

# Mission 2018

September 22, 2014

# Hal Gustin Day: 09/29/2014

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**Hal Gustin**

hlgustin@structint.com 720-320-6722 website: [www.structint.com](http://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



# Geographic Information Systems (GIS) for 12.000

Daniel Sheehan  
Senior GIS Specialist  
MIT Libraries





# Contact us

<http://libguides.mit.edu/gis>

[gishelp@mit.edu](mailto: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](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](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.



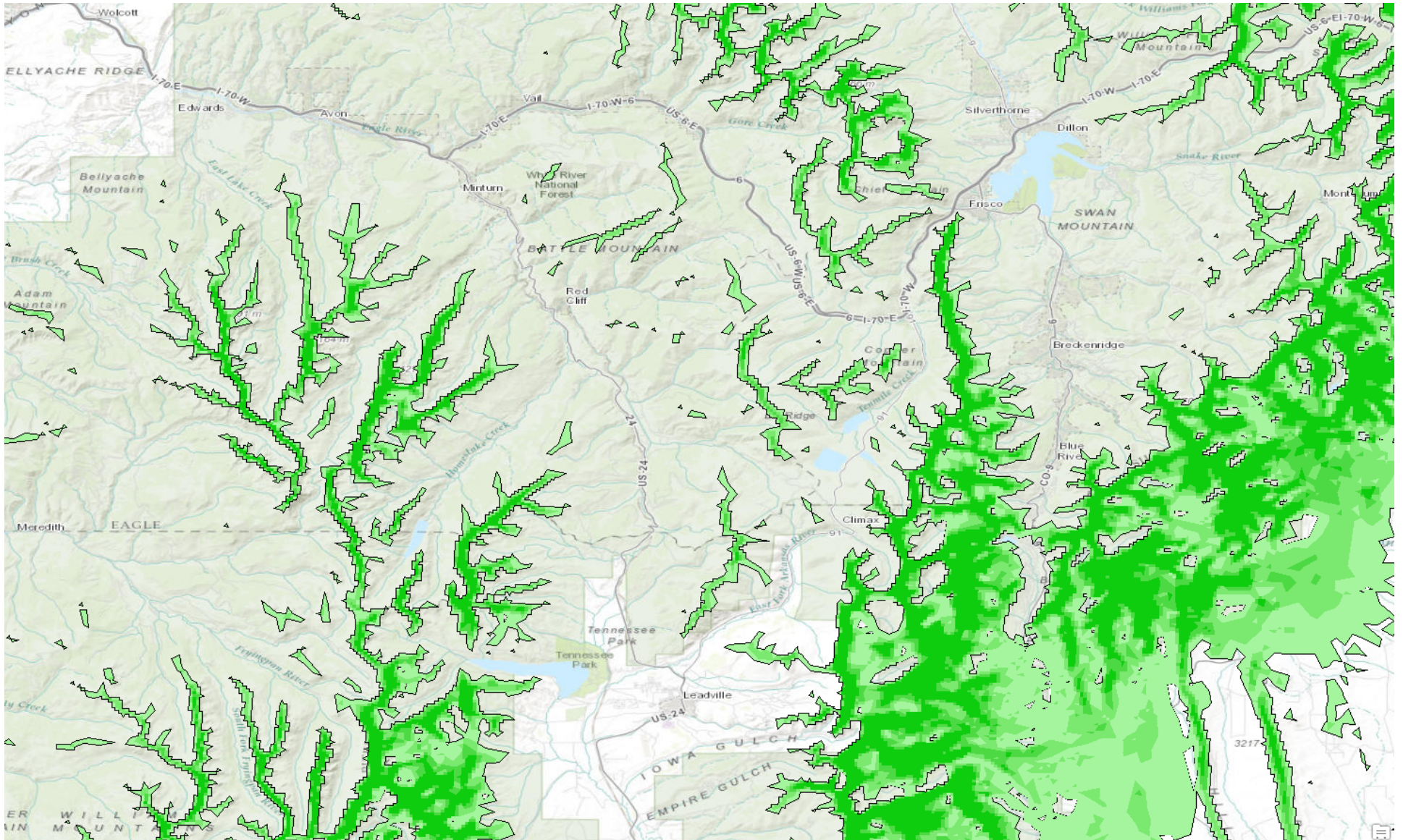
# What are the values?

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/m<sup>2</sup>)

