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Microgrids Can Play An Important Role In Reducing ERCOT's Fossil Fuel Dependency

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Microgrids Can Play An Important Role In Reducing ERCOT's Fossil Fuel Dependency

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By Eugene Preston, PE, PhD

February 10, 2016

- **The Loss of Load Expectation LOLE Hourly Model**
- **Visualizations of Renewable Power vs Demand**
- **Benefits of Microgrids to Owners and to ERCOT**

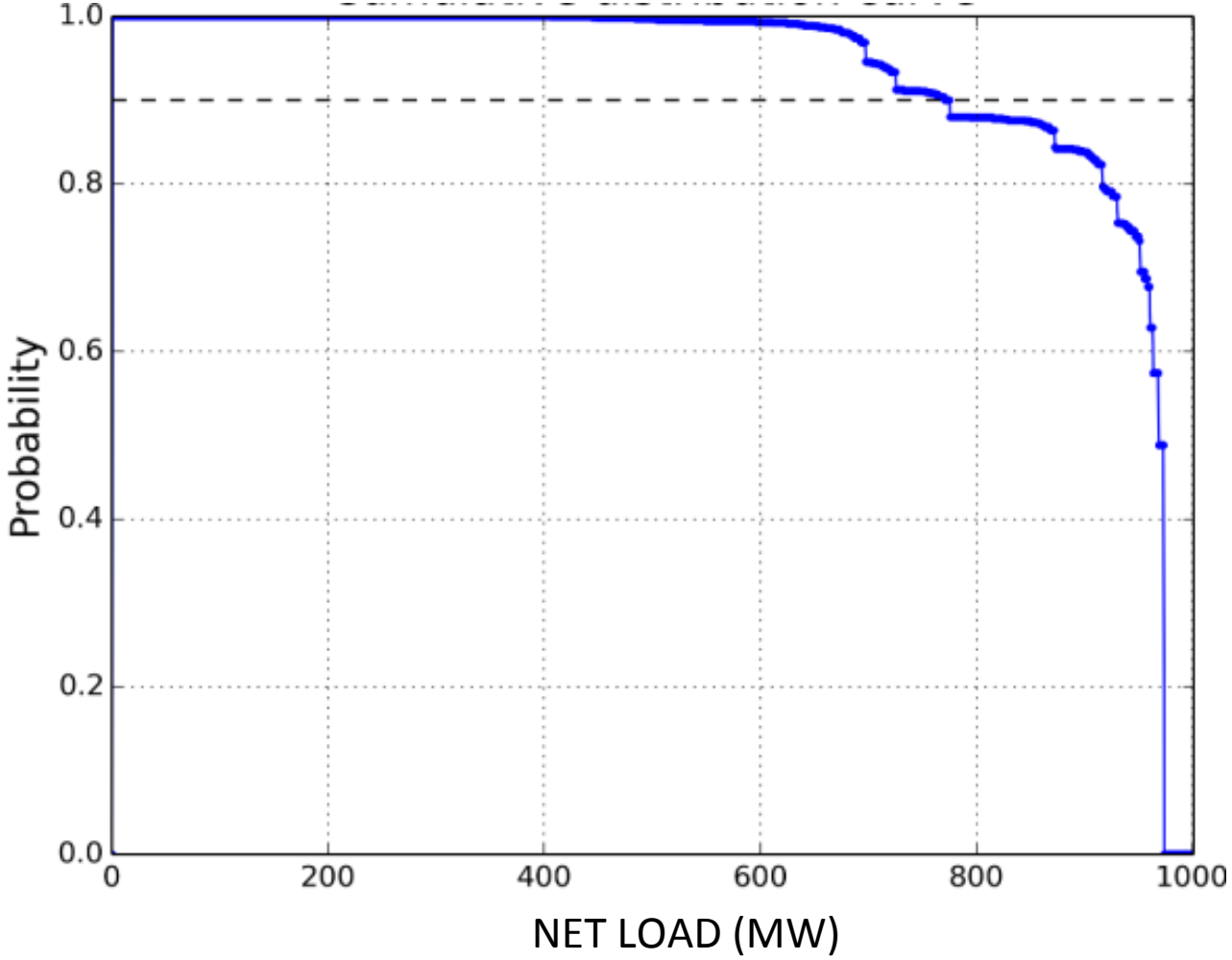
The Loss of Load Expectation LOLE Hourly Model

LOLE is a measure of the risk for loss of load due to insufficient generation capacity.

