

MARYLAND'S RENEWABLE GRID OF THE FUTURE

Prepared for
GRID-OF-THE-FUTURE conference
at Johns Hopkins University, Baltimore MD

January 29, 2016
Baltimore, MD

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Renewable Maryland Project: energy sector goals

- Affordable for all
- Renewable
- Resilient
- Reliable
- Efficient
- Democratized – consumer choice, transparent, equal access to choices



Maryland's energy system: 2011

BASELINE YEAR FOR ANALYSIS

Overview of Maryland energy system

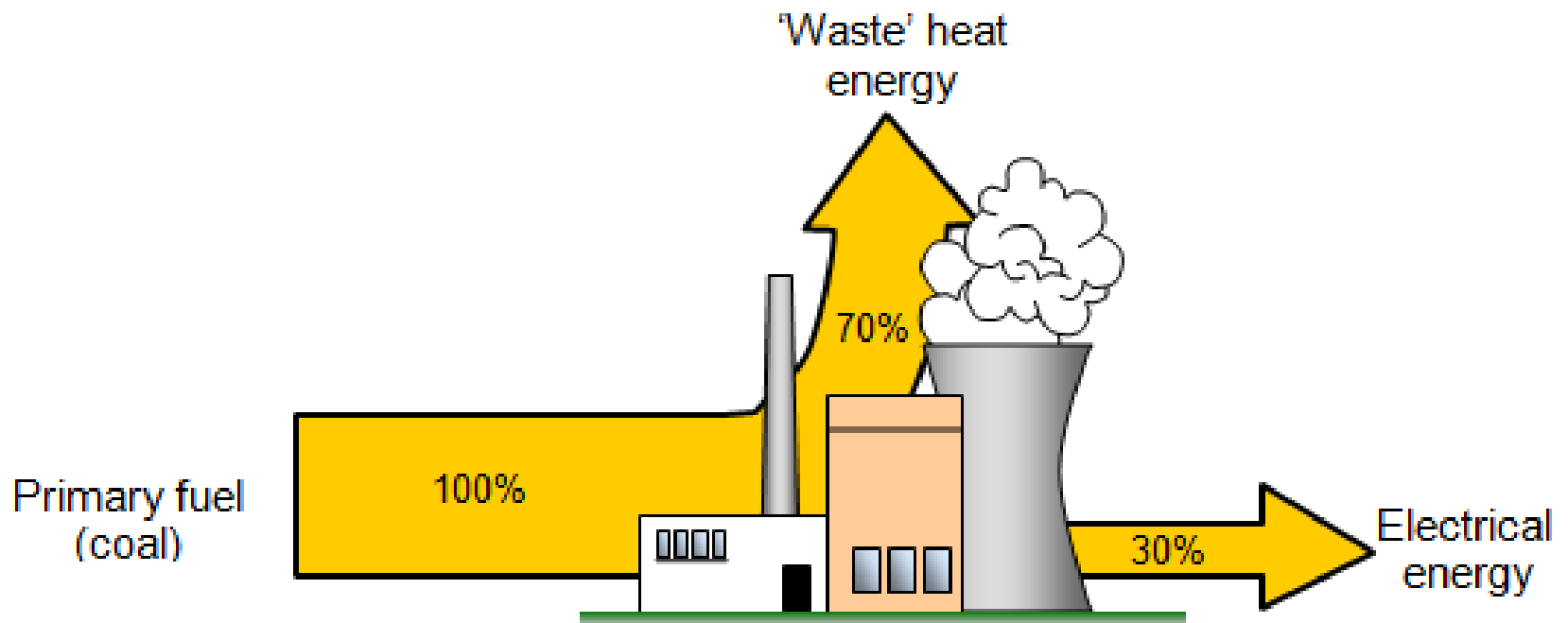
Present energy system

- ❑ Wasteful, polluting, mostly functioning; not robust or resilient
- ❑ Maryland sends **\$9 billion to \$12 billion per year** out of state to import fuels (oil, natural gas, imported electricity): we are, in effect, exporting jobs
- ❑ Significant water impacts



Today's energy system is wasteful

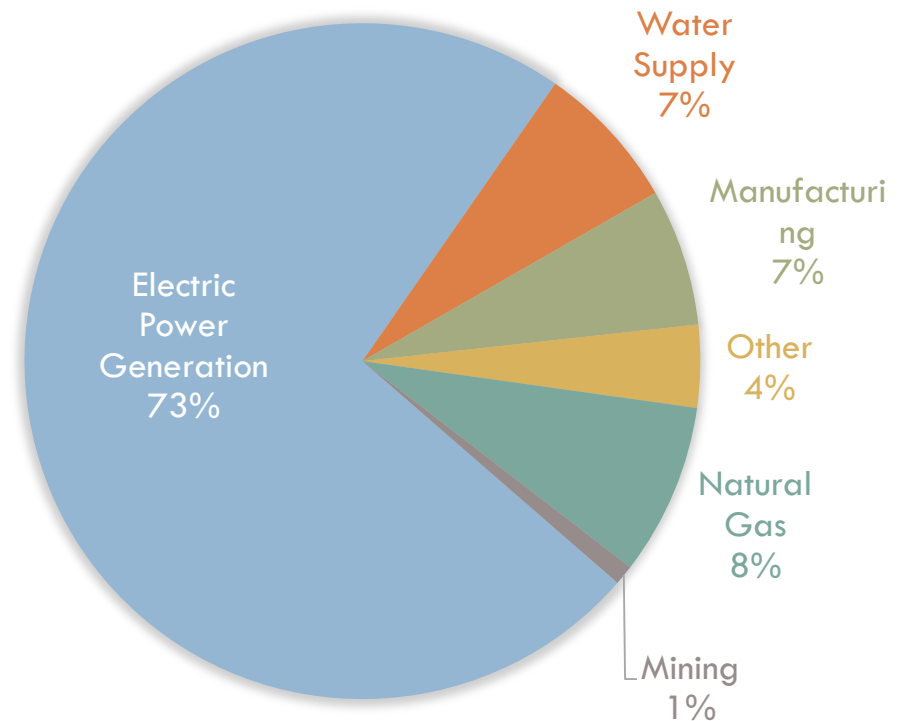
Example 1: Thermal electricity generation



