

ALL Talk and Hopefully Action

Energy Efficiency and Renewables

As seen by a practitioner of the art

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What is this talk about?

***Hope, progress, change, energy that really is too cheap to meter, without the nuclear waste part.**

***Efficiency**

***Lighting**

***Transportation**

***Wind**

***Solar electric**

***Solar water and heat pumps**

***Organizations that are doing good**

***Strange bedfellows**

***What you can do**

Short Bio

- Ex-paramedic and firefighter in Albany
- Solar water heater designer and manufacturer
- LED exit sign designer and manufacturer; saves 25,000,000 kwh/yr)
- Lighting we installed and made has saved 110,000,000 kilowatt hours/year.
- Installed 8 MW of solar (about 30,000 modules) in Oregon
- Policy committee of the Oregon Solar Energy Association
- Helped build the Rocky Mountain Institute (Amory Lovins)
- Installed solar with nonprofits in Nicaragua, Peru, Haiti and Oregon



ALL Talk and Hopefully Action

Quick quiz: pass and no fail

Who has installed solar in the last 2 years and prior?

Made their home more efficient?

Bought a more efficient vehicle and drives less?

Bought an electric vehicle?

Supported Seeds for the Sol or other good groups?

Lobbied to expand programs that help all this?





“In the face of today’s climate challenge, both despair and complacency are equally unwarranted.”

Amory Lovins

This talk is about hope and the amazing rate of progress in
renewable energy and efficiency.

Amory Lovins (Co-founder of the Rocky Mtn. Institute)

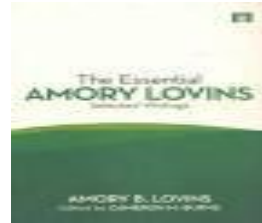
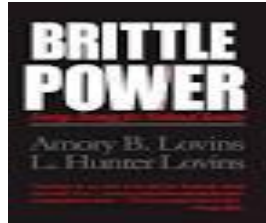
Energy efficiency and renewables become a thing in an article from Foreign Affairs. He looks at how we use energy and the best way to satisfy that need, rather than building power plants bigger and bigger. It is easier, safer and more comfortable to insulate your house, then import oil from the middle east.

He was named by **TIME magazine** one of the World's 100 most influential people in 2009. **www.rmi.org**

Energy Strategy: The Road Not Taken?

By [Amory B. Lovins](#) October 1976

Amory Lovins (some of his many books and studies)



**Wind power was about .07/kwh in 2009.
It is now as low at .02/kwh**

Bigger is better. GE is building a 12 mw windmill with 220 meter rotors. Each can power 16,000 homes.

Repowering

If you want a deep dive into wind NREL report:

https://emp.lbl.gov/sites/default/files/2017_wind_technologies_market_report.pdf

And more

https://en.wikipedia.org/wiki/Wind_power_in_the_United_States



**As of 2017, there was
82,183 MW of nameplate
wind turbines in the US
Texas has about ¼ of the
total at 22,599 MW.
Oregon has 3,213 MW.**

There are over 110,000 jobs in the wind industry and about 50,000 in coal.

Repowering Windmills



Pacific Power and others are taking older windmills, putting on new, longer better blades and upgrading the gearboxes. The payback can be just a few years and they can increase start-up from 7 mph to 3 mph, with up to 30% more power produced.

Bigger is better: GE Haliade X !!

How many seas will it take to power the world?

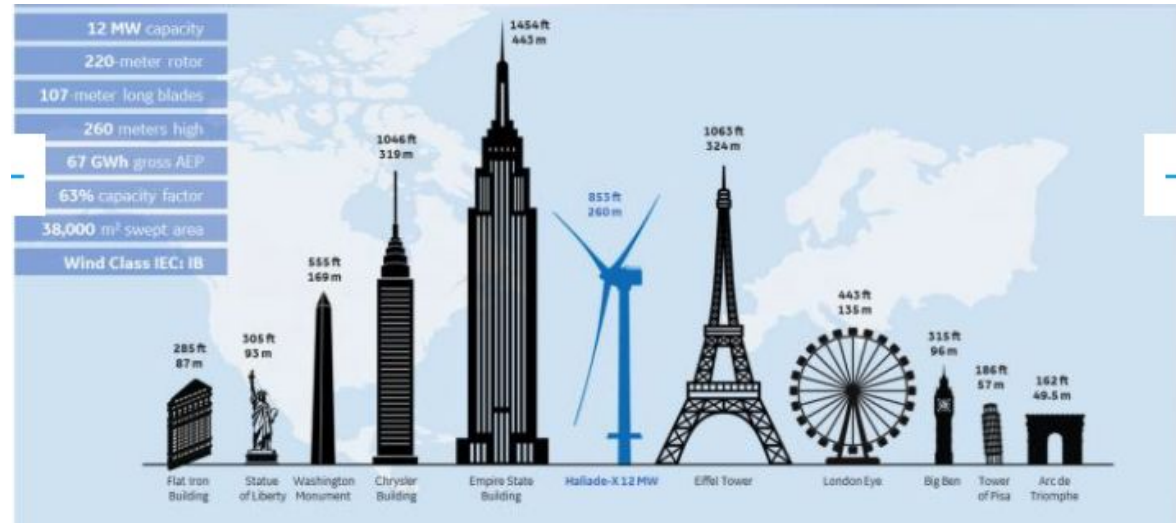
The answer is blowing in the wind.

<https://www.youtube.com/watch?v=ybh7NwZv7c8>

2 mins on GE

<https://www.youtube.com/watch?v=xKYClcExkMY>

5 mins on install



Someone hates wind and not just for the obvious reasons.