- Two Equivalent Calculations of LOLE (0.1 days/year desired)
  1) Direct Solution -> LOLE = $\sum_{365 max daily}$LOLP = the annual sum of each day's maximum Loss of Load Probability.
  2) Monte Carlo -> LOLE = ∑ loss of load days / number of years simulated (example: 500 days out of 5000 years).

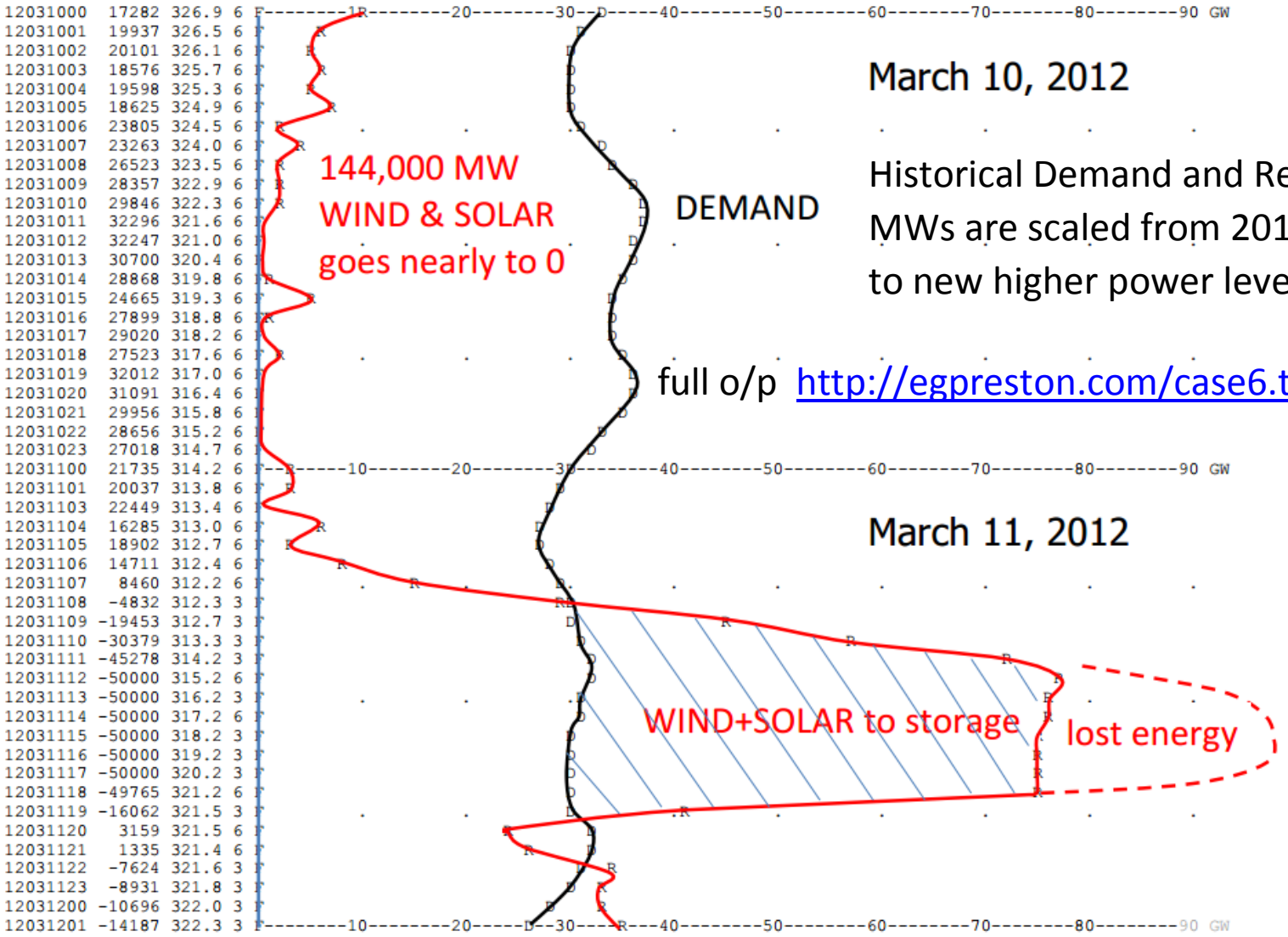
- Both methods utilize historical data from years 2010 – 2012
  - Hourly ERCOT Demand; peak is scaled to a future year.
  - Hourly Wind; scaled to future MWs in each of 3 areas, Panhandle wind, West Texas wind, and Coastal wind.
  - Hourly Solar; scaled to future MWs in each of 3 areas Austin area, San Antonio area, and Pecos County area.

