Mission 2018

September 22, 2014
Hal Gustin Day: 09/29/2014

Hal Gustin
hlgustin@structint.com 720-320-6722 website: www.structint.com

Occupation: Engineer
MIT year: 1973

This will be my eighth year as an alumni mentor to the 12.000 class. The first seven have been energetic, stimulating, and a lot of fun.

I love the premise of the class.

1. Identify a problem that is huge, difficult (almost intractable), with major implications for the world.
2. Assign it to a group of people with immense ability but no or very little exposure to the conventional ways of looking at the problem.
3. See what they come up with.

Each year, I've tried to help out however I can, not being myself an expert on whatever the topic is. In the process, I've learned a lot, had an exciting ride, and made some friends. I've also answered a lot of e-mails at 3 am. I look forward to more of the same this year.
New Readings are Posted

Class readings for week 4
- Here's a PDF of the IMF report on *How Much Carbon Pricing is in Countries' Own Interests? The Critical Role of Co-Benefits*. There's a summary [here](#).
- The world's population is soaring and might reach 12 billion by 2010. Check out this [short article](#).
- Greenland's snow is exceptionally dark. [Read why](#) it should worry you.
- Mohamed Al Hammadi, explains why the UAE has chosen to develop nuclear energy in an interesting [interview](#).
- More press about the low relative cost of [climate solutions](#), but as usual the [Push for New Pact on Climate Change Is Plagued by Old Divide of Wealth](#).
- Then there's [China](#).
- Learn more about [hydro power](#).
- CEO of Allegheny Conference wants to [shore up our energy grid](#), but as usual it's all about the money because when the grid is overworked, [traders profit](#).
- Engineers in the US have invented a battery, made of three molten metals, which could help [smooth the power supply](#) from renewable energy sources.

News of Interest

MIT Libraries
Geographic Information Systems (GIS) for 12.000

Daniel Sheehan
Senior GIS Specialist
MIT Libraries
Contact us

http://libguides.mit.edu/gis

gishelp@mit.edu
What is a Geographic Information System (GIS)?

• Tool for managing, processing, and visualizing geographic information

What is geographic information?

• Data about a specific place or places
Outline

• Brief description of GIS
• Case study – Locating transmission lines
  – Data sources
  – Data quality
  – Least Cost Path tool
For example

• Political boundaries
• Precipitation amounts
• Location of rivers and dams
• Wind power potential
• Elevation
• Population
Manage, process, visualize geographic data

• Storing elevation, population, and wind power potential data
• Find best routes from wind generated power to power consumers
• Where can wind power be generated and still be close to population centers?
How you might use GIS – cost path analysis

• And some data that may be useful
Visualizing Wind Data – determining best locations for wind farms

First, we need data

• National Renewable Energy Laboratory wind power potential datasets for the United States

http://www.nrel.gov/gis/data_wind.html

“The data provide an estimate of annual average wind resource for specific states or regions.”

• Case study: Colorado
How good is the data?

- Read the (FGDC) metadata
  
  http://www.nrel.gov/gis/data/GIS_Data_Technology_Specific/United_States/Wind/metadata/co_50m_metadata.htm

Abstract: Annual average wind resource potential for the state of Colorado, United States at a 50 meter height.

Purpose: Provide information on the wind resource potential for the state of Colorado.

However, the data is not suitable for micro-siting potential development projects.
What are the values?

WPC - Wind power class is an indicator of likely resource strength, with a higher wind power class representing higher wind resource levels at 50 meter height.

Wind Power Class Potential Density (W/m²)

- Poor: 0 - 200
- Marginal: 200 - 300
- Fair: 300 - 400
- Good: 400 - 500
- Excellent: 500 - 600
- Outstanding: 600 - 800
- Superb: > 800
Highest potential is on mountain ridges.
And moderate potential across the plains east of the Front Range
Add other data to see if wind power on the ridges of the Rockies is feasible

• Add elevation data
  – Derive slope information
• Add population information
  – Where do you need the electricity
• Add current land use information
  – Determine what land is available for utility lines
Digital Elevation Model (DEM)

10 meter resolution
Higher elevations are lighter
Slopes – yellow is 20%, red is 35%
Population – browns are > 1,000/KM²
Least cost path

• Accounts for costs associated with building across
  – Heavily populated areas
  – Steep slopes
  – Land uses not compatible with transmission wires
Least cost path
Some data sources

• NREL

• USGS
  – Global elev - http://reverb.echo.nasa.gov/reverb/
  – Landcover http://landcover.usgs.gov/
    landcoverdata.php

• Eastview
  – Landscan (population data)
    http://wms.cartographic.com/landscan/portal.aspx
    (from MIT only)
Welcome to the MIT Libraries

