The History of Energy

or how we got into this mess

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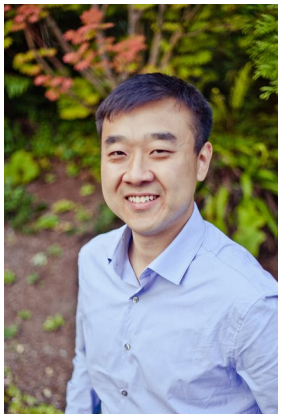
Last Edit: April 14, 2019

Hi! - Jimmy



- Energy Finance Efficiency Professional
- CEO, Distributed Energy Management
- Chair, MIT Enterprise Forum of the Northwest

- **BS. MS, MIT Material Science**
- **MBA, Oxford University**

- **Energy pervades everything we do**
- **Since it touches everything, how should we interact with it?**

Historical timeline – the need for high temperatures

Ages of Man	Metallurgical	Fuel	Technology
Stone Age 1.5M BCE – 2400 BCE	N/A	Hunter-Gather Agriculture 300 °C Wood	Human Animals 350 °C Campfire 800 °C Pit Kiln
Bronze Age 3000 BCE – 1500 BCE	850 °C Bronze	2000 °C Oil	1000 °C Bloomery
Iron Age 1300 BCE – 500 AD	1538 °C Iron	2000 °C Coal	2000 °C Blast Furnace

What the Greeks thought

- Energy (Ancient Greek: ἐνέργεια *energeia* "*activity*, operation")

- an indirectly observed quantity that is often understood as the ability to *do* Work.

- Work is the ability of one physical object to *move* a second physical object.

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Energy is never stationary

Environment / context is important

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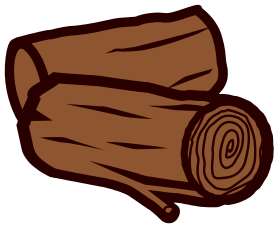

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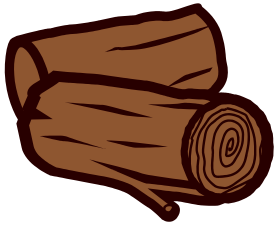
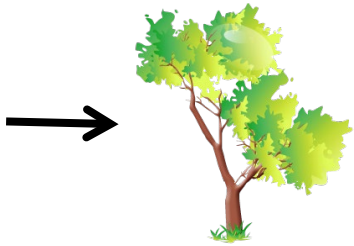
So what is energy?

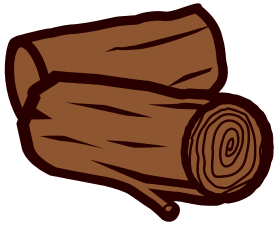


So what is energy?

The fuel by its lonesome is not very interesting



It isn't doing anything to release the energy



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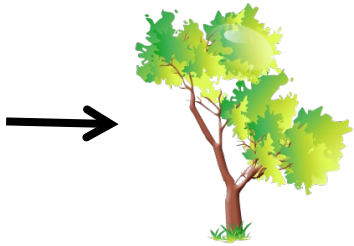

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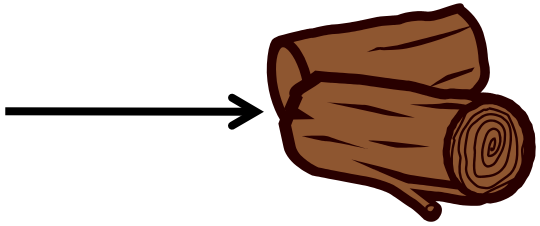
The science of energy is 'easy'

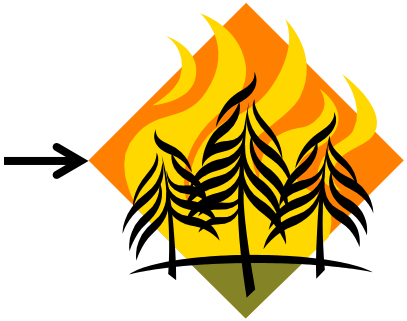


Easy = explanations exists

So what is energy?

