



CHP: The State of the Market

U.S. EPA Combined Heat and Power Partnership 2010 Partners Meeting

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ICF International

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Acknowledgements

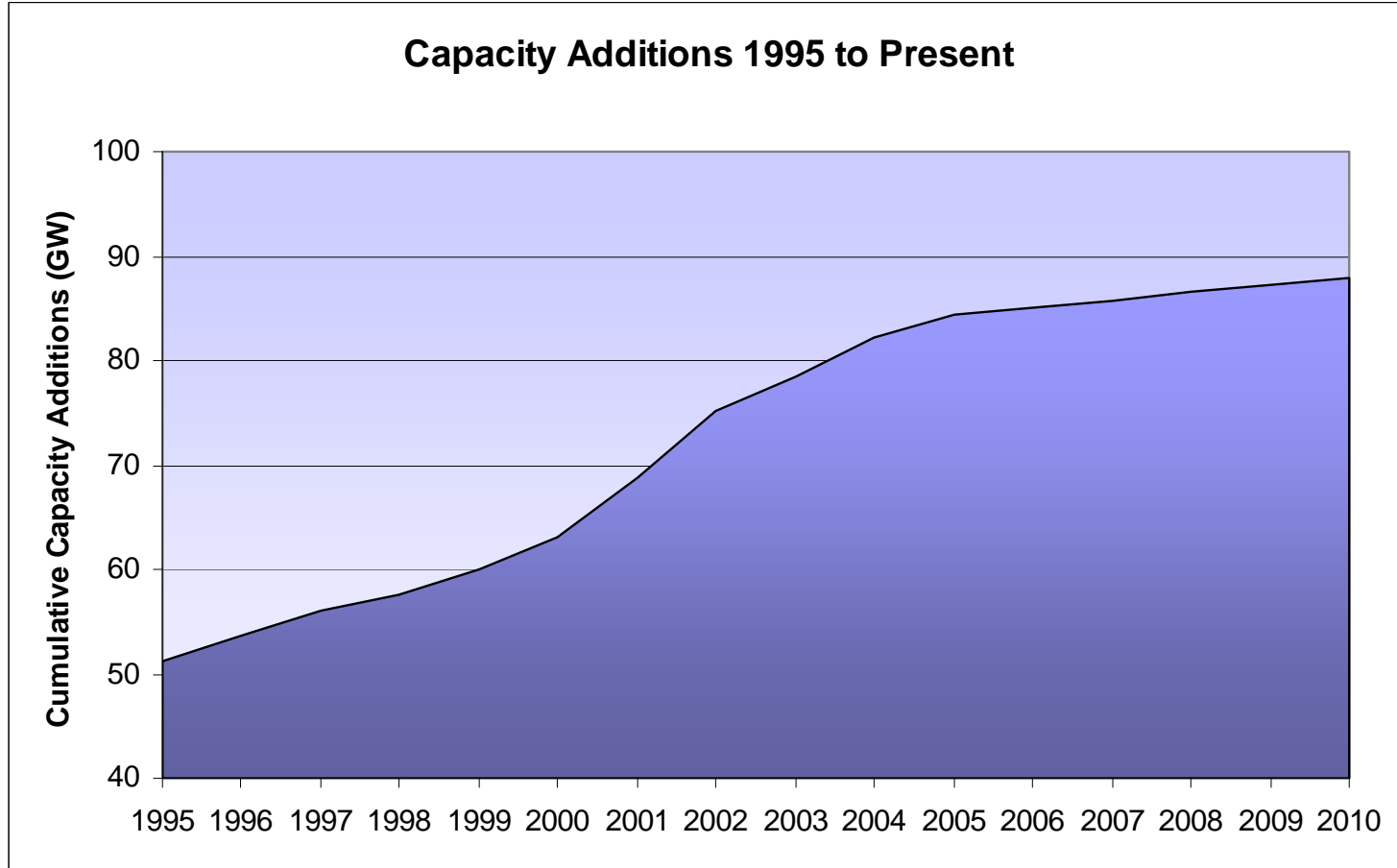
Based on work supported by:

- EPA's Combined Heat and Power Partnership
- DOE's Industrial Technology Program