Wind

https://www.youtube.com/watch?v=AXXMfut_tCTw

< 2 mins

“They are ugly, kill tourism, lower property values, and cause cancer.”

Is someone writing his biography or talking about windmills?

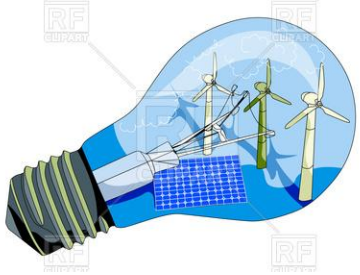


Windbag in Chief

Lighting



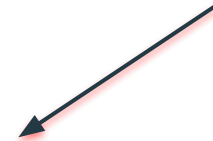
Lighting uses about 20% of the energy in commercial buildings.



Our lighting retrofits and new fixtures resulted in savings of 110,000,000 kwh/yr. This is equal to ¼ of the electricity used by the entire city of Albany.

The Energy Trust provides free LED light bulbs for homes that have incandescent bulbs and many other incentives for efficiency.

**CEC Direct Install program
Free is a good price.**



<http://www.corvallisenvironmentalcenter.org/energy/>

Free Energy Savings



The Energy Trust of Oregon (ETO)

Direct Install, a program of Corvallis Environmental Center, installs free LED light bulbs, low-flow faucet aerators, and low-flow shower heads to homeowners in Corvallis/Albany that have incandescents. It is funded through Energy Trust of Oregon with a fee paid by local utilities. For non-homeowners, ETO has a kit they send you.

www.energytrust.org

Lighting saves bigly, here's a comparison:



Old lighting: 400 watt Metal Halide (460 watts with ballast), 75,000 fixtures at 5,000 hrs. 15,000-20,000 hr. lamp life = 172,500,000 kwh/yr

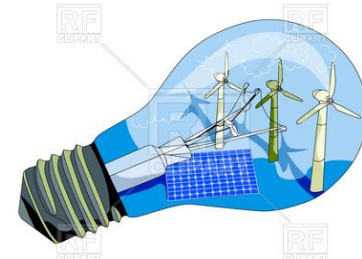
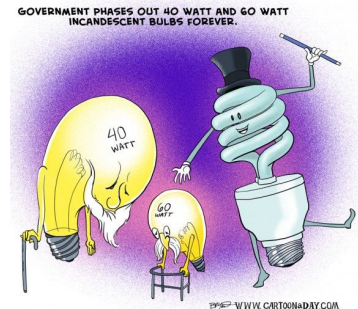
**New lighting: T5HO lights with occupancy sensors (224 watts)
= 76,500,000 kwh/yr
(24,000 to 36,000 hr. lamp life)**

**Newest: Today's best LED fixtures (94 watt)
= 28,200,000 kwh/yr
(up to 150,000 hr lamp life)**



What can changing one light bulb do?

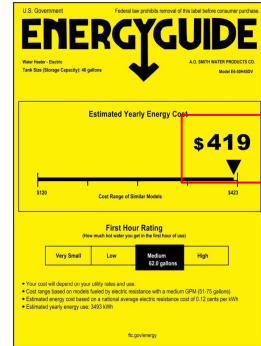
- (1) 75 watt incandescent (w/1000 hr life) x 25,000 hrs x .10/kwh = \$187.50 over its life.
 - (1) 13 watt LED bulb (25,000 hr life) x .10/kwh = \$32.50
- 1 LED bulb saves \$155 over its life!! (not including replacing the incandescent 25 times).
- Instant on, dimmable, no mercury and unaffected by cold.



Heat pump water heaters (solar water heater killers).

- *Lord Kelvin developed the idea of refrigeration in 1852.
- *Save up to 65% off your hot water bill. May be utility controlled for better integration with renewables.
- *As low as 2-3 year payback with a self-install. Every year about 1 in 13 water heaters are replaced.
- *If there is one thing you should do after this talk, it is to it is to replace your electric water heater with a heat pump water heater and swap out incandescent bulbs to LED. OK, that's two, but close enough.

Save energy, shift energy, quick payback.



Solar Water Heaters

Beginnings of modern solar water heaters

Batch Heaters

Thermosiphon/Passive/Active/Copper Cricket

Our systems

Jimmy Carter and Ronald Reagan

Legislation

Competition- HPHW

Climax Solar-Water Heater
UTILIZING ONE OF NATURE'S GENEROUS FORCES

THE SUN'S HEAT { Stored up in Hot Water for Baths, Domestic and other Purposes.

GIVES HOT WATER at all HOURS OF THE DAY AND NIGHT.
NO DELAY.
FLOWS INSTANTLY.
NO CARE. NO WORRY.
ALWAYS CHARGED.
ALWAYS READY.
THE WATER AT TIMES ALMOST BOILS.

Price, No. 1, \$25.00
This Size will Supply sufficient for 3 to 6 Baths.

CLARENCE M. KEMP, BALTIMORE, MD.

Price Of No. 1 Heater for 1892 Reduced to \$15.00 Net



Advertisement for the Climax solar water heater, 1892. The price of this, Kemp's smallest unit, had just dropped from \$25 to \$15.



