification of railway delivery: AS/NG/LW
  • undrgrd, intrdscplnry minor in Enrgy/Transp Infrstctre Design/Operations: AS/RB/DA
# Work Schedule & Responsibilities

## Task

### A. Develop model

1. Energy system
2. Freight transport
3. Pass. transport
4. Resiliency metrics
5. Sustainability metrics

### B. Develop solution method

1. Decomposition
2. Multi-objective
3. High perf. comp.

### C. Validate model

1. Energy system
2. Freight transport
3. Pass. transport
4. Resiliency metrics
5. Sustainability metrics

### D. Assess solution space

1. Wind & resource mix
2. Gasification, carbon, transportation
3. Transportation patterns & resource mix
4. Right-of-way
5. Prices of petroleum, nat. gas, & electricity

### E. Study interdependencies

1. High School prgms
2. Cmtny college prgms
3. Undergrd prgms
4. Graduate prgms

### Participants

- JM, RB, LW, NG, AS

### Year 1

- 1 2 3 4

### Year 2

- 1 2 3 4

### Year 3

- 1 2 3 4

### Year 4

- 1 2 3 4
Ongoing: 6 Website Tabs

1. Design: Objective, main questions/issues, approach, codes.
2. Models: Analytical models to perform functions
3. Technologies: Existing or potential, focus on data
4. Metrics (resiliency/sustainability): what they capture, how to compute
5. Interdependencies: Existing evidence, expected significance, how to analyze/characterize
6. State-Level
Tab 1, Design:
Application, main questions/issues, approach

• State objectives
• Describe how tool is intended to be applied
• Specify constraints, computing requirements
• State questions/issues/uncertainties/alternatives:
  - Optimization, inverse optimization, MPCC?
  - Uncertainties to handle; how to handle?
  - Deployment of decomposition methods?
  - Searching multi-dimensional decision space?
• Identify best responses to questions/issues/etc
• Lay out current “preferred” design with design steps
• Describe expected or actual results
• Most recent software
Tab 2, Models: Analytical models to perform functions

- Review existing tools and related literature
  - Energy: EGEAS, Promod, WASP-IV, Plexos, NEMS, Markal/Times
  - Transport: Transcad, Tranplan, Trips, Viper, FAF, AMS, HERS, MCIBAS, Heat

- Document ways to represent information & perform planning analysis, e.g., production costing (convolution or sequential, with transmission, without)

- Identify unique features of each tool

- Address “main questions/issues” in design tab
Tab 3, Technologies: Existing or potential, focus on data

- **Energy**: {production, conversion, storage, carrier}
- **Transportation**: {freight, passenger}, {fleet}, {rail, air, highway}
- **Attributes to capture**: description, presence, data, maturity rate, models, effects on and of other technologies, ...
- **Coordinate this with 1-credit minicourses to address energy de novo infrastructures**
Tab 4, Metrics: (resiliency/sustainability): what they capture, how to compute

- Resiliency: Availability, price stability, transport time, ...
- Sustainability: emissions, depletability, water usage, ...
- How to model/compute/integrate into design?
Tab 5, Interdependencies: Existing evidence, expected significance, how to analyze/characterize

- How will each system load the other?
- Will fossil/electric/transportation fuel technologies (e.g. IGCC) significantly decrease carbon footprint?
- How will investment in one system influence investment needs in other?
- Can tighter integration between 2 systems reduce environmental impact?
- How will passenger and freight transportation patterns change as PHEV/HT penetration increases?
- To what extent can electric storage capability and supply potential created by PHEV/HT be used to address wind/solar non-dispatchability?
- Can ROW needs be relieved by using same ROW for energy & transportation?
- Can spatial/temporal demand coordination be leveraged?
### Tab 6, State-Level:

- State objective of this work, application
- Summarize/map state infrastructure
- Identify modeling differences between state and national applications
- Describe expected or actual results