

Characteristics of the WorldWide Coal Fleet: Implications for CCS Retrofit RD&D

The NorthBridge Group

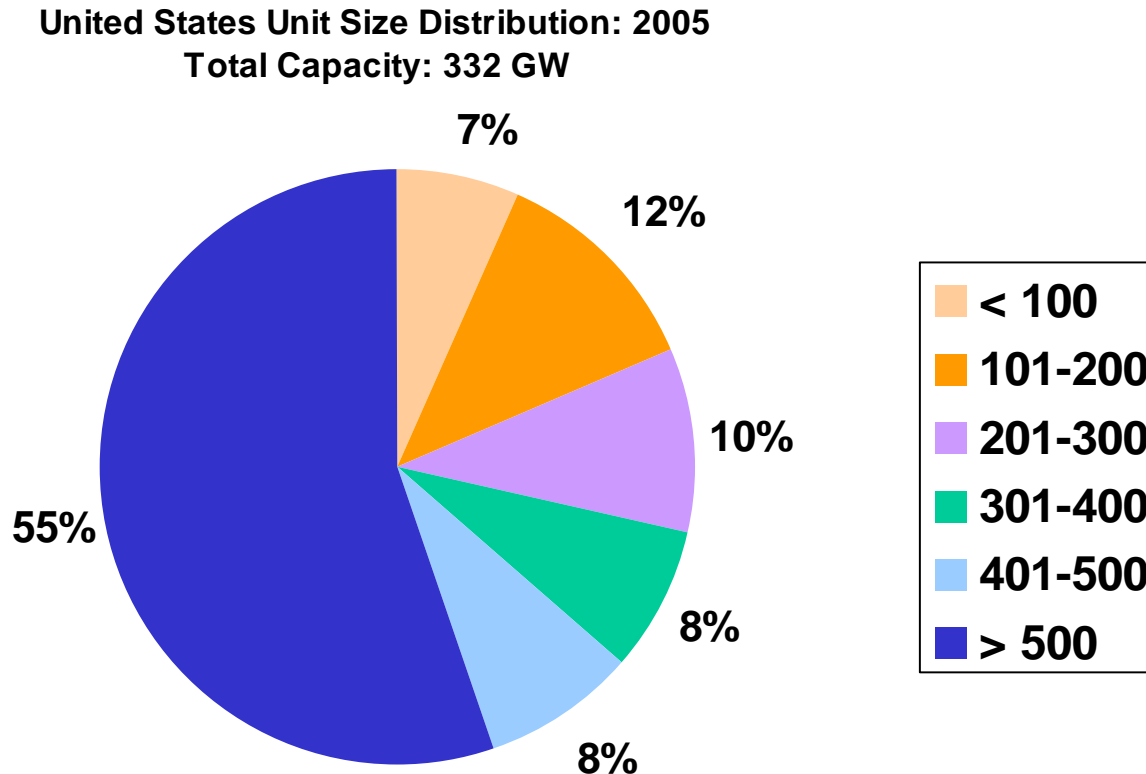
**MIT Symposium on CCS Retrofit Technology
Cambridge, MA**

March 23, 2009

EXISTING US COAL FLEET

By Unit Size

The US coal fleet currently exceeds 300,000 MW. Units greater than 300 MW in size account for about 71% of total capacity.