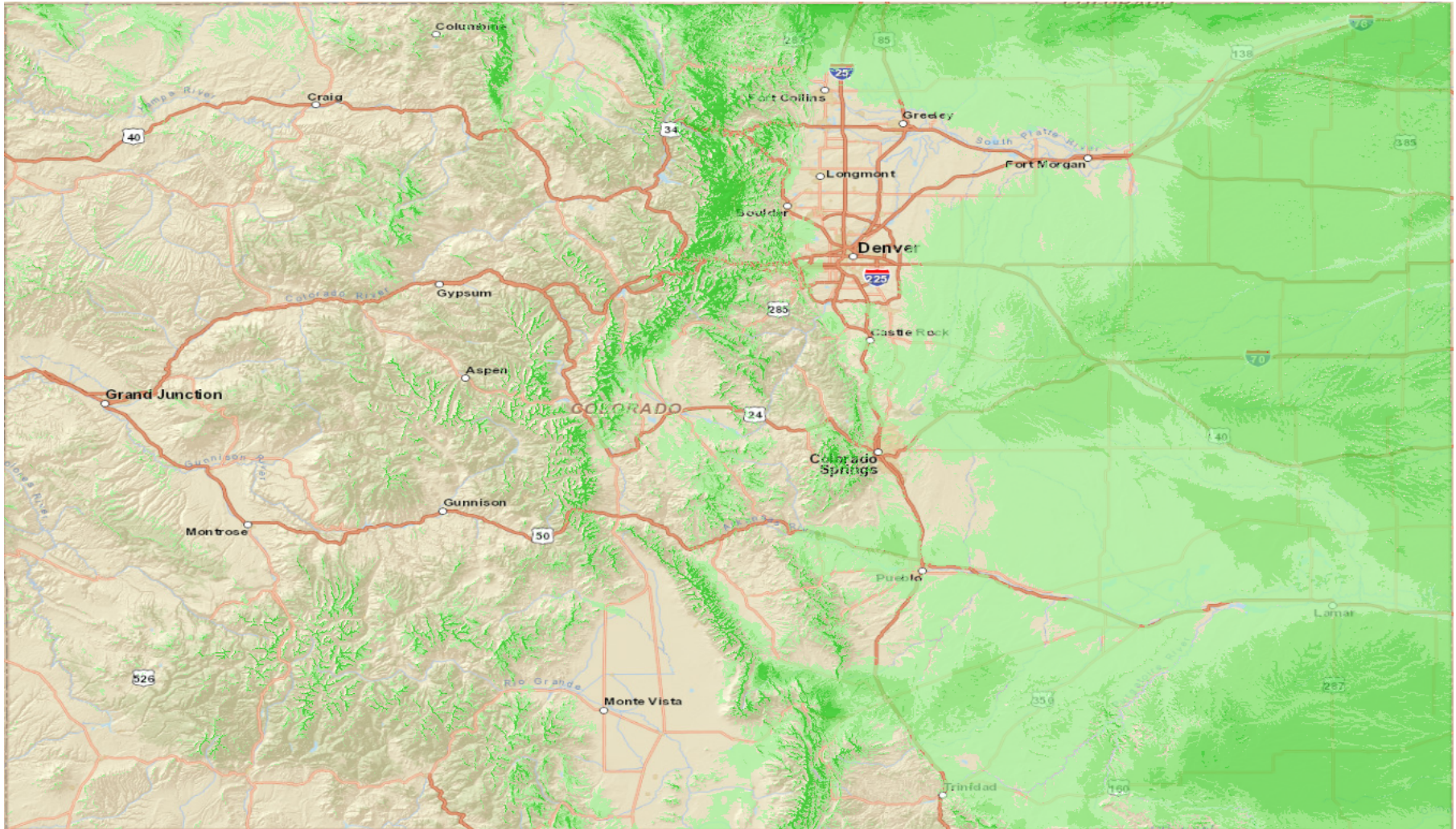
1	Poor	0 - 200	2	Marginal	200 - 300	3	Fair	300 - 400	4	Good	400 - 500	5	Excellent	500 - 600	6	Outstanding	600 - 800	7	Superb	> 800
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Highest potential is on mountain ridges.