CHP Market Status

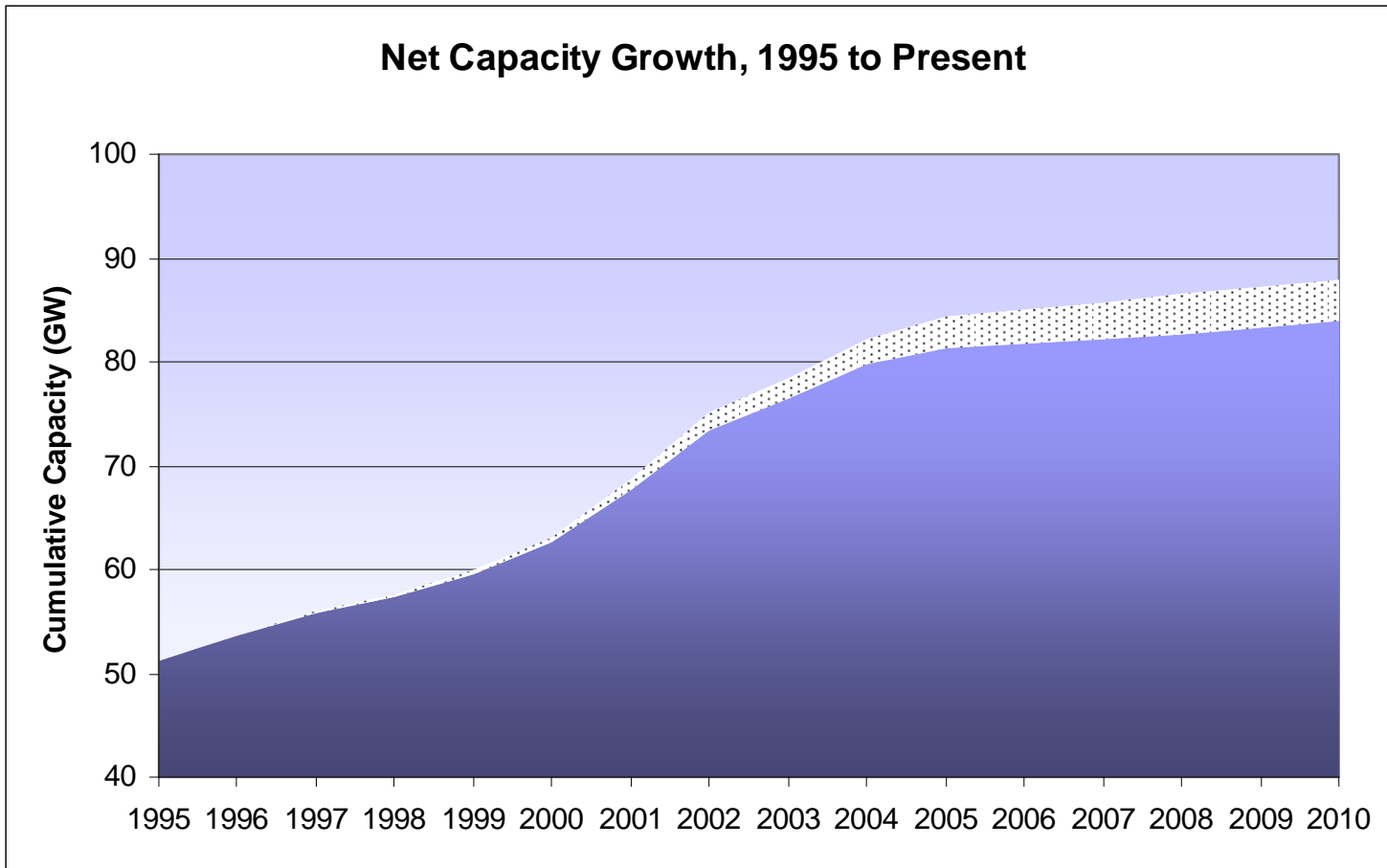
- Recent market activity
- Key policy issues at states
- Potential game changers

Over 35 GW of New Capacity Has Been Installed Since 1995



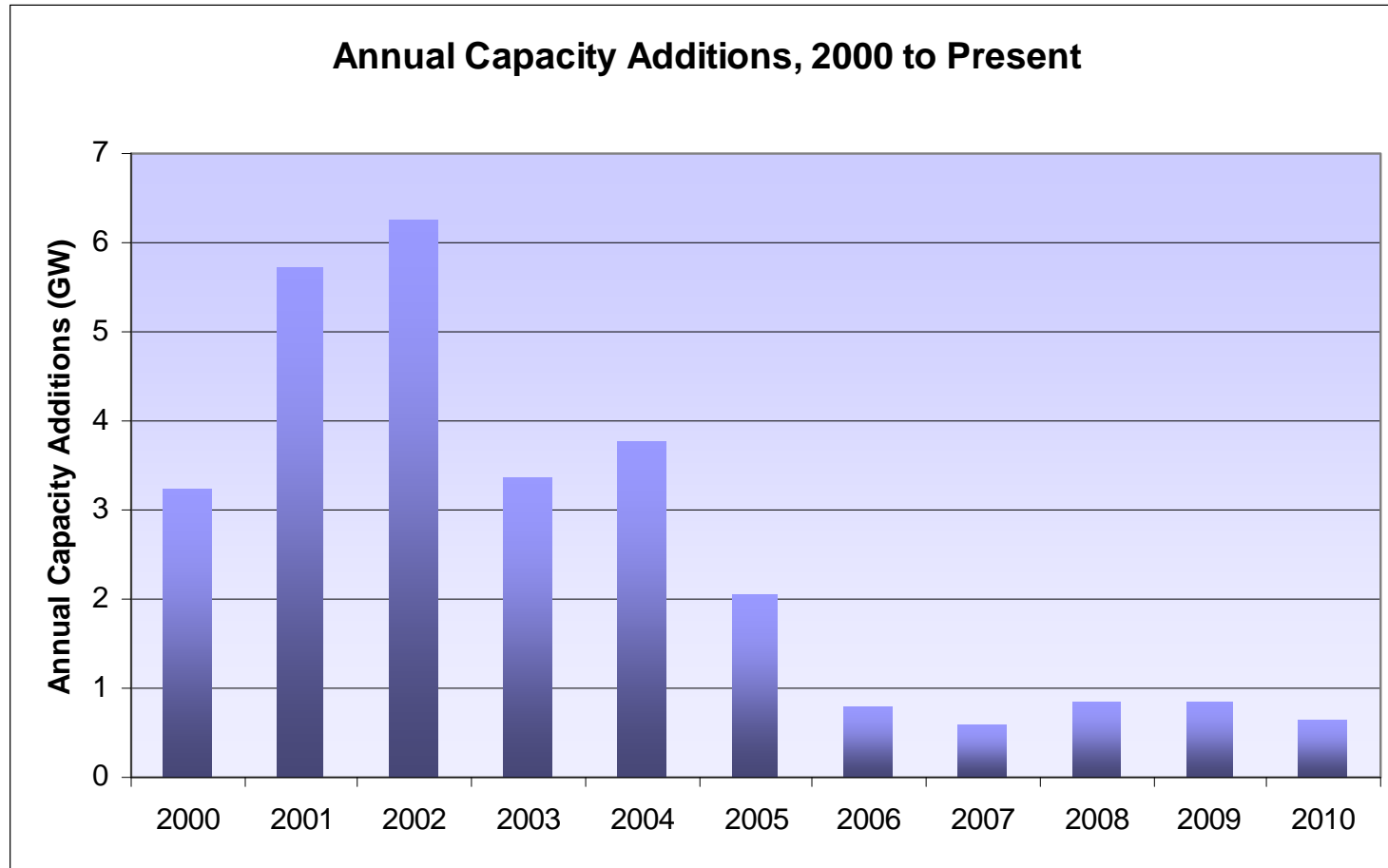
Source: CHP Installation Database – ORNL/DOE