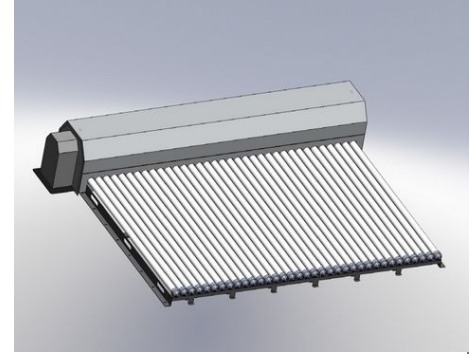
The most efficient solar water heater never made

**Heat Pump water heaters make too much sense.
There is more money in Solar PV.**

ETO/RETC incentives

China

<https://www.eenews.net/stories/1059983772>



Moving gently down the stream

Bigger pipes, softer curves, huge savings

<https://www.youtube.com/watch?v=NkJ5kwFcv0w>

24:59 into talk





Good Organizations Doing Good Things

www.gridalternatives.org

www.twendesolar.org

www.seedsforthesol.org

www.rmi.org

www.barefootcollege.org

<https://wecaresolar.org/resources/we-care-solar-suitcase/>

<https://www.youtube.com/user/gridalternatives>

<https://www.seedsforthesol.org/inspired-by-her-climate-reality-training/>

www.youtube.com/watch?v=KgLvP7vZLk0&t=172s Twende

www.youtube.com/watch?v=Ofn7jqPDTeY Solar cookers

www.youtube.com/watch?v=c7QHVMWceDA Solar suitcase

https://www.youtube.com/watch?v=LTRageo_9i8 M Kopa

<https://www.youtube.com/watch?v=Oo8iEL6Sqgl> Amory and batteries

https://www.youtube.com/watch?v=7dQo-iT5T_c Carbon free cities

<https://www.youtube.com/watch?v=hv5HS9n97JQ> Pacific Power

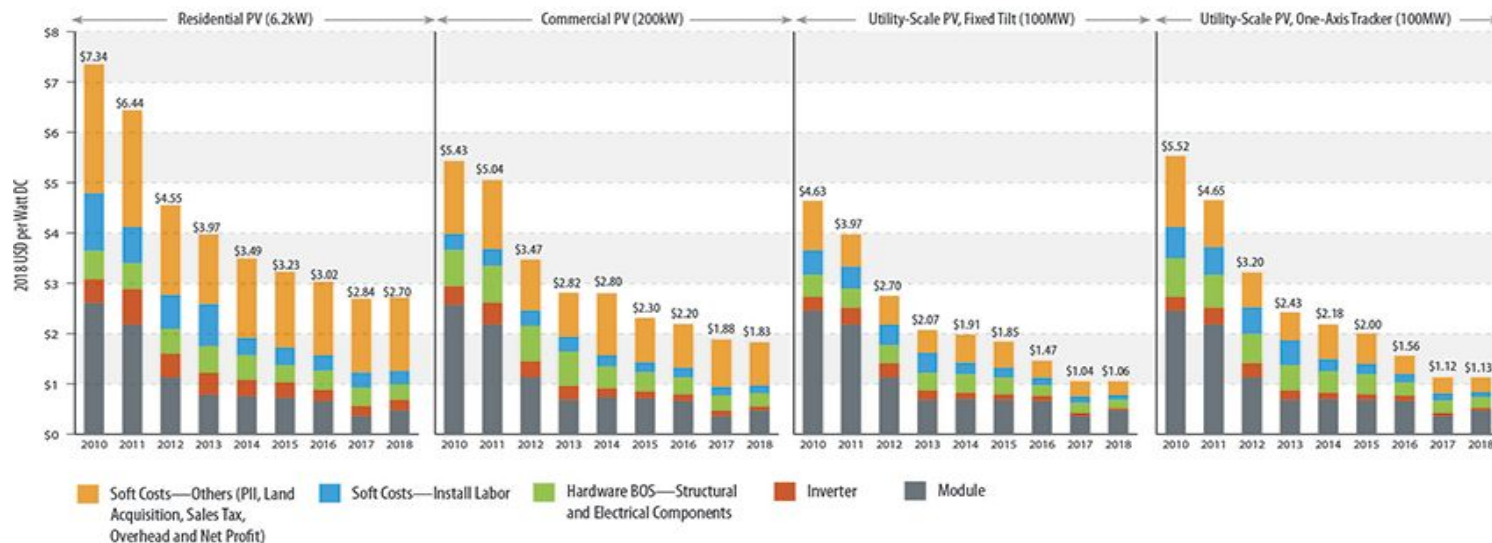


Cities	6.1
Twende	5.5
Lovins	4.4
M Kopa	3.4
Solar Suitcase	3
Grid Alternatives	2.4
Solar Cookers	3.1
Seeds for the Sol	2