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

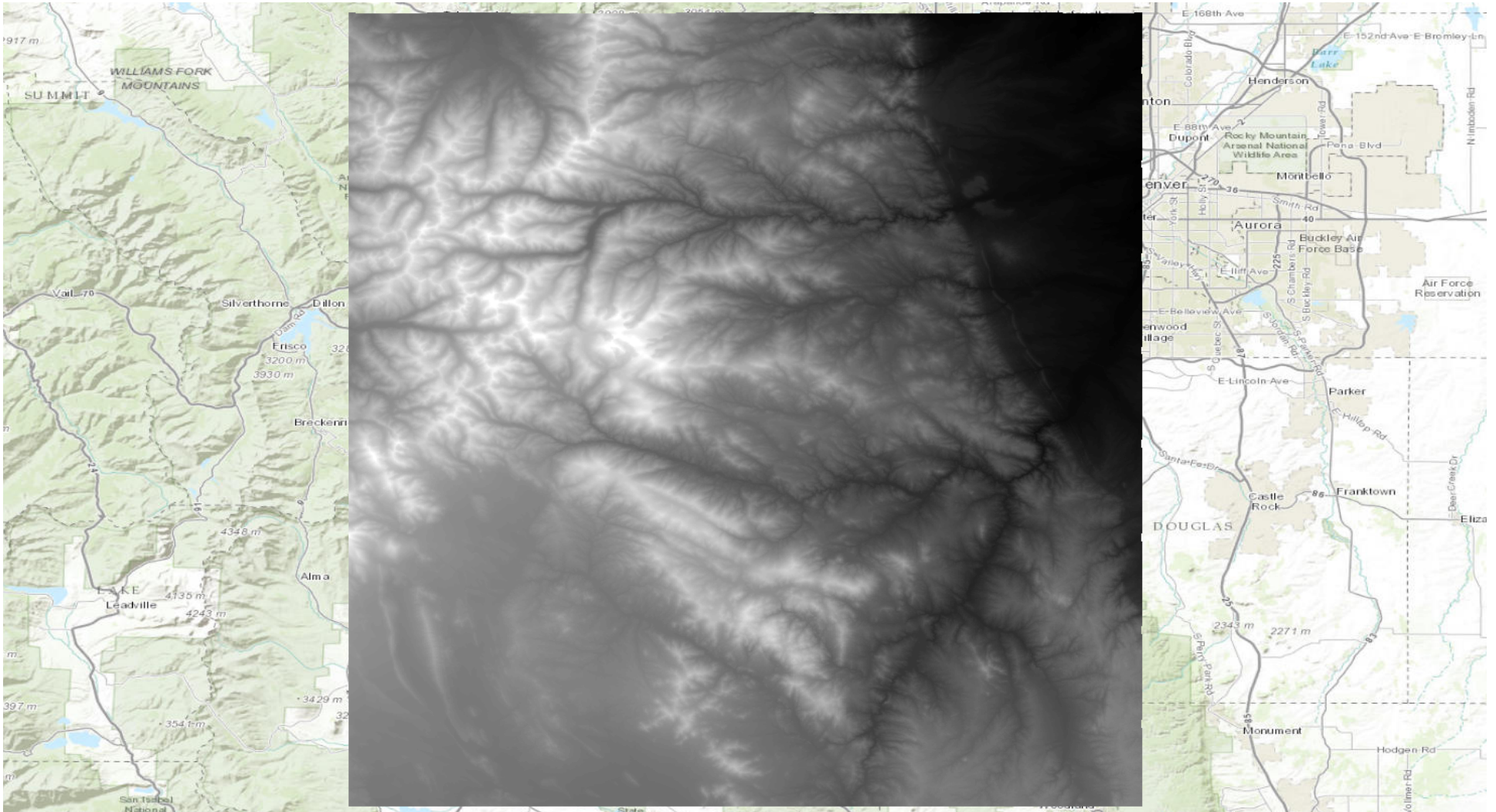
- Add elevation data
  - Derive slope information
- Add population information
  - Where do you need the electricity
- Add current land use information
  - Determine what land is available for utility lines