But Growth Has Slowed Since 2005, and over 4 GW of Capacity Has Been Retired



Source: CHP Installation Database – ORNL/DOE

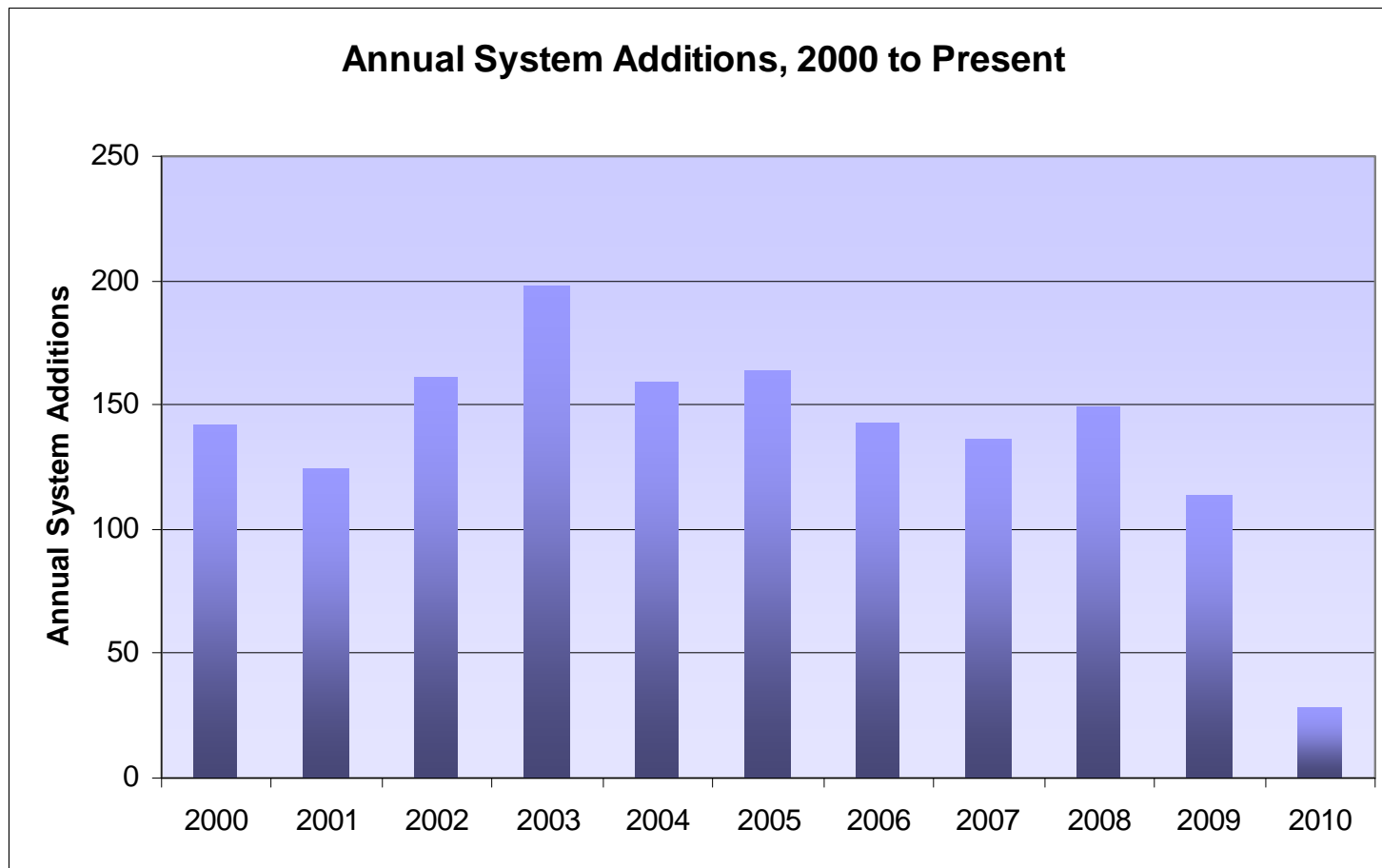
New CHP Capacity Additions Have Been Below 1 GW/Year Since 2006



