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MEMBER
FORUM
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ENERGY IN MOTION

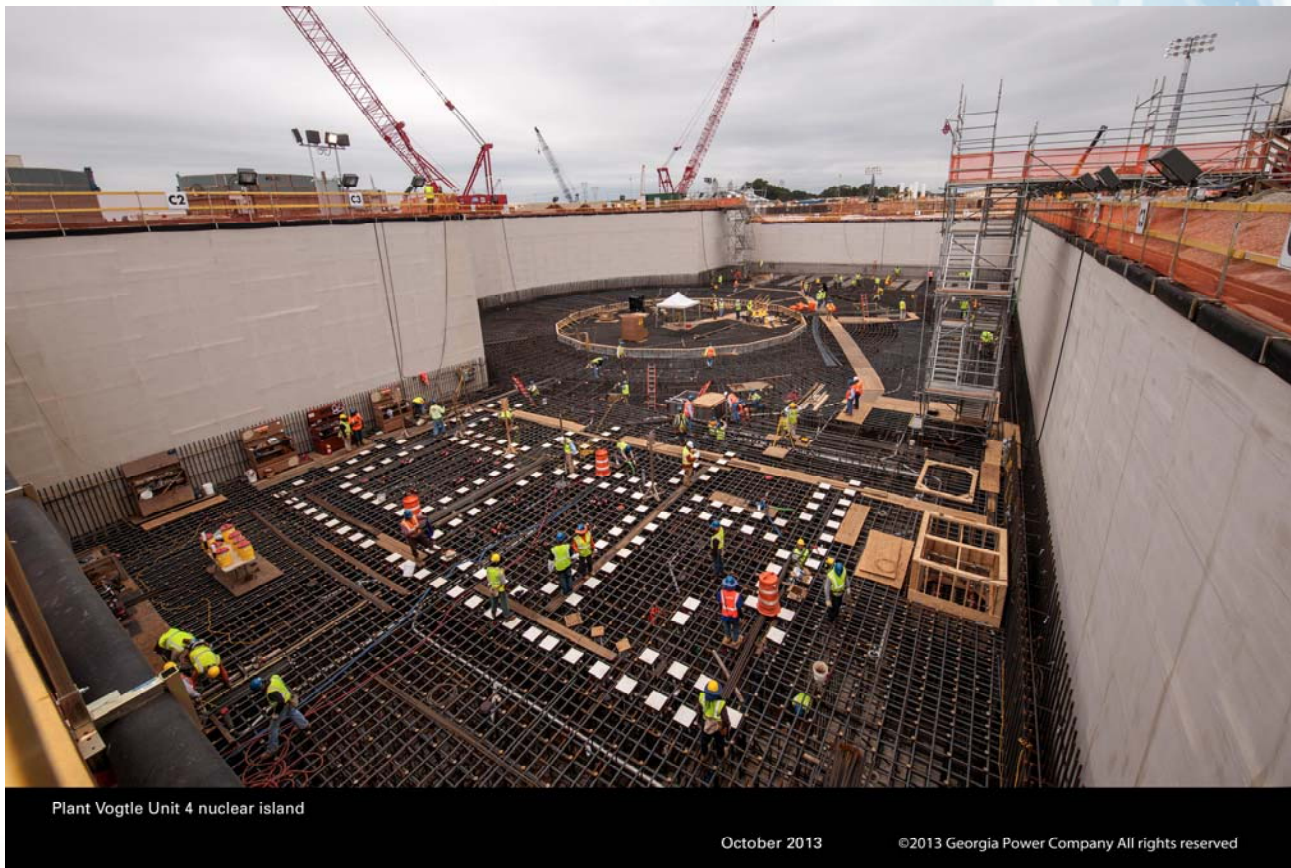
Dale Atkinson

The Future of Nuclear / Small Modular Reactors

Current Status of New Nuclear Power

- **4 new reactors being built:**
 - Vogtle 3 & 4 (Georgia)
 - Summer 2 & 3 (South Carolina)
- **All above are AP1000 design.**
- **Watts Bar 2 to be completed (Construction was halted in 1988):**
 - Target date: December 2015
- **173 new reactors are planned for construction by 2030 internationally.**
- **70 are presently under construction (30 in China alone).**