# Digital Elevation Model (DEM)

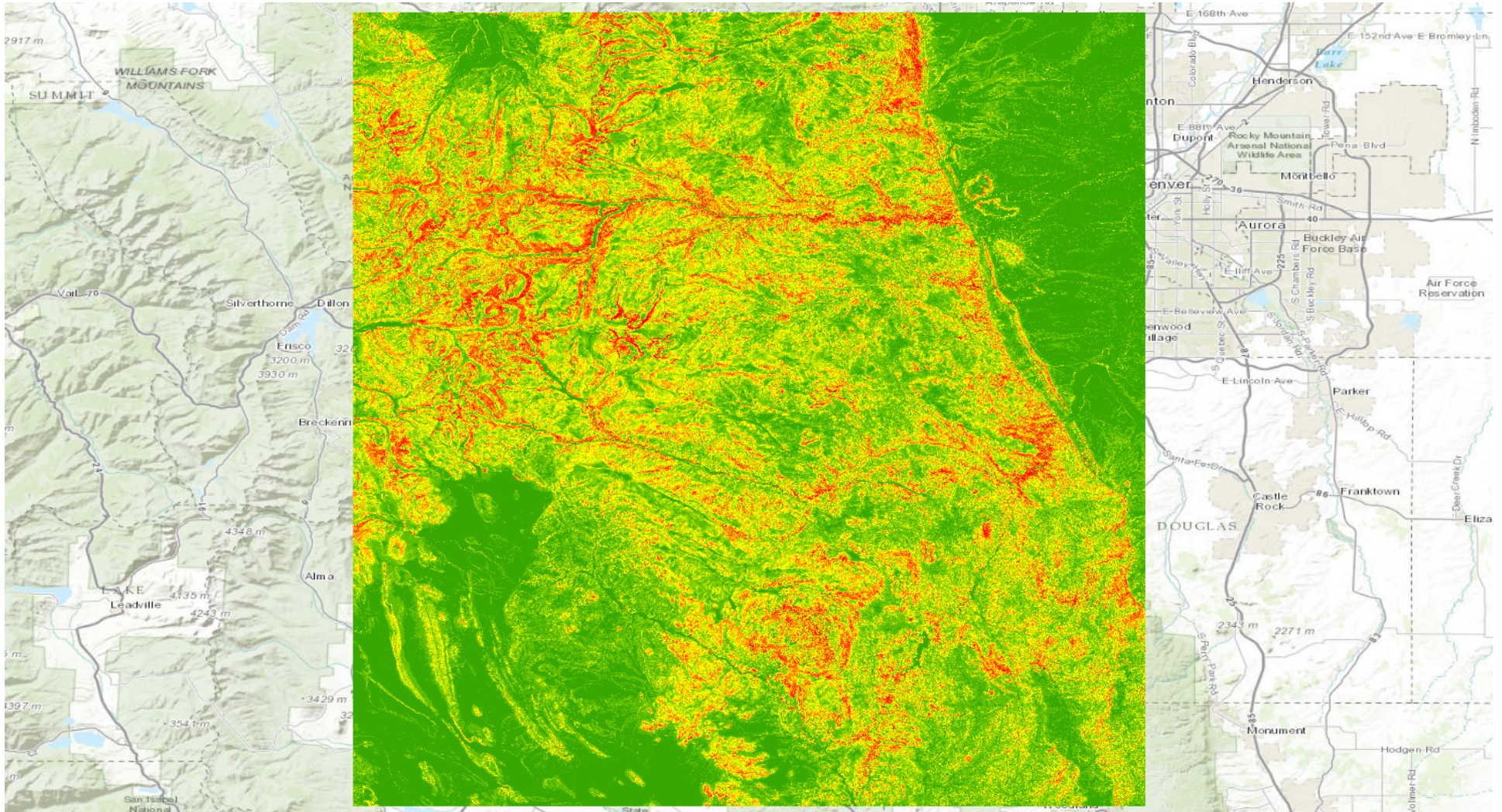
10 meter resolution

Higher elevations are lighter



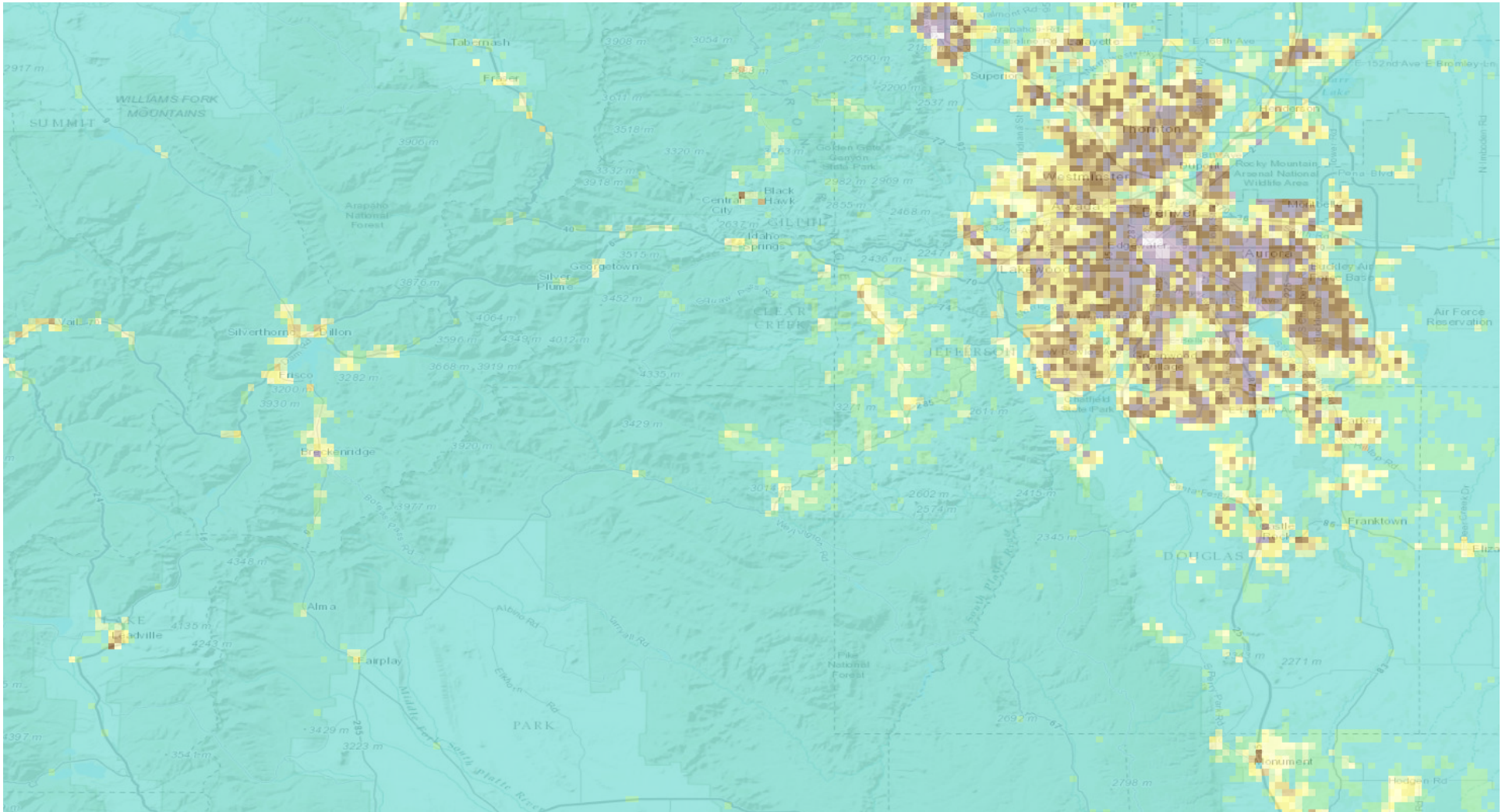


# Slopes – yellow is 20%, red is 35%





Population – browns are  $> 1,000/\text{KM}^2$

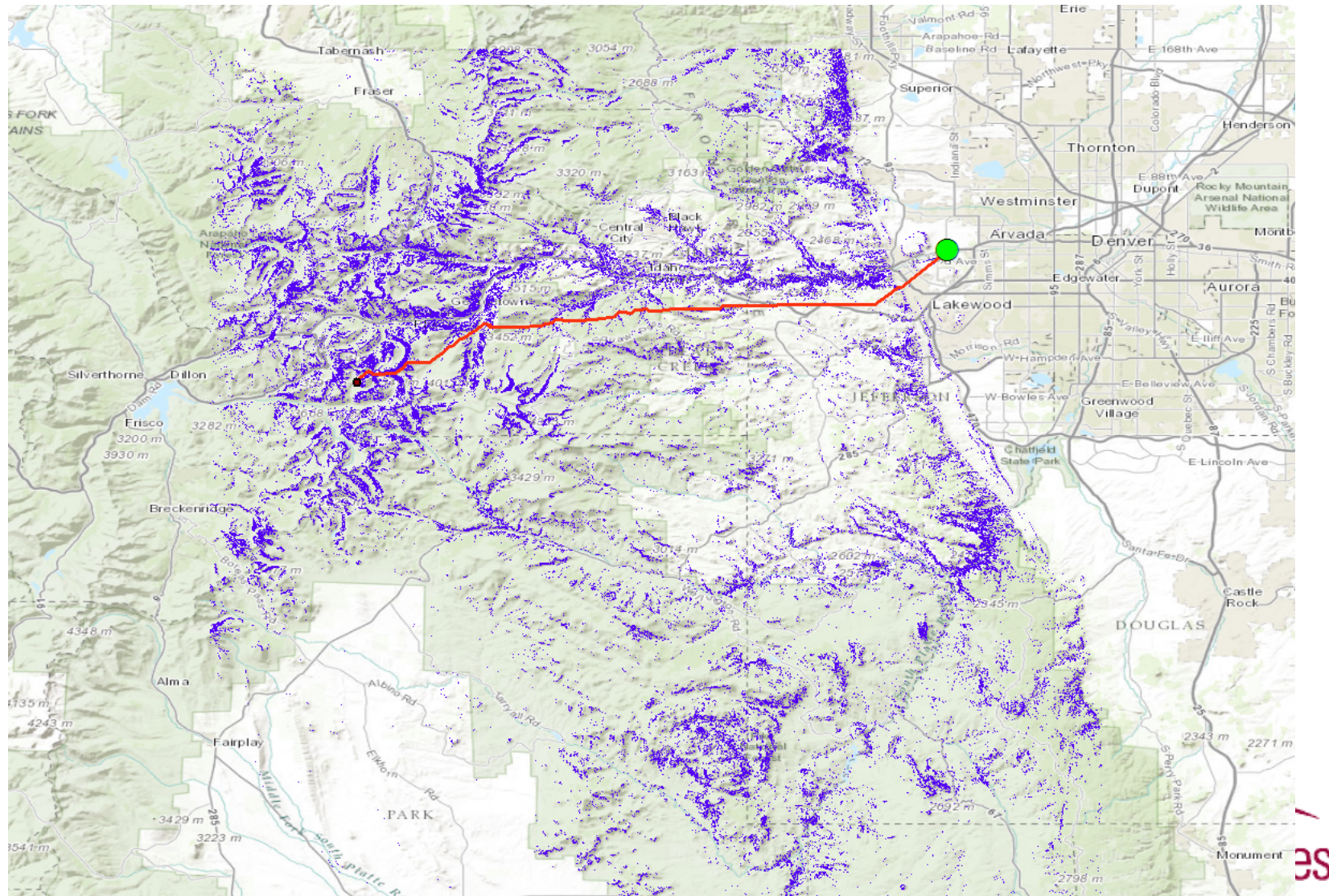


# Least cost path

- 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
  - Wind data - [http://www.nrel.gov/gis/data\\_wind.html](http://www.nrel.gov/gis/data_wind.html)
- USGS
  - US elev - <http://viewer.nationalmap.gov/viewer/>
  - 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