2010 data is incomplete

Source: CHP Installation Database – ORNL/DOE

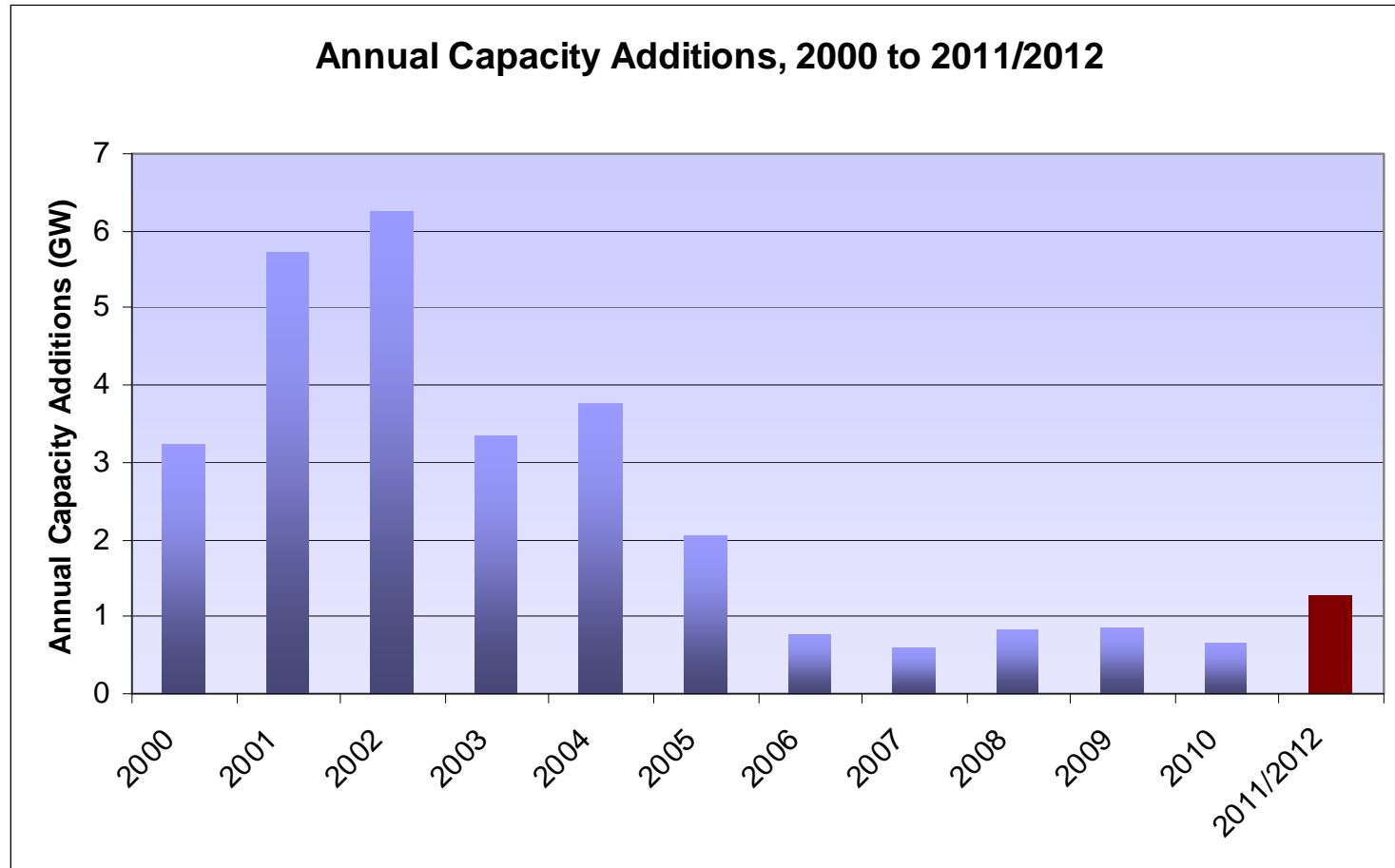
But the Number of New CHP System Additions Has Remained Steady