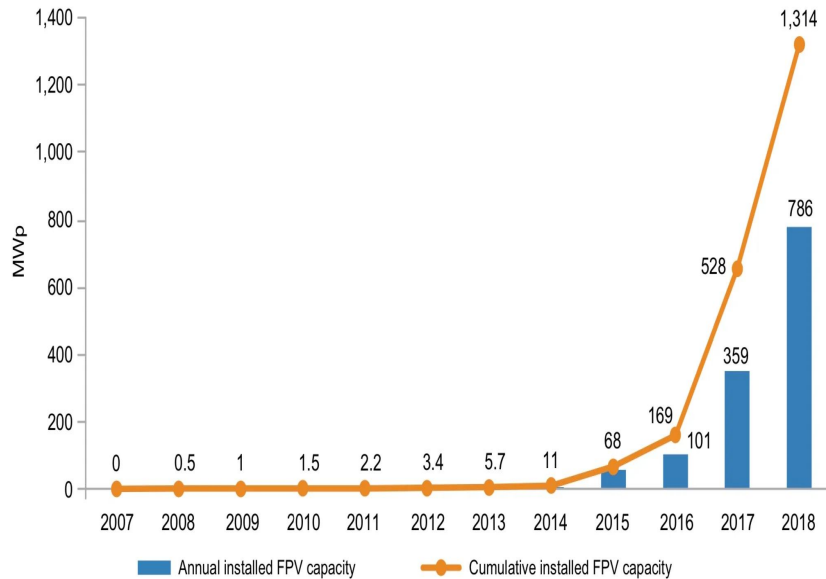


The real power too cheap to meter

- *Solar module big drop in prices, thanks in large part to the German Fit program
- *April 4, 2019 PPA (120 MW); the lowest cost in the country was in Idaho at .022/kwh with 1-2% escalator.
- *July 9, 2019 (200 MW) was a new low .0197/kwh (LADWP).



Floatovoltaics



Solar Inverters

DC/AC not AC/DC

Central Inverter

Bigger and bigger string inverters

Microinverters

Optimizers

Just out: 25 kw 3 phase inverter
the size of a 5 kw residential one



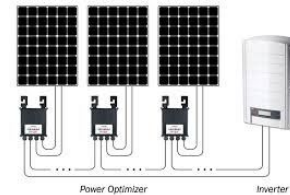
Vs



ENPHASE



M215-60-2LL-S25-IG

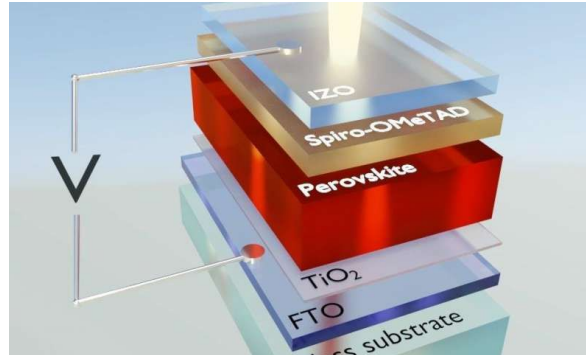


Solar Modules innovations

60 cell, 72 cell, bifacial, other



A 60 cell solar module used to be @ 230w 7 or 8 years ago; at best it is near 400 watts today. Wattages continually go up.



Legislation

RPS

FIT, RETC, BETC

GET

Property tax, SELP, Biz Oregon

1199

PUC

Federal: Credits, Depreciation, USDA



Don't count on legislation to save the day. Administrations change. Luckily, the economics don't, and efficiency and renewables are very cost- competitive, though tax credit changes will hurt.

Democracy makes strange bedfellows, but that's what makes it work

Green Tea Coalition



Debbie Dooley, one of the founders of the National Tea Party is a big solar supporter.

Turns out there is at least this one area of common interest. Everyone wants to be more independent, wants to save money, and almost no one likes buying from a monopoly.

Some Innovations

Qbotix https://www.youtube.com/watch?v=CzoiB_xi23Y

Game Change

Dynobond

Tenk

Bigger string inverters

Omco <https://omcosolar.com/omco-solar-multi-media/>

Floating solar

<https://www.youtube.com/watch?v=tVXKMySypzs>

Creative financing

<http://www.seedsforthesol.org/>



Price Drop in Solar*

100 kw 2013 (Albany Boys and Girls Bldg 1)

160 kw 2019 (ABnG Bldg. 2)

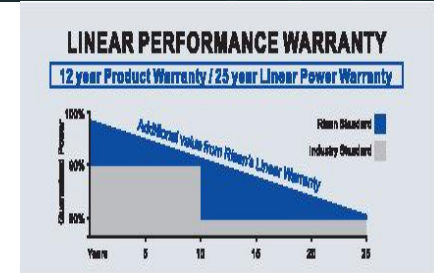
Modules	(434) 230w	(444) 360w
Module cost over 6 years	58% drop wholesale	
Labor	the same # modules/ labor, per kw 37% drop	
Inverter	(1) 100 kw/ 2,000 lbs, \$38,000	(2) 66 kw 150 lbs each, \$9,000

Racking costs less, with more power, same # modules and less labor.

Racking costs $\frac{1}{3}$ of what it was 8 years ago due to economies of scale and competition.

LCOE Solar 100 kw comp. Residential rates .10/kwh

\$/watt	100 kw	Corvallis kwh/yr	Klamath Falls	\$/kwh over 25 yrs Corvallis	\$/kwh K Falls
\$1.50	Fixed roof 15 deg	120,375	150,838	\$0.054	\$0.043
\$1.50	Fixed ground 30 deg	125,600	158,956	\$0.052	\$0.041
\$1.60	Tracker ground	142,389	180,638	\$0.049	\$0.039
\$1.58	Bifacial fix 30	133,136	168,493	\$0.052	\$0.041
\$1.68	Bifacial tracker	150,932	191,476	\$0.048	\$0.038

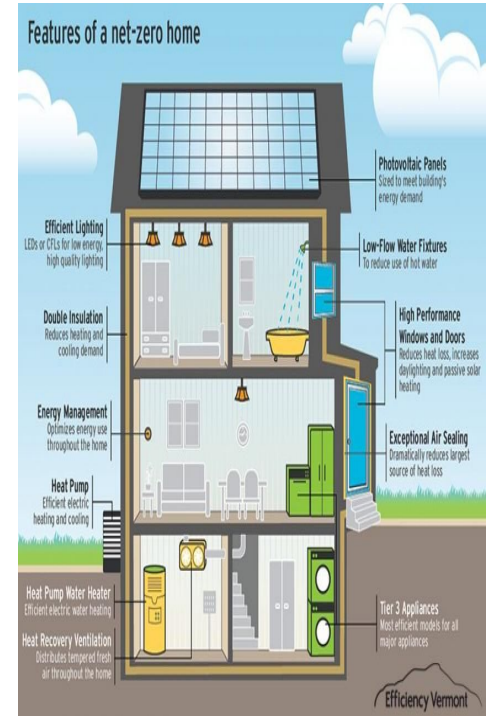


NuScale hopes to be @.06/kwh by 2025.
I hope for it to rain only at night.