Detail on Susquehanna River water use

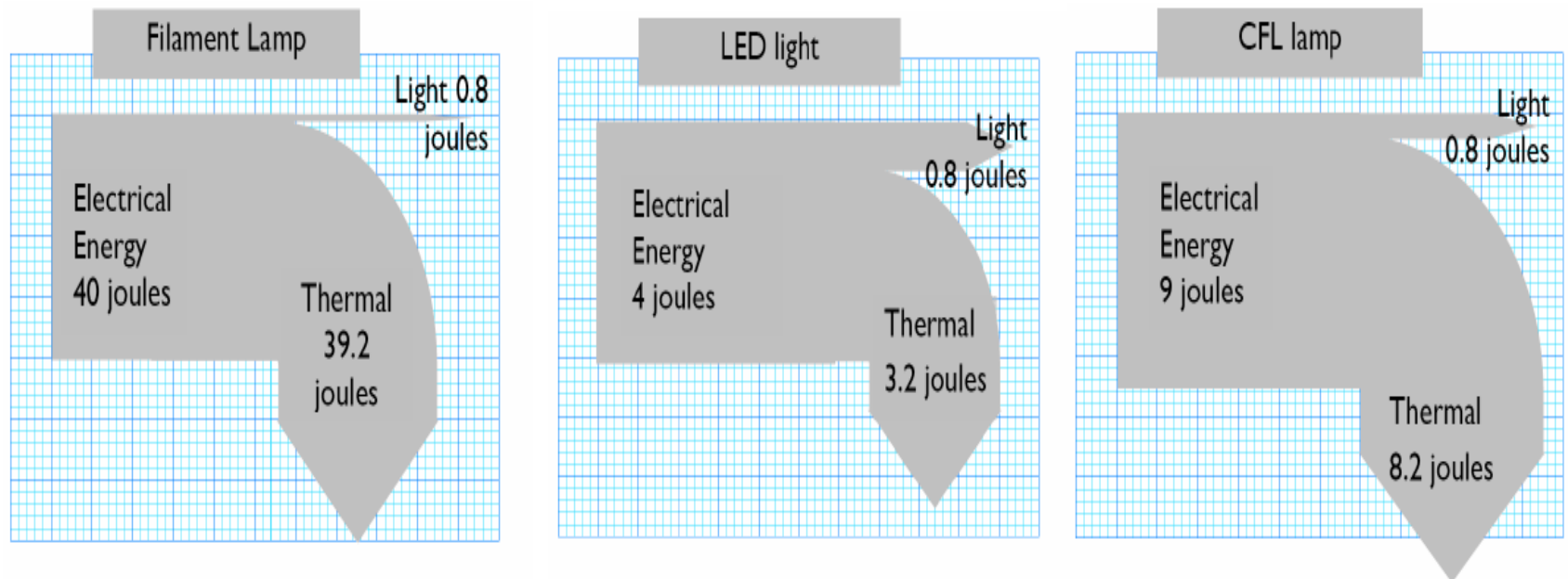
- About three-fourths of the water consumption is for thermal electricity generation (mainly coal and nuclear) – about 17 fossil and nuclear generating stations in the basin (to confirm)
- Connected to future security of water supply
- Water flow in drought years is critical for Chesapeake Bay
- Maryland has an interest in leading by example and persuading development of non-thermal generation upstream on the Susquehanna River

2011 reported consumptive use by major industry type



Today's energy system is wasteful

Example 2: Point of use in homes and businesses



Today's energy system is wasteful

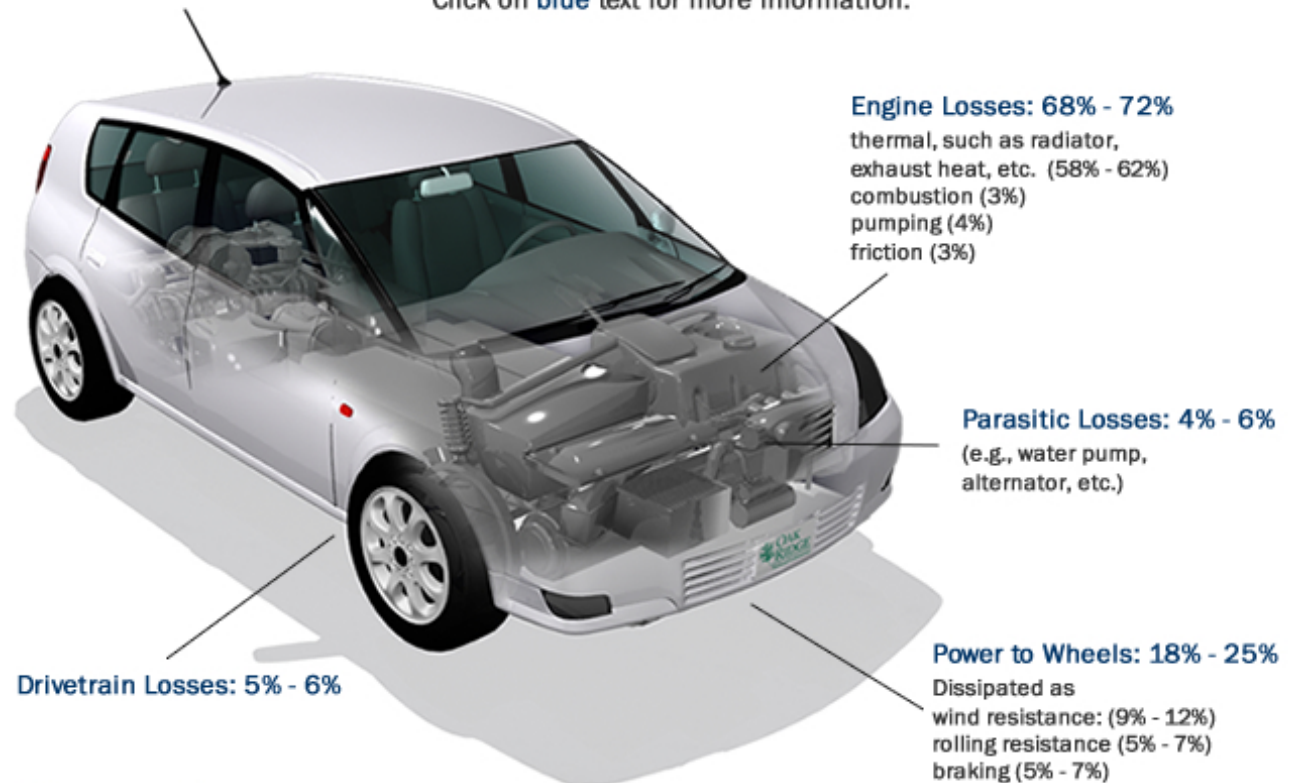
Example 3:

Typical gasoline vehicle: 75 to 82 percent waste

(not including oil production, pipeline, and refining losses)

Energy Requirements for Combined City/Highway Driving

Click on blue text for more information.