2010 data is incomplete

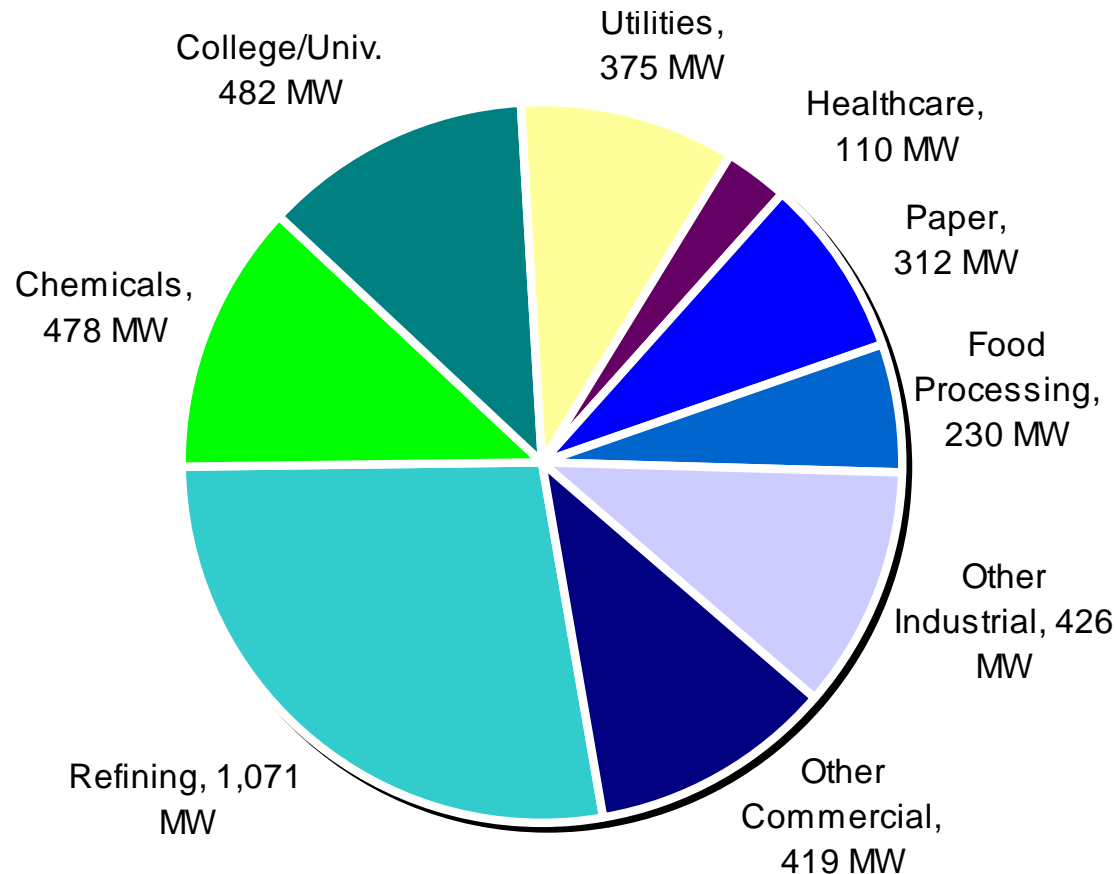
Source: CHP Installation Database – ORNL/DOE

About 1,300 MW of New CHP Capacity Is Currently in Construction or Engineering



Source: CHP Installation Database – ORNL/DOE

Capacity Additions by Application Since 2005



CHP Capacity Additions: 2005 - 2010

Source: CHP Installation Database – ORNL/DOE

Market Development - Current Conditions



- Most activity in states with favorable regulatory treatment and/or specific incentives
- Natural gas CHP in areas with supportable spark spread (Northeast, Texas, California)
- Biomass and opportunity fuels in Southeast, Midwest and Mountain
- “Hot” applications: universities, hospitals, waste water treatment, other institutional applications
- Growing interest in waste heat to power applications

California - Feed In Tariffs

- California enacted a CHP FIT for systems less than 20 MW and with excess power (AB 1613)
 - Must be sized to thermal load and > 62% efficiency
 - Price tied to natural gas and time of day and season (Market Price Referrent (MPR))
- FERC Rulings
 - CPUC's FIT not preempted by FERC as long as generators are QF's and the rate does not exceed the avoided cost
 - Approved multi-tiered rates (higher rates for higher efficiency)
 - Approved adders for transmission constraints and environmental externalities

California – QF Settlement

- Resolves open issues dealing with expiring Qualified Facilities (QFs) contracts
 - Over 2500 MW in QF Standard Offer Contracts ending
 - Six year dispute between QFs, IOUs and rate payer groups on how to proceed
- Shifts from avoided cost and determined pricing to competitive solicitations and market-based pricing
 - Establishes CHP Procurement Program with specific targeted for IOUs
 - 3,000 MW by 2015 (however, 2,300 MW of expiring QFs will be eligible to bid)

California – Self Generation Incentive Program



- Self-Generation Incentive Program – Capital cost subsidy to promote high efficiency and renewable generation
 - Initially included wind and renewable and fossil-fueled CHP
 - SB 412 re-instates fossil fuel-based CHP systems
- Staff report by CPUC with proposed guidelines released on Sept. 30th, 2010
 - Reinstates some combustion based systems but not all
 - Three key “guiding principles”:
 - Cost-effectiveness;
 - GHG reductions;
 - Financial need (<15% IRR)
 - Payment as “hybrid PBI”: 25% at commissioning and 15% per year for 5 years after that