Chris Sherratt
EAPS, Energy, Nuclear Science & Engineering, Environment Librarian
Terrascope & the MIT Libraries
Mission 2018: Our Energy Future

Chris Sherratt, Anne Graham, Michael Noga, Daniel Sheehan
your librarians
Our purpose today

To introduce you to the Libraries’ resources because this will
save you time when you need useful, reliable information
More reasons

You’ll *need* good, reliable information
More reasons

You’ll need good, reliable information

It’s important to decide where to search
More reasons

You’ll *need* good, reliable information

It’s important to decide *where* to search

Librarians are very friendly and want to get to know you!
So how do we make these introductions?
We will...

Show you the 12,000 library page
Show you the 12,000 library page

Give suggestions about where to start
Show you the 12,000 library page

Give suggestions about where to start

Show some examples, and

Meet with your team sometime later on
So let’s get started
Libraries are physical and virtual
Physical: 5 libraries in 4 buildings

D = Rotch = 7  E = Barker = 10,  B = Hayden = 14S  F = Dewey = E53
Virtual, for 12.000

Our energy future
carbon, nuclear, alternatives?

The Mission 2018 Community

**Student Teams:** Here's a list of the various topics and/or questions that, when combined and integrated, will provide a complete analysis.

**2018 Faculty & staff:** Instructors, TA's & UTF's for Mission 2018: Fall Semester 2014

**Review Panelists:** Experts with extensive knowledge about the special problems associated with energy.

**Library Liaisons:** Representatives from MIT libraries who assist teams with their research strategies. The 12.000 class library page for 2014 is [here](#).

**A list,** by team, of the **students** enrolled in Mission 2018.

**Here's a list** of Alumni Mentors with their related teams.
The 12.000 Libraries page
http://libguides.mit.edu/mission2018
Some book suggestions
(more in Barton)
And links to thousands of articles

**Use Databases to Find Articles**

Some articles live on the open Web, but many do not. Use these Libraries' databases to discover them and usually land on full text.

(Add / Edit Text)

- **CAB Abstracts**  
  A great source for articles and papers on energy applications all over the world.

- **Web of Science (ISI Web of Knowledge)**  
  Good for articles from many disciplines. Limit to SCI for science; SSCI for policy and economics.

- **Environment Index**  
  Useful for finding environmental policy articles

- **Compendex**  
  Covers all fields of engineering, including nuclear.

- **Political Science Complete**  
  Good source for articles, reference books and conference papers in political science.
AND we have...the World Bank e-library!
http://libraries.mit.edu
Think about where to start
Barton leads to MIT owned books

Author: Davis, Scott.
Title: Microhydro [electronic resource]: clean power from water / Scott Davis.
Online Access: Get this @ MIT Click button for available online volumes

Description: 1 online resource (xvii, 157 p.): ill.
Series: Wiser living series.
Format: Book
Note: "A Mother earth news book for wiser living"--Cover.
Bibliography: Includes bibliographical references (p. 144-145) and index.
Summary: Hydroelectricity is the world's largest -- and cleanest -- source of renewable energy. But in a vacuum about the smallest version of the technology dubbed "the simplest, most reliable, most practical, Microhydro is the first complete book on the topic in a decade. Covering both equipment options, and legal, environmental, and economic factors.

Subject: Hydroelectric power plants.
Renewable energy sources.

NOTE Subject links!
Here’s a basic, online book on wind
To find articles: use our subject databases

These are listed on the 12,000 page
They’ll link to full-text when available

CAB
Web of Science
Compendex/Inspec
These lead to citations!

1. Energy security for India: biofuels, energy efficiency and food productivity.
   By: Gunatilake, H., Roland-Holst, D., Suguio, G.; Energy Policy. 65 Oxford Elsevier Ltd. 2014, 717-767 Abstract. The emergence of biofuel as a renewable energy source offers opportunities for significant climate change mitigation and greater energy independence to many countries. At the same time, biocfuel represents the possibility of substitution between energy and food. For developing countries like India, which imports over 75% of its crude oil, fossil fuels pose two risks - global warming potential and long-term risk that oil prices will undermine real living standards. This paper examines India's options for managing energy price risk in three ways: biofuel development, energy efficiency promotion, and food productivity improvements. Our salient results suggest that biodiesel shows promise as a transport fuel substitute that can be produced in ways that fully utilize marginal agricultural resources and hence promote rural livelihoods. First-generation bioethanol, by contrast, appears to have a limited ability to offset the impacts of oil price hikes. Combining the biodiesel expansion policy with energy efficiency improvements and food productivity improvements proved to be a more effective strategy to enhance both energy and food security, help mitigate climate change, and cushion the economy against oil price shocks. (Journal Article 2014) 3070723
   Subjects: biodiesel; bioenergy; biofuels; climate change; crude oil; efficiency; ethanol; food security; fossil fuels; global warming; productivity; renewable energy; renewable resources; Developing Countries; Developing Countries; India, India
   Get this → MIT

