Our Electricity Future

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Outline

- Where we are
- Where we might go
- How we might get there:
  - Demand
  - Wind
  - PV
  - Geothermal
- Cost, other objections

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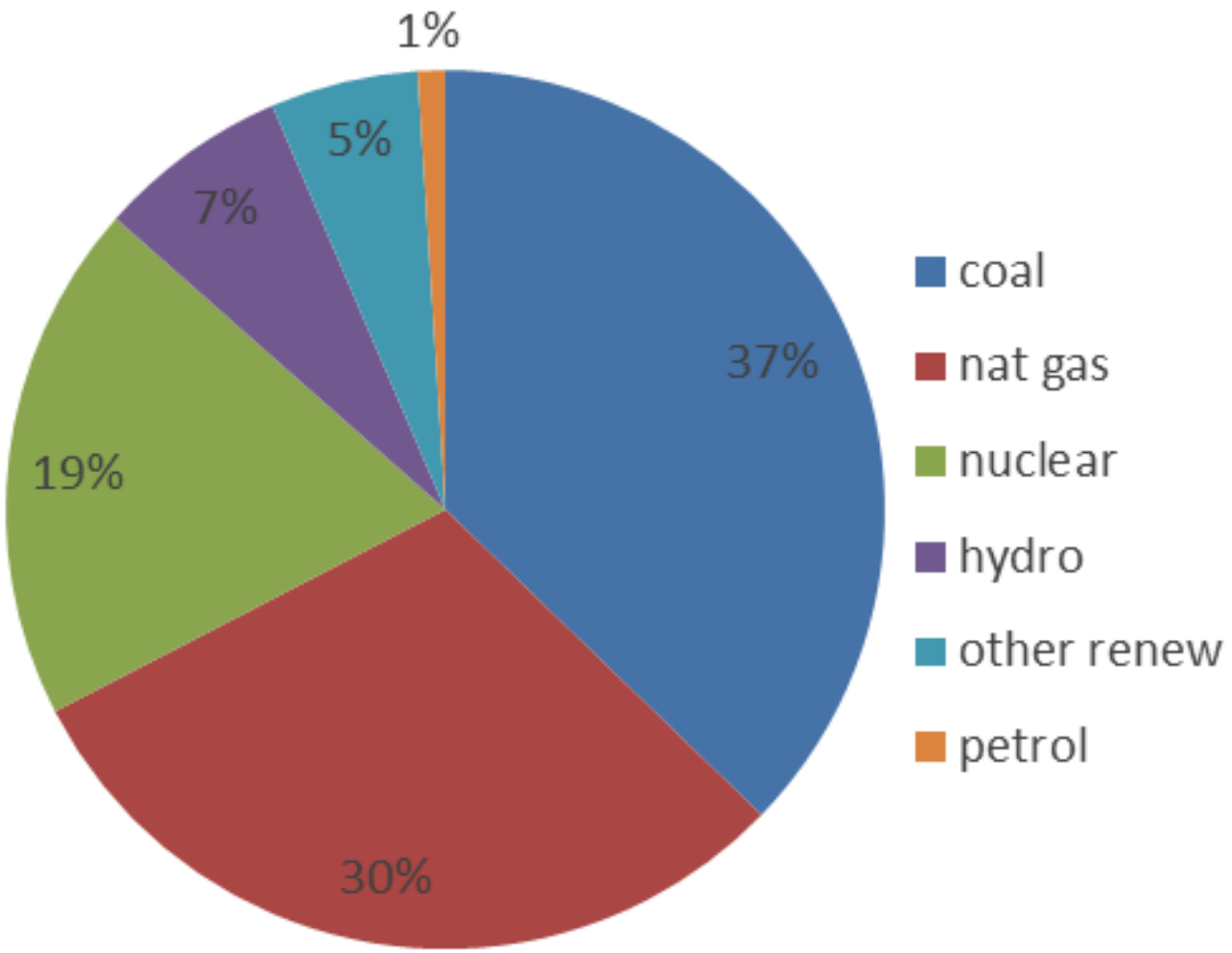
Present Electricity Fuel Mix