California – SCIP – Eligible Technologies

- **Fuel Cells**
 - Fossil fueled, Electric only - Approved on a per product basis
 - Fossil fueled, CHP – Pre-approved
 - Renewable, Electric only or CHP – Pre-approved
- **Gas Turbines**
 - Fossil fueled, CHP - Pre-approved
 - Renewable, Electric only or CHP - Pre-approved
- **Microturbines**
 - Fossil fueled, CHP – No, except potentially on a per product basis
 - Renewable, Electric only or CHP - Approved on a per product basis
- **Internal Combustion Engines**
 - Fossil fueled, CHP - No
 - Renewable, Electric only, or CHP - Pre-approved
- **Waste Heat, Bottoming Cycle CHP - No**

Massachusetts

- MA Alternative Energy Portfolio Standard – CHP is eligible technology
 - Target of 250 MW by 2020
 - \$20/MWh equivalent (about \$175/kWh)
 - CHP credit includes electricity and thermal
 - Metered power output and useful thermal reported quarterly with independent verification
- Green Communities Act (2009) directs utilities to purchase all cost-effective efficiency and makes CHP eligible
 - ***CHP kWh's are credited to utility's EE goals***
 - \$750/kW rebate based on cost effective test (roughly need < \$3000/kW, > 5,000 annual hours, full thermal utilization)

New Jersey

- Clean Energy Program supported increased energy efficiency and installation of clean energy technologies
 - Called for 1,500 MW of CHP as part of state energy plan
 - Provided \$450/kW incentive (first \$70 million offering closed end of 2009)
 - Program suspended with new administration in 2010
- Reallocation of \$18 million of ARRA funding to support CHP Grant program in September 2010
 - Solicitation issued by NJ Economic Development Authority on September 7, 2010 for projects ‘shovel ready’ by September 2011
 - Solicitation closed early October, 25 applications received, 17 passed first stage review
 - \$18M fully subscribed

Arizona

- CHP included in new Electric Utility Energy Efficiency Resource Standards
 - Investor owned and rural electric cooperatives
 - Energy savings equal to 20% of retail sales by 2020
- CHP included in Gas Utility Energy Efficiency Rule and Standard
 - 6% savings by 2020
 - CHP capital cost incentive offered by Southwest Gas

