



# Coal Baseload Asset Aging, Evaluating Impacts on Capacity Factors

**Workshop on Coal Fleet Aging and Performance,  
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Washington D.C.**

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U.S. DEPARTMENT OF

**ENERGY**

National Energy  
Technology Laboratory

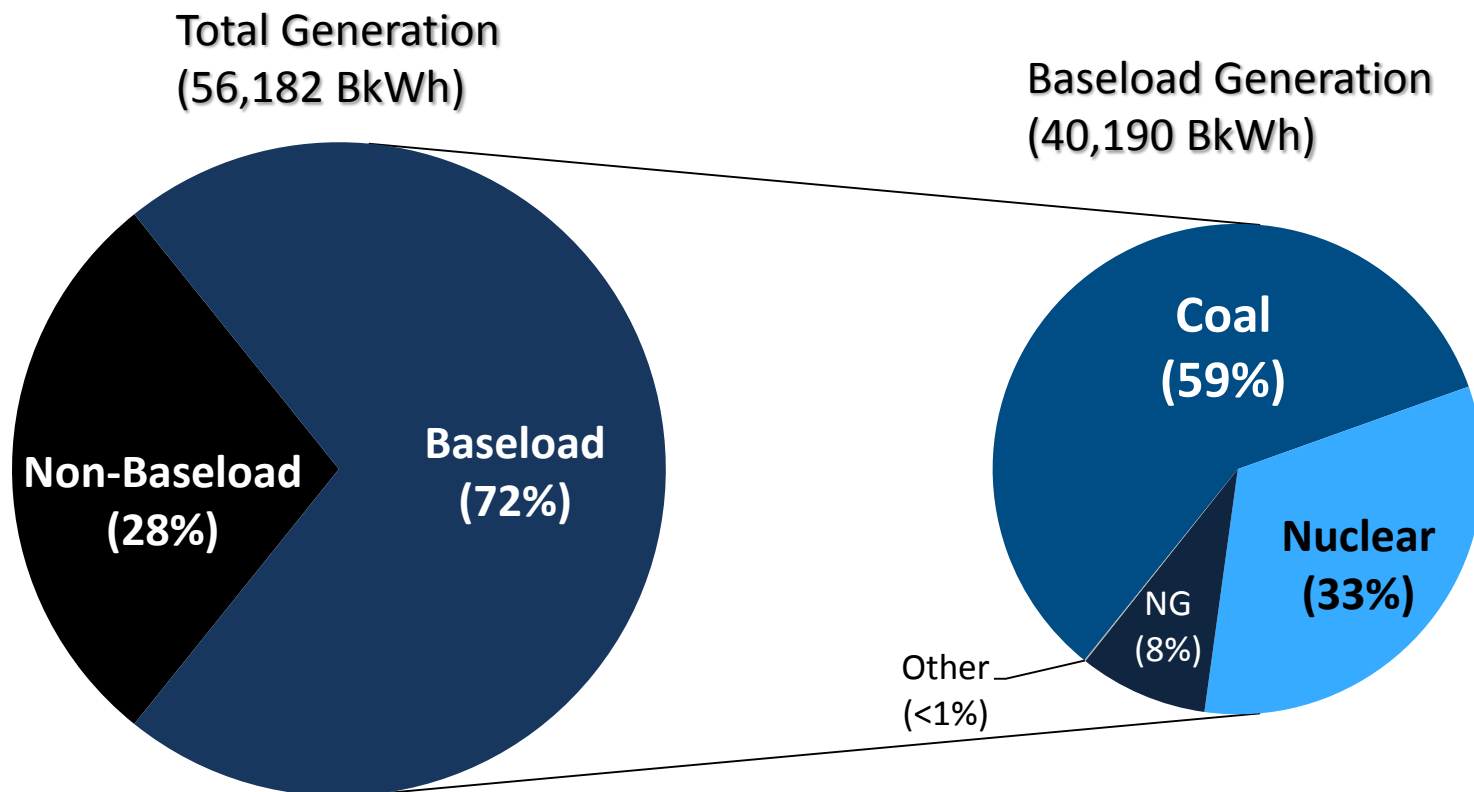
**AEO'13 - Issues in Focus** (page 42)  
*(Coal Capacity Factor Assumption)*

**Generation by fuel**

***“As natural gas prices increase in the AEO2013 Reference case, the utilization rate of coal-fired generators returns to previous historical levels and continues to rise, to an average of around 74 percent in 2025 and 78 percent in 2040.”***