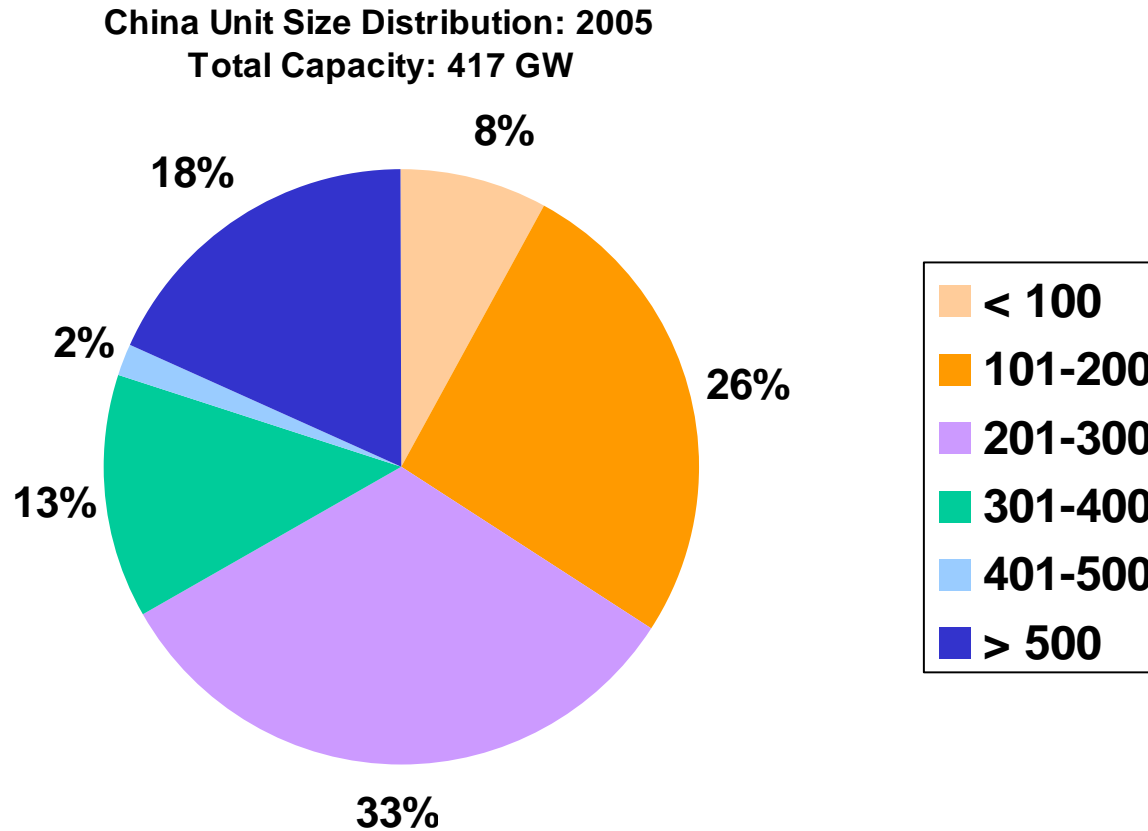


Sources: (1) IEA, *World Energy Outlook 2008*, and (2) Energy Velocity.

EXISTING CHINESE COAL FLEET

By Unit Size

The Chinese coal fleet exceeds 400,000 MW and is already larger than the US fleet. However, the average unit size is much smaller than in the U.S.