2. Review of past research and proposed action plan for landfill gas-to-energy applications in India.
   By: Siddiqui, F. Z.; Sadaf Zadi; Suneet Pandey; Khan, M. E.; Waste Management & Research. 31(1). London Sage Publications Ltd. 2013, 3-22 Abstract. Open dumps employed for disposal of municipal solid waste (MSW) are generally referred to as landfills and have been traditionally used as the ultimate disposal method in India. The deposition of MSW in open dumps eventually leads to uncontrolled emission of landfill gas (LFG). This article reviews the MSW disposal practices and LFG emissions from landfills in India during the period 1994 to 2011. The worldwide trend of feasibility of LFG to energy recovery projects and recent studies in India indicate a changed perception of landfills as a source of energy. However, facilitating the implementation of LFG to energy involves a number of challenges in terms of technology, developing a standardized framework and availability of financial incentives. The legislative framework for promotion of LFG to energy projects in India has been reviewed and a comprehensive strategy and action plan for refining LFG recovery is suggested. It is concluded that the market for LFG to energy projects is not mature in India. There are no on-ground case studies to demonstrate the feasibility of LFG to energy applications. Future research therefore should aim at LFG emission modeling studies at regional level and based on the results, pilot studies may be conducted for the potential sites in the country to establish LFG to energy recovery potential from these landfills. (Journal Article 2013) 3033851
Municipal solid waste - waste to energy conversion in India: an overview.

Author(s): Reddy, M. V.
Address: Department of Ecology and Environmental Sciences, Pondicherry University, Puducherry 605 014, India.; venkateshrinivas1@gmail.com
Language: English
Country of Publication:

Abstract: Municipal solid waste (MSW) is generated in enormous quantities, in India, causing environmental problems. It is collected primarily by sweeping in India and dumped on the outskirts of urban areas, which pollute the environment. Such MSWs also release methane and carbon dioxide, which are important greenhouse gases. MSW comprises biodegradable material. The MSW disposal methods in India mainly include landfilling, separating waste and composting, biomethanation, incineration, or conversion to refuse derived fuel (RDF). MSW can be converted to non-conventional energy (WtE). Otherwise, the MSW disposal in India open dumping facilitates breeding of ensuing serious environmental health problems. The WtE conversion is going to become important in thickly populated cities. The biodegradable waste can be processed by aerobic composting including vermiculture and by anaerobically, biomethanation. The non-biodegradable waste such as plastic can be processed for recovering energy. There are 16 such clean development mechanisms projects recovering energy from MSW in India, of which 11 are RDF-based and a few are biomethanation-based. However, landfill gas recovery projects were not successful in India. However, there are successful small projects in Tamil Nadu (India) deriving the CH4 gas from human-was biomethanation units generating electricity lighting street lights.

Number of References: 11 ref.
If you can’t see full text don’t give up!

Be sure MIT subscribes to the journal and the year you need: search Barton or Vera

IF we don’t subscribe, ask for it on ILB

Email us with pesky problems
Lastly for today: Databases for statistics

Look for

Statista
GlobalData Power (formerly eTracks)
IEA Databases
Statista: Wind in Colorado

Leading states in cumulative wind power capacity in the U.S. in 2013 (in megawatts)

<table>
<thead>
<tr>
<th>State</th>
<th>Capacity (megawatts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>12,355</td>
</tr>
<tr>
<td>California</td>
<td>5,830</td>
</tr>
<tr>
<td>Iowa</td>
<td>5,178</td>
</tr>
<tr>
<td>Illinois</td>
<td>3,568</td>
</tr>
<tr>
<td>Oregon</td>
<td>3,153</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>3,134</td>
</tr>
<tr>
<td>Minnesota</td>
<td>2,987</td>
</tr>
<tr>
<td>Kansas</td>
<td>2,967</td>
</tr>
<tr>
<td>Washington</td>
<td>2,808</td>
</tr>
<tr>
<td>Colorado</td>
<td>2,332</td>
</tr>
</tbody>
</table>
But you also get
A table from GlobalData Power

### Upcoming Nuclear Reactors in India

The following table lists upcoming nuclear reactors that will boost India’s nuclear installed capacity.

