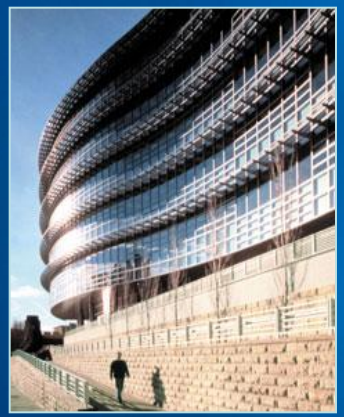
New Paradigms in Energy Production – Texas Style

8/23/2012

Bob Helms

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US Energy Profile

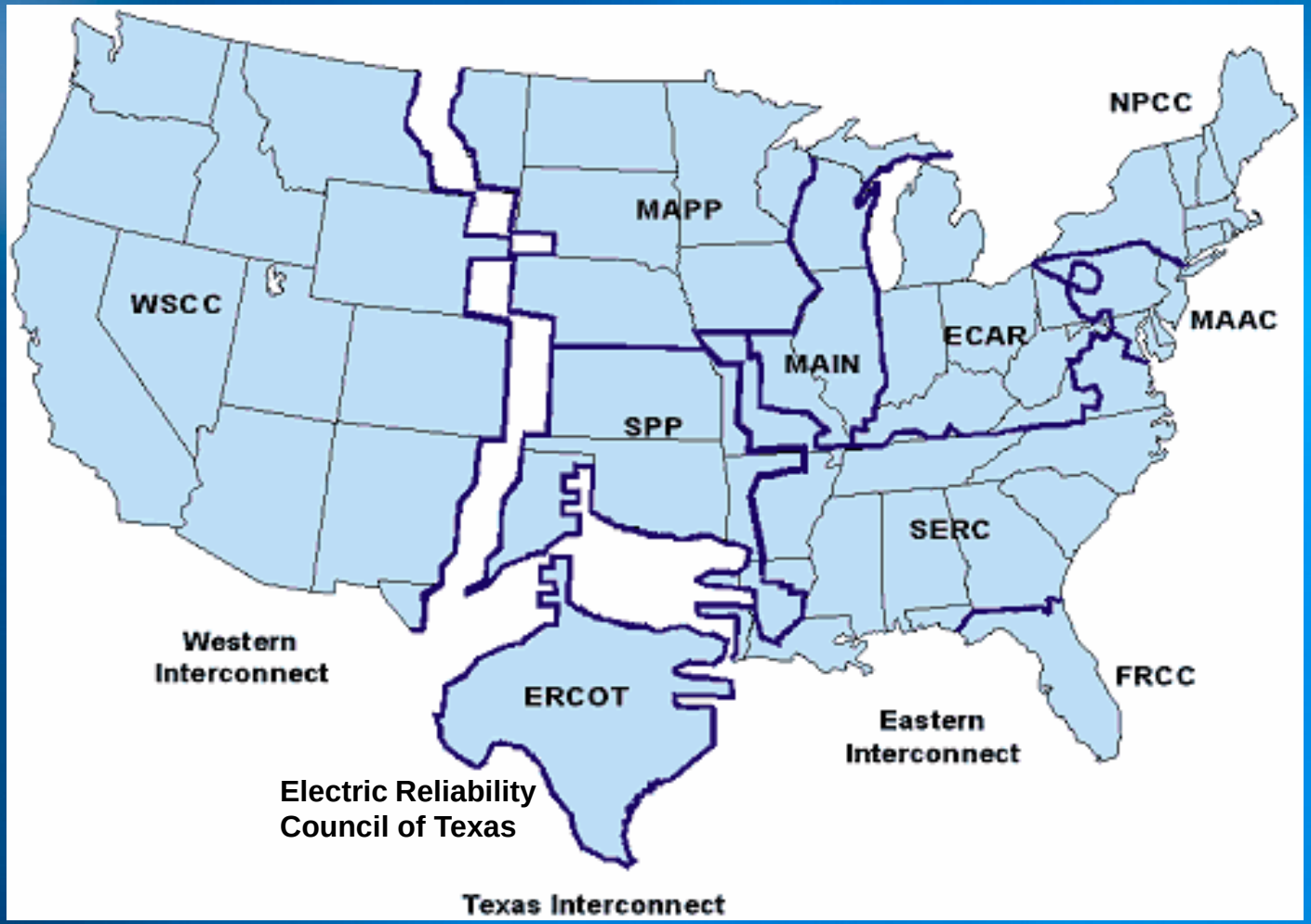
Source

- Oil – 25%
- Coal – 25%
- Nat Gas – 25%
- Nuclear – 10%
- Renewables – 10%
  - Mainly Hydro