The value proposition of energy is ‘hard’

Hard = changes for each context



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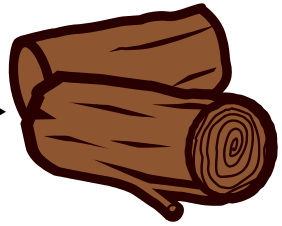


Is this how we relate to energy?

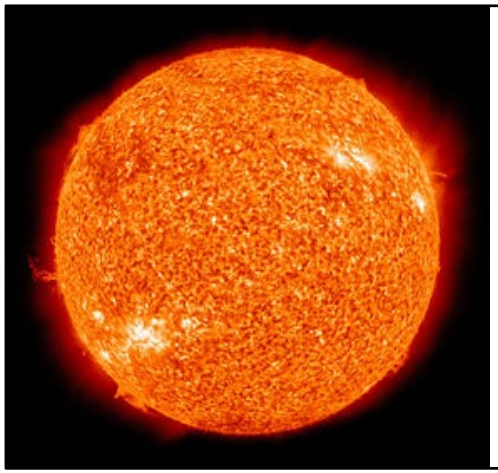
http://www.youtube.com/watch?v=BVxOb8-d7Ic

Where does the fuel come from?

- Energy from the sun

Energy from the moon

Energy from the earth



Solar

Wind

Hydro

Agriculture/Food

Tidal

Geothermal

Hydro

Fossil Fuels

Nuclear

Where does the fuel go?

The People Involved

Akio Toyoda
CEO Toyota
Builds cars

Rex Tillerson,
CEO ExxonMobil
Gasoline to runs cars

Douglas Oberhelman
CEO Caterpillar
Builds paving equipment

Richard Fairbanks
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Auto loans

Lynn Peterson
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Taxes and funds roads

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Getting you to work
on time

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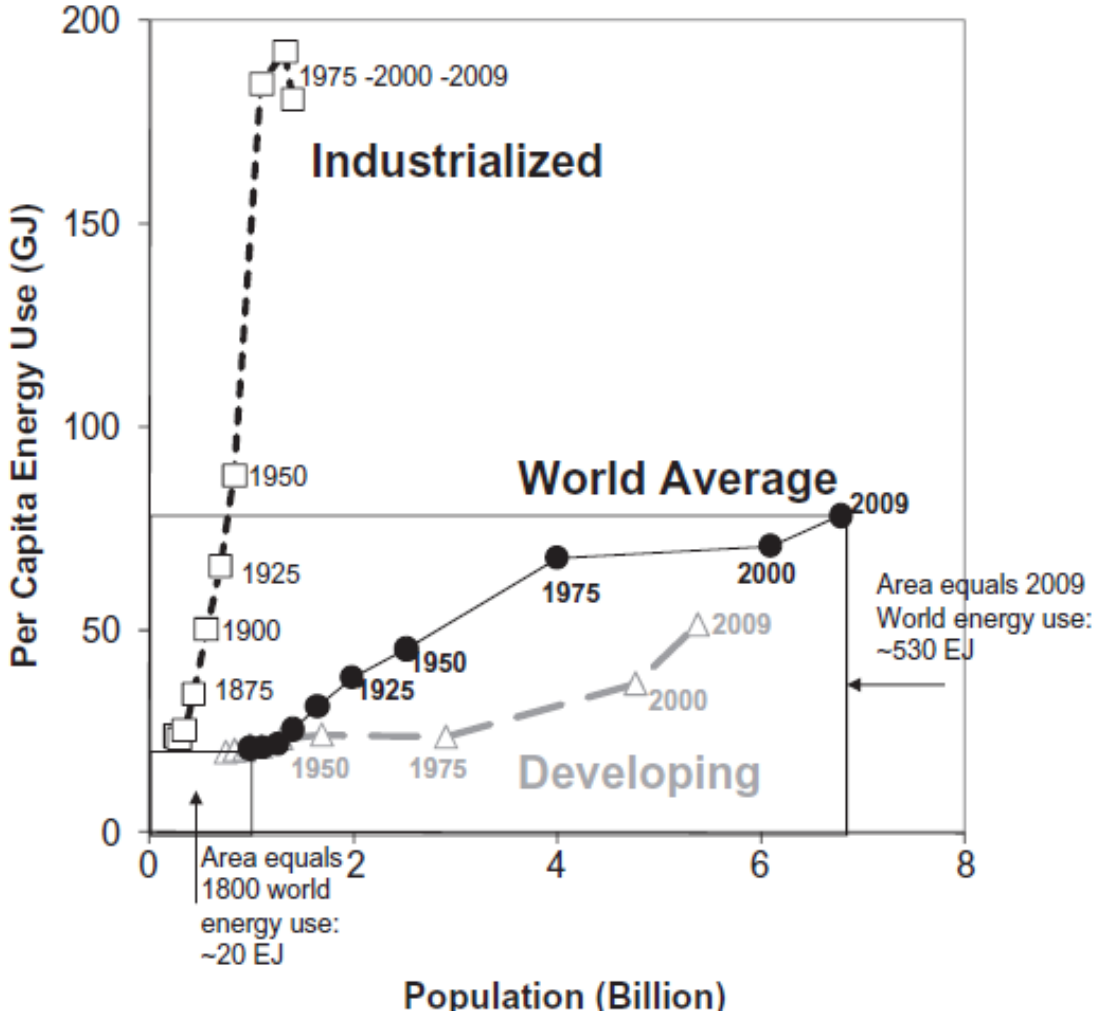
Need → manual solution → energy solution