# Baseload Generation (1998-2014)

A Dominant Factor in Power Generation... Critical to the Economy



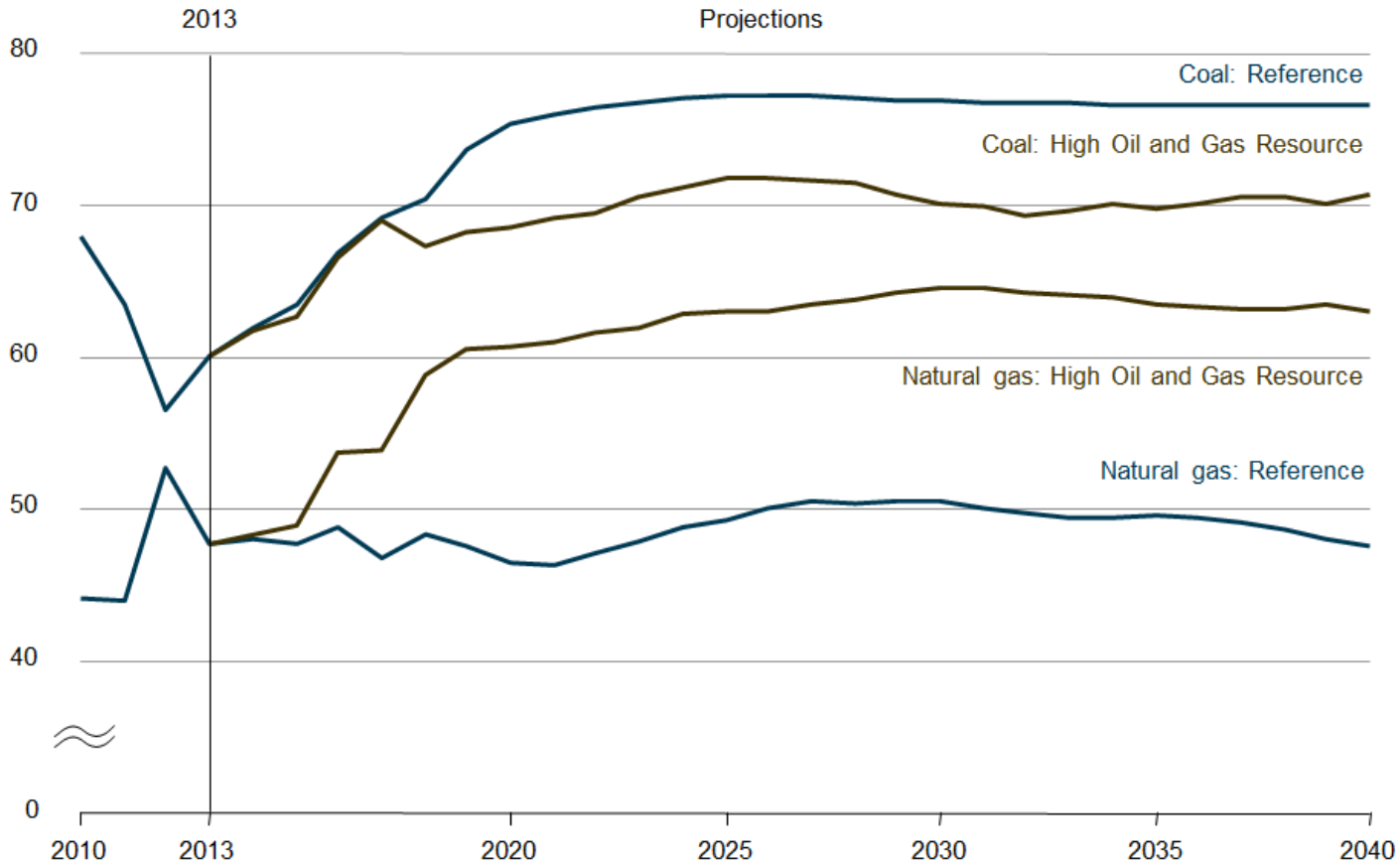
From 1998-2014, coal and nuclear generation accounted for **91%** of baseload generation

Source: Ventyx, Velocity Suite; Baseload is assumed to be generation with  $\geq 65\%$  capacity factor

# Annual Energy Outlook 2015 Capacity Factors

Figure 33. Coal and natural gas combined-cycle generation capacity factors in two cases, 2010-40

percent



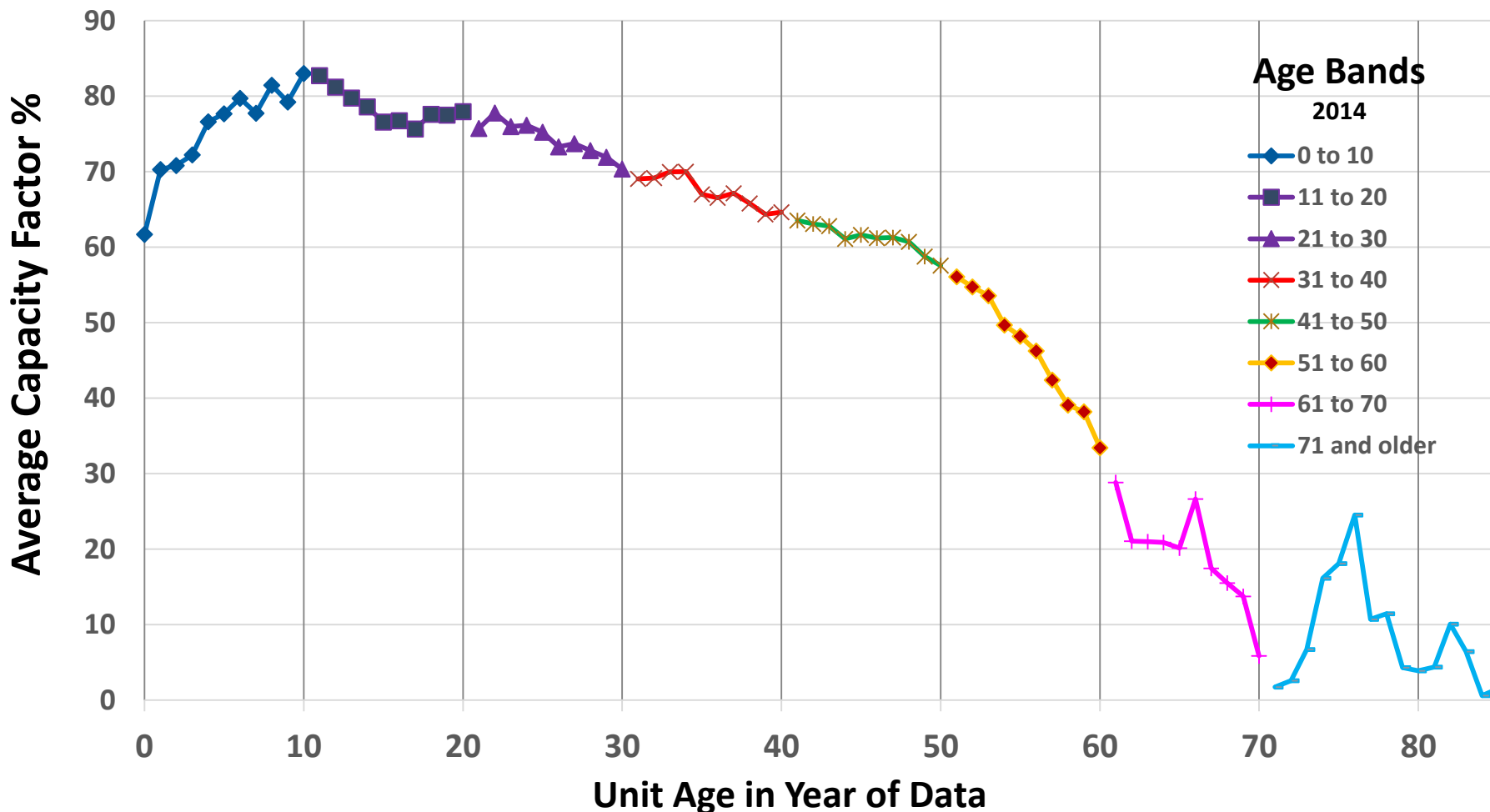
**AEO'15  
Reference  
case Coal  
c.f. at 75%**

