# Renewable Maryland

Background and context for developing a

Renewable Maryland Roadmap

*Prepared by IEER for January 14, 2013, stakeholder meeting in Annapolis, Maryland*

*Convened by Town Creek Foundation*

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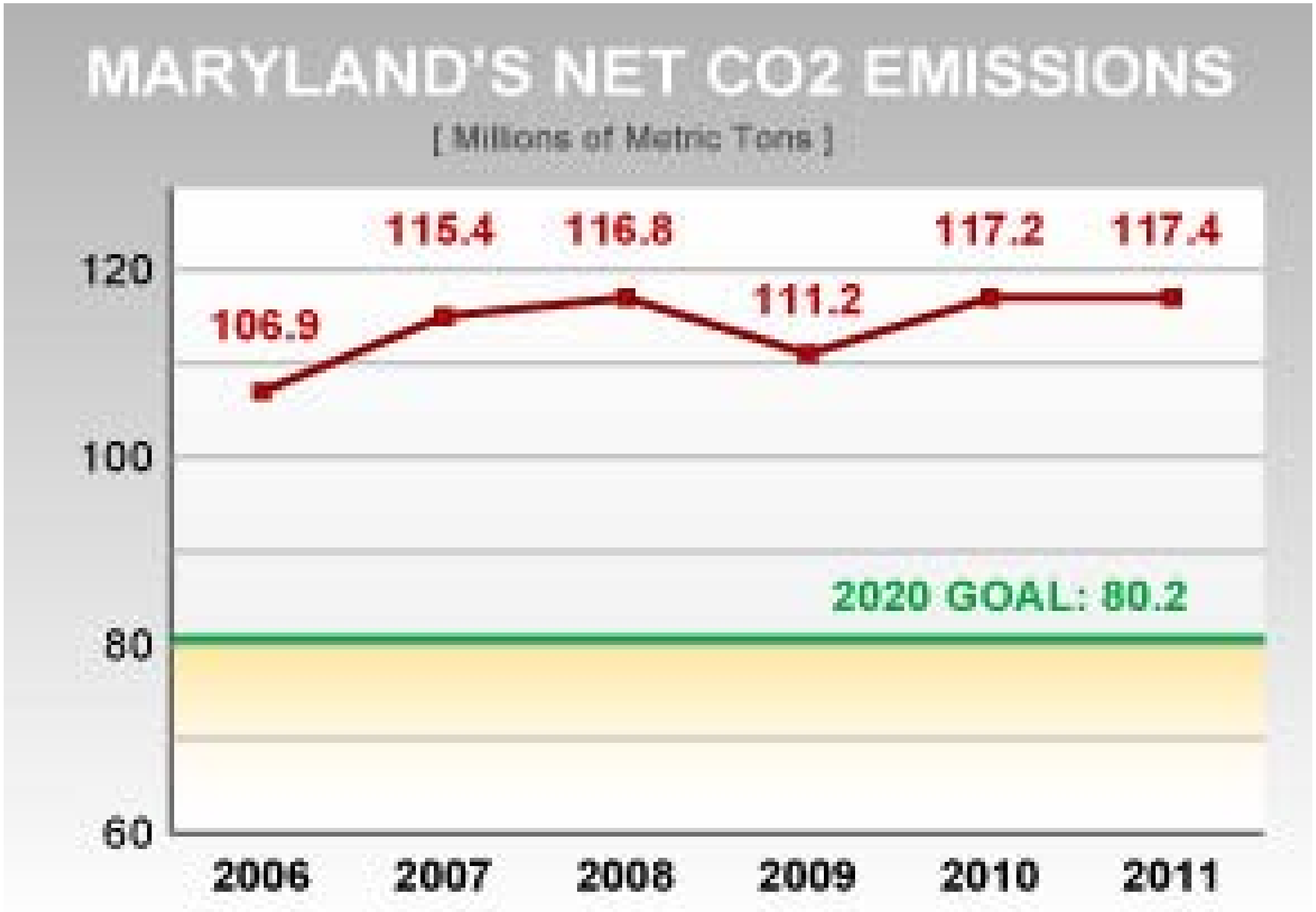
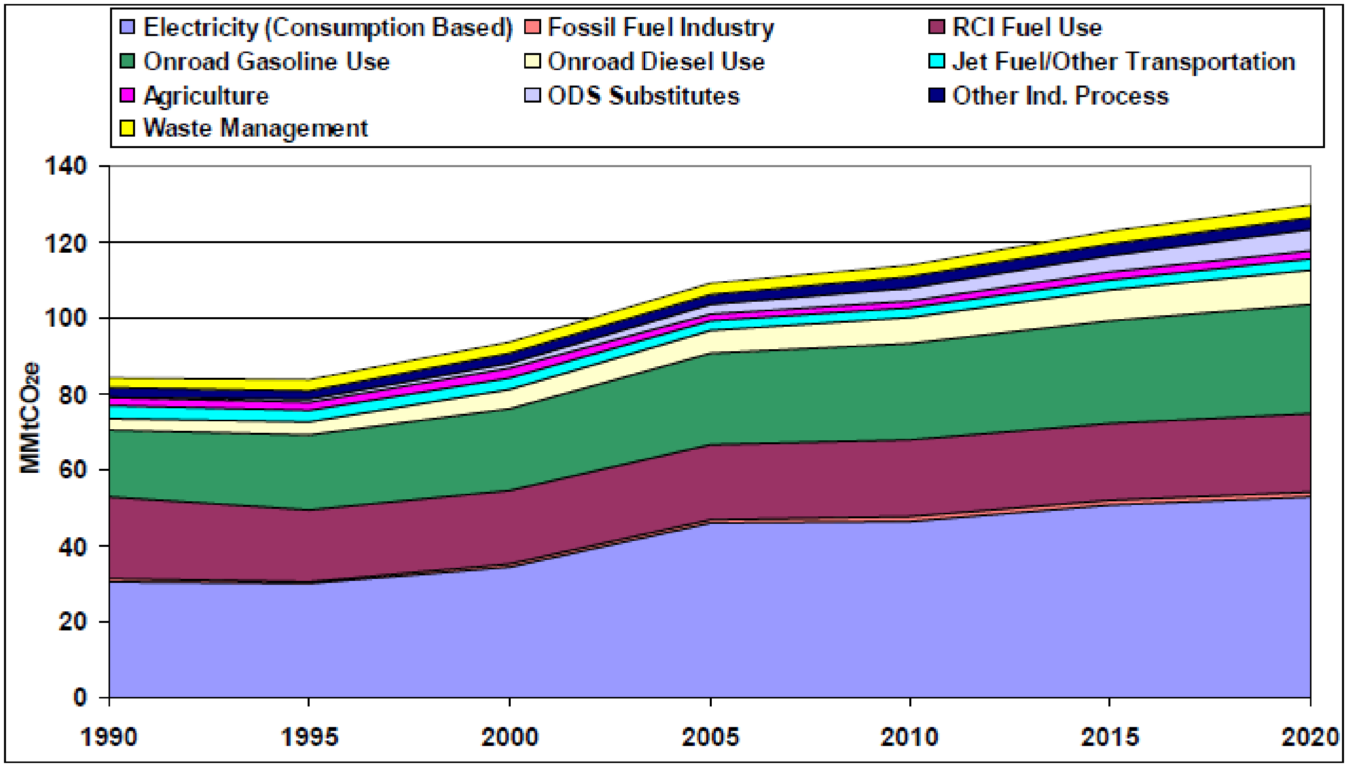
# MD: Not doing too well in GHG emissions (2050 goal – 23 million metric tons).