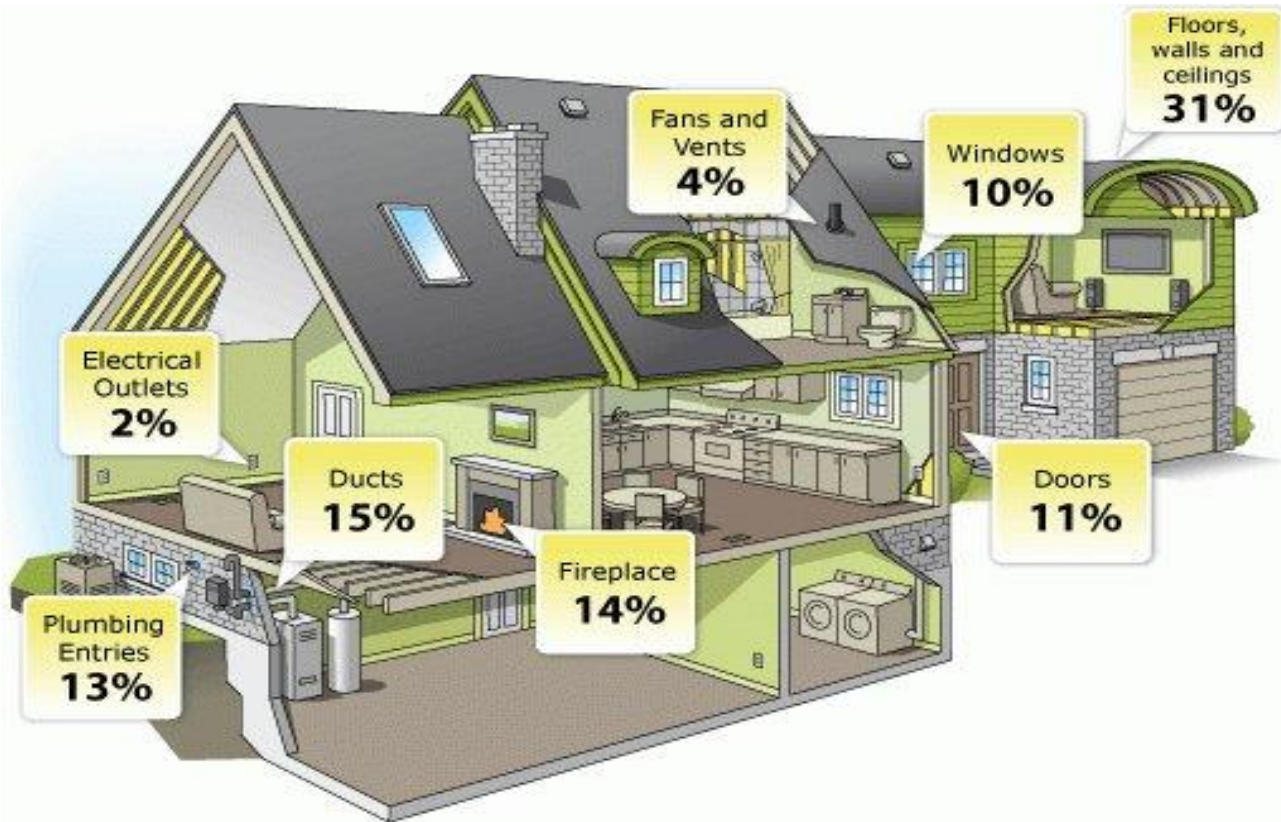


Idle Losses: 3%

In this figure, they are accounted for as part of the engine and parasitic losses.

Heating & cooling leakage in homes

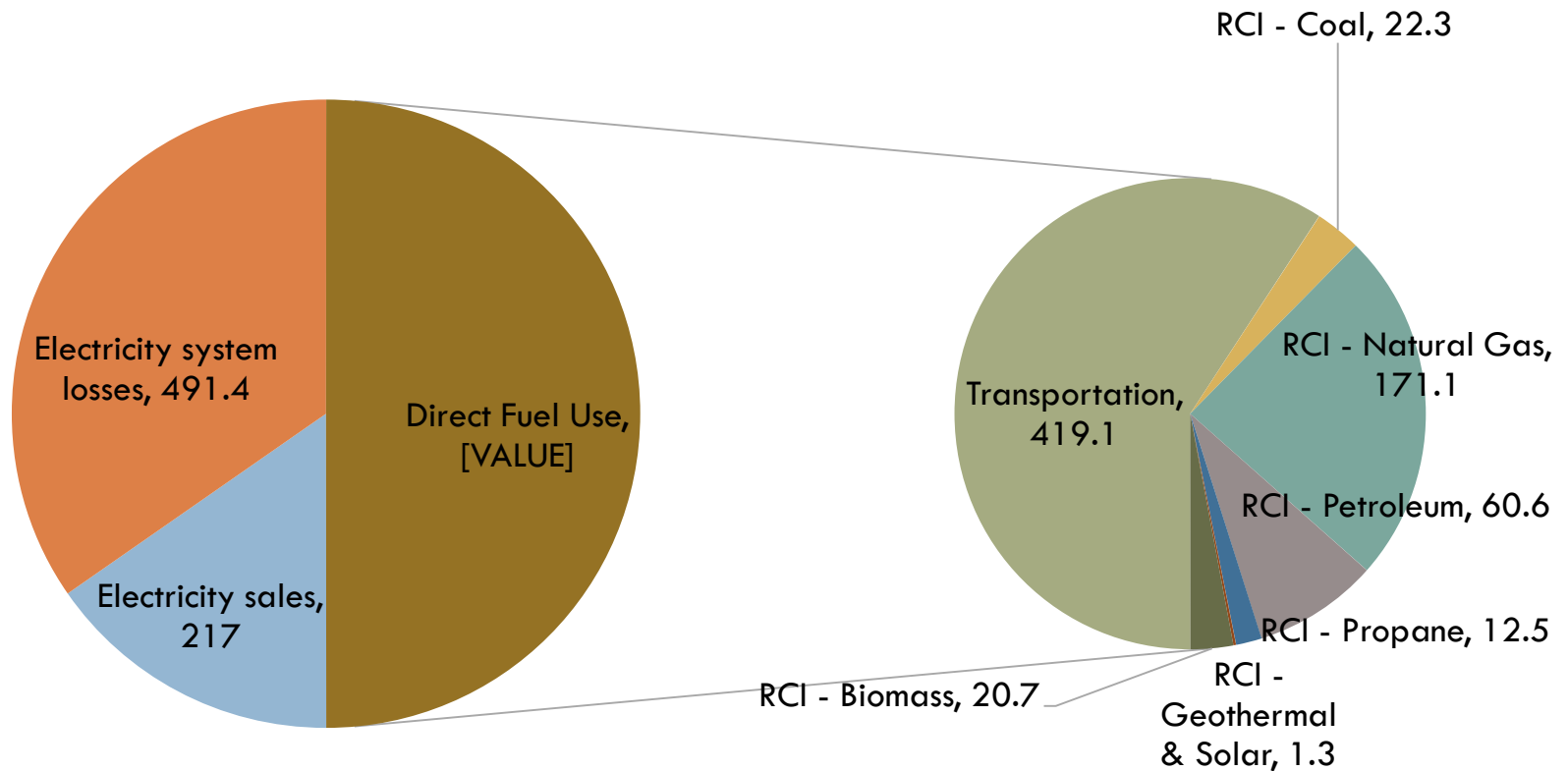
Net zero homes and passive heating and cooling energy systems can reduce leakage
~70 percent



Maryland primary energy use, 2011

(responsible for ~92 million metric tons CO₂)