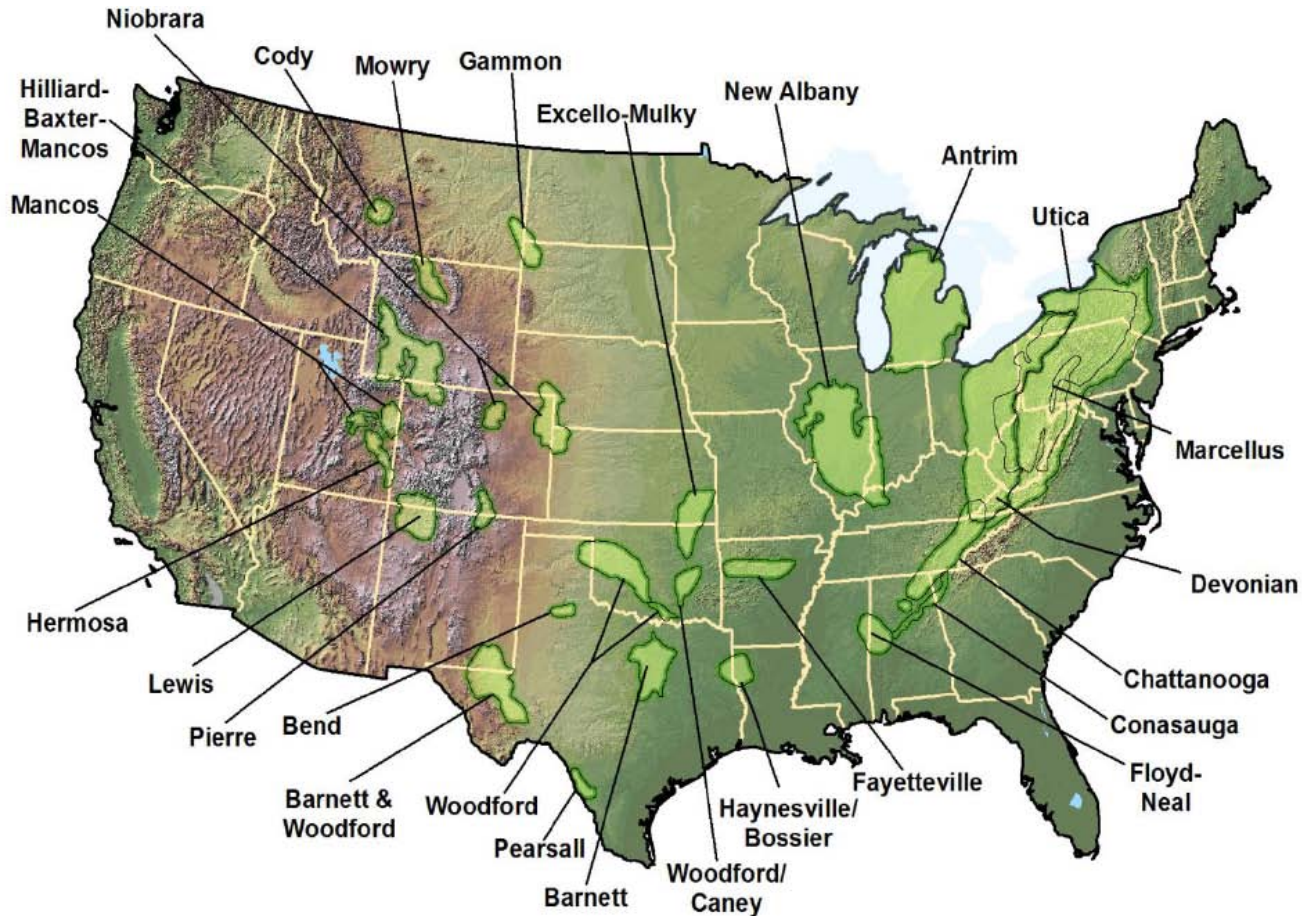
North Carolina

- CHP eligible for 35% renewable investment tax credit
 - HB 1819 signed by Governor Perdue on August 17, 2010
 - Credit of 35% of equipment, construction and installation
 - Up to \$2.5 million per project

Potential Game Changers

- Technology
- Climate Change Legislation/Regulation
- Outlook for natural gas

U.S. Shale Gas Resources



Revised Estimate of North American Natural Gas Resource Base



- Based on our most recent studies, we have significantly expanded our estimate of the North American Resource Base.
 - We have more than doubled the U.S. and Canada shale resource to 1,900 Tcf over the prior level of 825 Tcf.
- With 1,500 Tcf of gas in the supply curves at or below \$5.00 per MMBtu, the current U.S and Canada natural gas consumption level of 27 Tcf per year, could be met for another 55 years at attractive prices.
- The full potential of natural gas from unconventional formations (including shale) will subject to environmental concerns, land access restrictions, and drilling constraints.

Supply Growth is Concentrated Mostly in Areas with Growing Shale Production

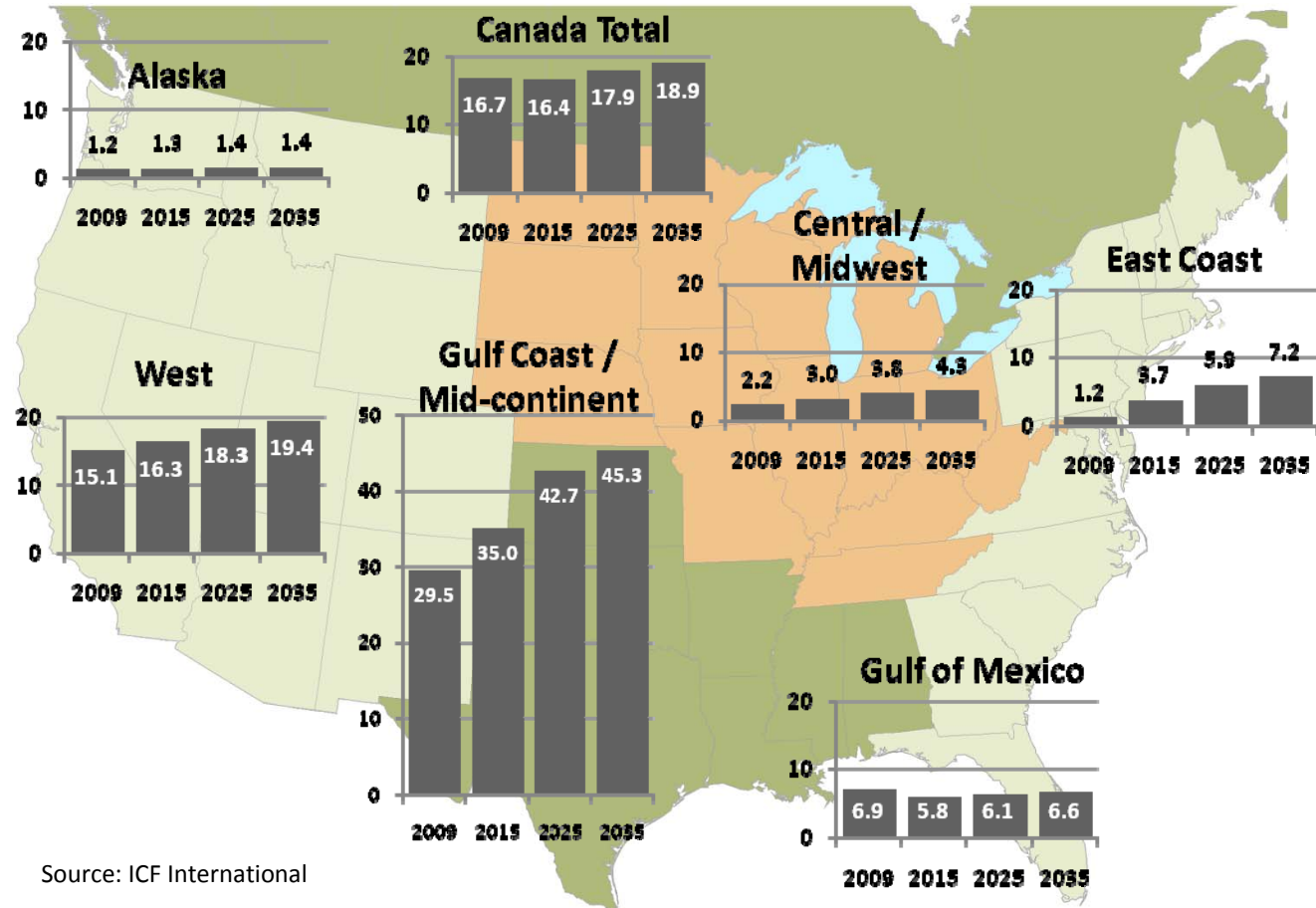
- Areas with the greatest growth in production are the Gulf Coast and Mid-continent and the East Coast (Marcellus Shale).