- Direct Solution is fast and accurate; uses F(x) http://egpreston.com/OPDC.txt
  - Hourly LOLP = 1 – F(net load x) is a ‘look-up’ where net load x = hourly load MW – hourly renewable MW.



Visualization of Renewable Power vs Demand

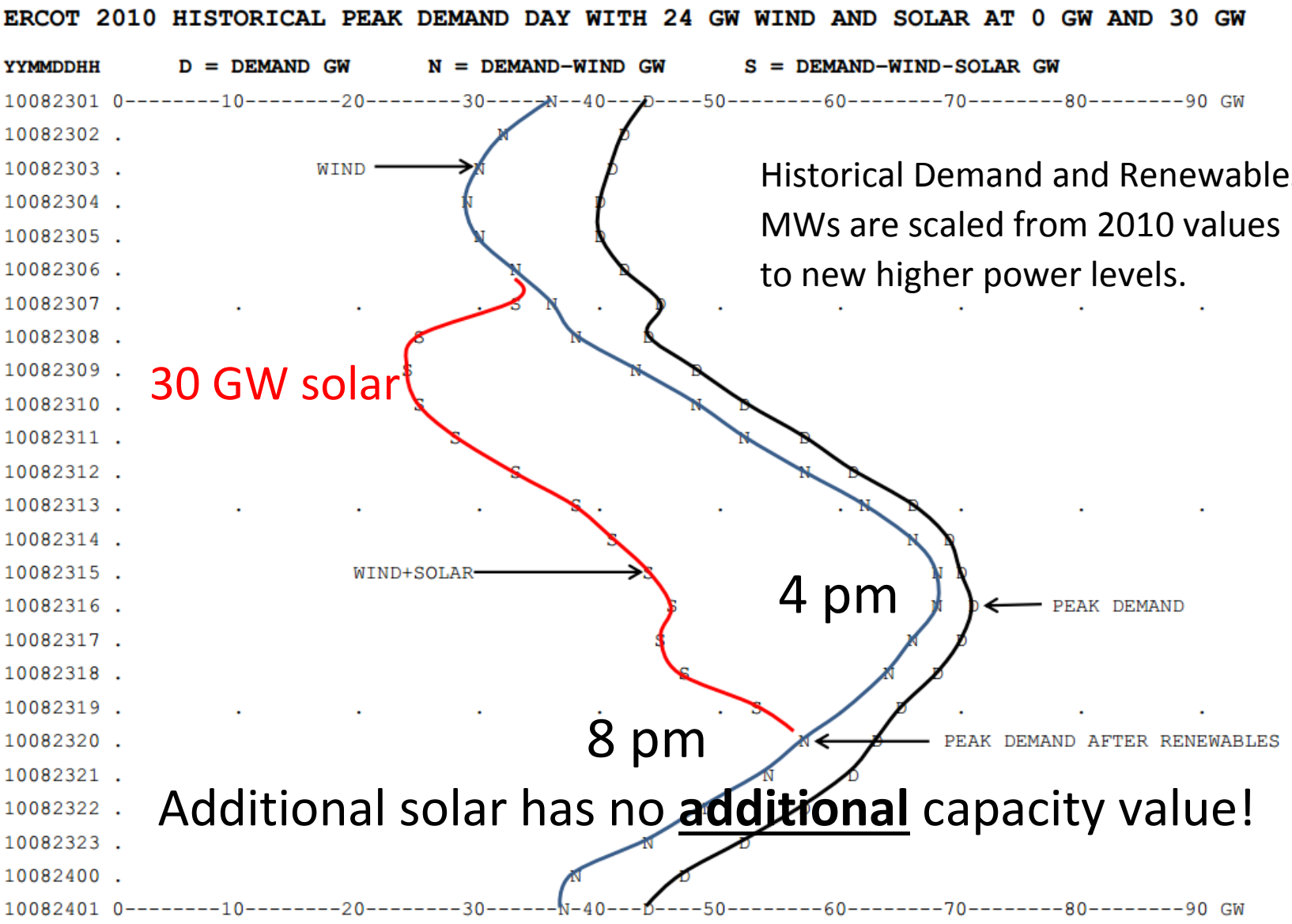
Days with nearly zero renewable power in ERCOT happen.