2011 Total Primary Energy Use, trillion Btu



RCI = Residential, Commercial & Industrial



Energy Equity and Justice

**HIGH ENERGY
BURDENS
=
ILL-HEALTH AND
HOMELESSNESS**



IMPOSSIBLE CHOICES: RENT, MEDICINE OR HEAT



**High eviction
and
foreclosure
rates**



**High public
shelter costs**



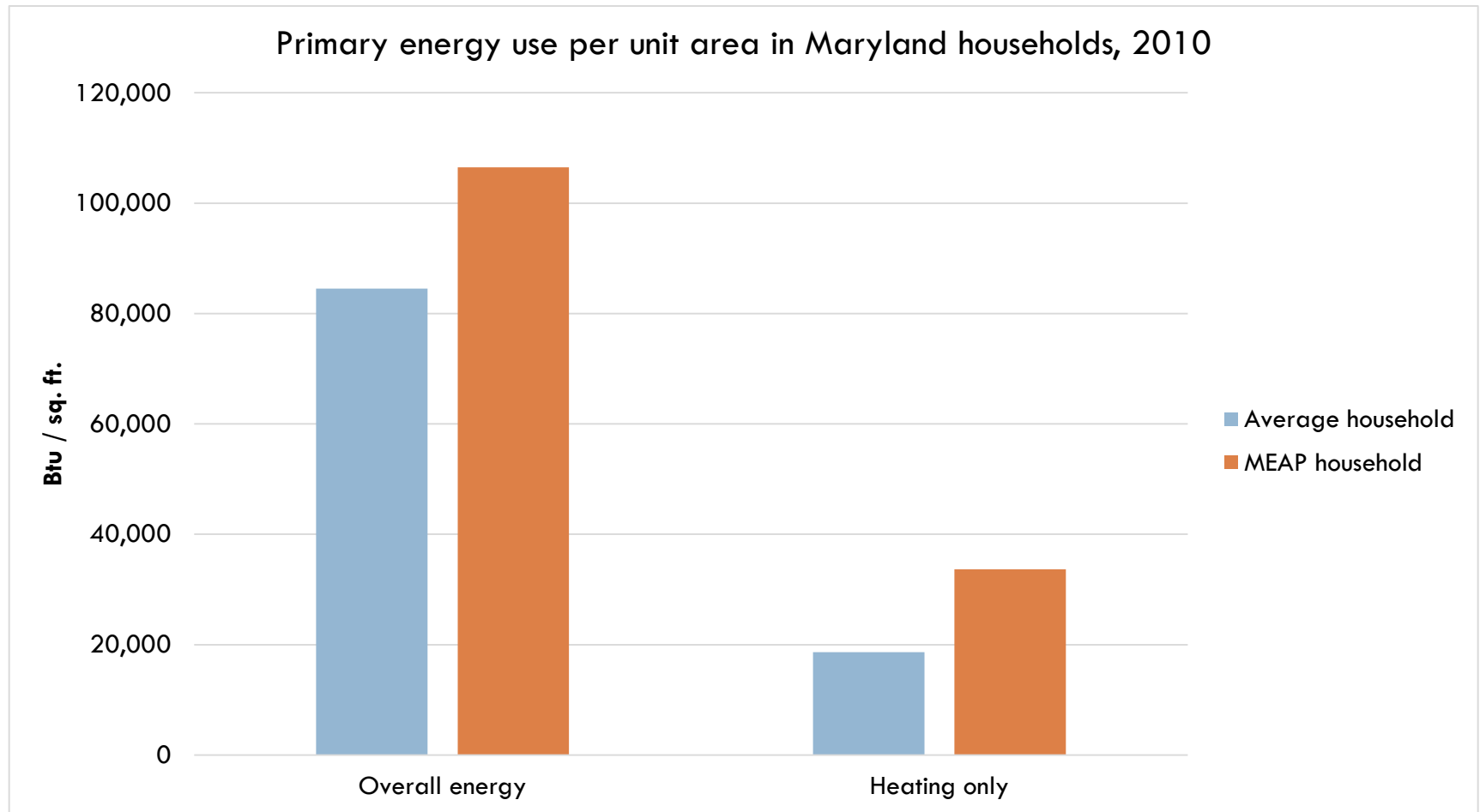
**High health
costs**

Renter-landlord issues

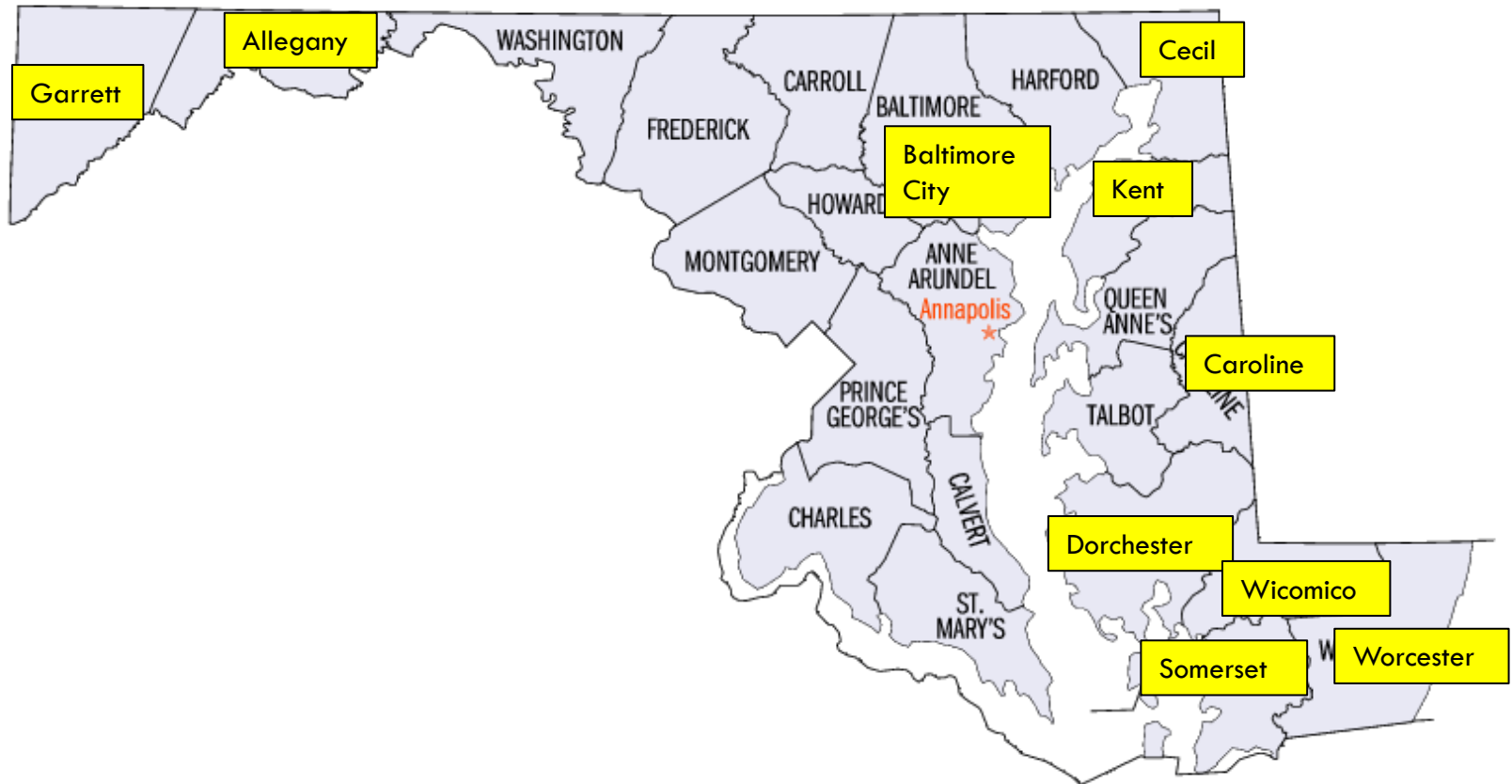


Renters often trapped in low efficiency homes

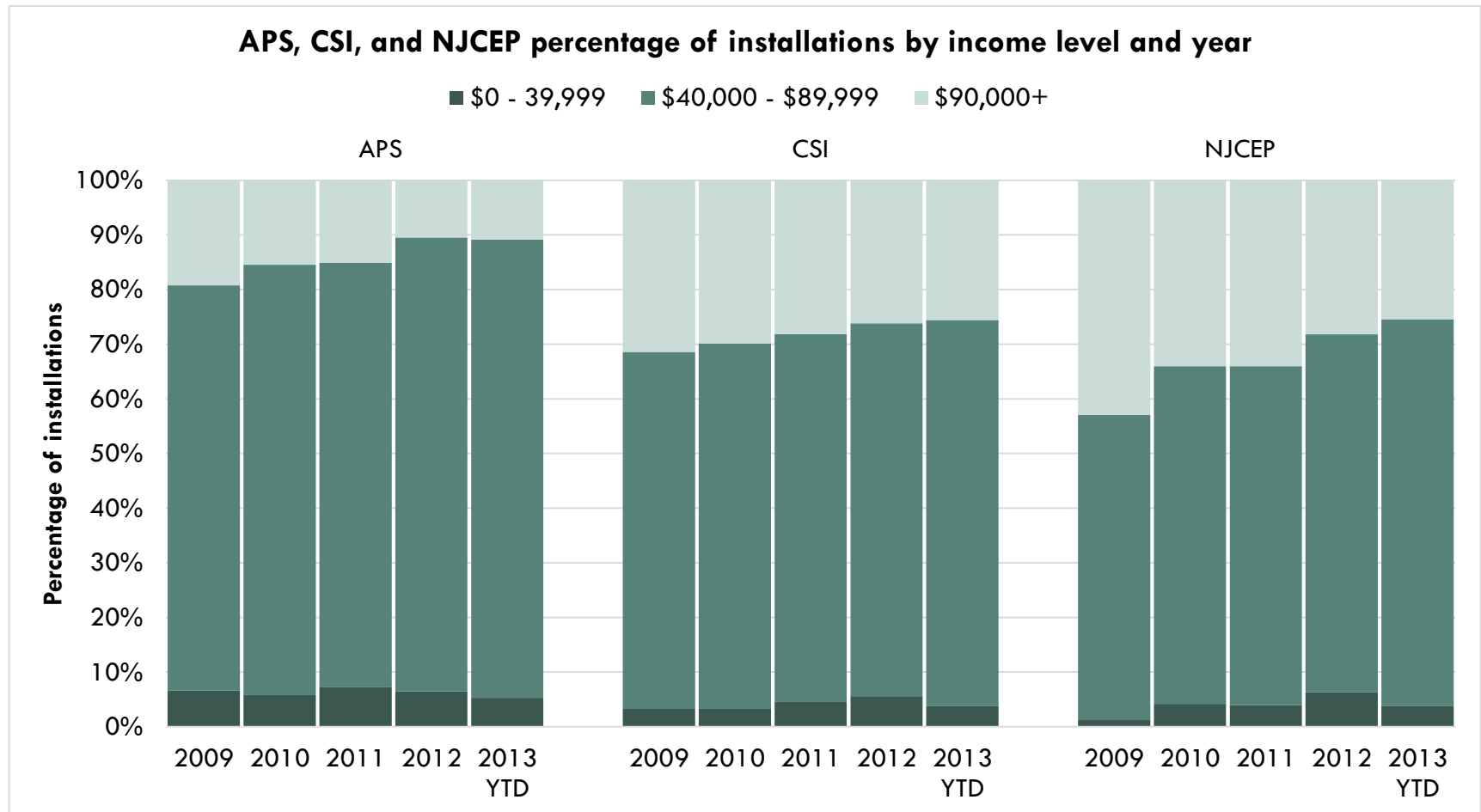
Low-income homes are relatively inefficient



10 areas of highest need where >10% households apply for energy assistance