Source: AEO'15 page 25, based on a November 2014 NEMS run



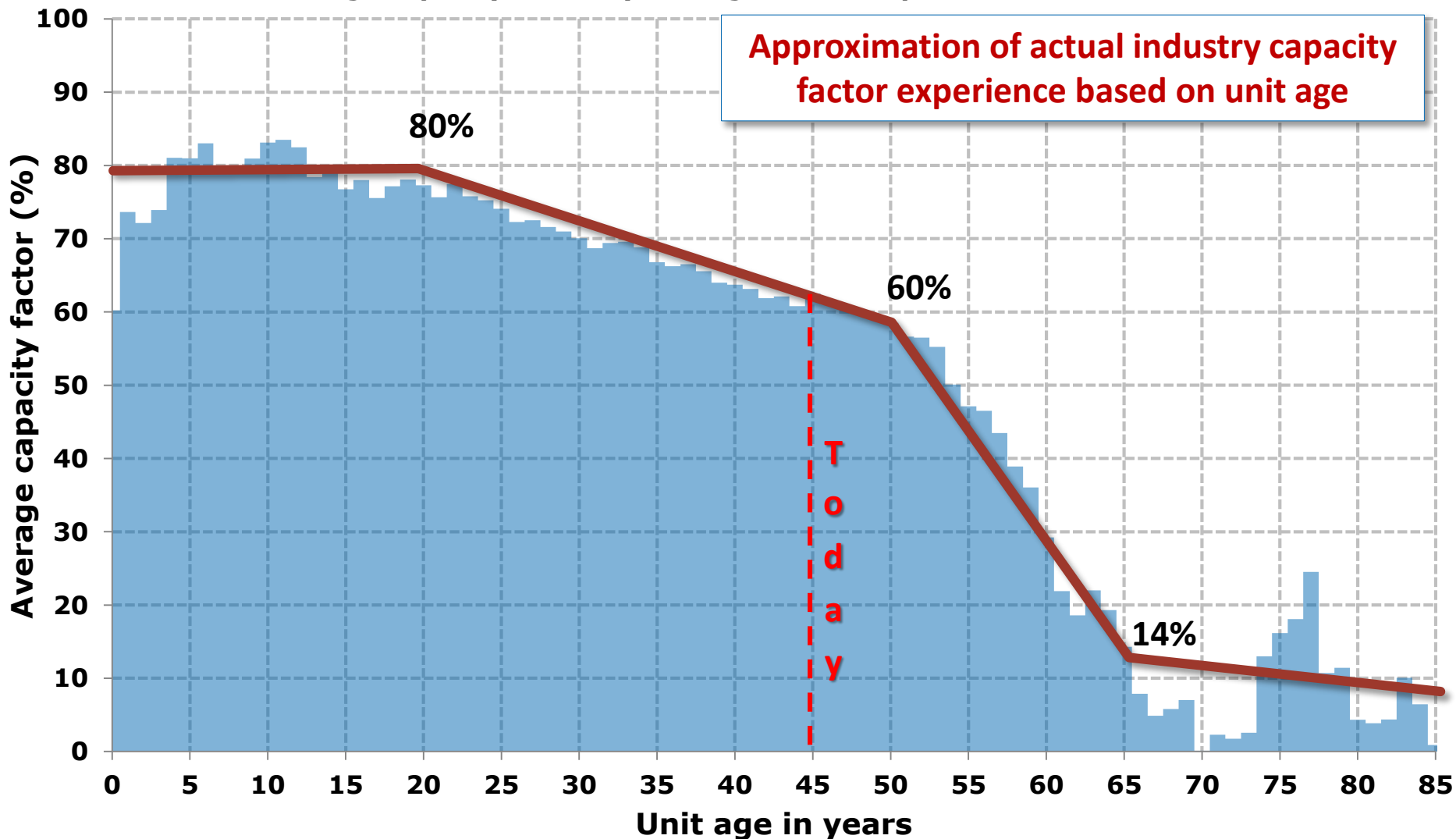
# Coal Units Capacity Factors in Age Bands

(1998-2014 Based on Age of Unit in Year of Data)