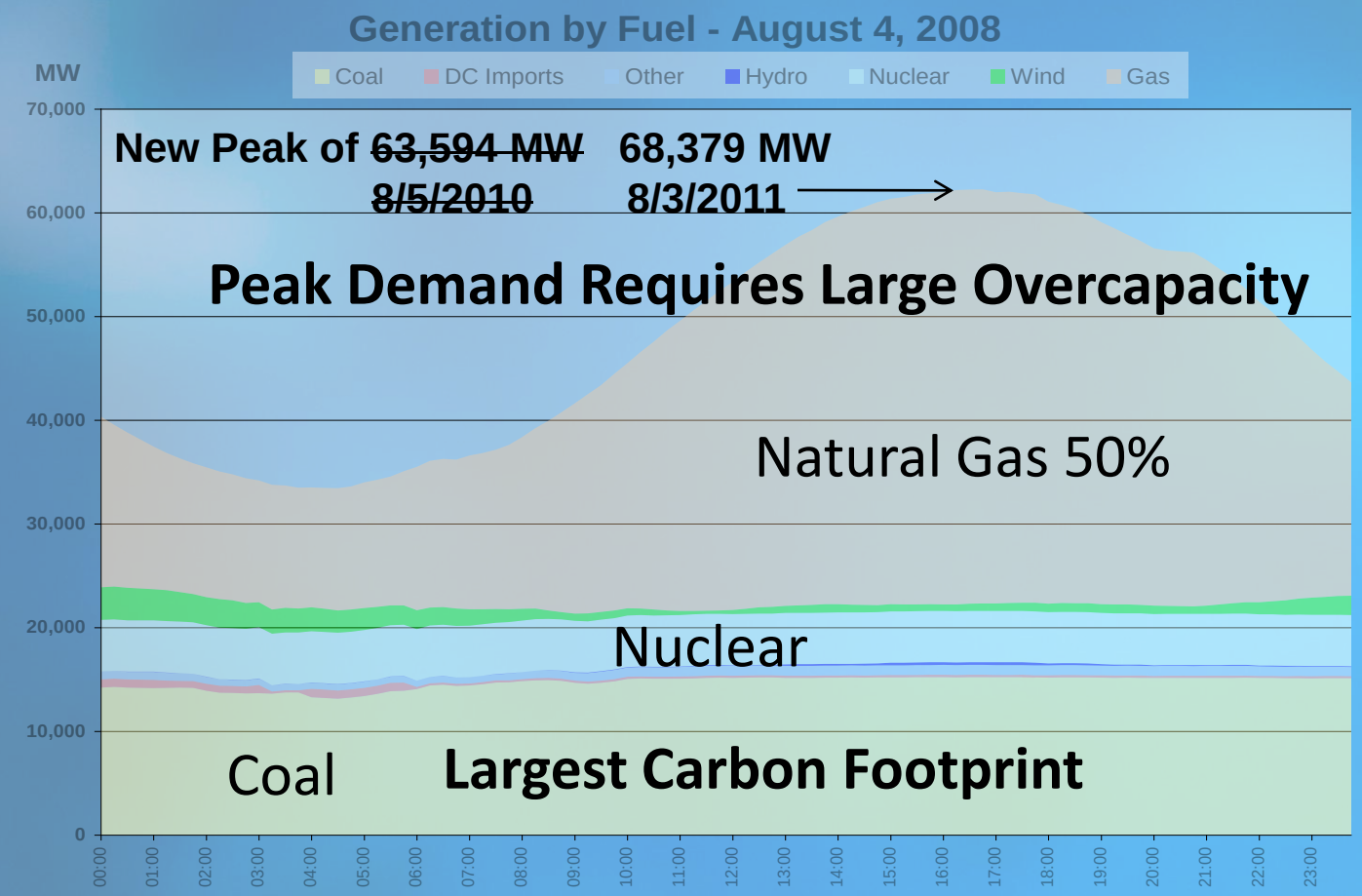
Use

- Electric Power – 40%
- Transportation – 30%
- Other – 30%

US Electric Power Distribution Management



Texas Demand vs Time of Day

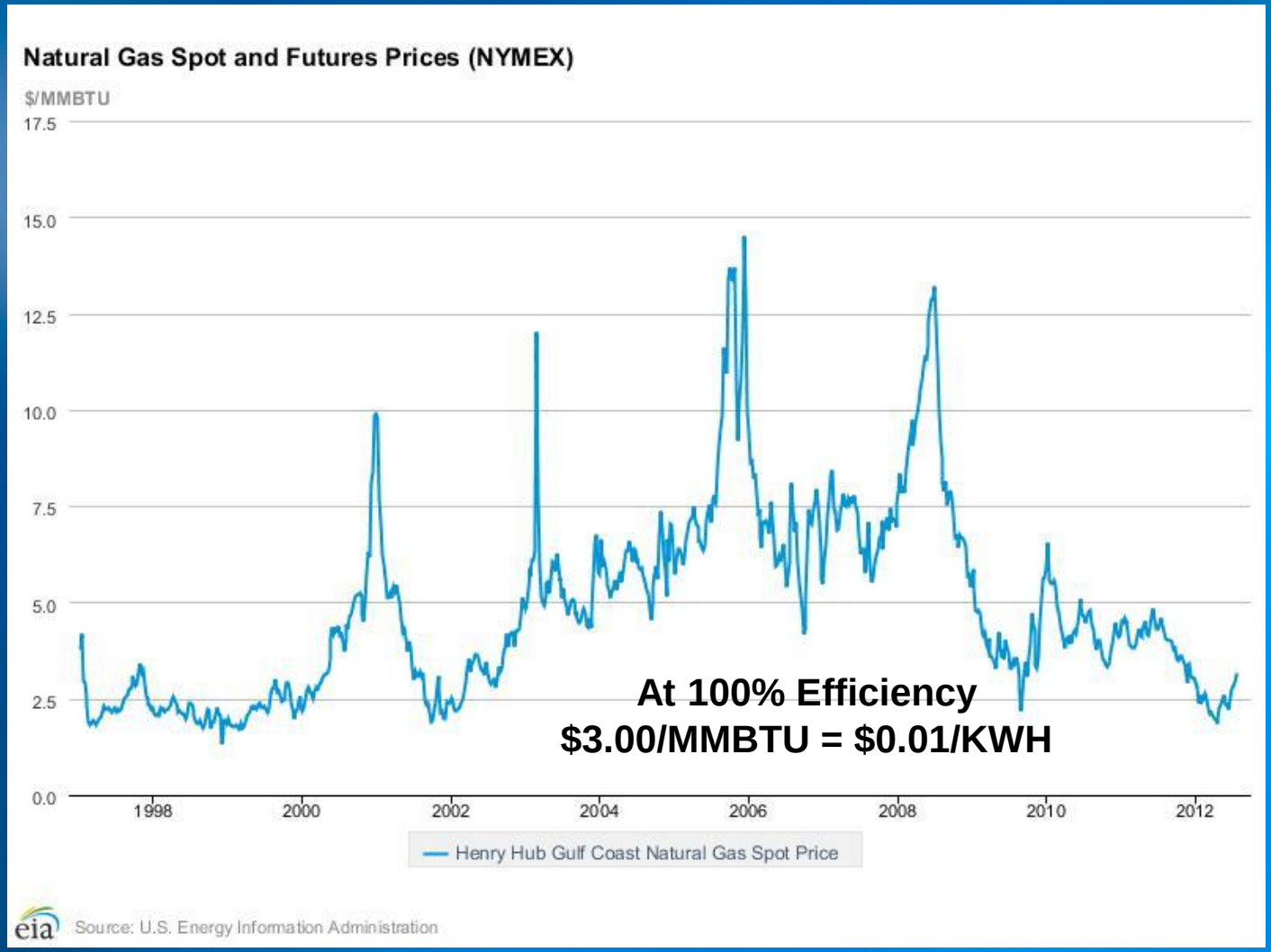


Midnight 12 Noon Midnight

Texas Energy Economics 101

- **Electric Power**
  - **Cost is Very Sensitive to the Cost of Natural Gas**
  - **Hydraulic Fracturing (HydroFracking) Combined with Horizontal Drilling has Increased the Nat Gas Supply Considerably**
    - **Especially in Texas**