Annual Total
4.054*10^15 Wh
Average 463 GW capacity

Still mostly coal
Nuclear constant
Wind, gas growing



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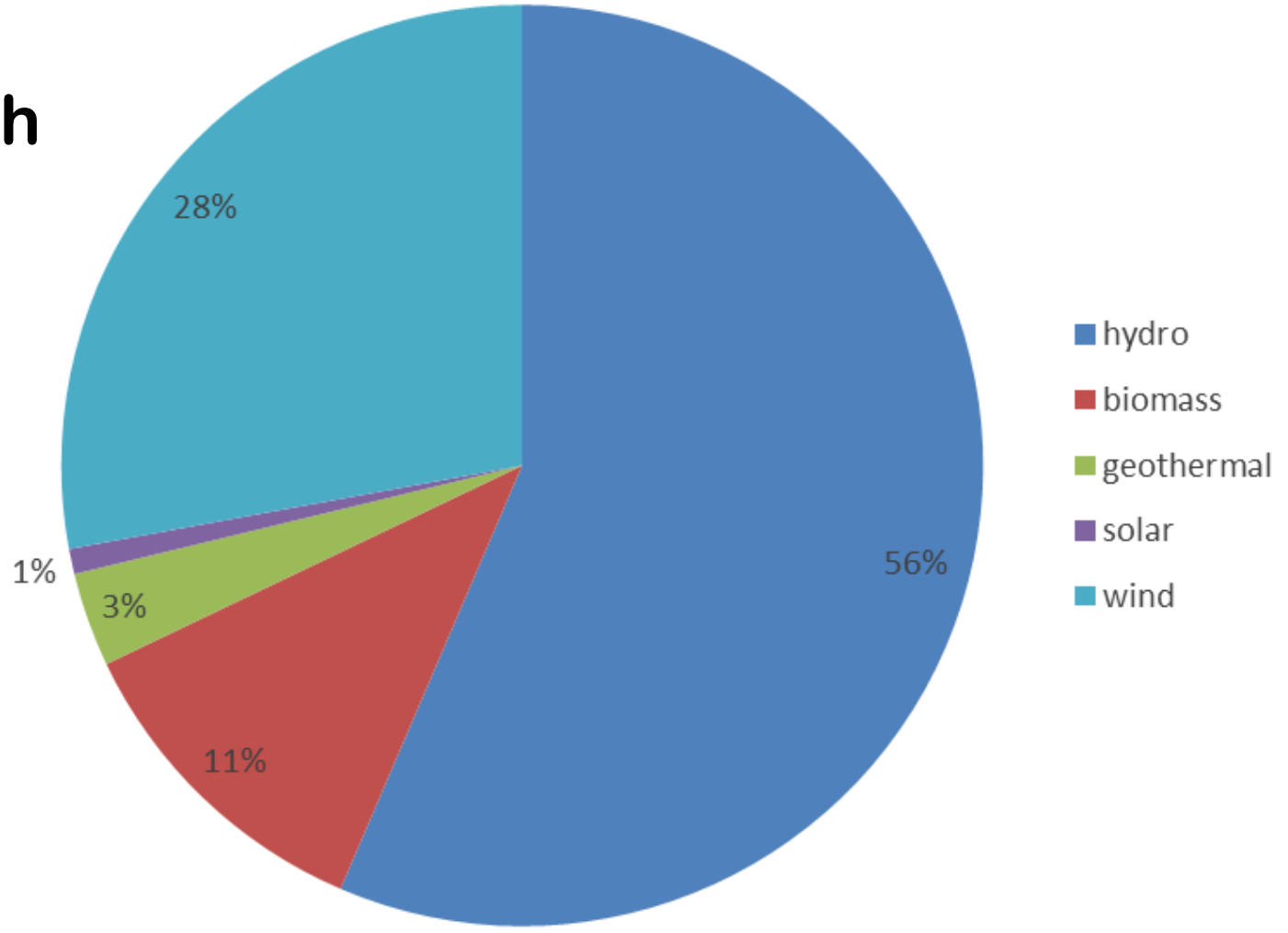
Renewable Energy by Source

Annual Total
495*10^12 Wh
Average 56.5 GW capacity

Mostly hydro, wind #2, others growing.



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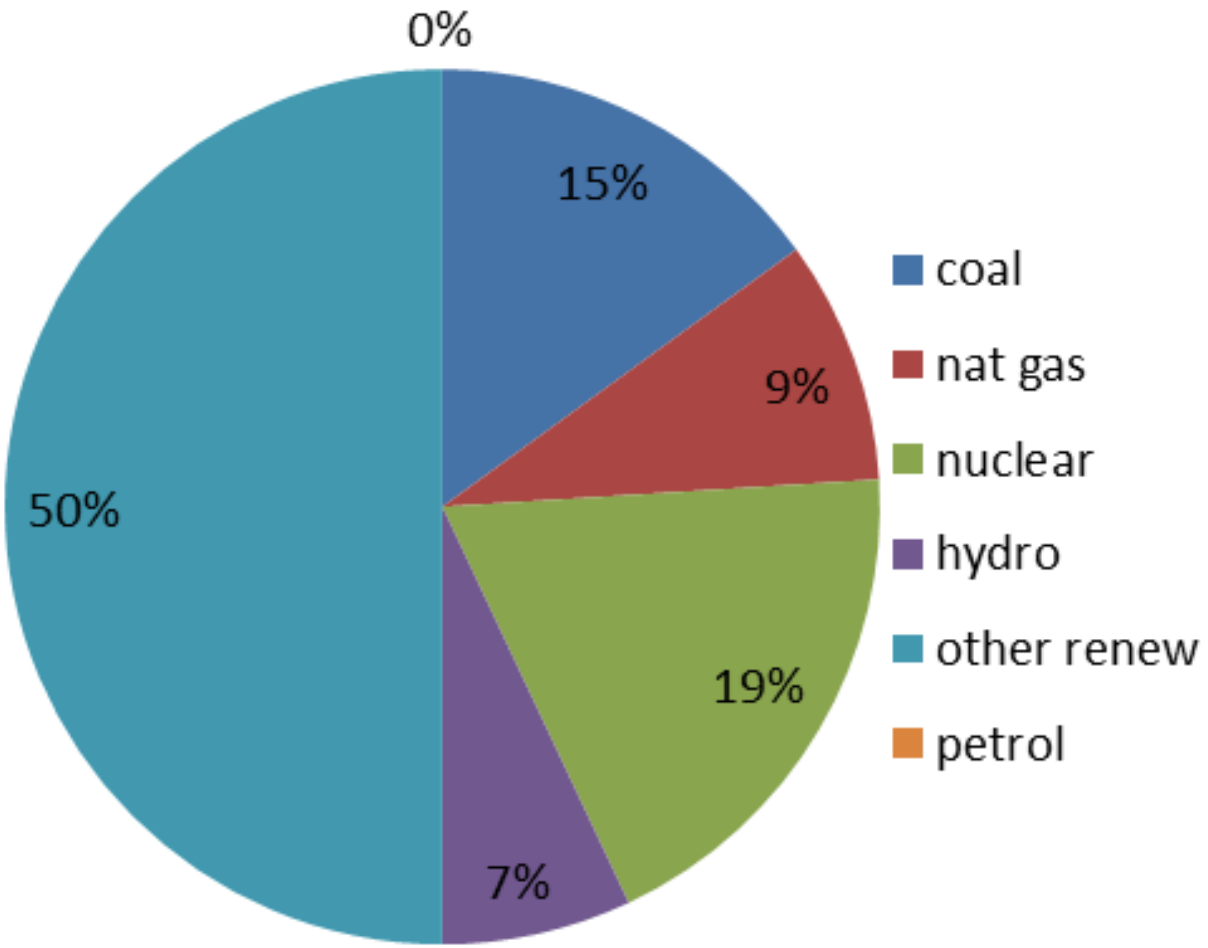
A Desirable Future