# GHG emissions Maryland – historical and state projections. Energy related emissions (CO2, CH4, N2O) ~91 percent

**Figure ES-2. Maryland Gross GHG Emissions by Sector, 1990-2020: Historical and Projected**



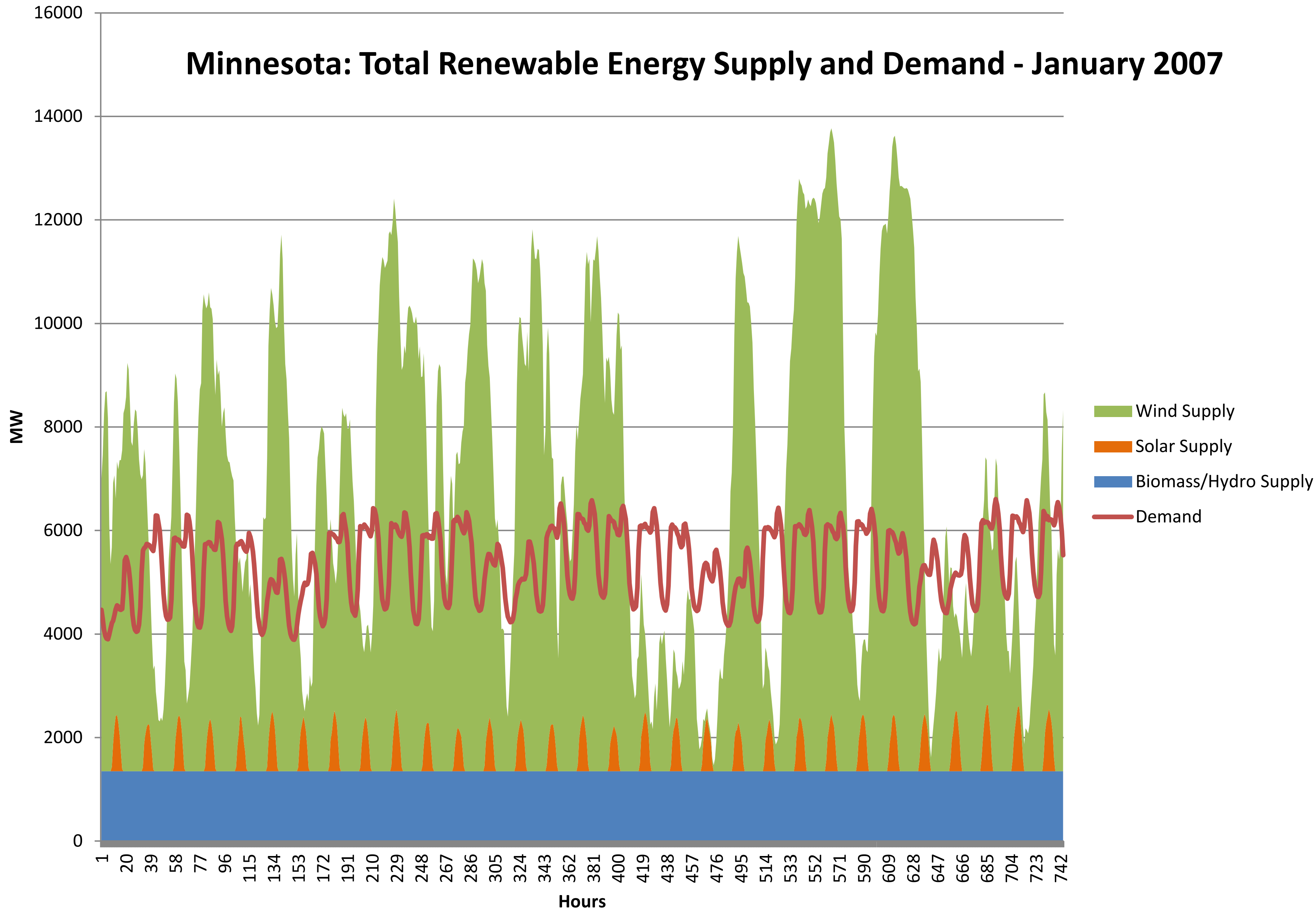

RCI – direct fuel use in residential, commercial, and industrial sectors. ODS – ozone depleting substance.

# GHG emission reductions assessment

- A nearly $CO_2$-emissions-free electricity sector is essential to major greenhouse gas reductions, 80 percent or more, by 2050 (or earlier).
  - On the order of 90 percent or more needed in the whole energy sector.
- We have shown it is technically and economically feasible in one state.

Major question for the Renewable Maryland Project: how to get a $CO_2$ emissions-free electricity sector formally adopted as a state-wide goal and ensure that it is combined with a practical set of policies and milestones to ensure we get there?

- The Renewable Maryland project seeks, with your participation, to answer that question.