Vogtle 3 Nuclear Island – October 2013 Startup 2017 – 1117 MWe



New Nuclear Power Plant Considerations

- **Capital Expense - \$2.5B (12 module SMR, 540MWe) to \$7B per unit (1117MWe AP1000).**
- **Time to first positive cash flow:**
 - Time to construct overall
 - Time to construct to first generation
- **Licensing:**
 - New designs require NRC certification - \$800M-\$1B
- **Cost competitiveness:**
 - Natural gas prices/renewables production tax credits
- **Carbon Free.**
- **Base Load – Some Load Following/Response Capability.**
- **Public Acceptance.**

Small Modular Reactor Advantages

- **Less capital - \$2.5B for 540MWe.**
- **Simpler construction.**
- **Simpler operation and maintenance.**
- **Passive safety features.**
- **Scalable – Modules can be built as needed.**
- **First module generates electricity (and income) prior to all modules being complete.**
- **Reasonable response to generation needs (some load following).**
- **Small emergency planning zones – if allowed.**

Energy Northwest SMR Interest Group

- **Made up of public and private entities.**
- **Purpose to stay aware of SMR technology, costs, benefits.**
- **Determine when and if appropriate to include new SMR construction in the energy portfolio.**
- **Status:**
 - Selected NuScale as the SMR of choice if we were to build today
 - Tracking SMR development for potential inclusion in integrated resource plans

DOE Funding Opportunity for SMRs

- **2012 -DOE announced \$452M in funding for SMR development.**
- **Round one: \$150M award to Babcock & Wilcox - mPower:**
 - TVA Clinch River
- **NuScale has applied for funding in the second round:**
 - Idaho National Lab site
- **The second round of applications is overdue for a decision.**

Energy Northwest and NuScale

- **NuScale's application :**
 - Idaho National Lab site
 - Energy Northwest signed on to potentially provide operating and maintenance
- **The DOE funding, if granted will help complete NRC design certification for the NuScale SMR.**
- **Actual first construction will depend on the owner and/or power purchase agreements.**
- **Energy Northwest continues to evaluate the former WNP-1 and WNP-4 sites for new construction.**

SMR Analysis

- **Determine a set of conditions where Small Modular Reactors are cost competitive when compared to a natural gas combined cycle (NGCC) power plant.**

NGCC Key Assumptions

- **30-year Natural Gas Price Forecast is Accurate.**
- **Capital: 100% Debt Financed at 5% Interest.**
- **Plant Capacity Factor: 96%.**
- **Initial Greenhouse Gas Costs: \$15/ton.**
- **O&M and GHG Cost Escalation: 3%.**
- **Project Life: 30 years.**