Renewable=
Wind + solar
Cut fossil fuels
Not shown:
cut demand!
Alternate:
double
nuclear, delete
all fossil.



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Steps along the Way

- Cut demand by 50%: primarily buildings
- Continue increasing wind & solar
- Continue decommissioning old coal
- Is this achievable?

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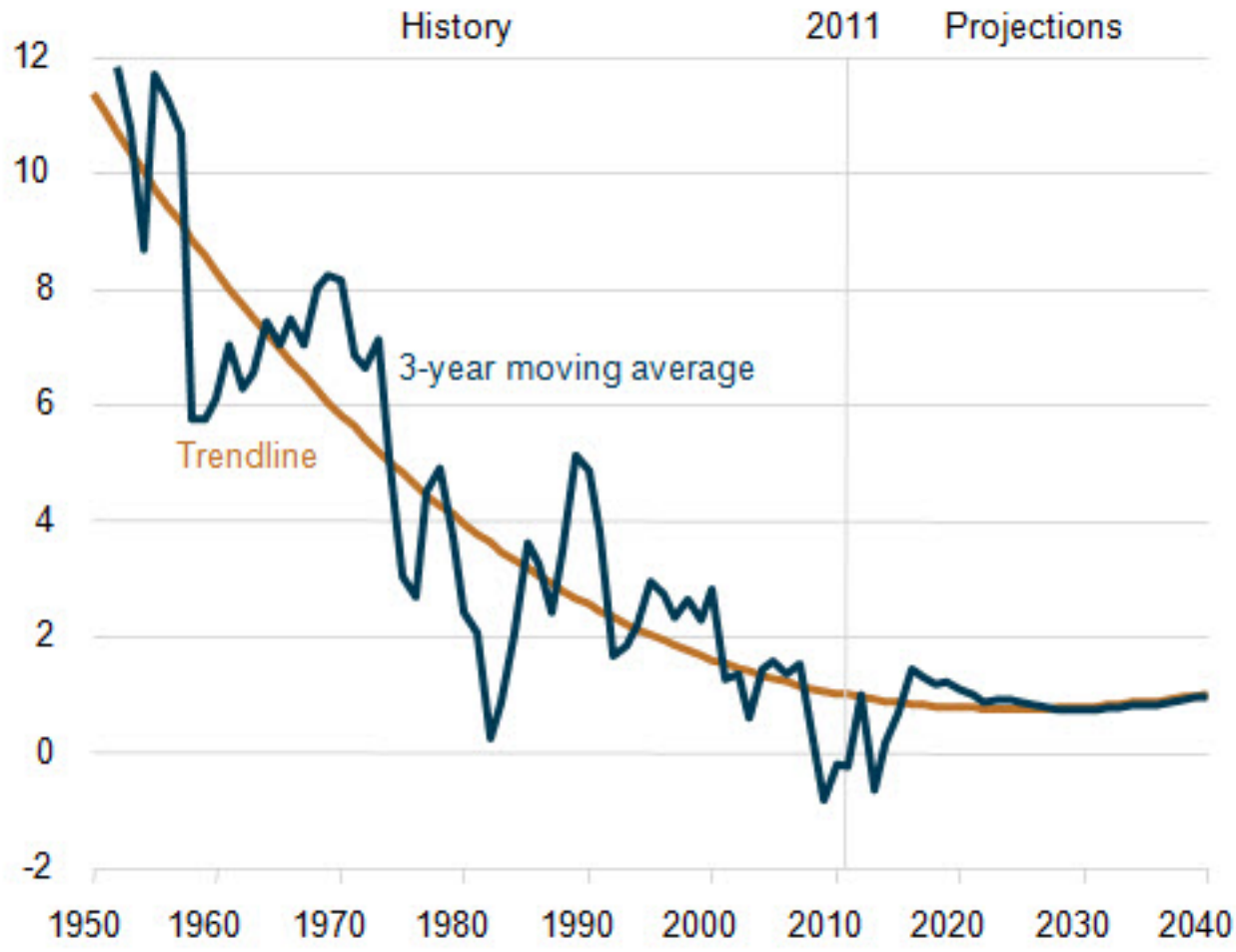
Demand Growth Projected

Nearing zero. Why not continue down?

Figure 75. U.S. electricity demand growth, 1950-2040 (percent, 3-year moving average)



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How to drive demand drop?

- Reward efficiency: tax credits or other incentives
- Advance technology: R&D dollars (lightbulbs, heat pumps…)
- Enable utilities to profit from conservation measures
- Raise electricity prices: GHG penalties
- From T Gray, US uses over 3x global avg energy, approx 1/2 in electricity. Compare Japan!