– These areas have high concentrations of shale gas resource.

- Canadian production will rebound as conventional production declines, but shale gas in British Columbia increases.

- Gulf of Mexico production declines as increases in Deep Water plays offset declines in Shallow Water production.

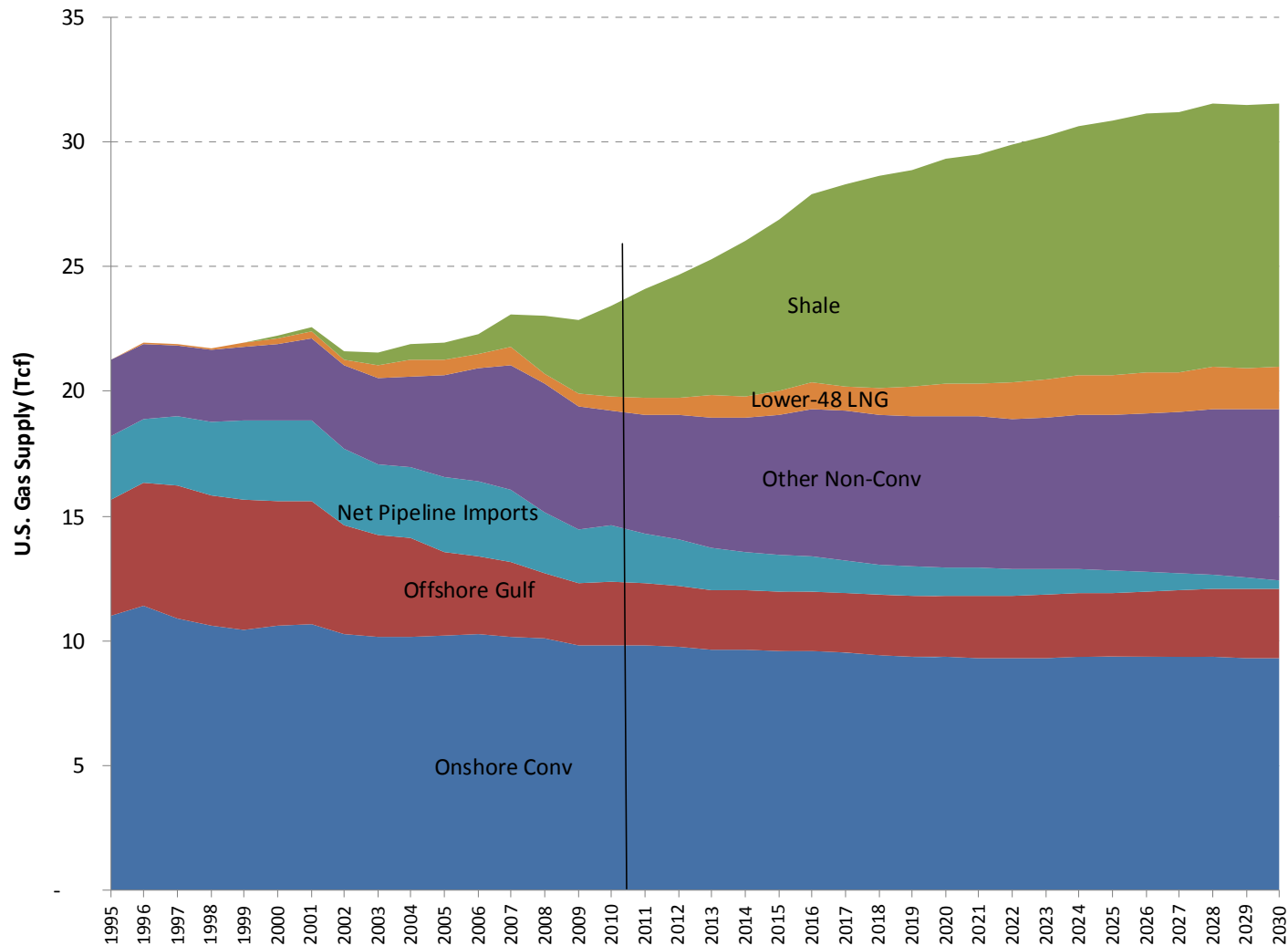
U.S. and Canada Regional Natural Gas Production (Average Annual Bcfd)



Source: ICF International

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U.S. Natural Gas Supply



Henry Hub Gas Prices Will Average Between \$5 and \$7 per MMBtu

- Henry Hub natural gas prices are projected to average between \$5.00 and \$7.00 per MMBtu.
- Robust growth in gas demand applies upward pressure on gas prices over time.
- \$5.00 to \$7.00 gas prices are sufficient to support the levels of supply growth in the projection, but not so high as to discourage market growth.

Average Annual Natural Gas Prices at Henry Hub (2008\$/MMBtu)



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CHP Is a Cost-Effective Source of Electricity

Cost of Delivered Electricity - Texas