Historical Demand and Renewables MWs are scaled from 2012 values to new higher power levels.

full o/p http://egpreston.com/case6.txt

Adding solar shifts the net load peak demand hour to later.

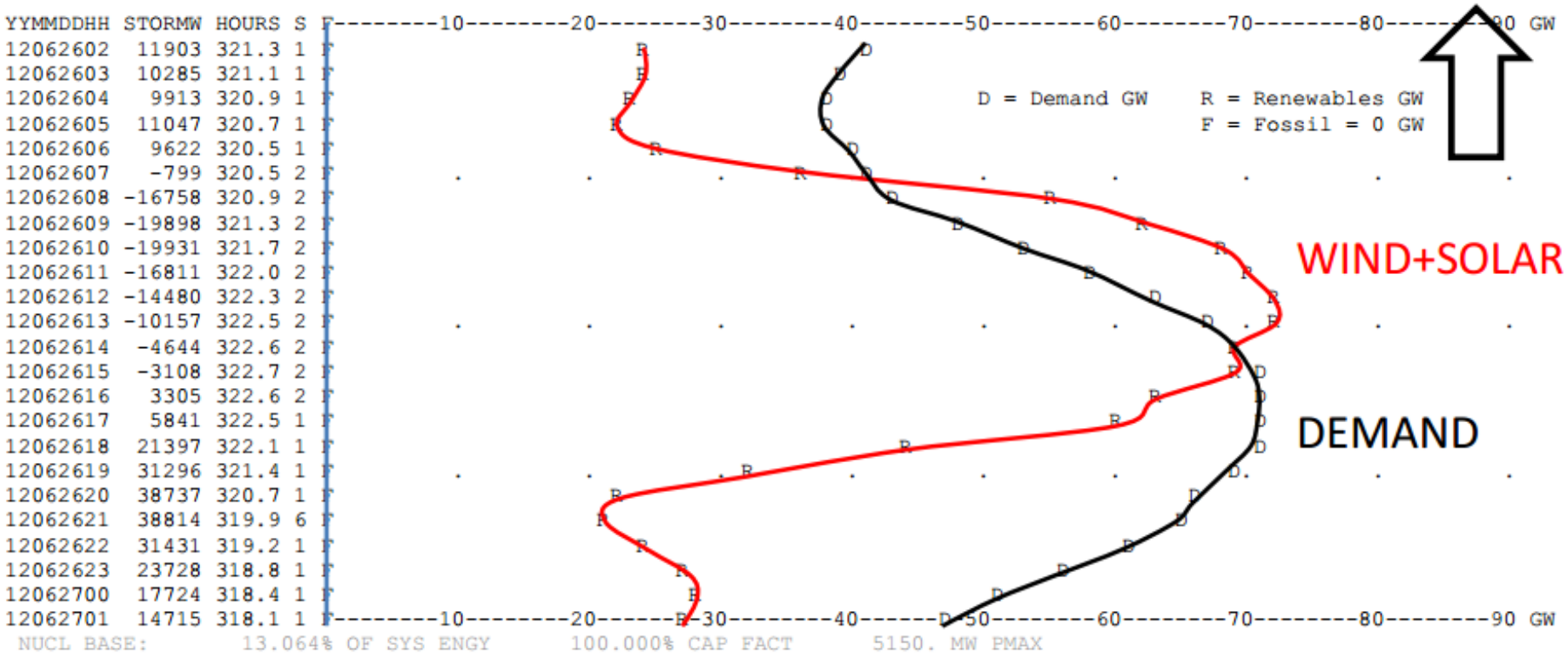


Historical Demand and Renewables MWs are scaled from 2010 values to new higher power levels.

Additional solar has no **additional** capacity value!

