Committee on Gas

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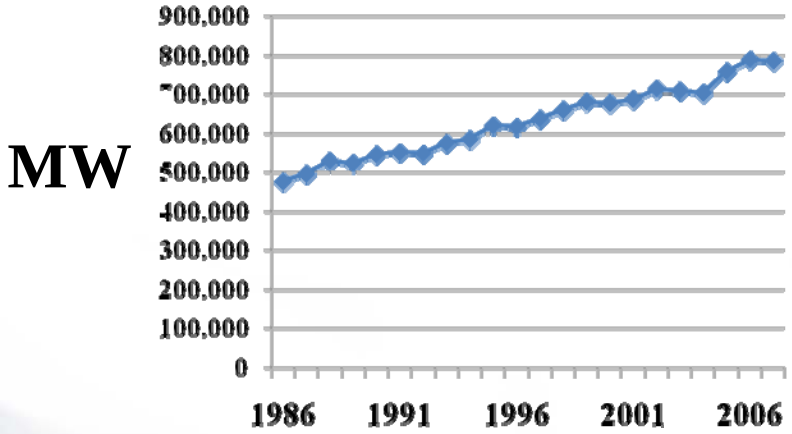
American Clean Skies

NARUC
JULY 22, 2008

US Electric Power

- **Size 1,000,000 MW**
- **Growth, 2.4%, 24,000 MW/year**
- **Mix of Capacity**

US EIA Summer Peak



Coal	31.2%
Nuclear	9.8%
Hydro	7.2%
Renewables	2.5%
Gas-Fired	41.2%

Power Concerns

- **24,000 MW/year load growth**
- **Emissions**
- **Acceptable prices**
- **National security**
- **Balance of trade**

Opinions/Plans

- President George Bush
- Barack Obama
- John McCain
- T Boone Pickens
- Al Gore

Common Themes

- **Import less oil**
  - **Balance of trade**
  - **National security**
- **Reduce emissions**
  - **Global warming**
  - **Health**
- **Reduce Demand**

Observations

Nuclear

- High installed cost, $6000/kW
- Long permitting & installation
- Base load
- Nuclear waste
- Terrorist concern
- Reduces emissions
- Reduces dependence on oil

10 years – Not Happening

The Journal Report, WSJ, June 30, 2008

Observations

Coal

- High installed cost, $2000/kW
- Long permitting & installation
- IGCC stalled
- Conventional coal stopped
- Reduces dependence on oil

10 years – Not Happening

Observations

Solar PV

- **High installed cost, $8250 /kW**
- **Intermittent generation**
- **Reduces dependence on oil**
- **Reduces emissions**

10 years - Negligible

The Journal Report, WSJ, June 30, 2008

Observations

Solar Thermal

- Installed cost, $4000 /kW
- Intermittent generation
- Takes a lot of land
- Reduces emissions
- Reduces dependence on oil

10 years - Negligible

Observations

Geothermal Power

- High cost $5000/kW
- Little resource
- Reduces dependence on oil
- Reduces emissions

10 years - Negligible

Observations

Wind

- **20% Wind by 2030 (DOE 2008)**
- **Intermittent resource**
- **Natural gas produces 22% of electricity**
  - **Consumption reduced by wind**
  - **Savings used to replace gasoline (displace 1/3 of imported oil)**

	1973	1990	Today
Oil Imported	24%	42%	70%

T Boone Pickens, WSJ, July 9, 2008

System Load

- Load varies with time of day
- Load varies with season
- Generation needs to match the load.
- Power cannot be stored

Wind Generation

- Generates power when the wind blows
- Intermittent
- Back-up generation required

Wind and SCC

Simplified Combined Cycle (SCC)

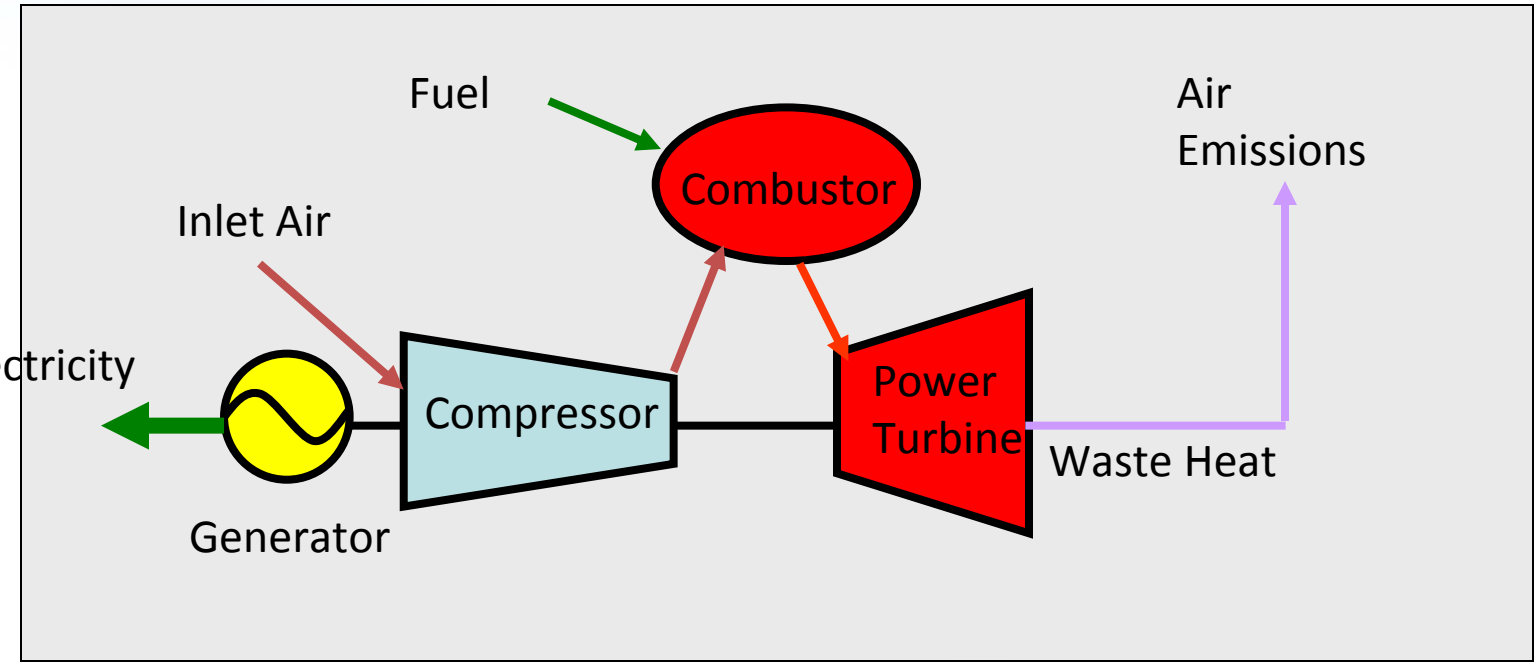
- **Maximizes use of pollution free wind**
- **Natural gas complements wind with the**
  - **Most efficient**
  - **Most reliable**
  - **Cleanest power**