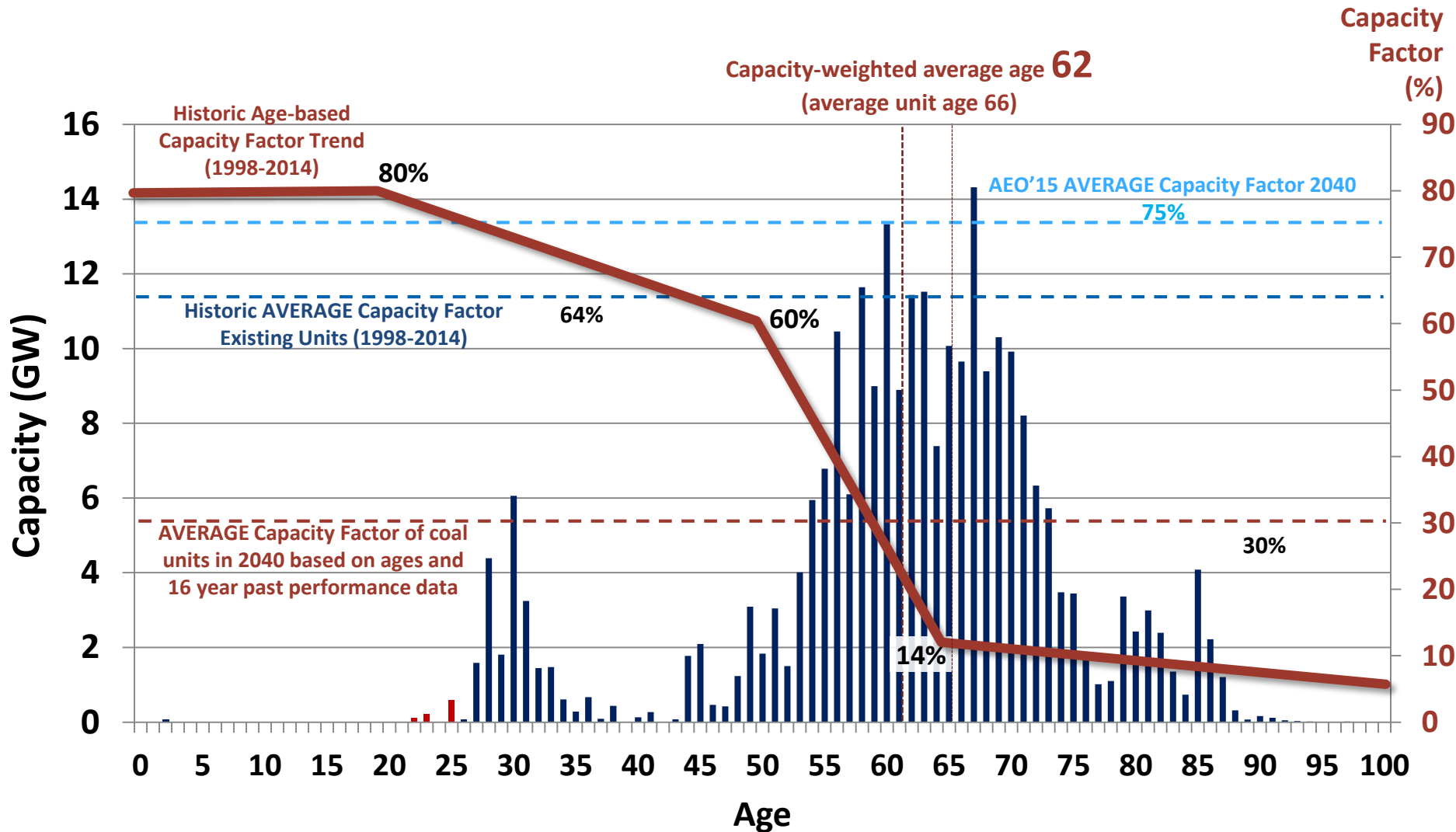


# Coal unit capacity factors drop off as they age

Average capacity factor by unit age for coal operations, 1998-2014



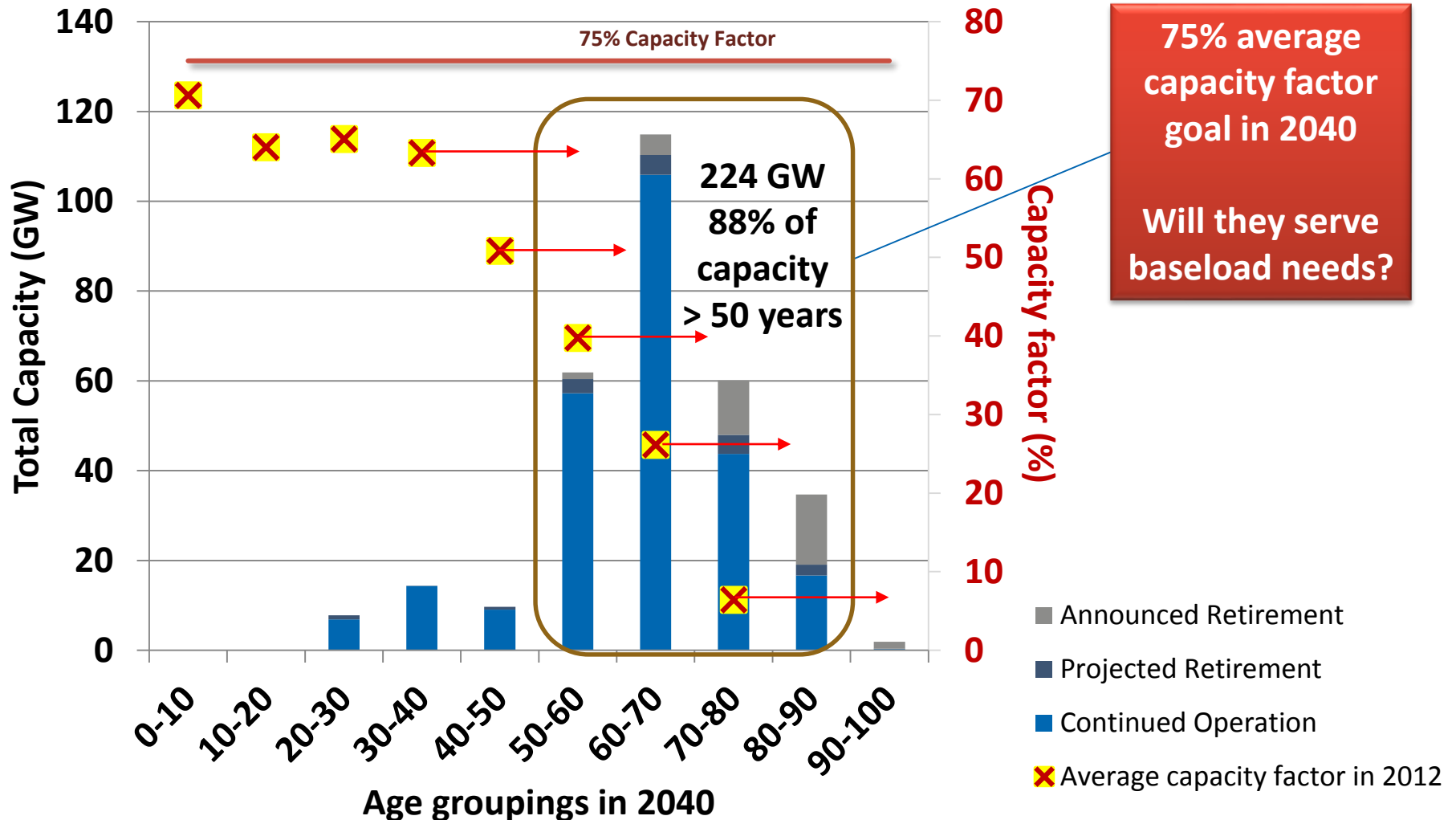
# Coal Capacity and Unit Ages in 2040



**Overestimation of coal unit capacity factors can result in reliability issues and underestimation of replacement baseload capacity need**

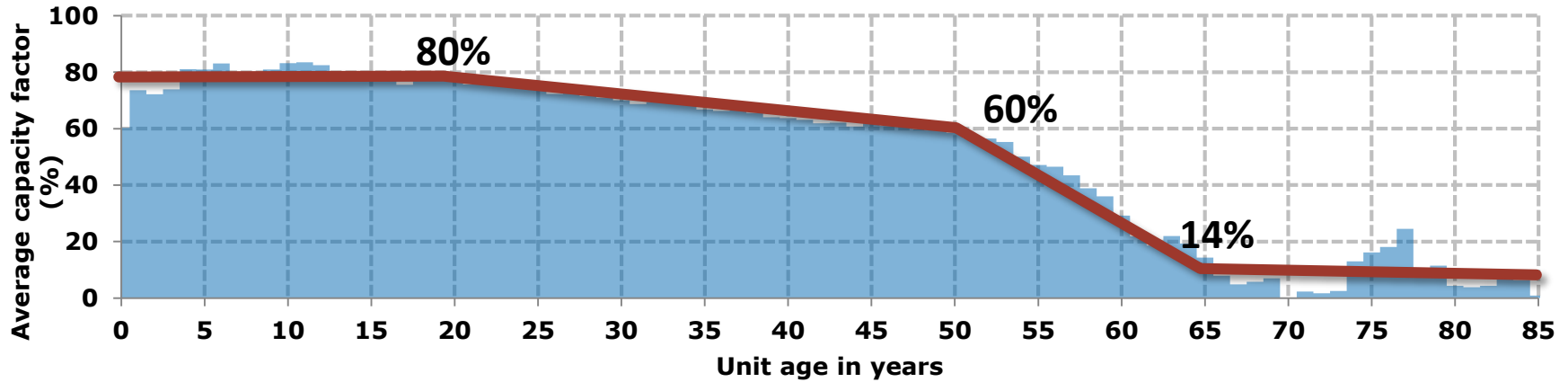
# Age Distribution of Existing Coal Units by 2040