#### Table 1: Power Market, India, Upcoming Nuclear Reactors, 2014–2020

<table>
<thead>
<tr>
<th>Reactor name</th>
<th>Type</th>
<th>Capacity (MW)</th>
<th>Status</th>
<th>First commercial year of operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaitapur 1</td>
<td>PWR</td>
<td>1,700</td>
<td>Financed</td>
<td>2018</td>
</tr>
<tr>
<td>Jaitapur 2</td>
<td>PWR</td>
<td>1,700</td>
<td>Financed</td>
<td>2019</td>
</tr>
<tr>
<td>Kovvada 1</td>
<td>BWR</td>
<td>1,600</td>
<td>Permitting</td>
<td>2019</td>
</tr>
<tr>
<td>Kovvada 2</td>
<td>BWR</td>
<td>1,600</td>
<td>Permitting</td>
<td>2020</td>
</tr>
<tr>
<td>Mthil Virdi 1</td>
<td>PWR</td>
<td>1,250</td>
<td>Permitting</td>
<td>2019</td>
</tr>
<tr>
<td>Mthil Virdi 2</td>
<td>PWR</td>
<td>1,250</td>
<td>Permitting</td>
<td>2020</td>
</tr>
<tr>
<td>Haripur</td>
<td>PWR</td>
<td>1,200</td>
<td>Announced</td>
<td>2019</td>
</tr>
<tr>
<td>Kudankulam 3</td>
<td>PWR</td>
<td>1,050</td>
<td>Financed</td>
<td>2019</td>
</tr>
<tr>
<td>Kudankulam 4</td>
<td>PWR</td>
<td>1,050</td>
<td>Financed</td>
<td>2020</td>
</tr>
<tr>
<td>Kudankulam 5</td>
<td>PWR</td>
<td>1,050</td>
<td>Permitting</td>
<td>2019</td>
</tr>
<tr>
<td>Kudankulam 1</td>
<td>PWR</td>
<td>1,000</td>
<td>Under construction</td>
<td>2014</td>
</tr>
<tr>
<td>Kudankulam 2</td>
<td>PWR</td>
<td>1,000</td>
<td>Under construction</td>
<td>2015</td>
</tr>
<tr>
<td>Rajasthan, RAPS 7</td>
<td>PHWR</td>
<td>700</td>
<td>Under construction</td>
<td>2016</td>
</tr>
<tr>
<td>Rajasthan, RAPS 8</td>
<td>PHWR</td>
<td>700</td>
<td>Under construction</td>
<td>2016</td>
</tr>
<tr>
<td>Kakrapar 3</td>
<td>PHWR</td>
<td>700</td>
<td>Under construction</td>
<td>2015</td>
</tr>
<tr>
<td>Kakrapar 4</td>
<td>PHWR</td>
<td>700</td>
<td>Under construction</td>
<td>2015</td>
</tr>
<tr>
<td>Chutka 1</td>
<td>PHWR</td>
<td>700</td>
<td>Announced</td>
<td>2020</td>
</tr>
<tr>
<td>Kalpakkam 1</td>
<td>FBR</td>
<td>500</td>
<td>Under construction</td>
<td>2015</td>
</tr>
<tr>
<td>Kalpakkam 2</td>
<td>FBR</td>
<td>500</td>
<td>Announced</td>
<td>2019</td>
</tr>
<tr>
<td>Kalpakkam 3</td>
<td>FBR</td>
<td>500</td>
<td>Announced</td>
<td>2020</td>
</tr>
<tr>
<td>FBR 4</td>
<td>FBR</td>
<td>500</td>
<td>Announced</td>
<td>2017</td>
</tr>
</tbody>
</table>
Almost the End: Are there Thoughts?
Questions?
Friendly Advice from UTFs ??!
Enjoy!
Education is the most powerful weapon that can be used to change the world.

Nelson Mandela

2014
Links to thousands of articles

Use Databases to Find Articles

Some articles live on the open Web, but many do not. Use these Libraries’ databases to discover them and usually land on full text.

(Add / Edit Text 🖋️)

- **CAB Abstracts**  
  A great source for articles and papers on energy applications all over the world.

- **Web of Science (ISI Web of Knowledge)**  
  Good for articles from many disciplines. Limit to SCI for science; SSCI for policy and economics.

- **Environment Index**  
  Useful for finding environmental policy articles

- **Compendex**  
  Covers all fields of engineering, including nuclear.

- **Political Science Complete**  
  Good source for articles, reference books and conference papers in political science.
Assignment 4

• Posted on the Mission 2018 Wiki
• Contains an exercise to familiarize you with the MIT libraries
• Please complete Exercise by Sept. 29
• On Oct. 1, your group will give a 5 minute presentation on the one or two most relevant articles found during your library searches