100% renewables requires about 14 days of expensive storage.

68 GW wind + 76 GW solar – 69.264 GW fossil (12.523 GW remains) + 50 GW storage for 330 hours (~14 days) to achieve zero fossil fuel generation, storage cost=~$6600bn



NUCL BASE: 13.064% OF SYS ENGY 100.000% CAP FACT 5150. MW PMAX

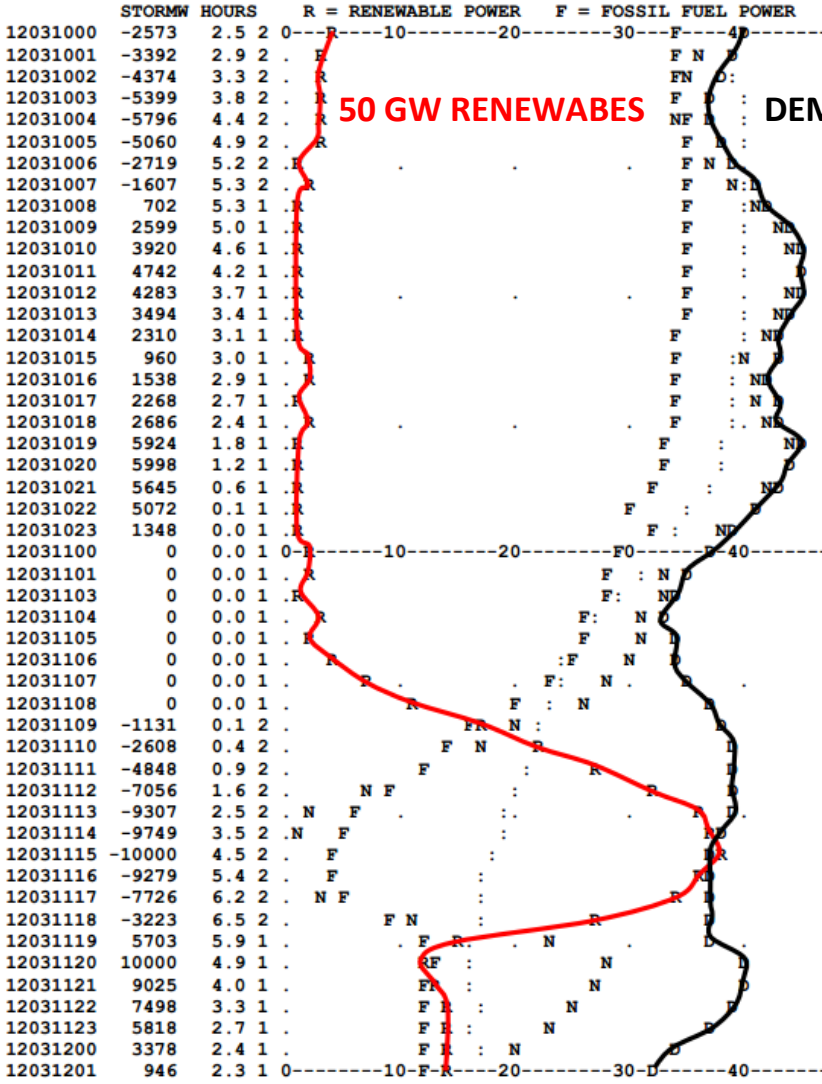
RENEWABLE: 110.873% OF THE TOTAL SYSTEM ENERGY
(WIND+SOLAR) 20.918% OF THE RENEWABLE ENERGY IS LOST