- Need creates solution
- Solution gets automated
- Automation addresses other needs

- RAILWAYS
- 1350 – human/animal operated railways in Germany
- 1769 – steam engine invented by James Watt

- LIGHTBULB
- 1802 – first incandescent lightbulb by Humphry Davy
- 1882 – first power station built by Edison

Energy consumption vs. population growth



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- ○ I want my items faster. Ship them as they become available. (at additional cost)

Thought experiment – the history of your industry

- Think about your industry or one you're familiar with.
- How does it solve a problem/need today?
- How was the problem solved during the revolutionary war? During Shakespeare's era? Romans?
- How has access to energy change the approach to the solution? Is the solution better today than it was? If so, how?

What this course is about

This is NOT a course about energy

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This is a course about our society
and the demands it places on energy

Philosophy of this Term

Energy is what has historically propelled societal accomplishments.

- It is a measure of work and accomplishment.

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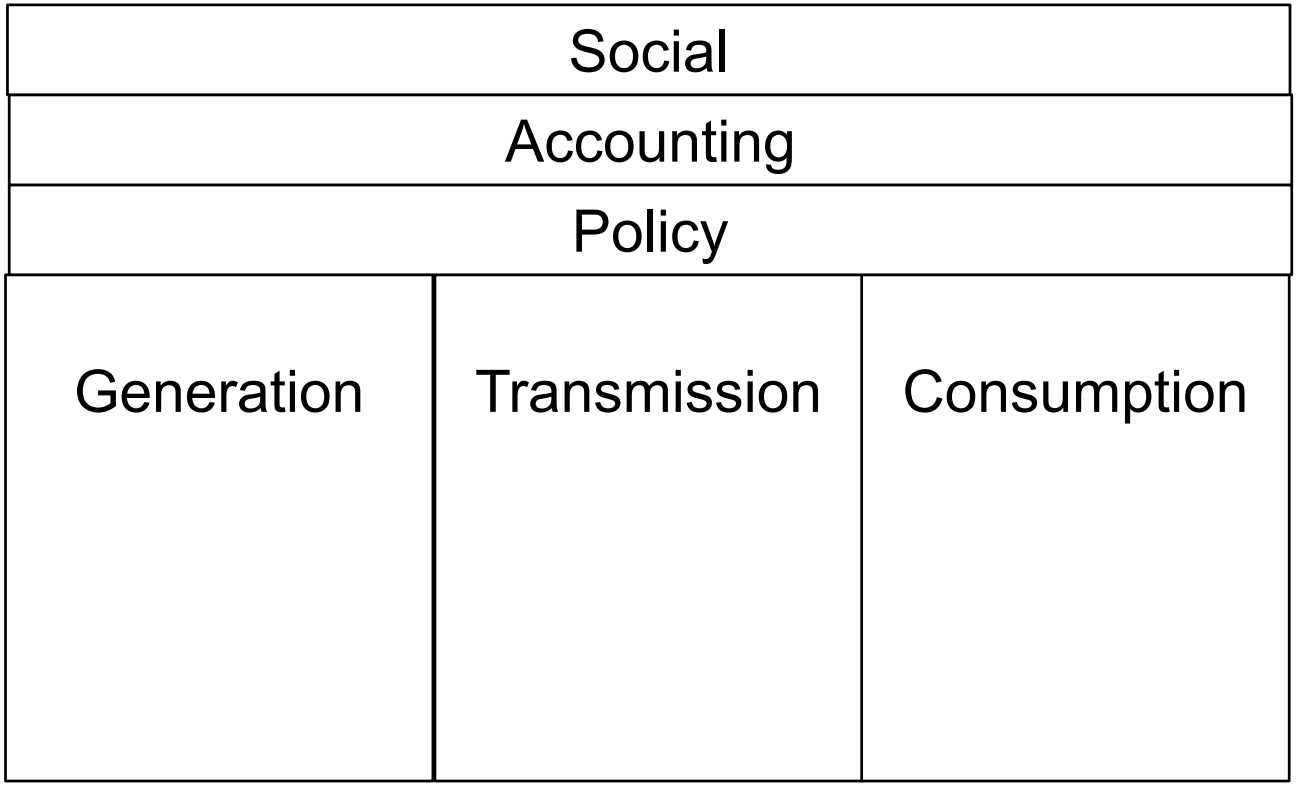
Access to energy has traditionally dictated strength of a civilization

- Energy is merely another resource.

Needs are based on our societal assumptions and expectations.

- Energy is a symptom, not the problem, that society faces.

Map for the term