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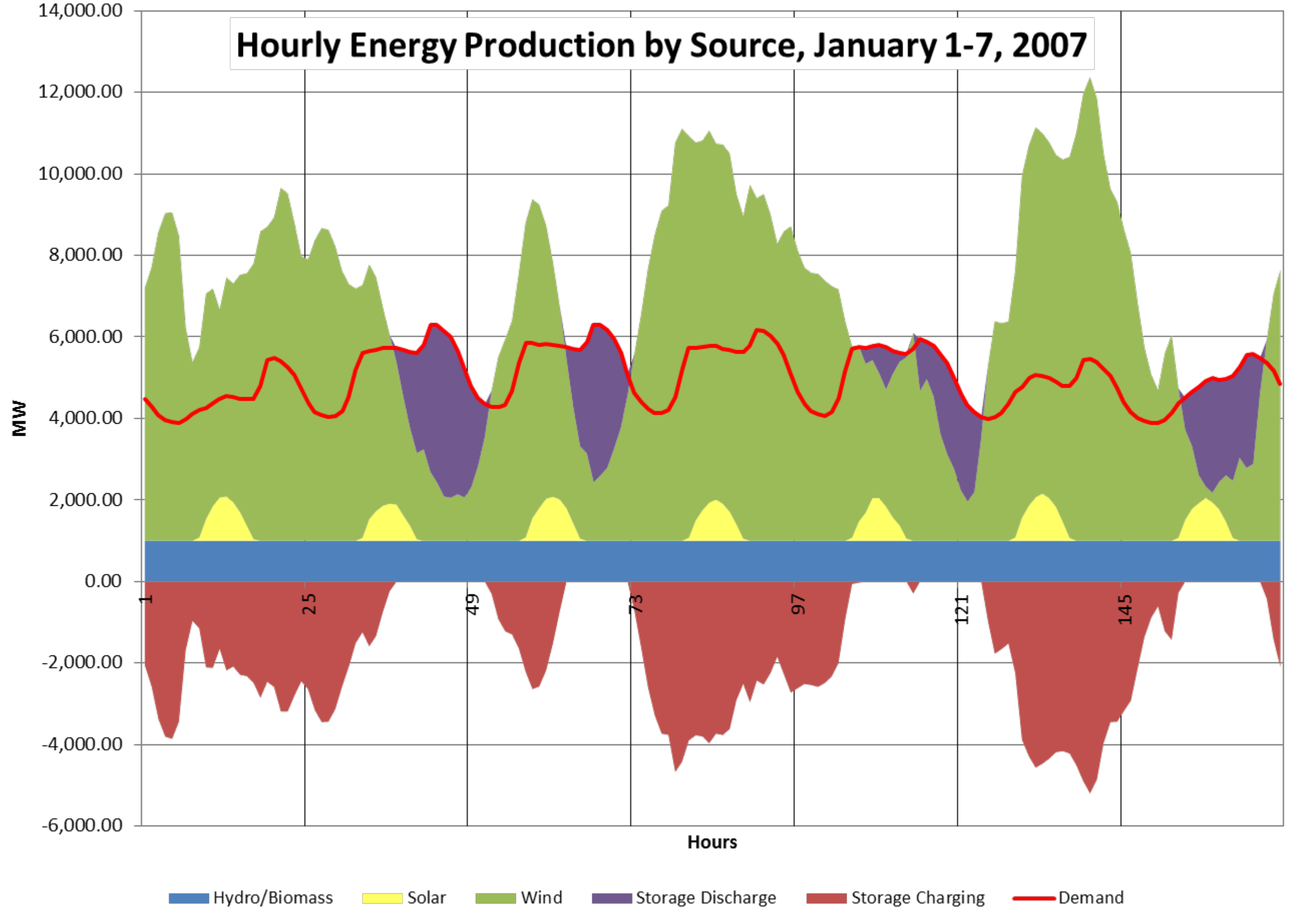
# MN: One week in the winter: wind + solar + hydropower/biomass storage meeting demand 24/7.