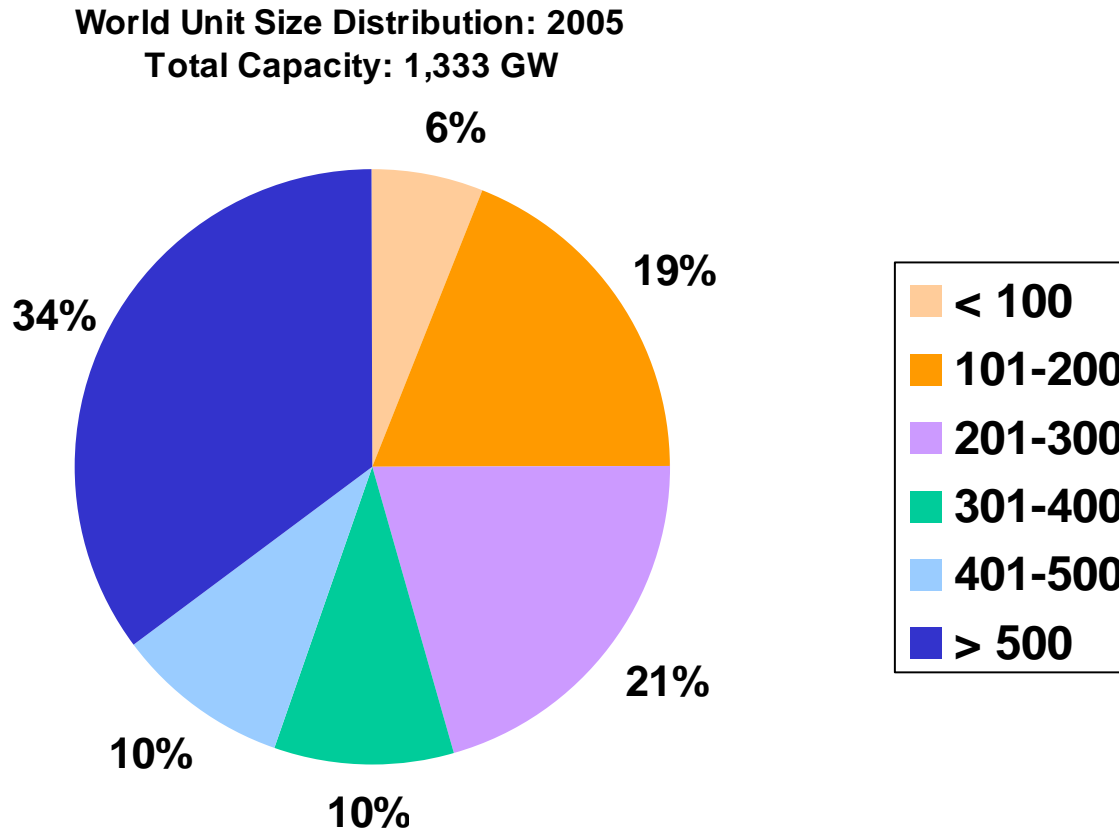


Sources: (1) IEA, *World Energy Outlook 2008*, and (2) Bhattacharya, *IEA Coal-Fired Generation*.

EXISTING WORLD COAL FLEET

By Unit Size

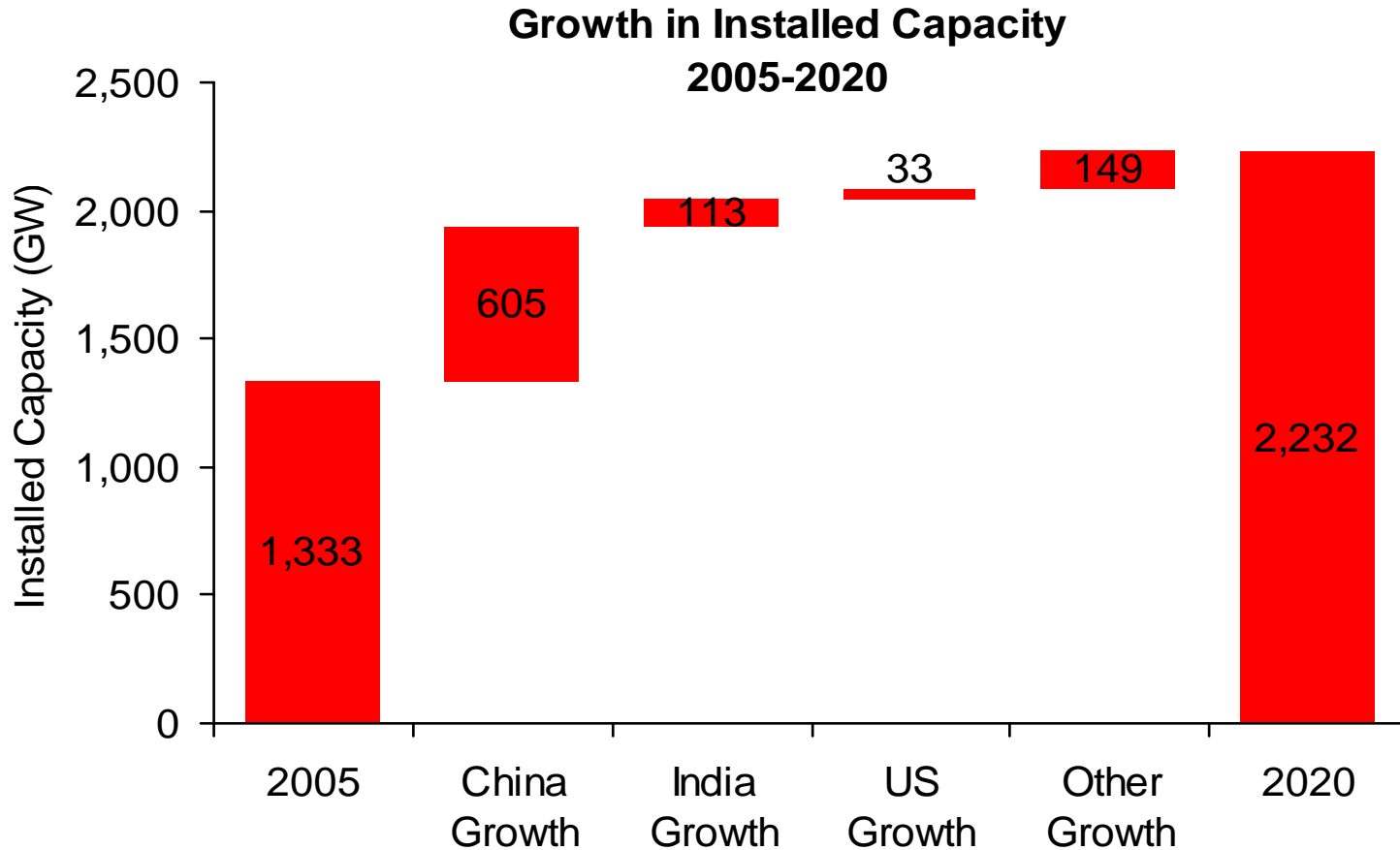
The U.S. and China account for over half of worldwide capacity, which exceeds 1.3 million MW. The world average unit size is between that of the U.S. and China.