Residences

Water Heating
Space heating and cooling
Lighting
Cooking
Windows

<https://www.windowquilt.com/VideoBrochure.htm>



Refrigerators (efficiency) and California

FIGURE 5: PERFORMANCE STANDARDS HAVE TRANSFORMED REFRIGERATORS



Even better, Net Zero houses

- *Corvallis 1 Net Zero habitat home
- *3 Albany Habitat Net Zero homes starting this year (OK, well, next year)
- *2025: ideally all new Habitat Homes nationwide (largest homebuilder in the country); in 2012 they built 94,618 homes.
- *Since 1976, 600,000 homes plus remodels.

Net Zero - Efficiency plus solar: Window, Walls, Air, Water, Heating, etc.

https://www.youtube.com/watch?v=C-Rk_YfNpJo

<https://www.youtube.com/watch?v=rR8T-9c64tc>

<https://www.youtube.com/watch?v=LAO2VH5smtg>

Net zero home retrofit <https://www.youtube.com/watch?v=WbyUU1JGexI>

Transportation

Bike/Electric/Skateboard

Carpool www.waze.com/carpool

Drive: Electric & Hybrid

BRT

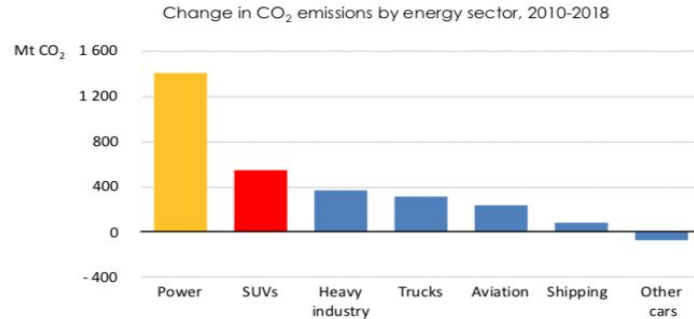
Train

Large SUV's are causing more pollution than EV's are saving

Travel less



Power and SUVs have been the main forces driving emissions higher



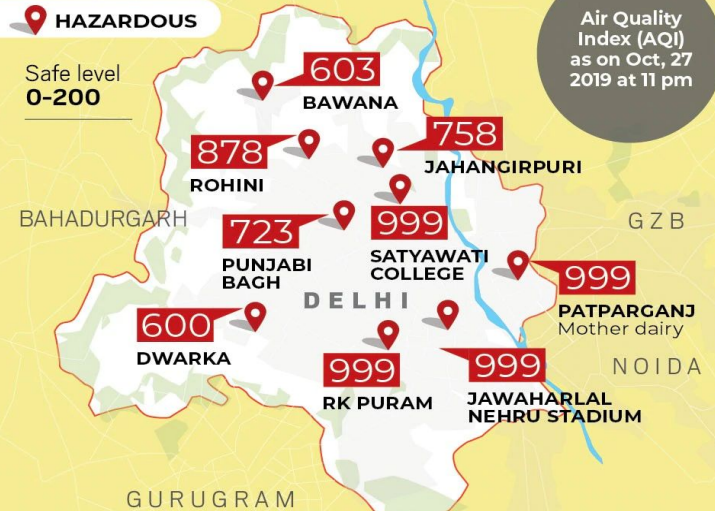
The global fleet of SUVs increased from 35 million in 2010 to over 200 million in 2018, becoming a major force in rising oil demand and the second-largest reason for CO₂ emissions growth since 2010

Alt. to clean energy- Dehli



ET

DELHI CHOKES: POLLUTION LEVELS TOUCH 999 ON DIWALI NIGHT



Source: Central Pollution Control Board via aqicn.org

FARIDABAD

DIU

This EV never needs to be recharged



Electric Vehicles



Green the grid..... Cut way down on internal combustion engines which are 20-40% efficient...Electrify transportation with vehicles with 90%+ motors. My Bolt costs .025/mile to charge up at home. My pickup costs.30/mile to drive. The average car weighs 4,100 lbs to move a few hundred pounds. A bicycle a lot less, a scooter even less.

1 kwh can power a scooter for about 80 miles, a Tesla for approximately 4 miles, the equivalent in gas in a car is about one mile, and a very efficient car two miles.

Ideally, cars would be charged to work with the utilities as storage for the grid (Vehicle to Grid V2G, Nissan worked on this). Chargers can be programmed for this.

Battery trends will make electric cars cost effective with ICE vehicle's in the near future.

Electric Vehicles

Tesla improves its mileage an average of 3% for year without changing batteries, their cars could go 1,000,000 miles.

VW said that [electric cars will soon reach price parity](#) with gas-powered vehicles.

[Volkswagen is planning to make a sub-\\$22,500 all-electric vehicle](#). It is expected around 2023. VW CEO Herbert Diess says the first vehicle on their new mfg. platform, the ID.3 electric car is 40% cheaper to build than the e-Golf.