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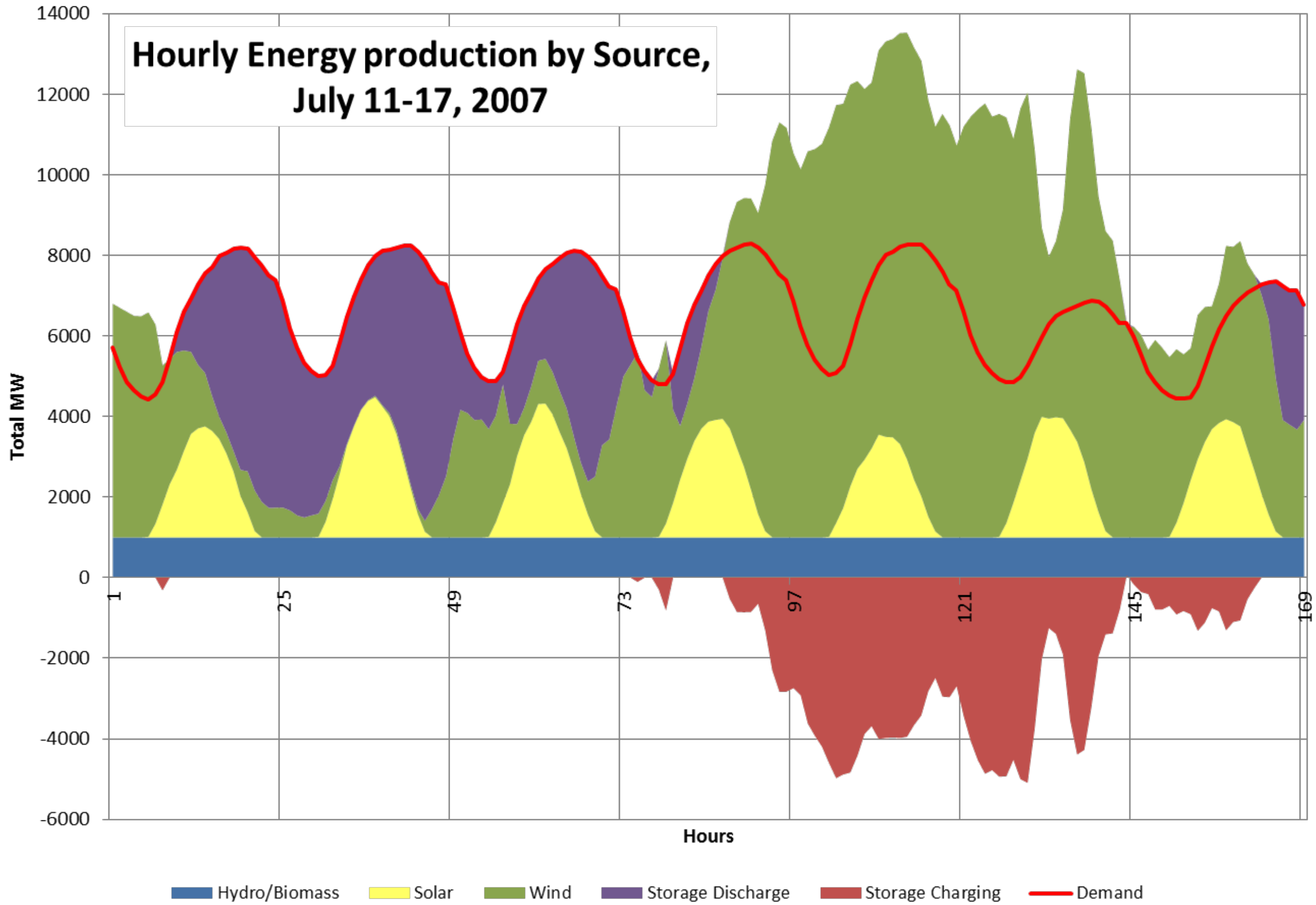
# MN: One week in the summer: wind + solar + hydropower /biomass + storage meeting demand 24/7.