Sources: (1) IEA, *World Energy Outlook 2008*, and (2) Bhattacharya, *IEA Work on Cleaner Fossil Fuels*.

PROJECTED GROWTH

The worldwide installed base is expected to grow by 67% between 2005 and 2020 to over 2 million MWs. 80% of that growth comes from China and India. China alone accounts for over two-thirds of growth.

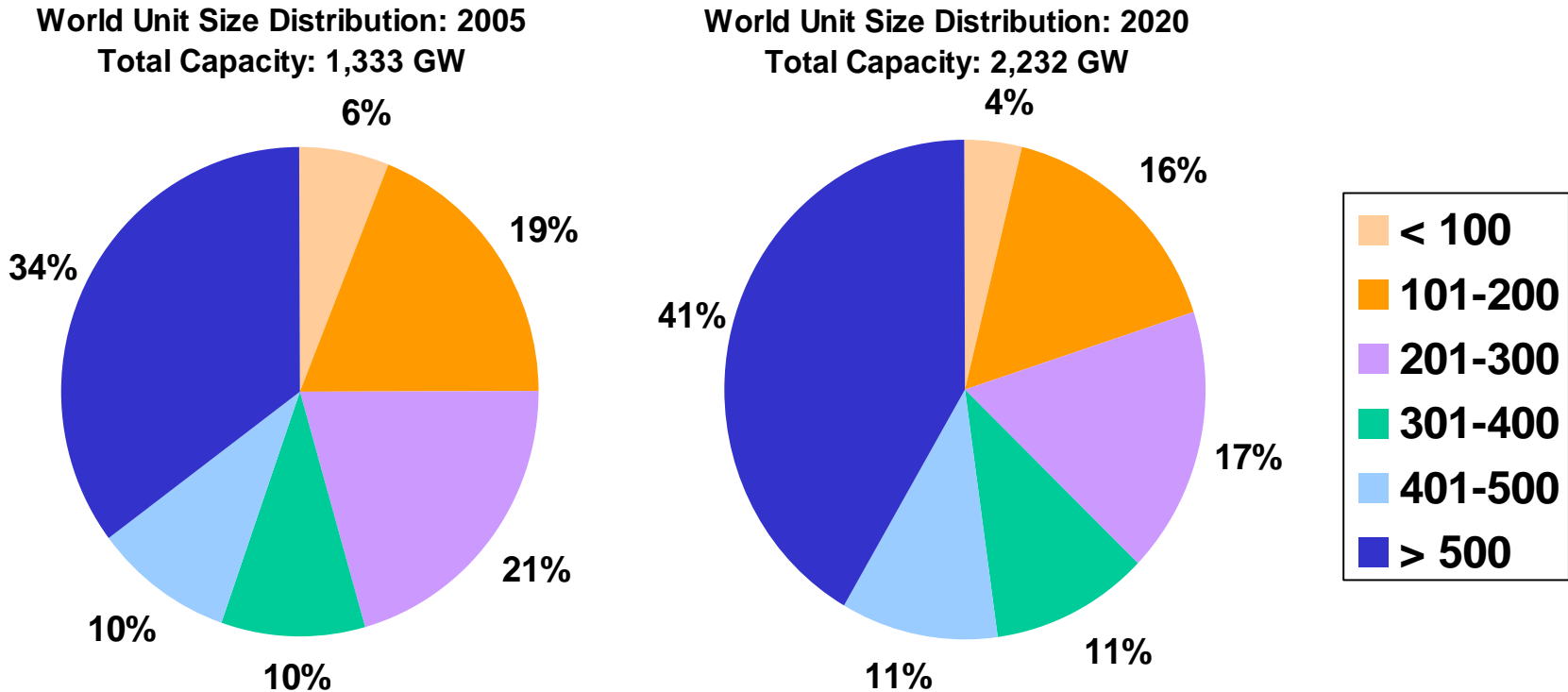


Source: IEA, *World Energy Outlook 2008*.