## (AEO 2015 Reference Case)

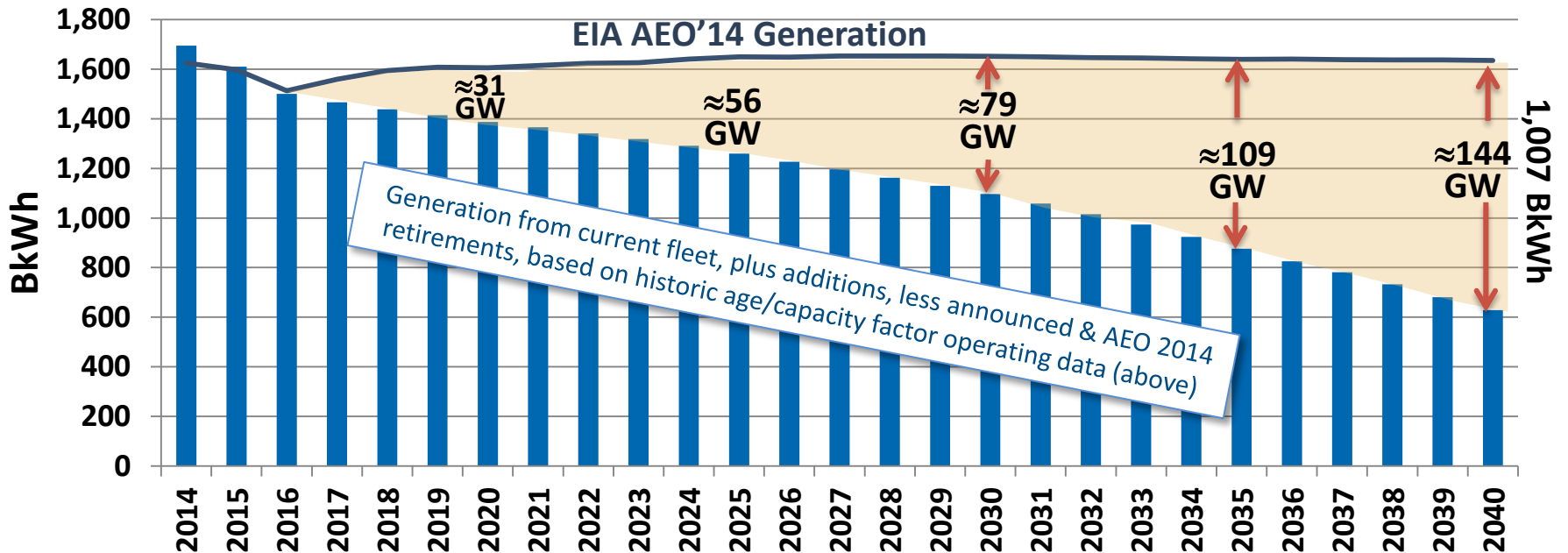




Average capacity factor by unit age for coal operations, 1998-2014



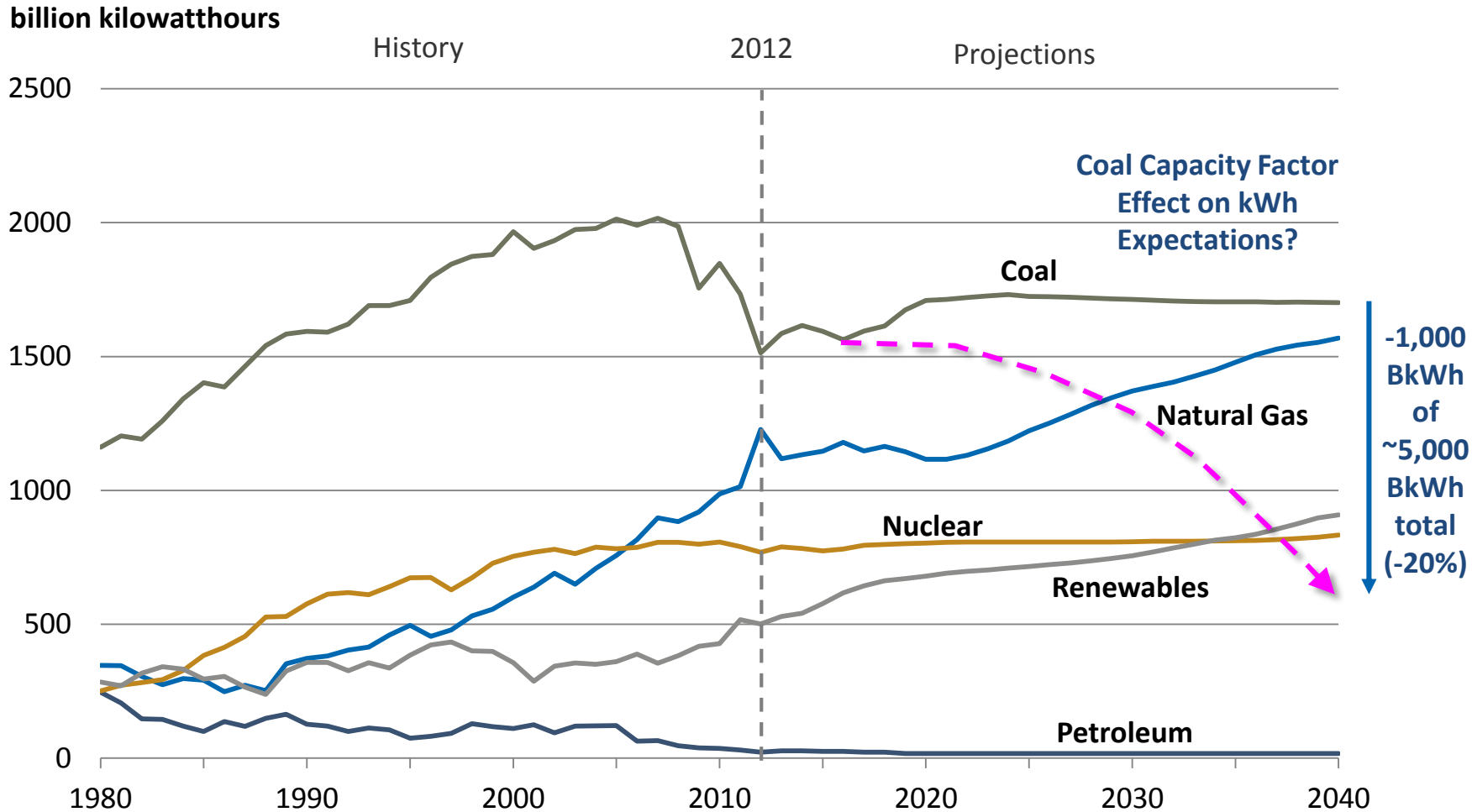
## Potential Baseload Coal GW Equivalence Needed