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Drivers for Capacity Additions

- Retiring old plants (nearly all coal)
- EPA regulations on emissions
- Renewable Portfolio Standards (RPSs) in many states
- Wind is lowest cost option excepting natural gas
- 'Fracking' driving down gas prices
- Very low cost Photovoltaics (PV)

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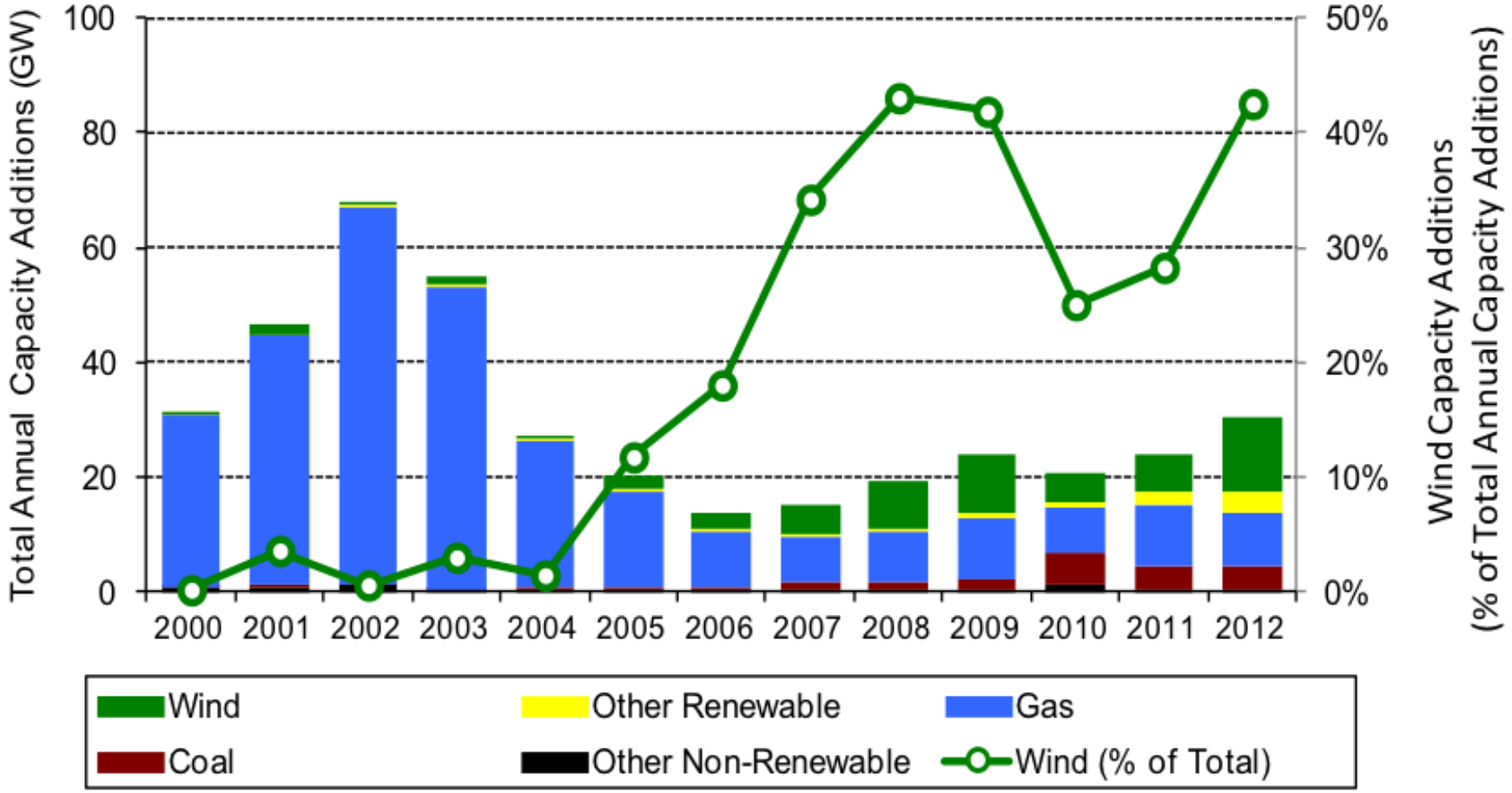
Capacity Additions by Source