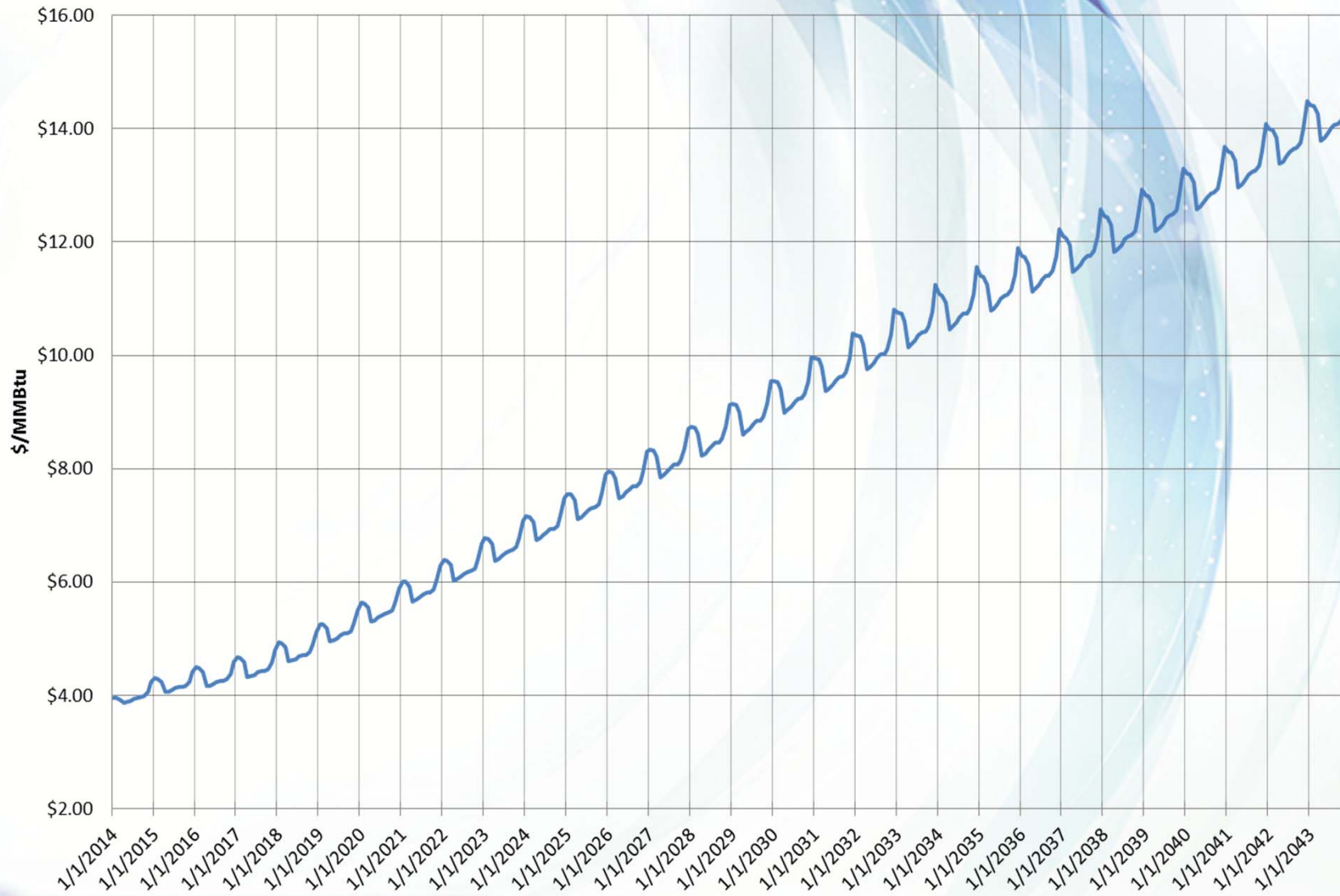
Henry Hub Gas Prices 1993-2013



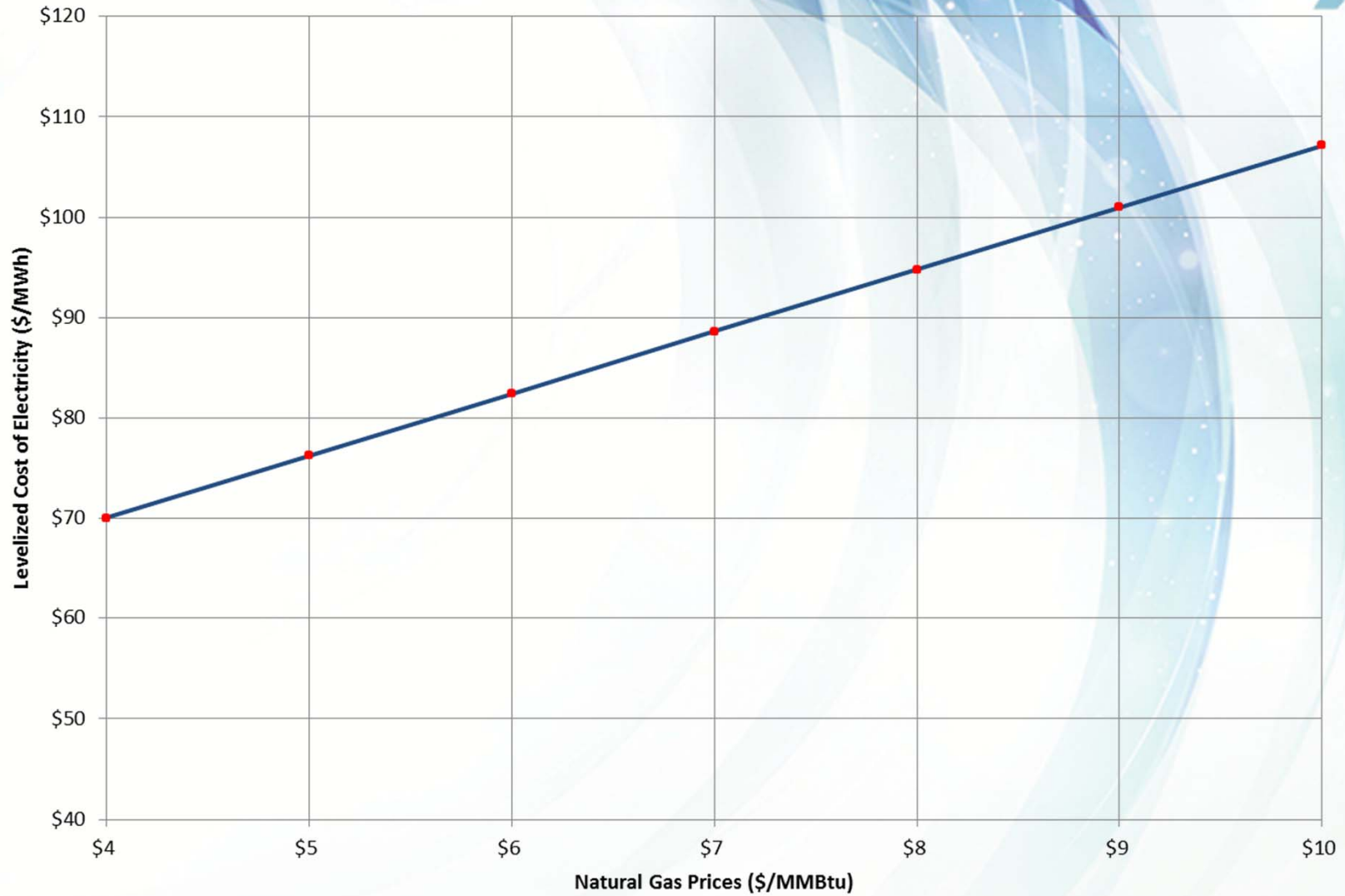
Oct 14, 2013, Reuters Reports:

- **"Today the Henry Hub prices are in one of the low price cycles and below replacement cost," Richard Guerrant, ExxonMobil's global vice president for LNG, told the World Energy Congress in South Korea.**
- **ConocoPhillips executive vice president Don Walette, speaking at the same panel discussion, said: "I think there is a misperception out there that with Henry Hub sales from \$3.50 we can land LNG in Asia for \$11, \$12 (per million British thermal units)."**
- **"Over time the arbitrage is going to be consumed ... and you can expect a convergence of prices."**

Henry Hub Natural Gas Price Forecast



LCOE vs NG Prices



Results

- **SMRs should be considered for resource plans ~10 years prior to forecasted gas price exceeding \$6.5/MMBtu assuming:**
 - \$15/ton CO2 fee
 - \$85/MWh SMR levelized cost
- **Current estimates indicate that SMRs should be considered in resource plans after 2014.**