Missing generation estimate 144 GW @80% average C.F. for new units to meet 2040 demand



# Electricity Generation by Fuel, 1980-2040

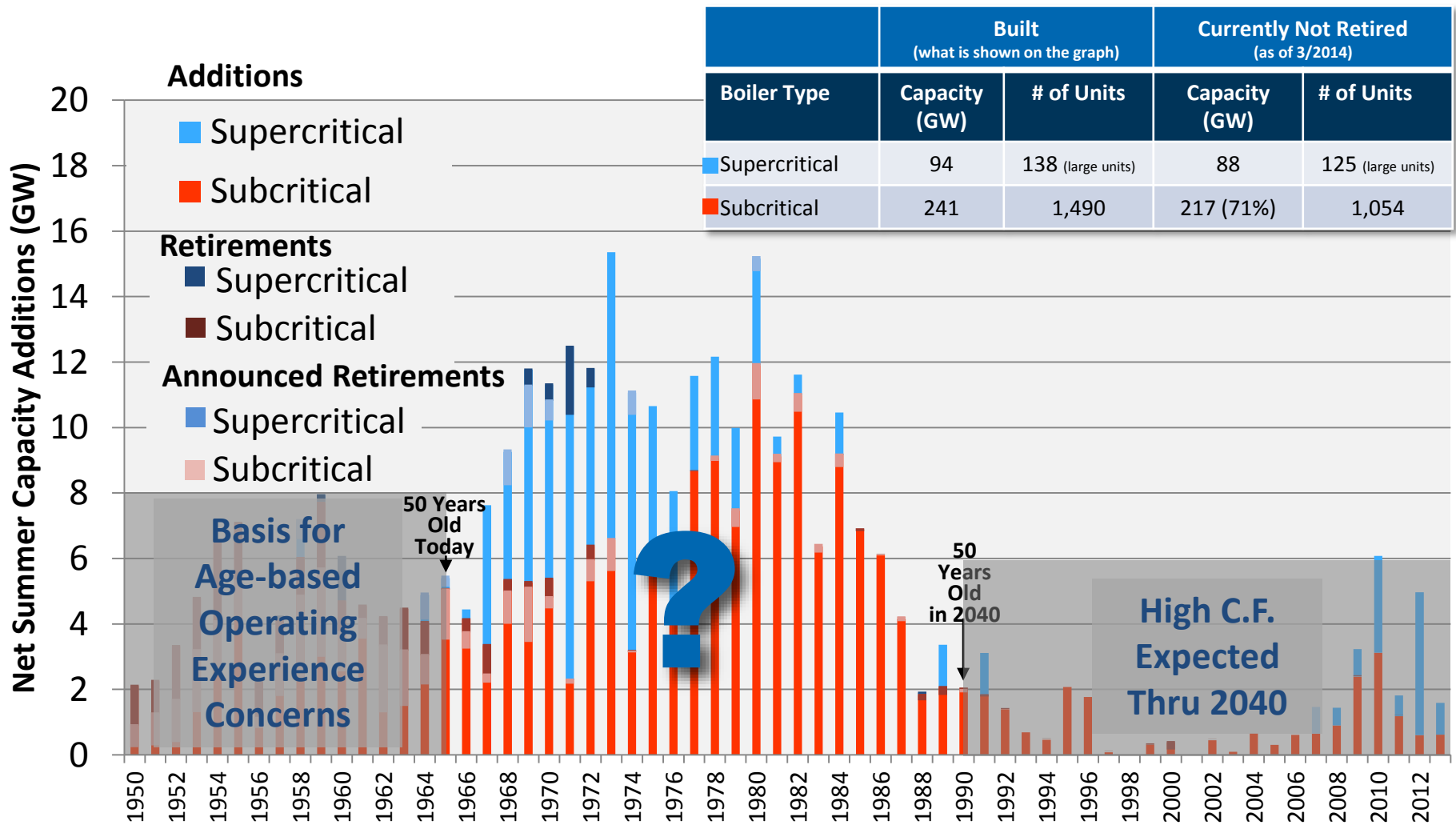


**Note:** Includes generation from plants in both the electric power and end-use sectors.  
**Source:** History: U.S. Energy Information Administration (EIA), Annual Energy Review;  
 Projections: AEO 2015 Reference case