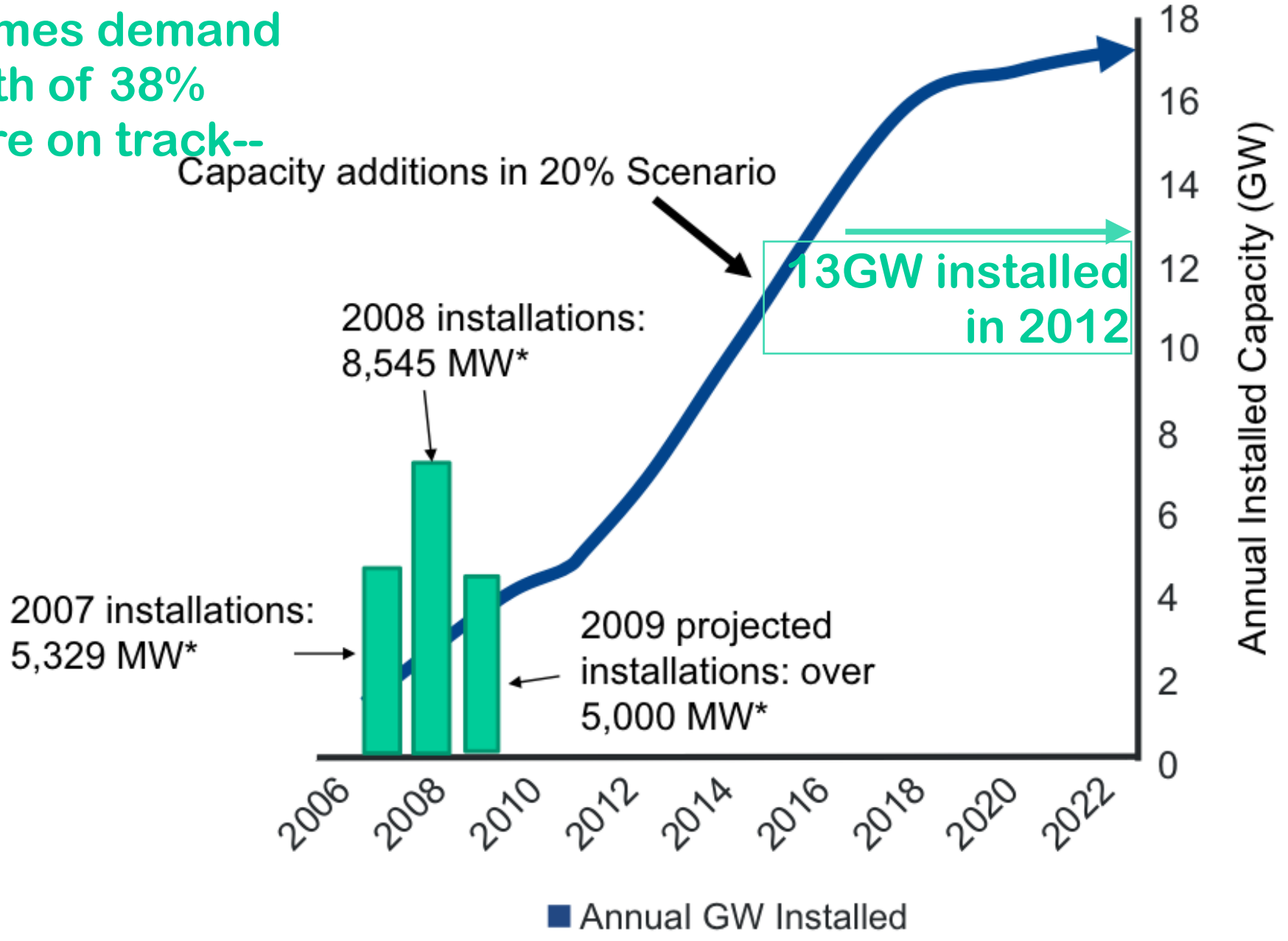
Wind Power Was the Largest Source of U.S. Generating Capacity Additions in 2012



- Wind was, for the first time, the largest resource added in terms of gross capacity, despite persistently low natural gas prices

DOE Scenario to 20% Wind

Assumes demand growth of 38%
We are on track--now.



*Source: AWEA, 2009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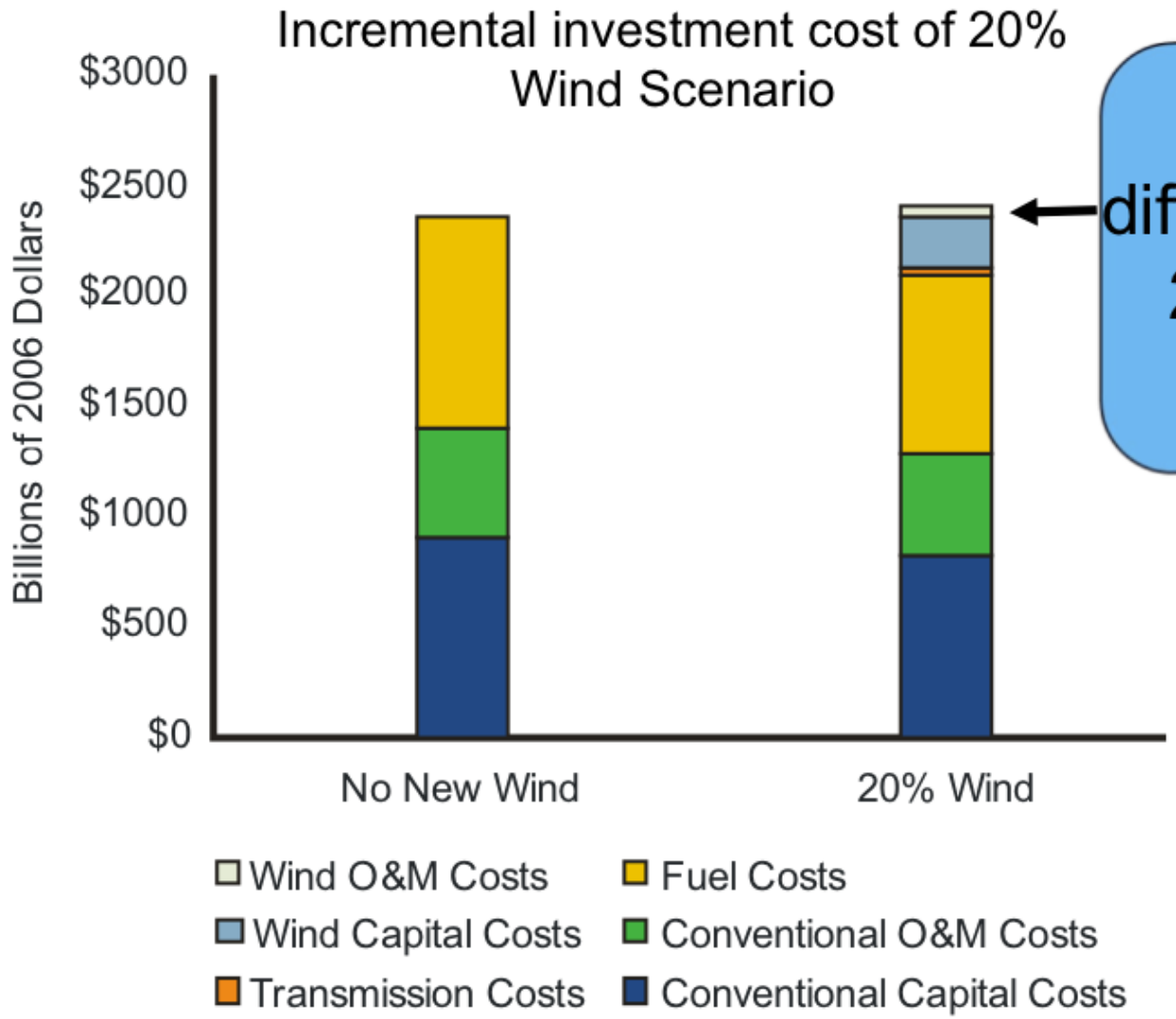
DOE Study in 2006