Theme of the term: Problems with no solutions

Overview – Energy 101		
Markets – Financial Markets		
Social – Water Access		
Generation	**Transmission**	**Consumption**
Coal	Transportation	Waste
Renewables	Constraints	Commissions

*** Intensives**

Map for the Curriculum

	Term 1: *How did we get into this mess?*	**Term 2:** *Escaping the hamster wheel.*	**Term 3:** *Problems with no solutions.*
Intensives	• Electric Grid • Waste • Transportation	• Energy of Food • Heat and Steam • Smart Grid	• Consumption • Climate • Marketing
Webinars	• Generation • Transmission • Regulation • Financial Markets • Water as Energy	• 'Clean' Generation • Distributed Generation • Energy Storage • Wholesale Markets • Adv. Manufacturing	• National Security • River Treaty • Critical Materials • Developing Countries • Oil Sands

Term 4: Action Learning Practicum
Do something about it!

Guests Include

- Steve Tobias, *Director of Strategy, National Grid*
- Amanda Goodin*, EarthJustice*
- AP Hurd*, Touchstone Corp*
- Philipp Schmidt-Pathmann*, WRSI*
- Jeff Clarke*, Alderwood Water District*

And many more…

Expectations

- Prepared for class discussions
- Homework
- Class participations
- Cold Calls (!)
- Wiki participations
- Group work

The Ultimate Rule

In summary

- Energy is an indirect measure of work
- Value proposition of energy is valid only in the context of the situation
- Finding an optimal solution is *easy*
- Implementing an optimal solution is *hard*
- Energy is a symptom of our society, not the problem