The Chevy Bolt increases its' range by 10% without increasing the battery size

Ford announced it will end making passenger cars in the US. the only exception is the soon to be out electric Mustang

California announces their state govt. Won't buy any cars from companies pushing to lower energy/pollution standards in vehicles.

Self driving costs come down, technology gets better. Cars typically sit 90%+ of the time, Ideally car sharing will cut down on the number of cars out there, less traffic, more efficiency...

Trump is not going to save coal.
They continue to shut down, due to
cheaper solar and gas (gas: bad).

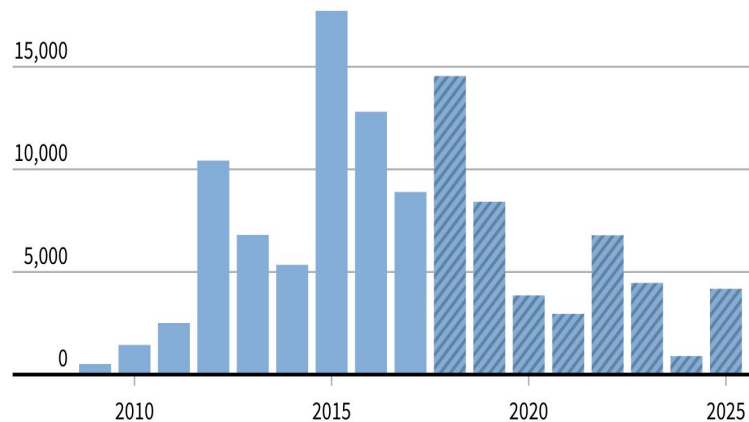
As of 2018, 70 percent of coal capacity
in the U.S. had a higher running cost
than renewables, and by 2030, that
number is expected to reach 100
percent.



Clean Beautiful Coal

COAL UNITS SHUT

20,000 megawatts of coal units shut



Natural Gas

Gas has a much better lobby than coal, and methane leakage is higher than estimates.

<https://www.youtube.com/watch?v=UCSNwYInMXg>

2 mins

<https://www.greenpeace.org/usa/global-warming/issues/natural-gas/>

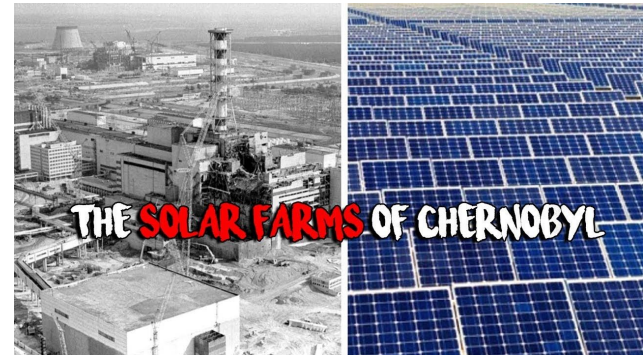


Nukes Suck



**Fukushima
Chernobyl
Three Mile Island
Browns Ferry
Windscale
Kyshtm
Idaho Falls SL1
Enrico Fermi
Peach Bottom 2 and 3
Paks
Davis-Besse**

NuScale



NuScale

Probably better, safer, faster and maybe cheaper technology, but so what?

Projected to cost about .06/kwh in 2026; large solar is $\frac{1}{3}$ of that today and getting even cheaper as is efficiency.

Even with battery storage, solar is lower in cost than nuclear.

There is no permanent waste repository for stuff that is deadly for tens of thousands of years.

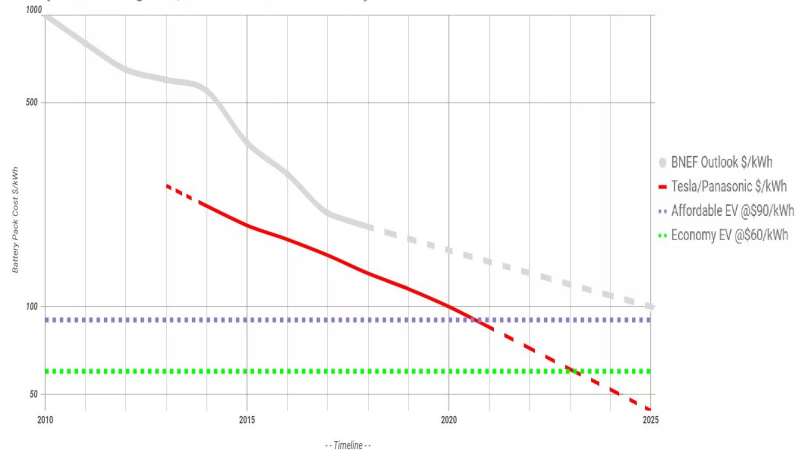
Nuclear terrorism with dirty bombs from waste is an issue.

There has never been a nuke plant made on budget (remember: too cheap to meter).