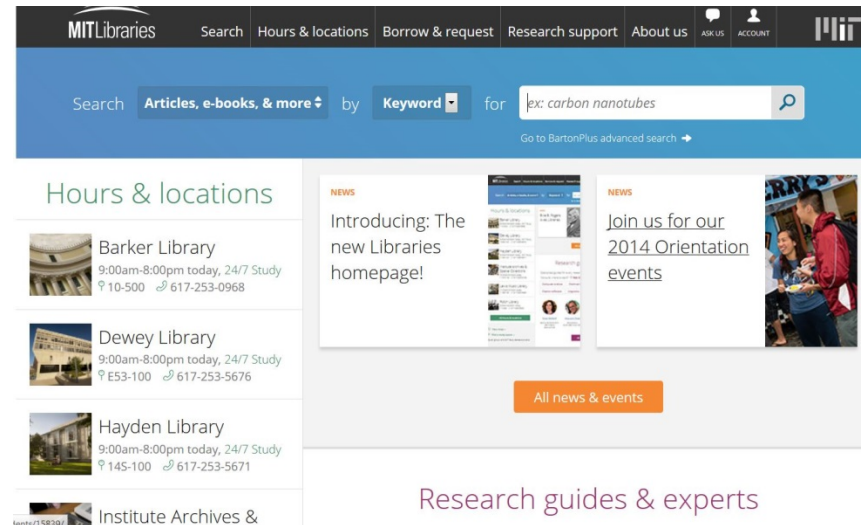
Give suggestions about where to start

Show some examples, and

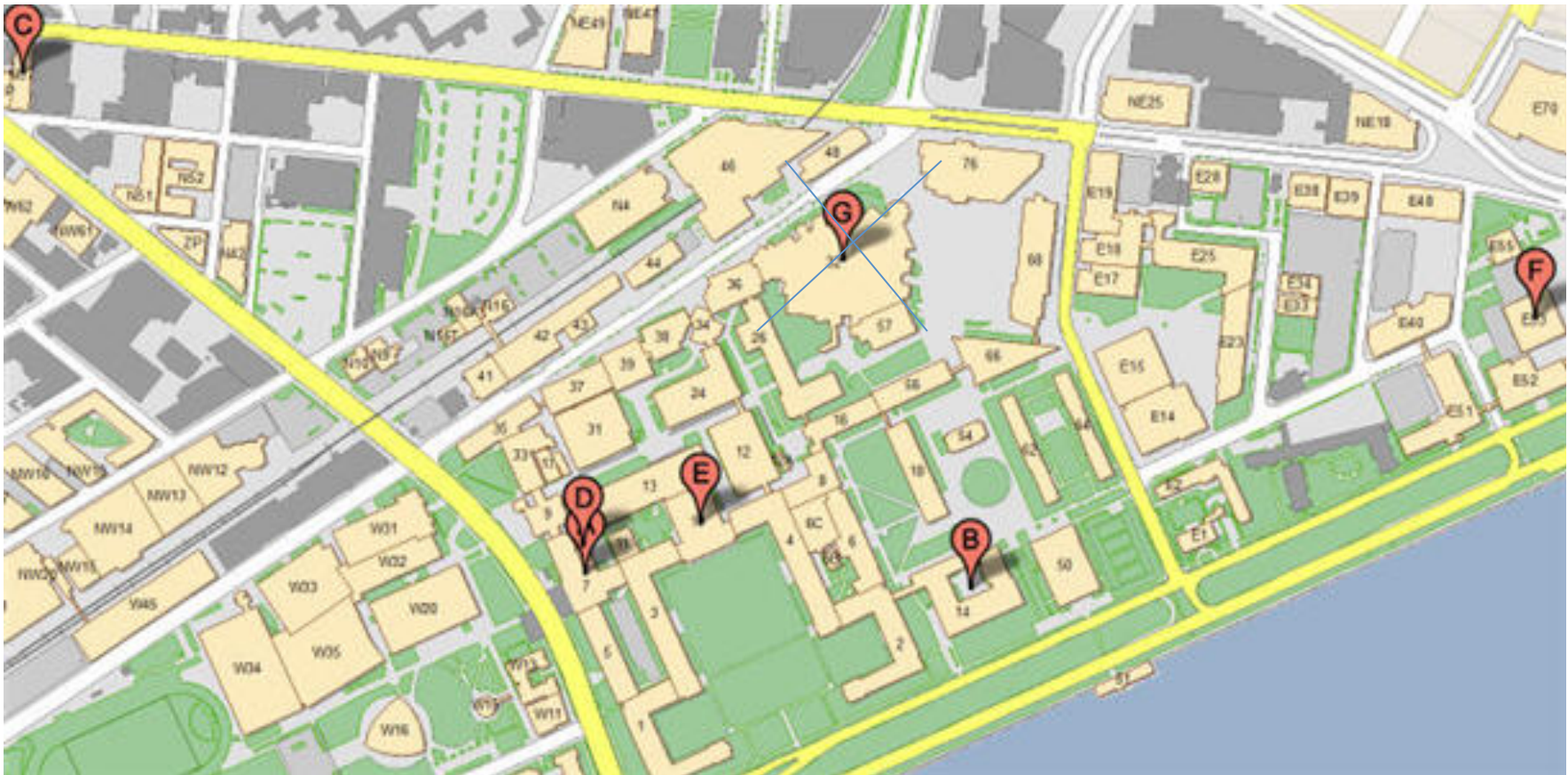
Meet with your team sometime later on

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




## 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 Liasons:** 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

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- [Energy](#)
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- [Environment](#)

#### Welcome to Mission and the MIT Libraries

[Energy!](#) Tons of resources right here!!

Contact librarians anytime ([12-lib@mit.edu](mailto:12-lib@mit.edu))

Background reading suggestions are on the [Books](#) tab.

Go to [Mission 2018](#)

#### Find Current News


- [Environment and Energy Daily](#)  
Good source for current news on many aspects of our environment.
- [LexisNexis Academic](#)  
for news from many sources including the NYT

#### 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.

- [CAB Abstracts](#) new  
A great source for articles and papers on energy applications all over the world.

#### Chris Sherratt



**Atmospheric and Oceanic Sciences, EAPS**

**Contact Info**  
Science Library  
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**Links:**



# Some book suggestions (more in Barton)



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**Books**

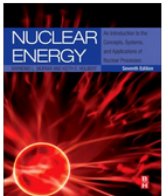
### Online Encyclopedias

Good for background info.

- We suggest 5 titles to choose from here

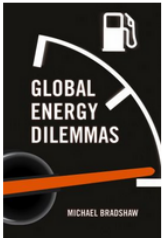
### Ideas...

Some teams might begin with

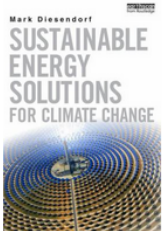


**Nuclear Energy** - Keith E. Holber  
Publication Date: 2014

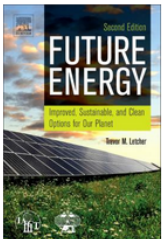
### Librarians' suggestions



**Global Energy Dilemmas** - Mike Bradshaw  
Publication Date: 2013  
Today's global energy system faces two major challenges: how to secure the supply of reliable and affordable energy; and how to rapidly transform to a low-carbon, efficient and environmentally harmless energy supply.

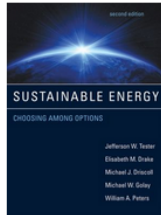


**Sustainable Energy Solutions for Climate Change** - Mark Diesendorf  
Publication Date: 2014  
Coming soon! This book brings together the science, technology, economics and policy issues.