2% investment difference between 20% Wind and No New Wind

The 20% Wind Scenario would require an incremental investment cost of roughly $0.50 per month per household.

Did not anticipate fracking. Already coal is less than projected here.

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Climate Change Benefits: 20% Wind by 2030

- Reduce CO2 emissions by 7,600M metric tons through 2030, and 7,400M metric tons through 2050.
- Hold electric sector GHG emissions FLAT through 2030 despite increased demand.
- Displace 50% of natural gas and 18% of coal generation, reduce gas cost by $128B, eliminate need for >80 GW of new coal capacity, lower electricity prices.
- Reduce water consumption in the electric sector by eight percent, or four trillion gallons by 2030, nearly 30% of the savings in the arid West.

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Photovoltaics: price trends

(NREL Sunshot)

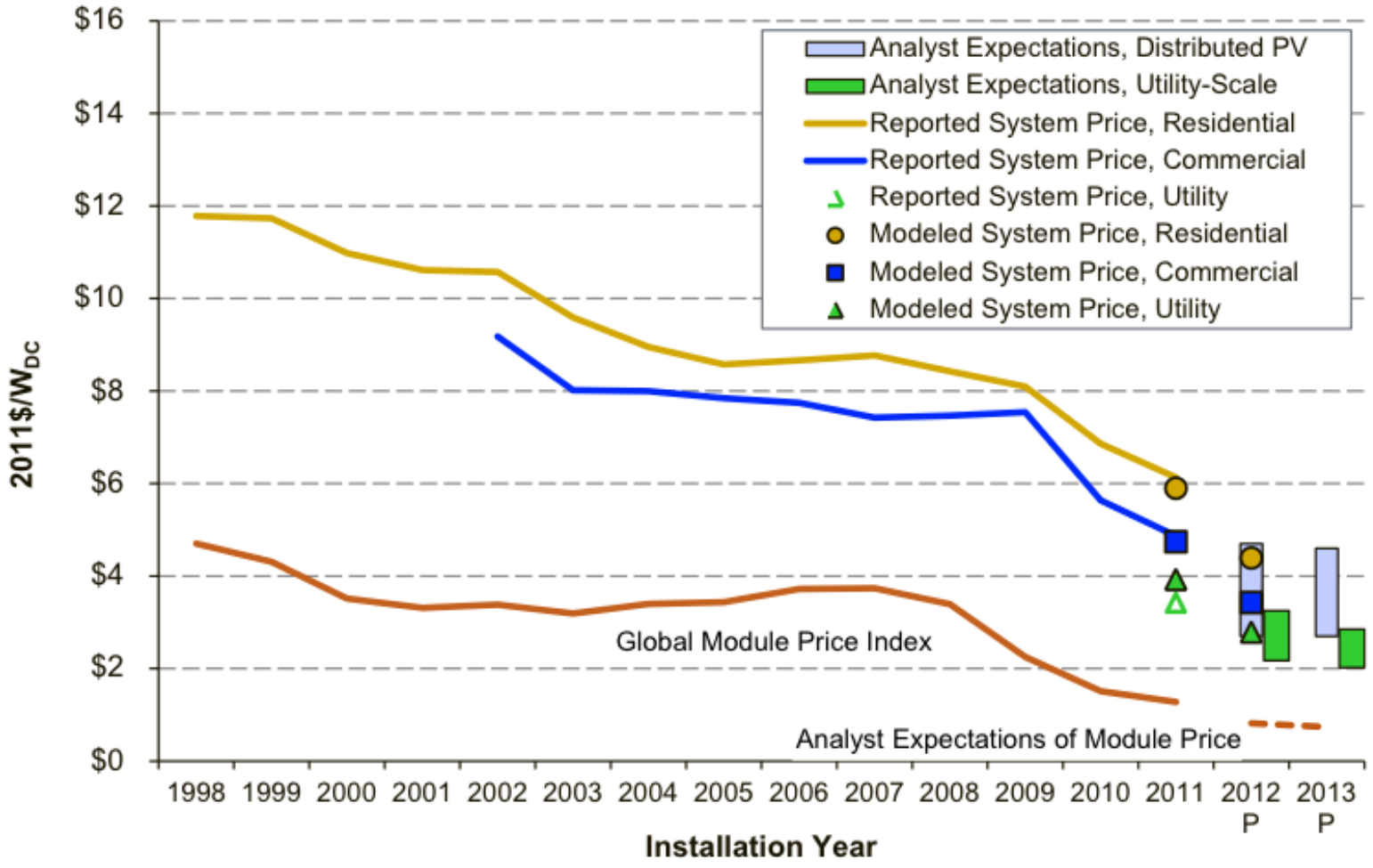

Figure 1. Reported, bottom-up, and analyst-projected average U.S. PV system price over time

