# Coal is the Cornerstone of Our Energy Future

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### Energy is Good

People in Societies with Greater Access to Electricity:



25% 90% average percent of population with access to electricity

## A Transmission Line for Much of the World

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In Africa, women typically carry 20 kilograms of fuel wood an average of 5 kilometers every day – it takes 5 hours



**Global Electricity Consumption-1970-2030** 



### **Everything, Everywhere, All the Time:** Increases needed by 2030 to meet demand

<ul> <li>Nuclear power</li> </ul>	38%
<ul> <li>Oil production</li> </ul>	43%
<ul> <li>Renewable energy</li> </ul>	61%
<ul> <li>NG production</li> </ul>	64%
<ul> <li>Coal production</li> </ul>	74%

# **Two Different Worlds**

There is no such thing as clean coal"
 National Resources Defense Council.

 When asked how China would ever meet the growing demand for electricity, liquid fuel and NG, Du Minghua, Director of the Beijing Research Institute replied: "Coal is the solution to all three".

## Out of Poverty: Coal Based Energy has Propelled China Forward



Note: Poverty measure follows World Bank Definition of \$1 per day income Source: IEA, 2007; EIA, 2008 INDIA NEEDS ELECTRICITY----DESPERATELY





### **Coal is India's only Energy Advantage**



India's Share of the World's Energy Reserves



Increase in Billion Kilowatt Hours 2006 - 2030

### And That Future Revolves Around Coal

In 2030, more than 3.3 billion people will depend upon coal for more than 50% of their electric power.



### **Source of Electricity**



# Carbon Capture and Storage is the Technological Pathway

—**G**rbon capture and storage technology hold enormous potential to reduce our GHG emissions as we power our economy with domestically produced and secure energy" President Barack Obama

—prosprity depends upon reliable, affordable access to energy. Coal... is likely to be a major and growing source of electricity generation for the foreseeable future.... We must make it our goal to advance carbon capture and storage technology to the point where widespread, affordable deployment can begin in 8 to 10 years"— Steve Chu, Secretary of Energy

### **That Was Then**

#### The Dramatic Success of Clean Coal Technology



### Why Retrofit with CCS is so Critical



Global Coal Based Generating Capacity in GW

# Coal with CCS is Among the Low Cost Alternatives

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#### National Academy of Sciences latest assessment of America's energy future, July, 2009

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Breaking News From National Coal Council Report Issued Last Friday on 21<sup>st</sup> Century Low Carbon Coal Technologies

- Conducted at request of Secretary Chu to assess potential contribution of coal based generation with CCS
- Deployment of coal with CCS can replace the existing coal fleet and provide up to 3,000 terawatt hours of electricity at affordable rates using 1.7 billion tons of coal.
- Construction of about 360 GW of coal generation with CCS at a \$1.2 trillion investment cost will yield a \$2.7 trillion GDP benefit, provide over 28 million job years during construction and support over 800,000 permanent jobs.
- Coal's carbon content creates a competitive advantage for America by enabling enhanced oil recovery of 2 million barrels per day

Available at : http://www.nationalcoalcouncil.org/

## The Scale of the Challenge





# WHERE WILL THE ELECTRICITY COME FROM IN THE UNITED STATES?



# **Cooling Degree Days**

#### April, May, June, July, August, September



### Scale Sets the Context: If Power Plants Were Draft Animals



Mule Natural Gas- 21%



Sled Dog Hydro- 6%

Carrier Pigeon Wind- 1%

Workhorse Coal- 49%

> Burro Nuclear—19%



### 36 States Obtain at Least 30% of Their Electricity from Coal





### The Power Of One Coal Plant



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John Amos Coal Power Plant 2,933 MW The True Cost Of Wind Generation

- 1. 6000 turbines at 1.5mw and each 420 feet high
- 2. 120,000 acres of wind turbines
- 3. 2,200 or more MW of NG plant to back up wind
- 4. More than 1,000 miles of ridgeline consumed.

More NG Means Higher Electric Rates

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### EIA: Gas Supply 2008 - 2020

2h



### A Six Nation Cartel Could Control Over 60% of the World's Natural Gas



Source: British Petroleum, 2009



### ALTERNATIVE FUELS: The Scale Needed to Replace Coal in the U.S.

- NUCLEAR: 250 more reactors
- NATURAL GAS: 17 more Trillion Cubic Feet
- HYDRO: 500 facilities size of Hoover Dam.

The reality of physics is that electricity cannot be stored in large quantities – an inevitable constraint on solar and wind generation. Geographic Dissonance: 80% of the Class 4 Wind is Far Removed from 70% of the Electricity Load

-Class 4 wind or higher can be useful for

generating wind power with large

turbines, EIA, 2009

1 8 5 5



70% of Electricity Load

### Wind Generation's Performance During 2006 California Heat Wave



\* Adapted and estimated from Dixon, U.S. DOE (2006)

1 Store

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# Electricity Makes the Difference: Korea

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South Korean preschool children average 3 inches taller and 7 pounds heavier than North Korean Children

The Infant Mortality Rate in North Korea is 12 times higher than South Korea

South Korea ranks 32<sup>nd</sup> in GDP/capita. North Korea ranks 156th

Only 20% of North Koreans have access to electric power. South Korean access approaches 100%

### Lest We Forget :

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### **US Coal Reserves vs. Oil and NG Reserves**





1988

1978

1968

1998

2008

 The Steady Decline In U.S. Oil

From 1968-2008, U.S. oil production declined the equivalent of the annual production of Iran.



# What Two Million Barrels a Day from Coal to Liquids Could Do

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#### **CO2- EOR Can Lead to 2 Million B/d** Coal's Carbon Content is a Competitive Advantage:



 Provide access to 70 billion barrels of economically recoverable oil

• Create enough demand for CO2 to offset the emissions of 70 GW of coal based generation for 30 years

• Yield oil that is 50-80% —cabon free"

1. Clean Coal Fuel Supply 2. Carbon Capture 3. Electricity Production 4. Carbon Dioxide Injection

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5. Enhanced Oil Recovery 6. Carbon Dioxide Injection 7. Saline Aquifer Storage Two million barrels of oil per day from EOR would require CO2 from 360 million tpy of coal.