**Future Energy** - Trevor Letcher (Editor)  
Publication Date: 2013

### Also...




**Sustainable Energy** - Jefferson W. Tester et.al.  
Publication Date: 2012  
A widely used textbook designed for students. MIT authors!









And links to thousands of articles

## Use Databases to Find Articles

edi

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](#)     
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# AND we have...the World Bank e-library!



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**China: A New Approach for Efficient, Inclusive, Sustainable Urbanization**

China can save a total \$1.4 trillion (15% of last year's GDP) if it builds more efficient, denser cities. A new World Bank-China joint report recommends using those savings to expand social services to all people—including migrants.

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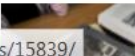
**Barker Library**  
9:00am-8:00pm today, 24/7 Study  
☎ 10-500 📞 617-253-0968



**Dewey Library**  
9:00am-8:00pm today, 24/7 Study  
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# Think about where to start

The screenshot shows the MIT Libraries website interface. At the top is a dark navigation bar with the MIT Libraries logo and links for Search, Hours & locations, Borrow & request, Research support, About us, ASK US, ACCOUNT, and the MIT logo. Below this is a blue search bar area. The search bar contains the text 'microhydro' and a magnifying glass icon. To the left of the search bar, there are buttons for 'Search', 'Articles, e-books, & more' (with a dropdown arrow), 'by', 'Keyword' (with a dropdown arrow), and 'for'. Below the search bar, there is a link 'Go to BartonPlus advanced search' with a right arrow. A dropdown menu is open from the 'Articles, e-books, & more' button, listing the following options: 'Articles, e-books, & more' (BartonPlus (mega-search)), 'E-journals & databases' (Vera), 'Books & more at MIT' (Barton catalog (classic search)), 'Books & more worldwide' (WorldCat), 'Course reserves', 'Website' (Site search), and 'More search tools & help' (Images, data, DSpace, etc.). To the left of the search bar, there is a 'Hours' section with a list of library locations and their hours. To the right of the search bar, there is a 'NEWS' section with a headline 'What's new at the Libraries this fall' and a photograph of a person standing in front of a building. Below the search bar, there is a large orange button that says 'All news & events'.

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# 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
- Published** Gabriola Island, B.C. : New Society Publishers, c2003.
- 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 d vacuum about the smallest version of the technology dubbed "the simplest, most reliable a practical, **Microhydro** is the first complete book on the topic in a decade. Covering both A 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

Wiley Online Library



Access  
provided by




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Home > Energy > Wind Energy > Understanding Wind Power Technology: Theory, Deployment and Optimisation

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Table of Contents  
Reviews  
Author Biography

## Understanding Wind Power Technology: Theory, Deployment and Optimisation

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Editor(s): Alois Schaffarczyk

Published Online: 25 APR 2014 08:54PM EST

Print ISBN: 9781118647516

Online ISBN: 9781118701492

DOI: 10.1002/9781118701492

### About this Book

Wind energy technology has progressed enormously over the last decade. In coming years it will continue to develop in terms of power ratings, performance and installed capacity of large wind turbines worldwide, with exciting developments in offshore installations.

Designed to meet the training needs of wind engineers, this introductory text puts wind energy in context, from the natural resource to the assessment of cost effectiveness and bridges the gap between theory and practice. The thorough coverage spans the scientific basics, practical implementations and the modern state of technology used in onshore and offshore wind farms for electricity generation.

## SEARCH

In this book

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databases

These are listed on the 12.000 page

They'll link to full-text when available

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Web of Science

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# These lead to citations!



Searching: **CAB Abstracts** | [Choose Databases](#)

india	TI Title	Search	Clear	?
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### 1. **Energy security for India: biofuels, energy efficiency and food productivity.**



Academic  
Journal

By: Gunatilake, H.; Roland-Holst, D.; Sugiyarto, G.; **Energy Policy**; 65 Oxford:Elsevier Ltd,2014,761-767 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, biofuel 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 pollution 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 increases 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)20143070723

**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**

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### 2. **Review of past research and proposed action plan for landfill gas-to-energy applications in India.**



Academic  
Journal

By: Siddiqui, F. Z.; Sadaf Zaidi; Suneel 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 gainful 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)20130303651



# one example

## 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**.;  
venkateshsrinivas1@gmail.com

**Source:** [International Journal of Environmental Technology and Management](#) 17 (2/3/4) Geneva: Inderscience Enterprises Ltd, 2014, 283-292

**Language:** English

**Country of Publication:** Switzerland

**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 land filling, separating waste and composting, biomethanation, incineration, an 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 vermicomposting 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 i **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 CH<sub>4</sub> 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!*

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IF we **don't** subscribe, ask for it on ILB

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# Lastly for today: Databases for statistics