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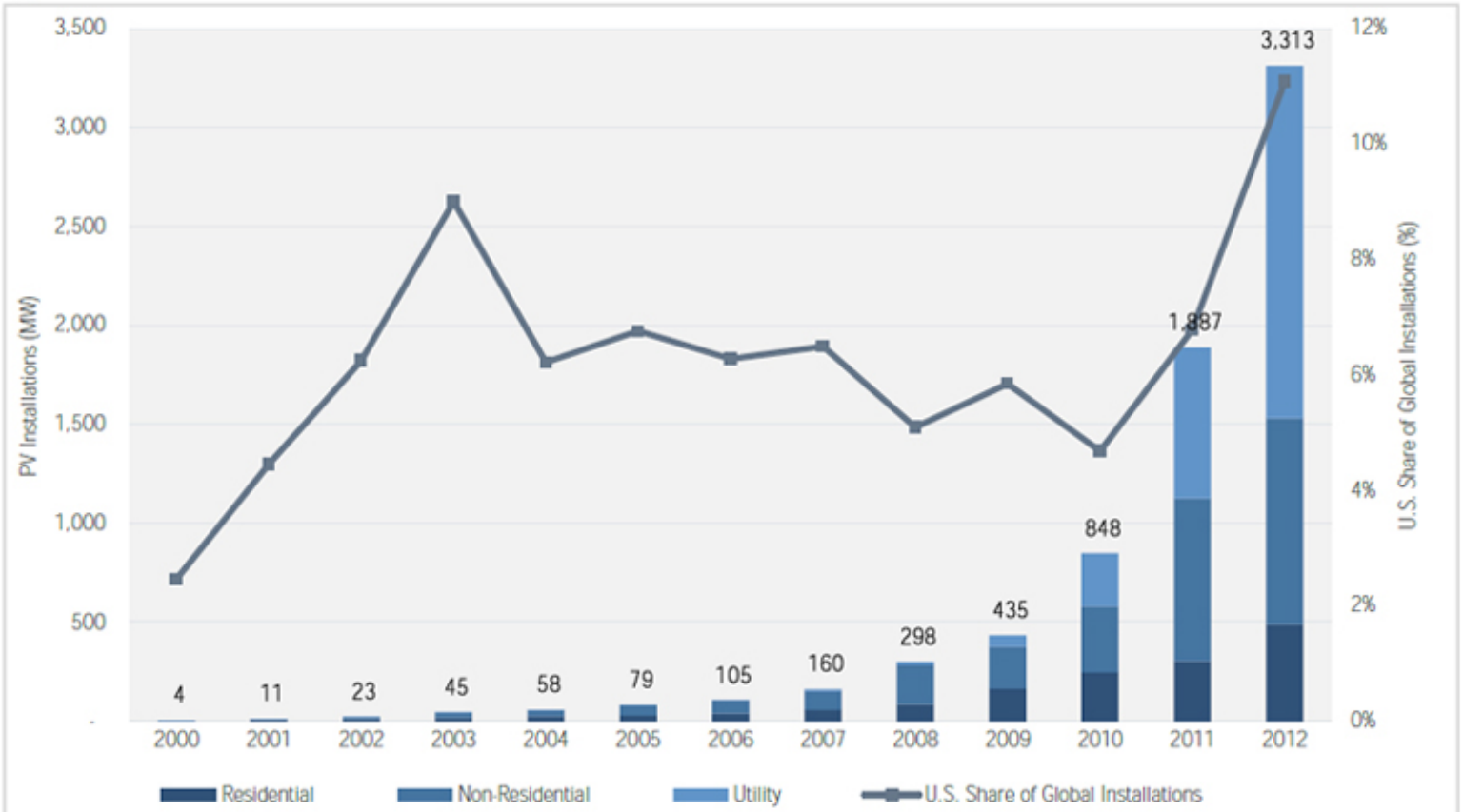
PV Capacity Additions

Figure 2.1 U.S. PV Installations and Global Market Share, 2000-2012



Installations (MWdc)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Residential	1	5	11	15	24	27	38	58	82	164	246	302	488
Non-Residential	2	3	9	27	32	51	67	93	200	213	336	826	1,043
Utility	0	3	2	3	2	1	0	9	16	58	267	760	1,781
Total Installations	4	11	23	45	58	79	105	160	298	435	848	1,887	3,313

PV Market Drivers (and not)

- PV is not cost competitive at utility scale
- Large-scale installations driven by state RPS carve-outs
- PV does compete at retail prices
- Current market surplus not expected to last forever, but not likely to fade fast.

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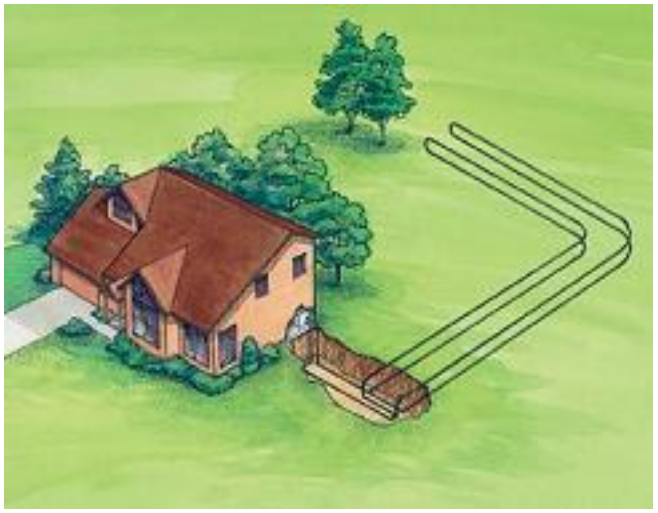
Geothermal Heat Pumps

- Energy conservation, not generation
- Cost $4-6K/ ton, $12-24K/ house
- 40-70% decrease in utility costs
- Major way to 'maintain lifestyle' without serious global imbalance.