Low income households get almost no access to solar (CA, AZ, NJ research)



Note: APS = Arizona Public Service; CSI = California Solar Initiative; NJCEP = New Jersey's Clean Energy Program). Source: Recreated by IEER from Hernandez 2013, Figure 3 (p. 4). This report, *Solar Power to the People: The Rise of Rooftop Solar Among the Middle Class*, by Mari Hernandez, was published by the Center for American Progress.



GRID OF THE FUTURE

Affordable, Democratized, Near-zero Emissions,
Equitable, Resilient

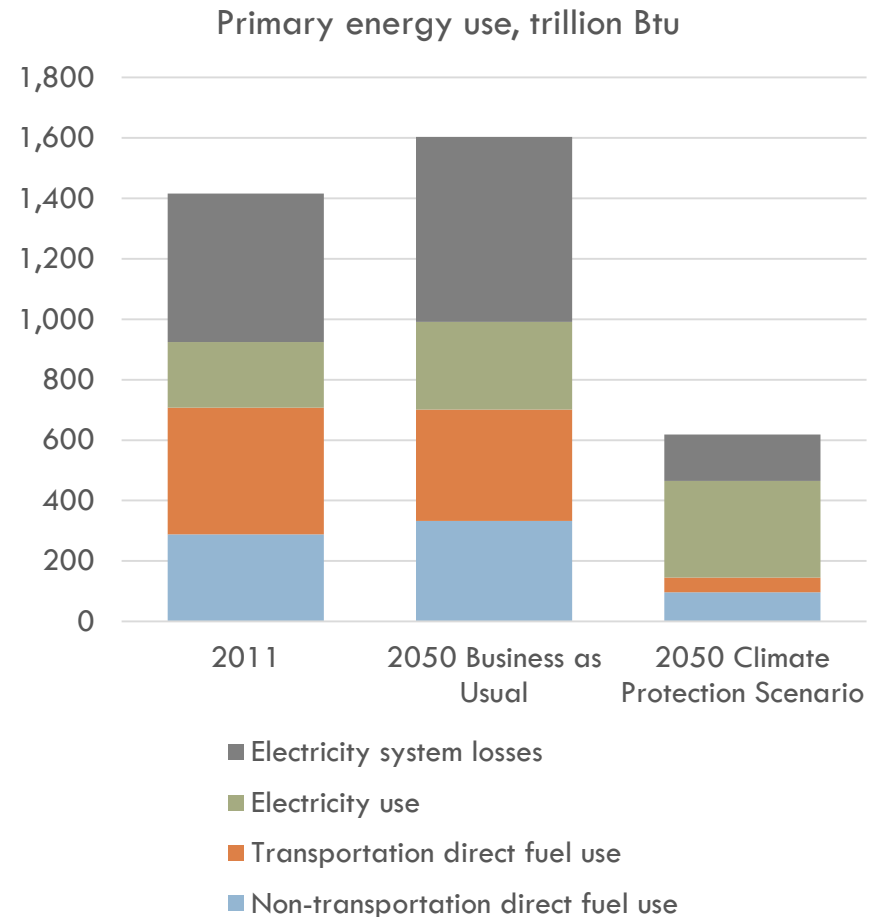
Maryland's main renewable energy sources: wind and solar