Battery Trends

Trend Data for Battery Pack \$/kWh - Tesla vs. Market Average (BNEF research)

{Cost Axis is Log Scale, dashed lines are estimated data}



Lithium-ion battery price survey results: volume-weighted average

Battery pack price (real 2018 \$/kWh)

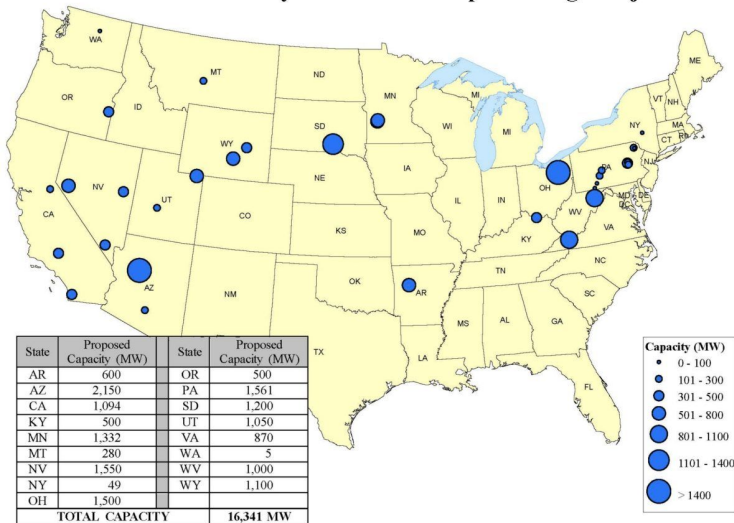


Source: BloombergNEF

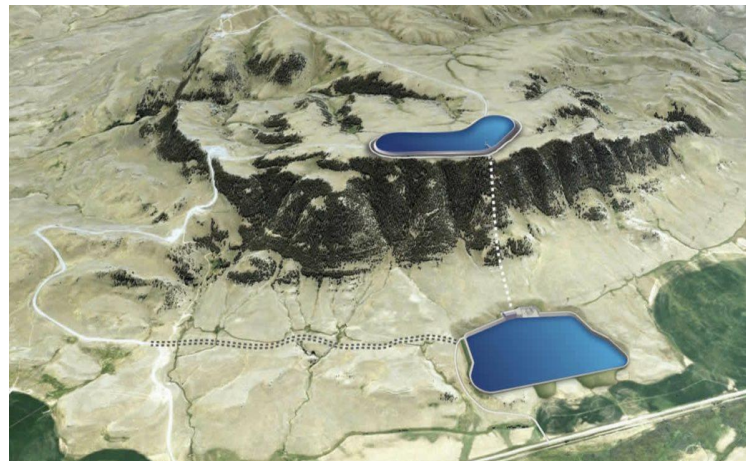
Pumped Storage

Proposed systems outside of Klamath Falls, Oregon and Goldendale, Wa.

Issued Preliminary Permits for Pumped Storage Projects



Source: FERC Staff, February 1, 2019



Global study in 2019 shows 530,000 sites worldwide that would work.

<https://www.sciencealert.com/scientists-spot-530-000-potential-pumped-hydro-sites-to-meet-all-our-renewable-energy-needs>

Trump drops out from the Paris Accord! America Responds !!

**2,187 Cities and Counties
287 Colleges and Universities
350 Cultural Institutions
59 Health Care Organizations**



Albuquerque, Aspen, Ashland, Anchorage, Berkeley, Boston, Boise, Boulder, Corvallis, Missoula, Orlando, Cleveland, Columbus, Cincinnati, Englewood, NJ (my home town), NYC

Amazon, Amy's Kitchen (they have our lights), Ben & Jerry's, Campbell Soup, Ebay, Facebook, Gap, Google, Ikea, Intel, Nestle, Nike, Paypal, Seattle City Light, Stonyfield Yogurt

And thousands of others!!!!

<https://www.wearestillin.com>

<https://rmi.org/cities-in-red-and-blue-states-a-ct-for-a-clean-energy-future/>

Utility News

XCEL Energy going carbon-free, overwhelmed with low bids for renewables

Ohio to eliminate RPS, bail out coal and nukes

Tri-State rebuffs offer to replace three coal plants mostly with renewables

Nevada to install world's largest battery

FPL starts building 750 MW of new solar on its way to 2 GW by 2020

There is certainly some utility green washing happening as they talk solar and fight solar at the same time.



Jobs, Jobs, Jobs

More than 350,000 people last year worked in part or in whole on solar energy production (with over 260,000 of those employees spending the majority of their time on solar). This is more than 40 percent of the overall electrical generation workforce and exceeds the *combined* employment of coal, gas, and oil workers connected with producing electricity that reached just under 200,000, with coal at @50,000.



What can we do?

Start with low cost easy to do projects:

- *Get an energy audit of your house and do the measures: insulation, weather-stripping, etc.**
- *Upgrade to LED lights.**
- *Drive less, carpool more, ride a bike more.**
- *Don't waste food (40% ends up wasted; it takes a lot of energy to grow, ship, cool, cook...). Food in dumps creates methane.**
- *Eat less meat (cows produce bad methane).**
- *Wash laundry in cold water.**
- *Hang up clothes to dry.**
- *Help Habitat build affordable efficient houses.**

Even More to do:

- *Smart-plug strips that turn off loads.**
- *Adjust thermostat to more efficient setting; use a smart thermostat, such as Nest.**
- *During summer, open windows at night to cool house down and .save on AC.**
- *Better shower and sink faucets; use less hot water.**
- *Switch out to a heat pump water heater if you have electric and a way to ventilate it with unheated outside air.**
- *Go solar or join community solar when it is available, or work with Seeds for the Sol and the Solar Co-op.**
- *Upgrade heating system, ideally to very efficient ductless heat pump.**
- *Add insulating window quilts.**
- *When replacing your car, consider a hybrid, plug-in hybrid, and ideally a fully electric.**
- *Get your friends to do the same.**

Unintended consequences of bad things:

- *Climate change contributes to dry forests, fires intensify.
- *PG&E causes fire in fire-prone area (Paradise, CA. etc.).
- *Power gets shut off during risky times. Battery sales go thru the roof in California.
- *No one volunteers to rake the forests in California!