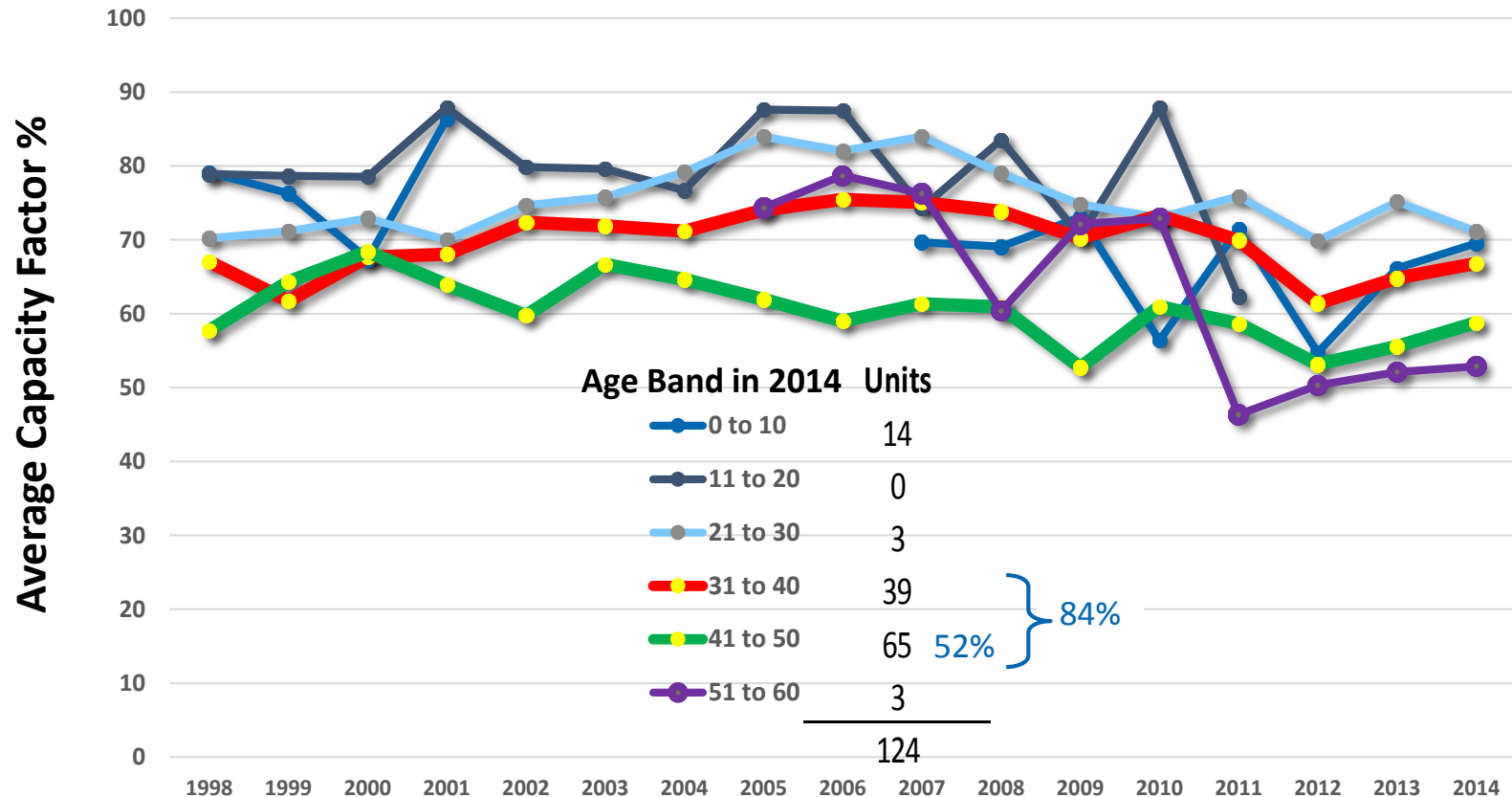
# Historic Coal-Fired Capacity Additions

## Segmented by Subcritical and Supercritical (1950-2013)

*Will the Units of the '70s and '80s Age, Maintain and Operate Like those of the '50s and '60s?*