WORLD IN 2005 VS. WORLD IN 2020

By Unit Size

The unit size of additions is larger, on average, than the existing fleet average. As a result, the world average unit size in 2020 is greater than in 2005.



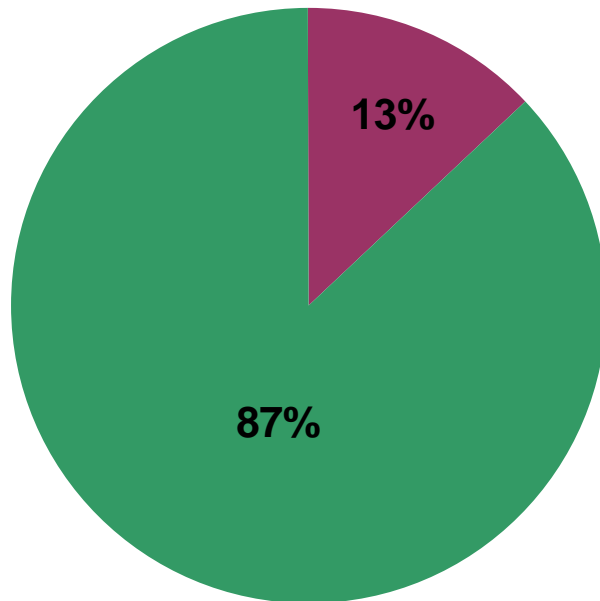
Sources: (1) IEA, *World Energy Outlook 2008*, (2) Bhattacharya, *IEA Work on Cleaner Fossil Fuels*, and (3) NorthBridge Analysis.

WORLD IN 2005 VS. WORLD IN 2020

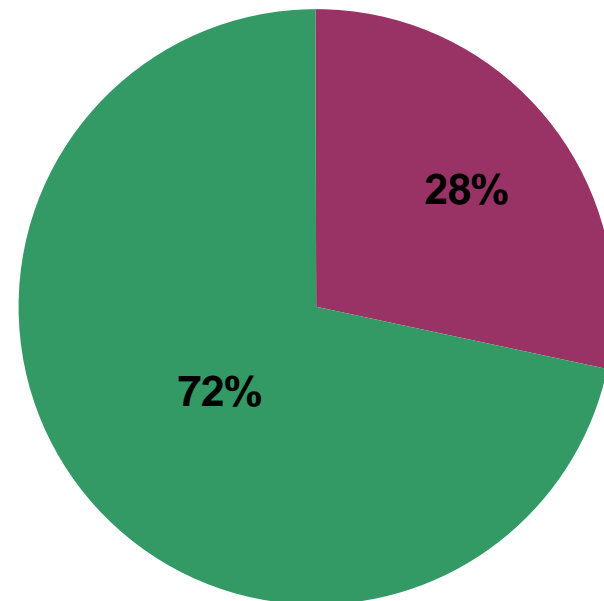
By Steam Condition

Today, only about 13% of capacity is supercritical. Supercritical additions are expected to account for about 50% of new capacity – bringing total supercritical capacity to about 28% in 2020. But subcritical capacity will continue to comprise the majority of the fleet.

World Capacity by Steam Condition: 2005
Total Capacity: 1,333 GW



World Capacity by Steam Condition: 2020
Total Capacity: 2,232 GW



■ **Supercritical** ■ **Subcritical**

Sources: (1) IEA, *World Energy Outlook 2008*, (2) IEA, *Energy Technology Perspectives 2006*, and (3) NorthBridge Analysis.

IMPLICATIONS

- The world coal fleet is large and growing.
- By 2020, CO₂ emissions from coal generation will grow to 12 billion tons per year – three quarters of total electric sector emissions.
- CCS retrofit technologies are an essential abatement option for this very large source of greenhouse gases, but the installed base will present challenges.
 - 37% of capacity is expected to be smaller than 300 MW.
 - 72% of capacity is expected to be subcritical.
- RD&D efforts must take the diversity of the installed base into account – it will not be sufficient to focus exclusively on large supercritical applications.