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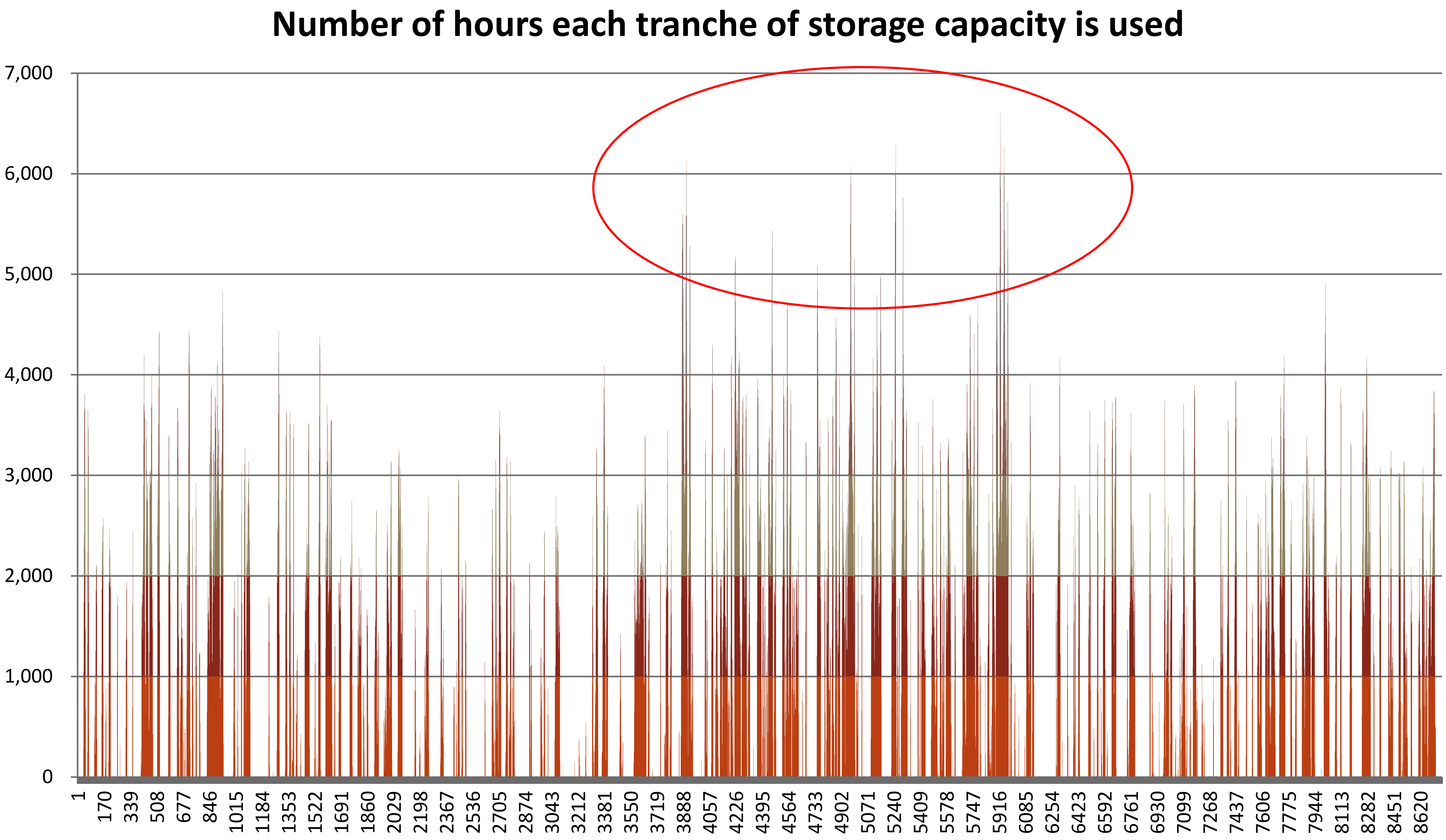
# Relational system peak: relation solar and wind supply to demand