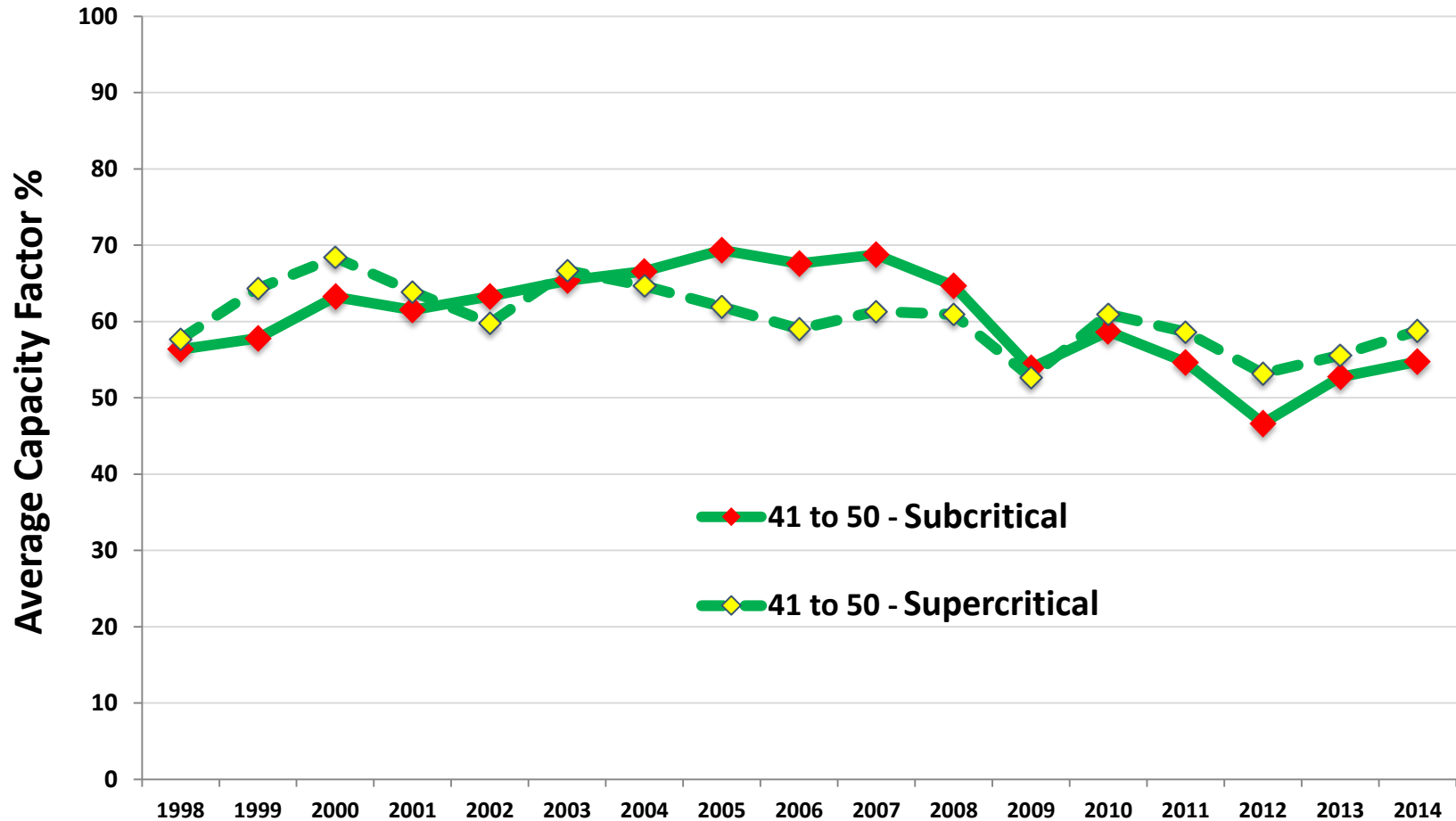


# Supercritical Unit Capacity Factors (by 10-year Age Band)



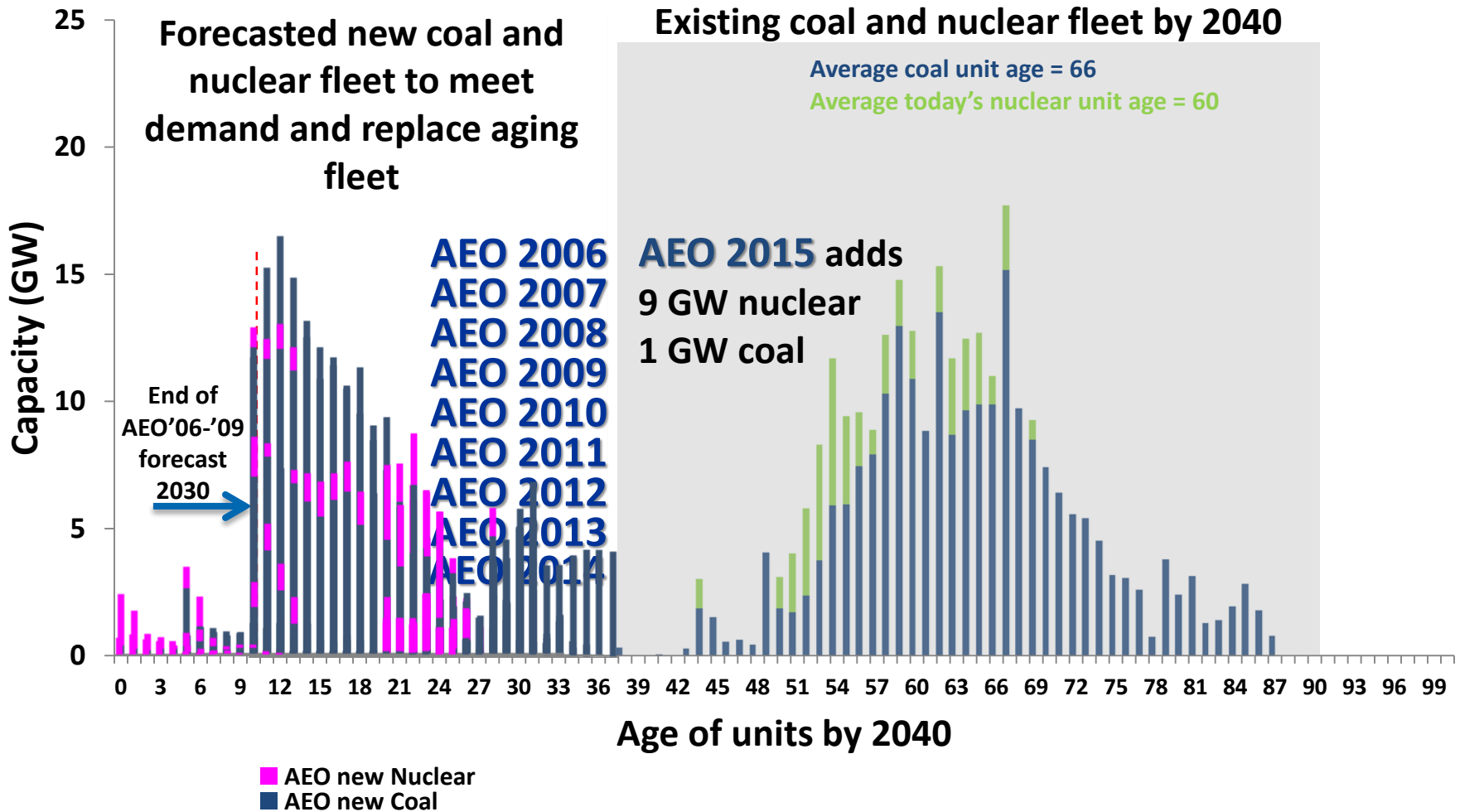
*Few supercritical units have surpassed 50 years old;  
majority of units are beyond 40 years, with average age 62 in 2040*

# Supercritical vs Subcritical Capacity Factors (41-50 Age Band)



*No significant capacity factor advantage for supercritical units that have passed beyond 41 years of age (52% of all supercritical units)*

# Coal & Nuclear Baseload Capacity Renewal (by 2040)



# Constraints of the NSR Regulation

## Affects Ability to Perform Major Maintenance



Monday, February 10, 2014 1:53 PM ET  Exclusive

### EPA plans to tackle permitting pitfalls in climate rule, but industry wonders how

- *The U.S. EPA says it will seek to ease permitting obligations that are expected to crop up for power plants required to make retrofits to meet the agency's climate rule for existing facilities*, a top official with the agency said Feb. 9 at a conference in Washington, D.C.
- *At issue is the EPA's new source review program, which requires power plants to obtain permits prior to making modifications, such as boiler heat rate improvements to meet the climate rule.* Industry groups say that it is an unduly onerous and "very complicated process" that causes "significant delays."
- *The EPA is "certainly comfortable acknowledging that we will need to address NSR [new source review]"*
- *EPA faces an uphill battle, recalling that in a past case a federal appeals court ruled that an attempt to make changes to the new source review program was not in the agency's "statutory purview."*

*Result: "The state could also develop conditions for a source expected to trigger NSR that would limit the unit's ability to move up in the dispatch enough to result in a significant net emissions increase that would trigger NSR."*

*Per June 18, 2014 Federal Register for ESPS*



# Conclusions

- **Past coal plant operating performance reflects declining capacity factors after age 50; uncertainties for meeting generation forecast by assuming high coal capacity factors**
- **Anticipation that supercritical coal plants will perform distinctly better with age, not supported by early evidence**
- **Industry practice, under positive economic conditions, is to replace the baseload asset base before reaching age 60**
- **A significant portion of the generation forecast relies on infrastructure performing well at unprecedented average age**
- **NSR recognized as a limiting regulatory issue for coal-plant major maintenance; resolvable by reducing capacity factor**
- **QER emphasized concern for aging U.S. energy asset base**