We have 10x more than needed: Supply \sim 1 Million GWh/yr while 2011 demand was only \sim 69 thousand GWh/year

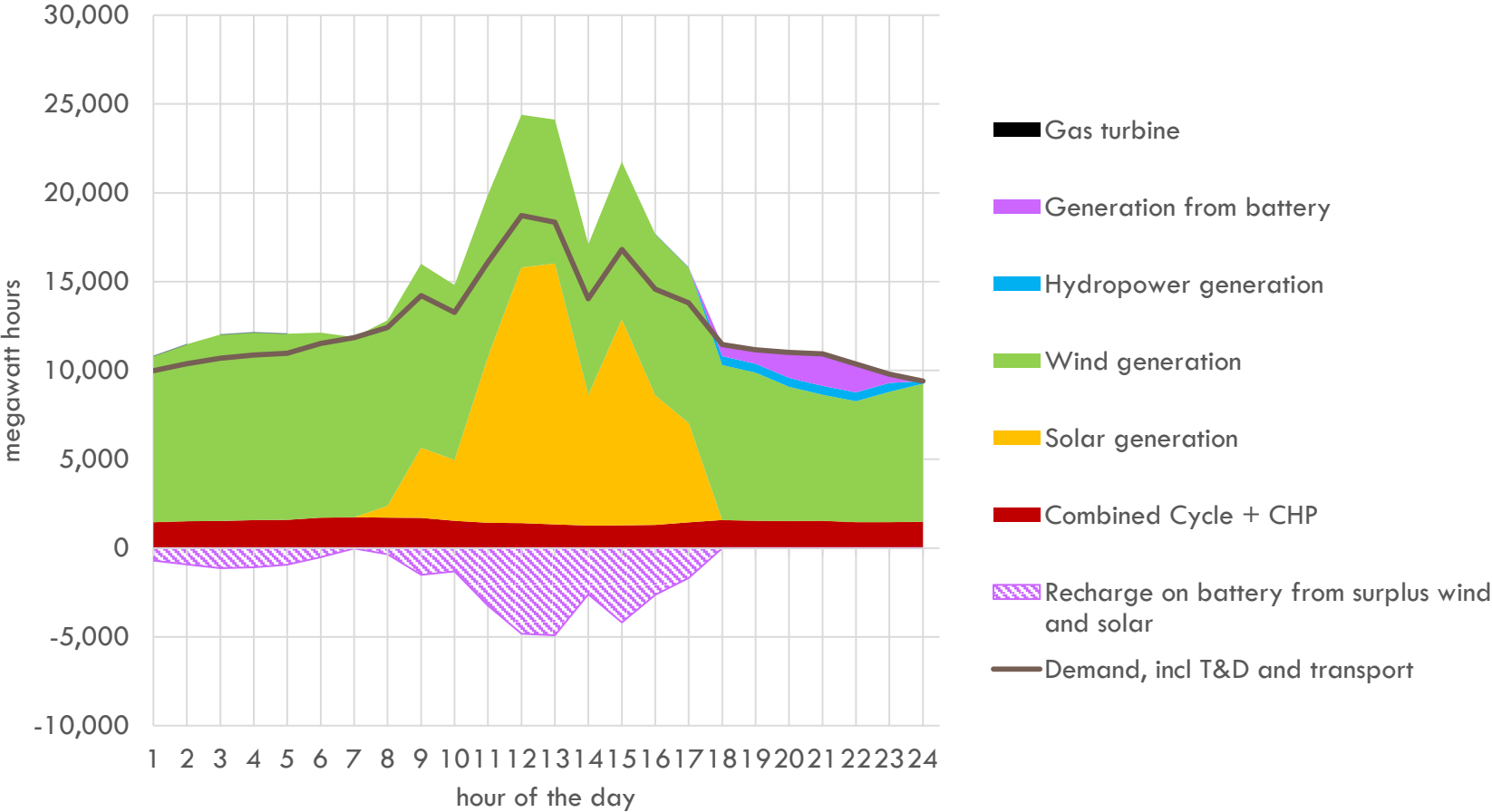


The transition in brief

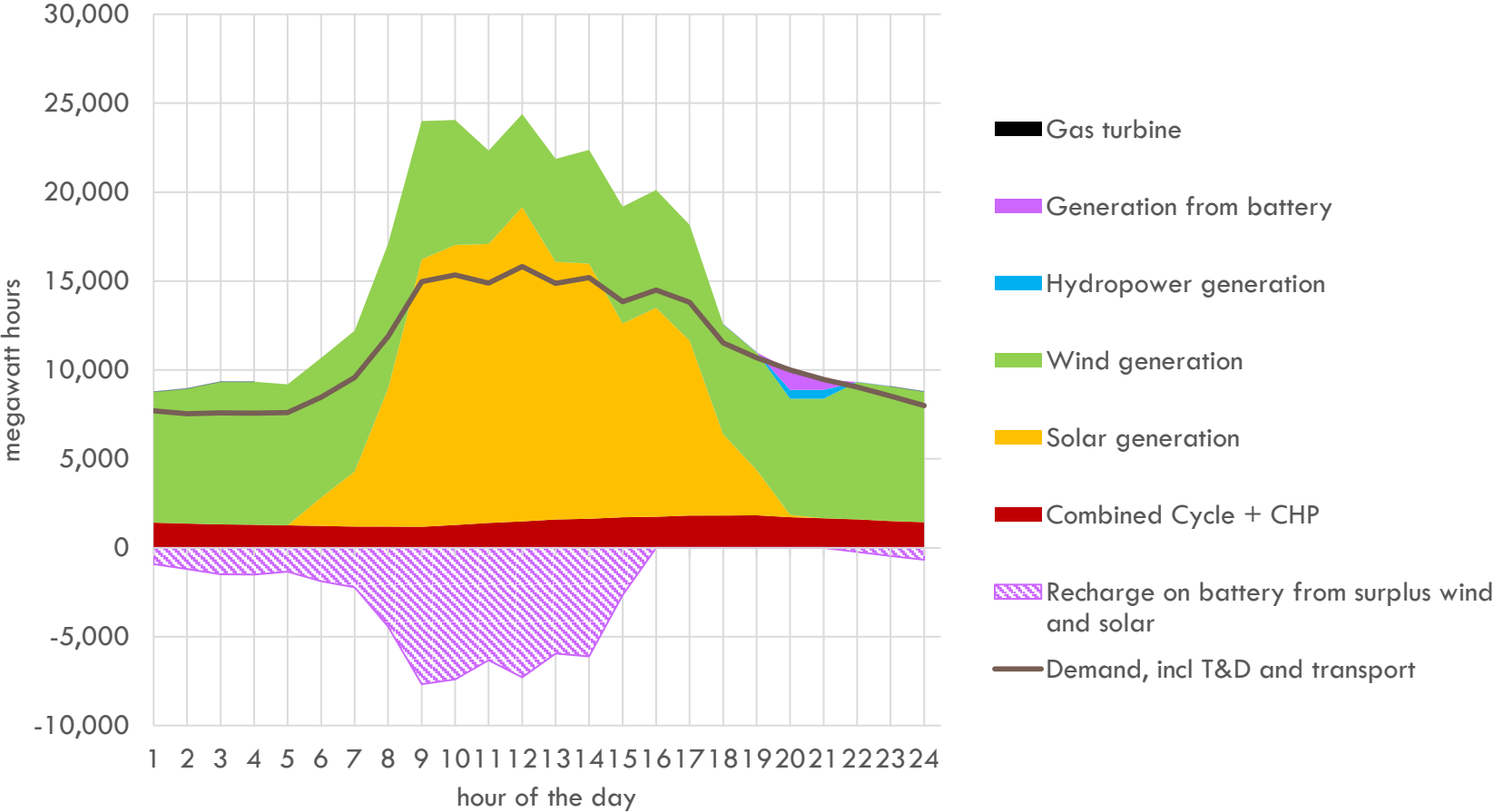
- Eliminate energy waste systematically
- Use mostly wind and solar generation
- All road transport goes electric
- HVAC is by efficient electric heat pumps
- Result: energy consumption goes down by ~60 percent even as the economy grows by 2x