Natural Gas Price History

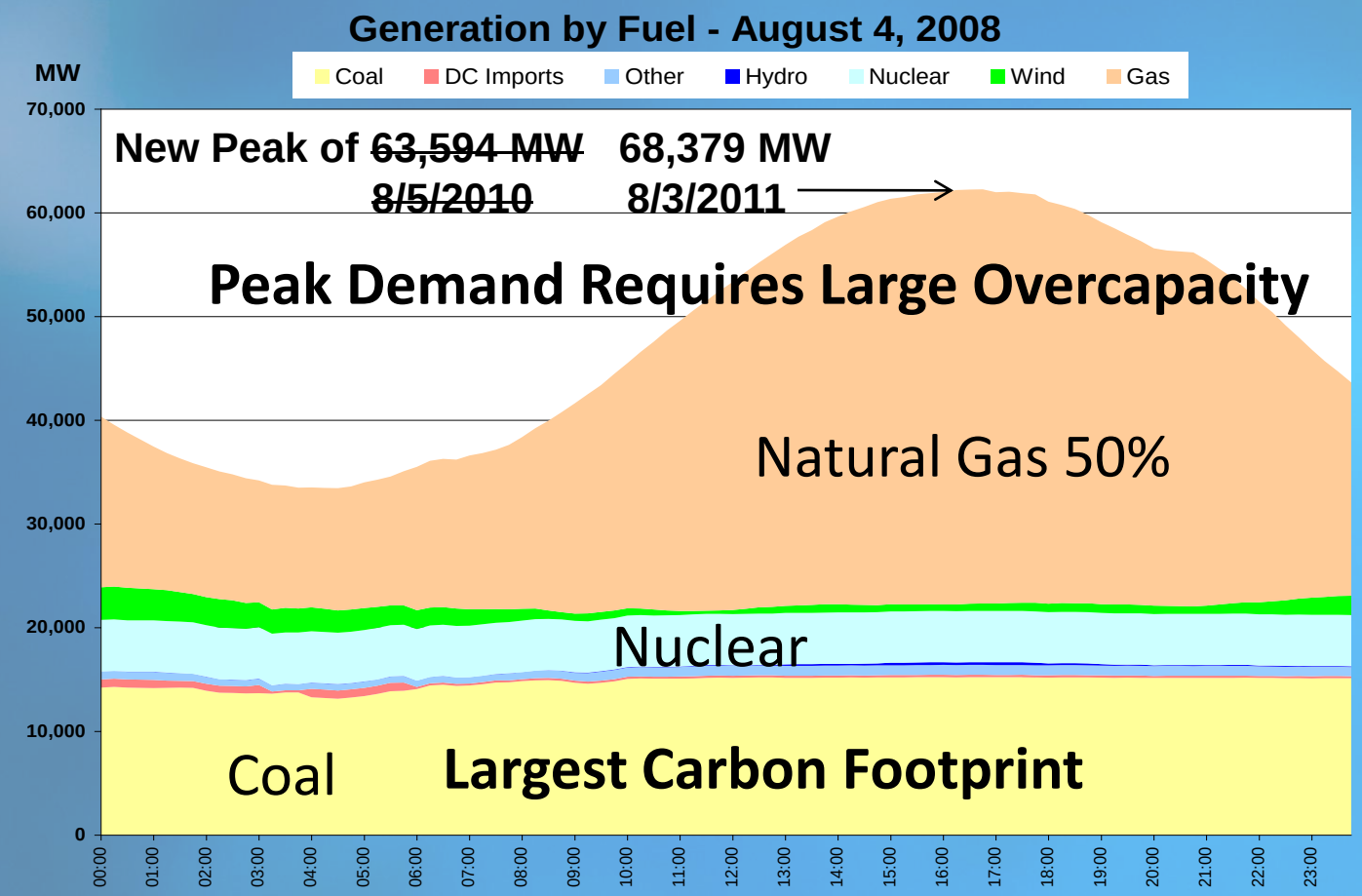


Henry Hub Prices after eia.gov

Part 1 - Conclusions

- **Plentiful, Cheap Natural Gas is a Significant Barrier to New Renewable Installations in Texas**
  - **Note CO_2 Production, However**
  - **Increased Interest in Methane Fuel Cells (e.g. BloomEnergy)**
- **Conservation and System Efficiency is Still a Best Practice to Reduce Energy Consumption**
- **Solutions to Reduce and/or Shift Peak Loads can Provide Significant Energy (and Cost Savings)**

Texas Demand vs Time of Day



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Peak Load Reduction Strategies

- Requires 6-12 Hours of Storage
- Smart Meters
- Storage
  - Thermal
  - Batteries
- On-Site Generation
  - Particularly Solar
    - With Storage (Solar Peaks 3 Hrs Early)
- What About Electric Car Charging Stations?

DFW Airport TES System

- Thermal Storage Moves 15 MWatt's Off Peak
- 90,000 Ton-Hrs
- 6 Million Gallons
  - Large Footprint

Electrical Storage Solutions in Texas

Results on Ultracapacitor Materials Research – J. Ferraris Group