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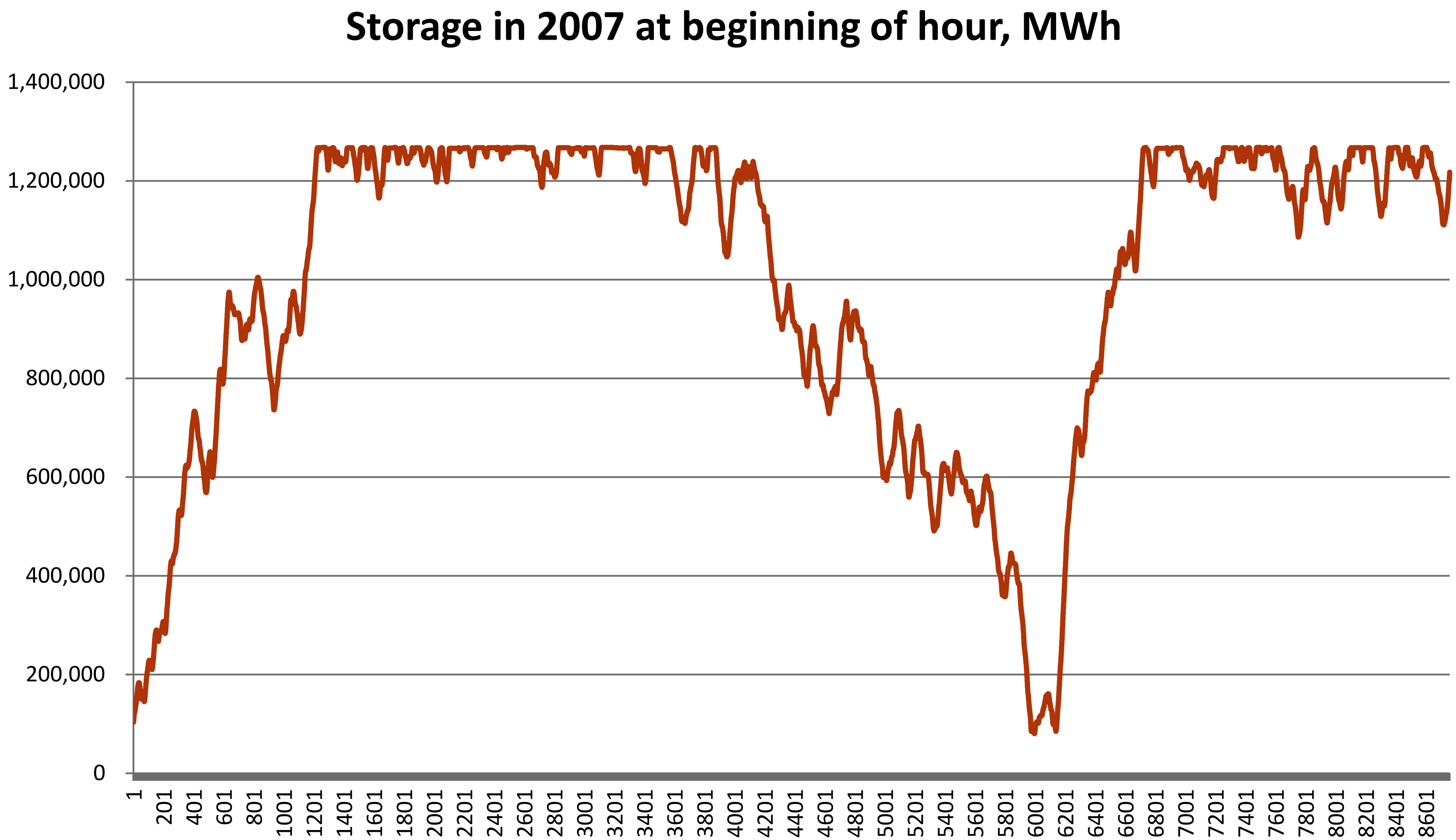
# Storage states, hour-by-hour, 2007 data