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https://www.energyguide.com/library/EnergyLibraryTopic.asp?bid=ppl&prd=20&TID=22041&SubjectID=9542

IRENA Projected Cost/kWh to 2020

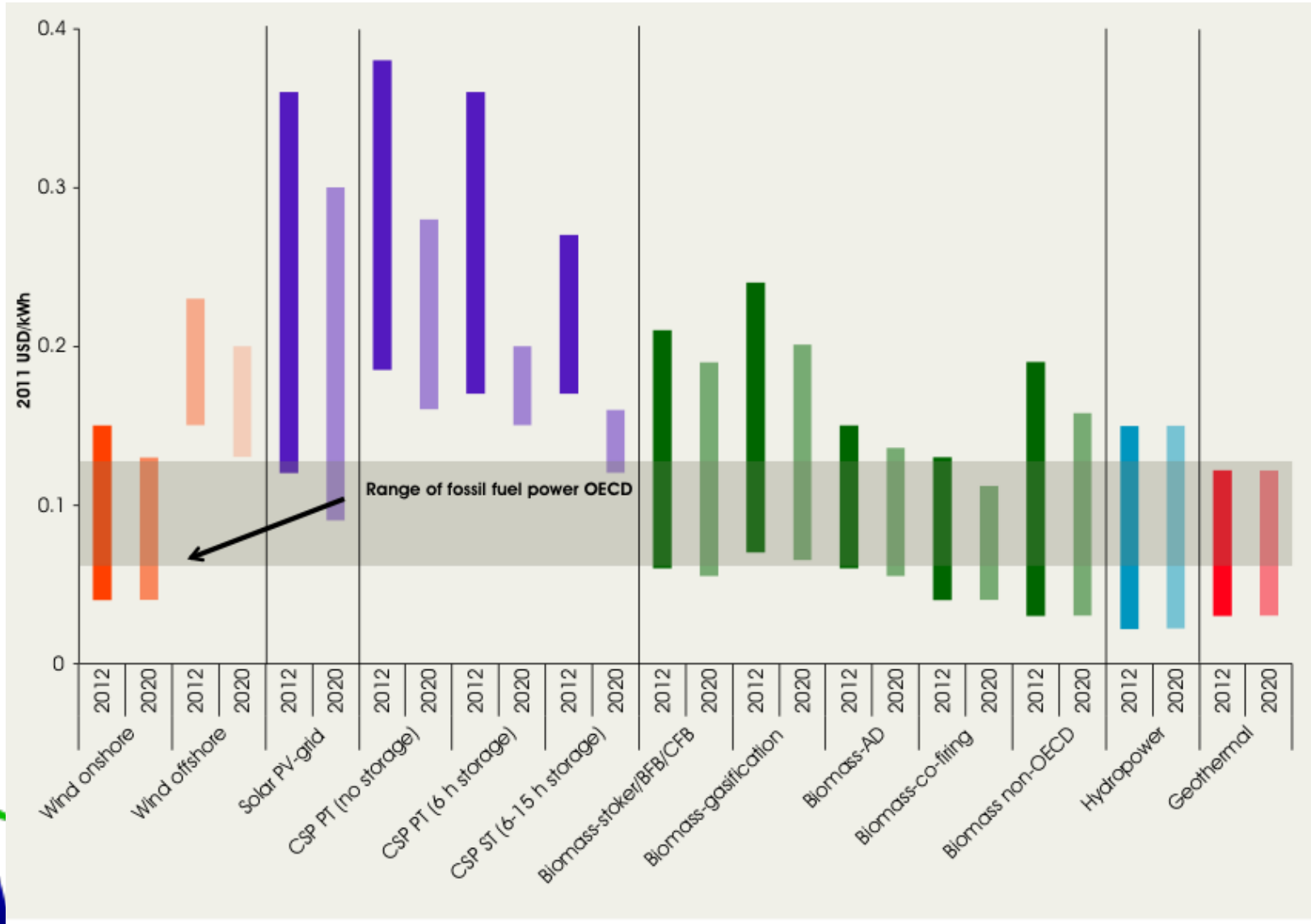

FIGURE 10.1: LEVELISED COST RANGES FOR RENEWABLE POWER GENERATION TECHNOLOGIES, 2012 AND 2020

Note: *This is based on an assumed cost of capital of 10%. The bands reflect ranges of typical investment costs (excluding transmission and distribution), fuel costs and capacity factors. PT = parabolic trough, ST = solar tower, BFB/CFB = bubbling fluidised bed/circulating fluidised bed, AD = anaerobic digester.*

So what do we do?

- Buy 'Windmade' when you can
- Get a Home (and Church) Energy Audit
- Pull last year's electricity bills and set a kWh goal (cut 50%?)
- Install a sustainable clothes dryer
- Have your roof surveyed for PV
- Install geothermal heat pump or adjust the thermostat
- Talk about it!

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Resources

- NREL.gov, energy.gov
- windpoweringamerica.gov
- http://www.irecusa.org/
- DSIREUSA.org
- http://www.interfaithpowerandlight.org/
- windustry.org
- http://energy.gov/energysaver/articles/geothermal-heat-pumps

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