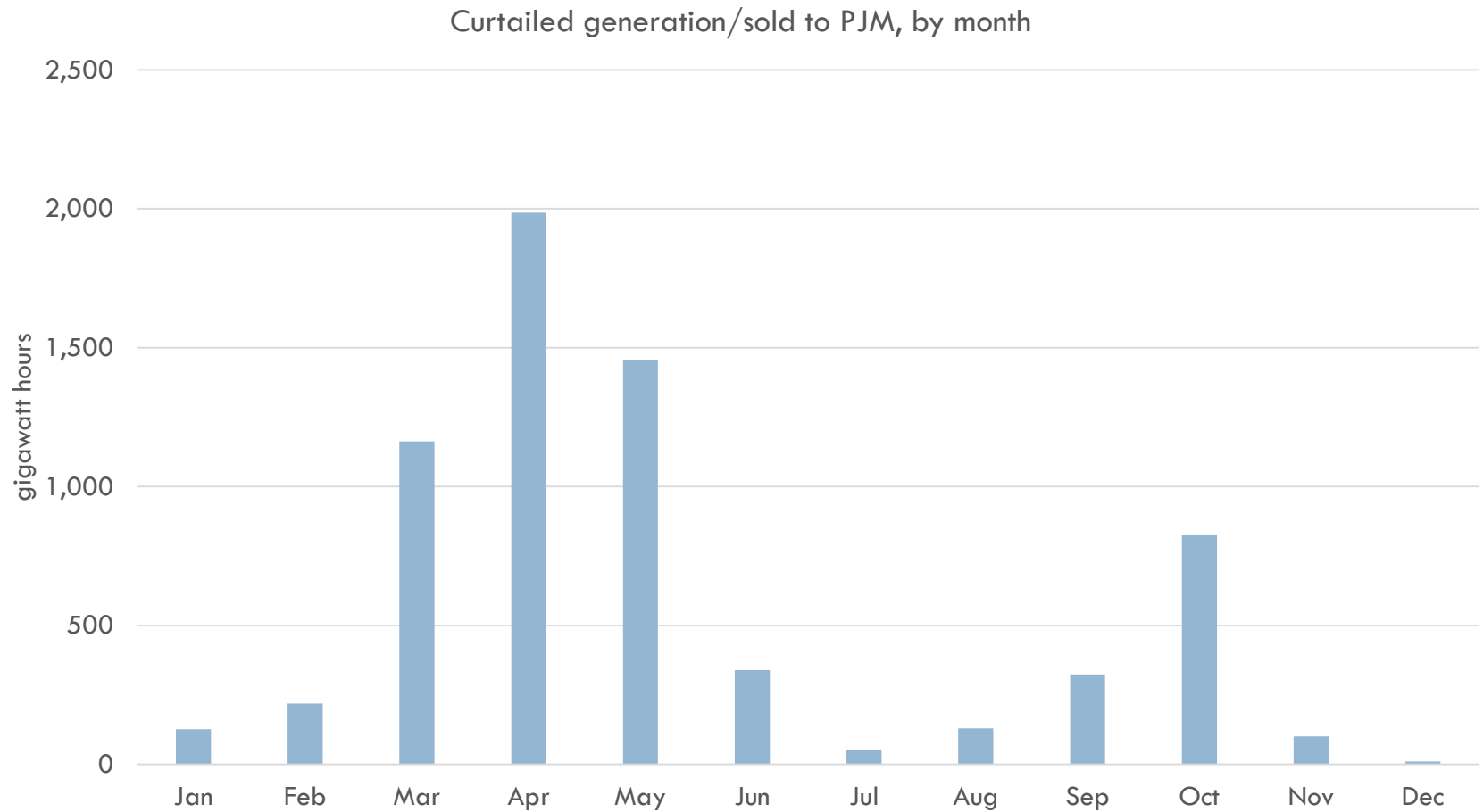
24 hours, typical winter day



24 hours, typical summer day



Life would be simpler with economical seasonal heat and coldness storage technologies

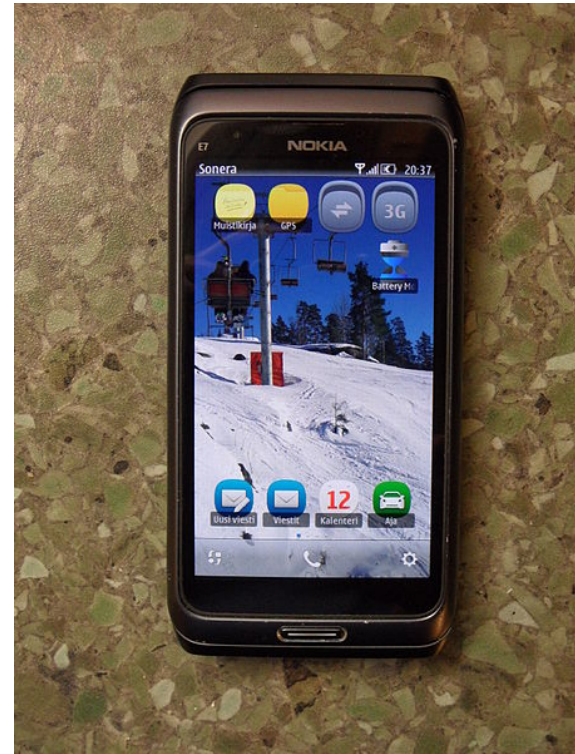


The energy system

Now:



Where it needs to be:



Current Grid vs Smart Grid

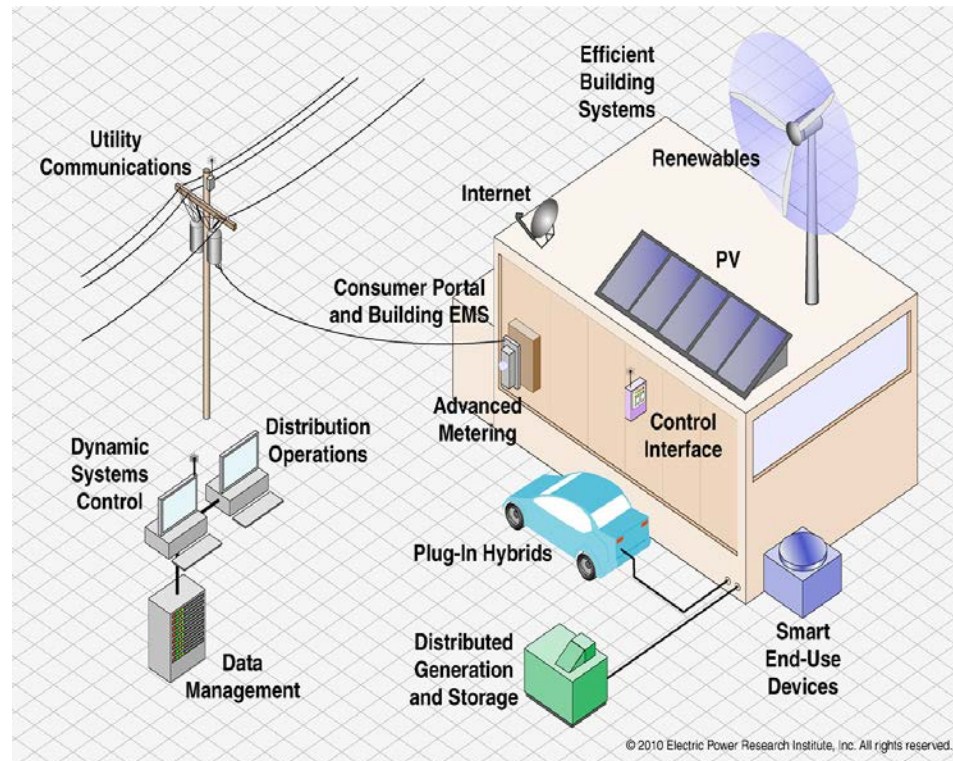
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	Current Grid	Smart Grid	Comments
Communications	None or one-way; typically not real-time	Two-way, real-time	Customer needs smart devices and real-time information
Customer interaction	Limited	Extensive	
Metering	Electro-mechanical	Digital (enabling real-time pricing and net metering)	Affordable bills will require real time control of consumption and ownership of energy production

GOTF Features

Renewable, Resilient, Democratized

- Solar and wind mainstays of energy system
- Increase efficiency
- Storage, CHP, microgrids
- Demand response
- Control consumption to minimize bills
- Electrified transportation and HVAC
- Provide services to the grid, including via V2G and local storage ownership



Affordable Energy Program

- Limit bills to 6 percent of income
- Lower cost of energy supply with solar (Photo: low-income housing, Seattle)
- Reduce energy needs by efficiency increases
- Reduce costs in the long-term and reduce need for assistance.
- Better health, lower emissions, lower cost
- Start creating jobs in solar and efficiency energy in areas with higher proportions of low-income households
- Needs action by Public Service Commission and legislature



Energy Justice and GOTF

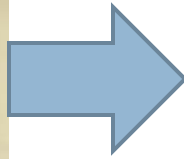
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- Universal solar access and universal internet access
- Once Affordable Energy Program in place, assistance can be in the form of investment: smart appliances + smart devices (tablets, phones, etc.) to optimize bills
- Large collateral benefits of internet access – education, work, economic opportunity
- Electric vehicles: lower fuel and maintenance cost + V2G revenue potential
- Infrastructure in low income areas: Building community solar + electric vehicle charging + distributed stationary storage
- Financing: PACE, Green Bank, On-bill financing
- Electrified public transport like electric bus rapid transit?

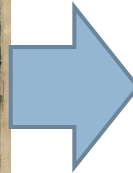
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How long will it take

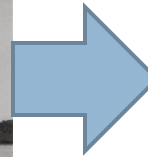
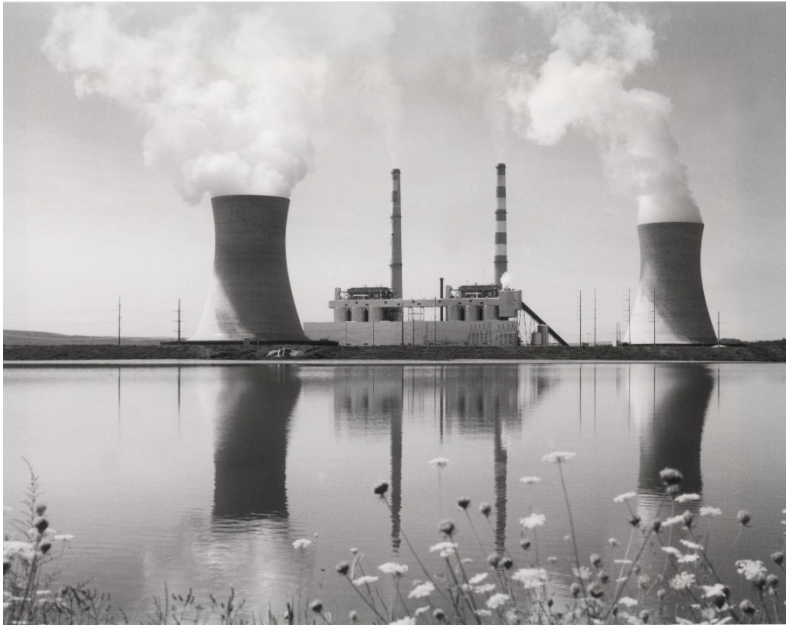
Oil lamps to electric bulbs: ~20 or 30 years



Horses to petroleum tractors: 30 or 40 years



This transformation can be done by 2050,
possibly earlier



Conclusions

- We can have a healthy, affordable, reliable, and emissions-free energy system by 2050.
- Policy certainty – GHG reduction and efficiency targets, etc. – will allow for investment on the scale needed
- If we are farsighted enough, we can bring large numbers of industrial jobs to Maryland
- Maryland must really lead to have a good chance of persuading industry to set up here rather than elsewhere.



Thank you & Questions

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