# Base case: Solar and wind $2000/kW from 2025 onward

| | Base case | Efficiency Tranche 1 | Efficiency Tranche 2 |
|---|---|---|---|
| Level of efficiency | No efficiency change | Medium efficiency (33%) | High efficiency (additional 17%) |
| Cost, $/MWh | $176 for generation | $30 for efficiency Tranche 1 | $100 for efficiency Tranche 2 |
| Average cost of electricity services $/MWh at different efficiency levels | $176 | $128 | $115 |
| Annual services supplied by generation, MWh | 8.68 | 5.82 | 4.34 |
| Annual services supplied by efficiency, MWh | 0 | 2.86 | 4.34 |
| Annual elec. bill for generation | $1,529 | $1,024 | $764 |
| Annual cost of efficiency | $0 | $86 | $234 |
| Total annual cost for residential electricity services | $1,529 | $1,110 | $998 |
| 2010 cost | $920 | $920 | $920 |
| Annual cost difference | $609 | $190 | $78 |

# Solar and wind $1,500/kW in 2025

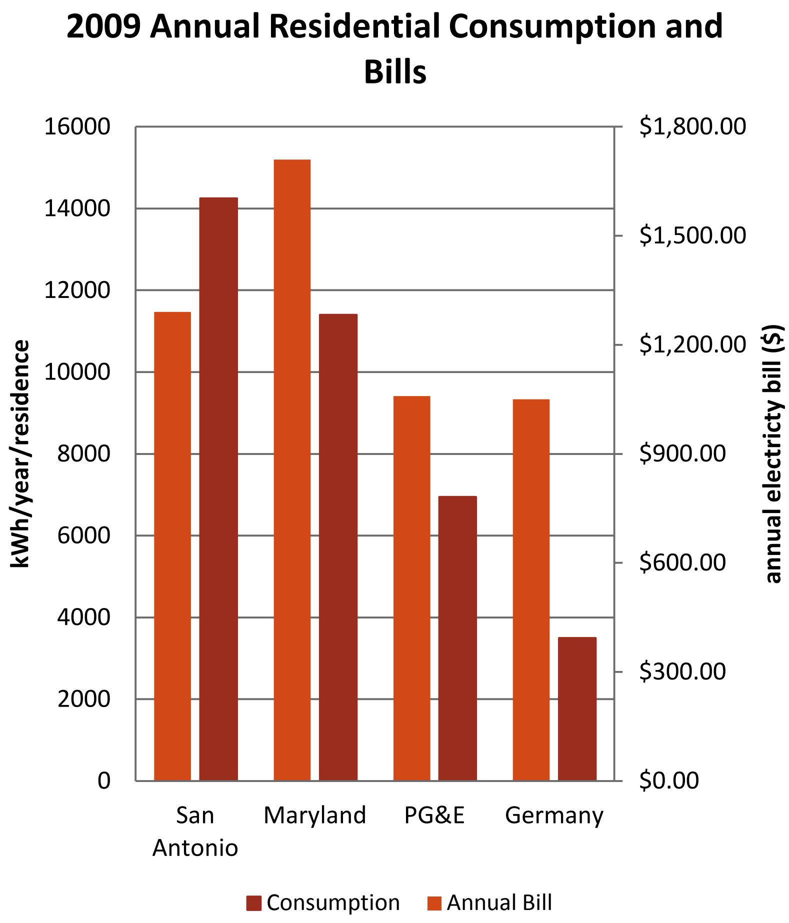
| | Lower cost case | Efficiency Tranche 1 | Efficiency Tranche 2 |
|---|---|---|---|
| | No efficiency change | Medium efficiency (33%) | High efficiency (additional 17%) |
| $/MWh | $154 | $30 | $100 |
| Average cost of electricity services $/MWh at different efficiency levels | $154 | $113 | $104 |
| Annual services supplied by generation, MWh | 8.68 | 5.82 | 4.34 |
| Annual services supplied by efficiency, MWh | 0 | 2.86 | 4.34 |
| Annual elec. bill for generation | $1,336 | $895 | $668 |
| Annual cost of efficiency | $0 | $86 | $234 |
| Total annual cost for electricity services (generation plus efficiency) | $1,336 | $981 | $901 |
| Total annual cost for in 2010 | $920 | $920 | $920 |
| Cost difference: renewables – 2010 | $416 | $61 | ($19) |