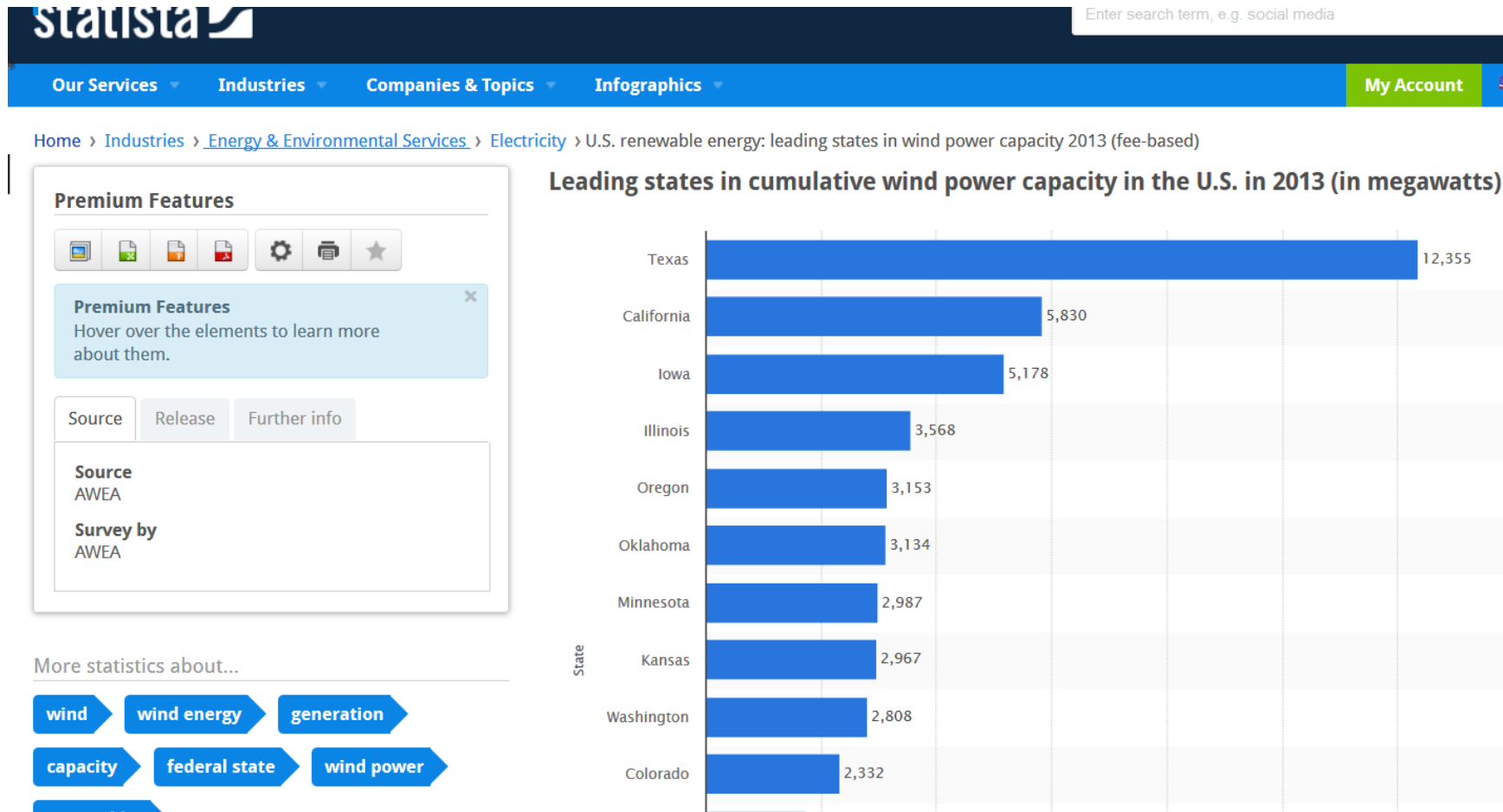
Look for

Statista


GlobalData Power (formerly eTracks)


IEA Databases

# Statista: Wind in Colorado





# But you also get


 U.S. Fossil Fuel Consumption

 Wind Power Market


## Recent Statistics

 Offshore wind turbines - worldwide


 Cree's operating income 2008-2014


 Cree's total assets 2008-2014


## Related Reports


 2012 Renewable Energy Data Book  
128 page/s

 Renewable energy sources in the United States - Statista Dossier 2013  
60 page/s

 Renewables 2014 Global status report  
215 page/s

 The Global Cleantech Report 2012  
470 page/s

 SRREN - Special Report on Renewable Energy Sources and Climate Change Mitigation  
1544 page/s

 Wind power in the United States - Statista Dossier 2013  
60 page/s



# 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.

<b>Table 1: Power Market, India, Upcoming Nuclear Reactors, 2014–2020</b>				
Reactor name	Type	Capacity (MW)	Status	First commercial year of operation
Jaitapur 1	PWR	1,700	Financed	2018
Jaitapur 2	PWR	1,700	Financed	2019
Kovvada 1	BWR	1,600	Permitting	2019
Kovvada 2	BWR	1,600	Permitting	2020
Mithi Viridi 1	PWR	1,250	Permitting	2019
Mithi Viridi 2	PWR	1,250	Permitting	2020
Haripur 1	PWR	1,200	Announced	2019
Kudankulam 3	PWR	1,050	Financed	2019
Kudankulam 4	PWR	1,050	Financed	2020
Kudankulam 5	PWR	1,050	Permitting	2019
Kudankulam 1	PWR	1,000	Under construction	2014
Kudankulam 2	PWR	1,000	Under construction	2015
Rajasthan, RAPS 7	PHWR	700	Under construction	2016
Rajasthan, RAPS 8	PHWR	700	Under construction	2016
Kakrapar 3	PHWR	700	Under construction	2015
Kakrapar 4	PHWR	700	Under construction	2015
Chutka 1	PHWR	700	Announced	2020
Kalpakkam 1	FBR	500	Under construction	2015
Kalpakkam 2	FBR	500	Announced	2019
Kalpakkam 3	FBR	500	Announced	2020
FBR 4	FBR	500	Announced	2017

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

edit

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