Tsunami severely damages Fukushima nuclear plant in Japan.
People move away.
Solar and wind will be replacing the energy sited in the area
evacuated by the local people.



Chernobyl melts partially down, large area gets abandoned, the area is getting a large solar system.



- *Even the Kentucky Coal Museum understands the future.
- *Trump proposes relaxing rules on waste from coal plants.
- *Murray Energy (large Trump donor), the largest private coal mine owner in U.S., files Chapter 11 (along with many others).
- *Automation and mountaintop removal, along with competition from gas and renewables, are leading to death spiral of coal.



Chapter 14 Natural Capitalism <http://www.natcap.org/sitepages/pid67.php>

Curitiba, Brazil

Jamie Lerner Architect, Urban Planner, Mayor for 3 terms, Governor

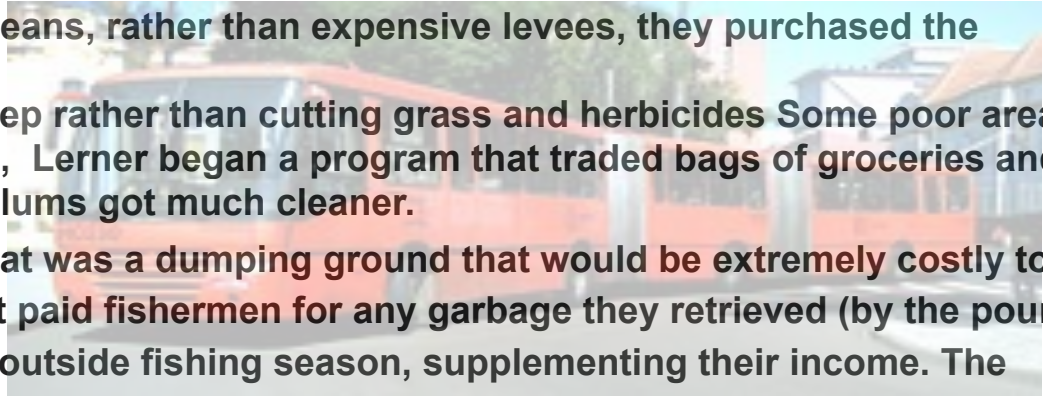
Bordered by a flood plain like New Orleans, rather than expensive levees, they purchased the floodplain and make parks.

A leader in parks per capita. Used sheep rather than cutting grass and herbicides. Some poor areas had streets too tight for garbage trucks, Lerner began a program that traded bags of groceries and transit passes for bags of trash. The slums got much cleaner.

Similarly, Curitiba has a nearby bay that was a dumping ground that would be extremely costly to clean up. Lerner began a program that paid fishermen for any garbage they retrieved (by the pound). That way, they can make money even outside fishing season, supplementing their income. The savings to Curitiba is in the millions.

Lerner instituted many innovative social and educational programs. Barrio kids can be apprenticed to city employees if they want to avoid going to school. Although his term as mayor is not without controversy, Curitiba does not have the gangs of much more populous cities such as Rio de Janeiro.

Pioneered BRT at a small fraction of subway costs, eliminating 40% of the traffic



We need Concrete Solutions

Concrete production creates about 8% of the world's man made emissions of CO₂, both from making cement and the curing process giving off CO₂.

Solutions come in many forms, some include:

Using renewable energy to heat up limestone in the mfg.

Burning tires to help with the heat process (helps get rid of tires also, idea from MIT)

Different ingredients in the mix, one developed by EFPL research institute in Switzerland than can reduce 30% off carbon compared to Portland cement.

NJ company developed process that uses CO₂ to harden concrete.

3D printing that uses less concrete

Make buildings that last longer so we don't waste so much, recycle it more.

grist.org/article/cement-has-a-carbon-problem-here-are-some-concrete-solutions/

Solar Thermal



Heliogen, a company that emerged from stealth mode on Tuesday, has discovered a way to use A.I. and a field of mirrors to reflect so much sunlight that it generates heat above 1,000 degrees Celsius.

For the first time, concentrated solar energy can be used to create the extreme heat required to make cement, steel, glass and other industrial processes.

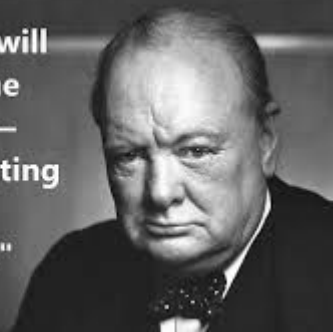
Cement accounts for 7% of global CO₂ emissions

<u>20 year earnings</u>	Kwh saved/yr	\$ saved per year at today's rates	Typical install cost	Simple payback	20 year savings	Savings w/incentives over 20 years
Electric water heater to HPWH	2,500	\$250	\$1,100	4.40	\$3,900	
Incandescent to LED bulb (1000 hrs/yr)	62	\$6.20	\$3	0.48	\$121.00	
5 kw solar	5,750	\$575	\$12,500	21.74		\$3,975
5 kw solar of large scale w/bifacial and tracker	7,500	\$750	\$5,500	7.33	\$9,500	\$11,150
Insulating Curtains						
Driving less, electric bike...						
Replacing old refrigerator						
Wash laundry in cold water						
Add insulation						

**Sunlight travels 94,000,000 miles to reach us. Make it worth the trip.
Efficiency savings are invisible -- don't forget about them!**



**"Americans will
always do the
right thing —
after exhausting
all the
alternatives."**



Questions??

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Now, what will you do?

<https://www.youtube.com/watch?v=nMWR6v-X0E0>