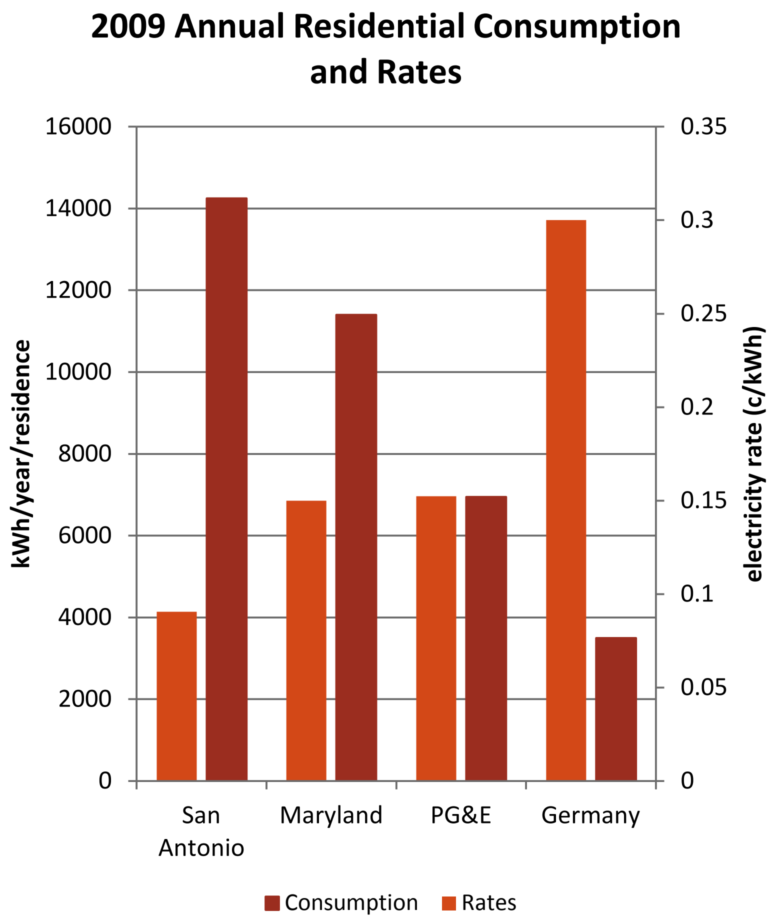
*IEER Report: Renewable Minnesota*

# Conclusions of the Minnesota study

- A fully renewable electricity sector is technically feasible. Resources are plentiful and can accommodate growth.
- Cost is at the lower end of estimated nuclear costs (without taking account of nuclear subsidies such as insurance and uncertainties about waste, and project delays)
- Would create roughly 50,000 jobs (continuous, but not net)
- Without efficiency, the cost of will likely be higher, but with efficiency the overall cost of electricity services would be about the same
- Can be made more efficient using demand dispatch and other technologies, probably more economical by reducing relational peaks, storage requirements and spilled energy
- Attention needs to be paid both to short term and seasonal variations in demand, and in relation to solar and wind supply

# Bills, rates, and demand: an initial analysis



# Renewable MD: overcome the limitations of MN and UT studies

Technical and economic feasibility of a fully renewable electricity sector demonstrated, but gaps remain to actually get the goal adopted.

- No connection to existing short and medium term policies
- Single centralized energy storage (compressed air) with siting issues
- In-state renewable resources only.
- Natural gas not taken into account
- No consideration of distributed grids, microgrids, demand dispatch
- Little coordination in advance with groups seeking legislative, regulatory changes towards an emissions free economy.
- No continuing process to ensure updates and relevance to changing technology, economics or legislative and regulatory opportunities.
- Getting one state to see that 80% GHG reductions translates to approximately 100 percent renewable electricity sector would be a huge advance.

# Project Overview

- Connect the long-term goal of an emissions-free energy sector (phase out all fossil fuels at the latest by 2050) in Maryland to potential intermediate steps.
- Tentative starting point: three studies that will progressively feed into each other followed by an integrated roadmap – putting it out there as one starting point for discussion
    - Buildings and distributed energy production/microgrids/demand dispatch (includes efficiency, electricity and natural gas)
    - Transportation, including efficiency, electrification of transportation and connection to distributed generation and demand dispatch
    - Large scale supply for remaining energy sector
    - Integration of the various elements, with milestones

# Questions for group

- How does your work connect to this on a day-to-day basis?
- Is it realistic to have a vision of 100 percent or close to 100 percent renewable electricity sector adopted as part of 80% GHG reductions?
- What kinds of milestones – dates, specific efficiency and renewable supply goals, microgrids, smart grid – would be useful?
- Is the existing plan for a buildings and distributed supply study, transport study, and supply study reasonable?
- How to connect our technical work with your advocacy on a routine and ongoing basis?
- How to make sure that the overall direction and technical analysis stays relevant with changing costs and legislative and regulatory opportunities.

**Process**

- **Active advisory group.**
- **Blog for stakeholders to provide opinions and suggestions?**
- **Update meetings or conference calls?**