Device	Energy (J)	Volume (cm^3)	Mass (g)	Energy density (J/cm^3)	Energy density (Wh/kg) packaged
Panasonic Lithium Ion battery	23700	17.7	42.5	1339.0	154.8
A123 systems Lithium Ion battery	23800	34.2	70	695.9	94.4
Panasonic lead acid battery	54800	230	590	238.3	25.8
Maxwell Technologies PC-10 ultracapacitor	31.3	3.35	6.3	9.3	1.9
NESSCAP CO. LTD Ultracapacitor	26.5	2.4	3.6	11.0	2.1
Panasonic Electric double layer capacitor	2.65	1.11		2.4	
United Chemicon aluminum DLC	5	35.5		0.1	
UTD EDLC based on Poly(AN-*co*-VIM) (unpackaged)					**46 Wh/kg**

Tesla Roadster

288 HP
375 v Motor
245 Mile Range

125 MPH
1000 lb Battery

0-60 in 3.7 sec
215(56) KW(H)

www.Teslamotors.com

Part 2 Conclusions

- Many Parts of the US Benefit from VERY Low Cost Electric Power
  - Natural Gas
- Near Term Opportunities
  - Effective Use of Current Infrastructure
    - Storage & On-Site Generation
  - Improved System Efficiencies
  - Strategy that Does Not Require Grid-Tied Charging Stations for Electric Vehicles

Is Energy Independence Possible?