RENEWABLE: -23.937% OF SYS ENGY LOST

1036948. GWH 100.000% OF SYS ENGY IS NON FOSSIL
0. GWH 0.000% OF SYS ENGY IS FOSSIL FUELS
1036948. GWH 100.000% TOTAL (3 years)

LOAD RAMP UP 1027 MW/MIN ON 11020718 YYMMDDHH
LOAD RAMP DOWN 939 MW/MIN ON 12030508 YYMMDDHH
MINIMUM DEMAND -44850 MW ON 12122815 YYMMDDHH
STORAGE: 49755 MAXIMUM DISCHARGE (+) MW -50000 MAXIMUM CHARGING (-) MW
16500000 MAXIMUM CHARGE ENERGY MWH 330.0 MAXIMUM CHARGE ENERGY HR 4.7 MINIMUM CHARGE ENERGY HR

An Achievable Plan for 2030? 24 GW Wind, 26 GW Solar, 10 GW Storage for 8 hours, 70 GW Fossil, 5 GW Nuclear



see http://egpreston.com/30stor10.txt

10% nuclear energy

32% renewable energy

58% fossil energy

$42 bn 10 GW grid storage *

or

$11 bn microgrid storage **

* $1/W + $.4/Wh flow battery

** $.3/W + $.1/Wh Li-ion

** (public announcements)

Some of the Benefits of Home Microgrids to ERCOT

- Assume 1 million 10 kW microgrids in ERCOT
- 50 kWh per microgrid is 5 hours at 10 GW capacity
- ERCOT utilizes the microgrids as an ancillary service
- Avoids the need to install 10 GW of grid level storage
- 10 GW instant emergency power is available to ERCOT
- Individual microgrids decide when to purchase/sell
- Storage power is distributed throughout ERCOT
- Microgrid storage reduces the need for new transmission
- Microgrids are programmed to be system stabilizers
- Microgrids absorb excess renewable power off peak
- Microgrid peak load shaving reduces ERCOT demand

Some of the Benefits of Home Microgrids to Owners

- Can operate independently off the grid during an outage
- Integrates operation of solar panels, EVs, and battery
- Minimizes the demand charge of a cost of service rate
- Provides an opportunity to purchase low cost grid power
- Optimizes timing of large loads like swimming pool pumps
- Provides an electronic quick EV charging system off the grid
- Low cost microgrid 10 kW converter cost is only $3000
- Tesla Li-ion 50 kW home microgrid battery cost is $5000*
- 6 kW solar panel cost is $12,000 provides annual 8 GWh
- 1 kW nuclear costs $8,000 and provides annual 8 GWh
- Nuclear? Yes, directly financed with crowd source funding
- Microgrid with nuclear and solar has zero CO_2 emissions

* (Announced $100/kWh by Elon Musk with his new factory in production.)