"Wind and natural gas are natural partners for green power"

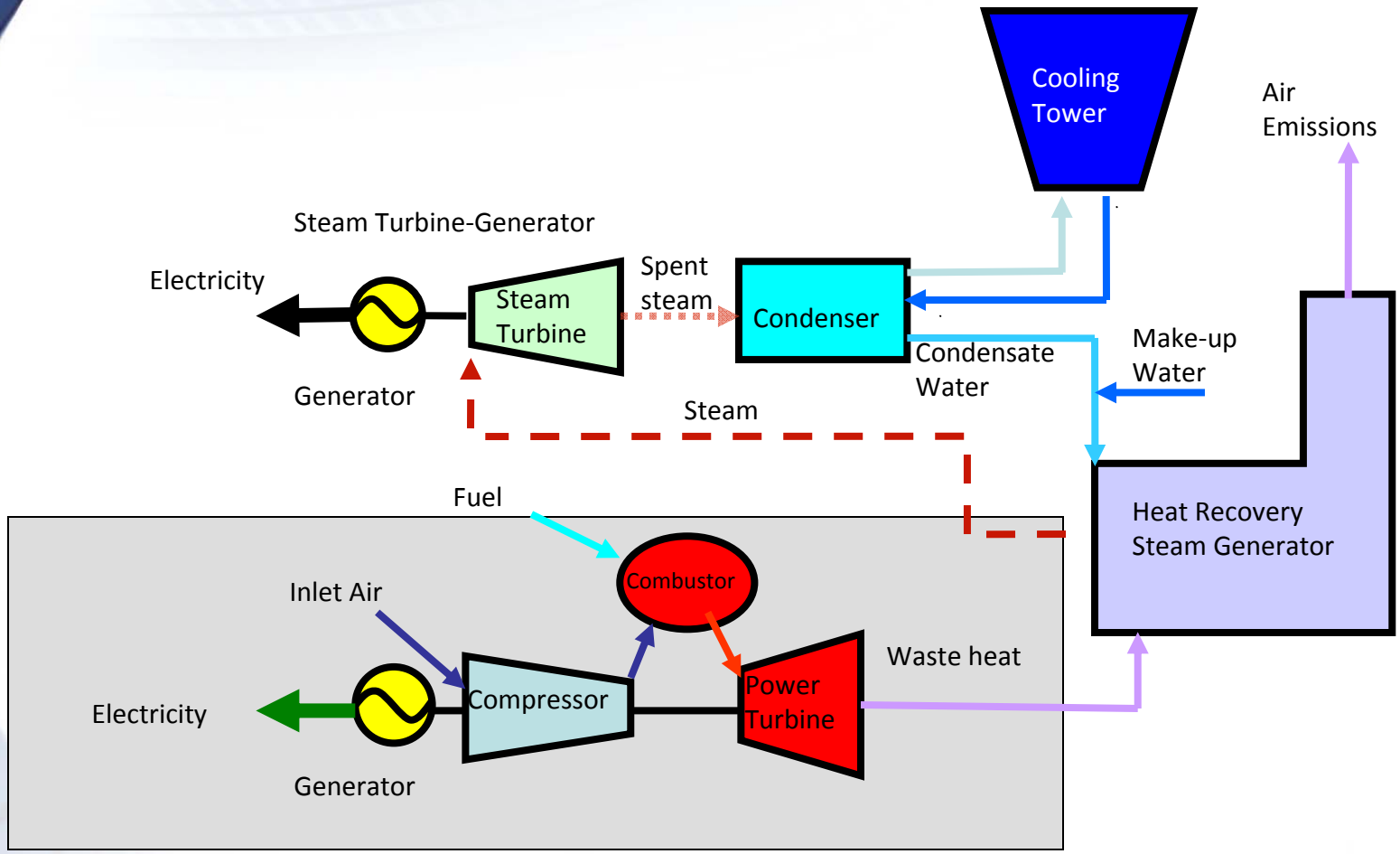
SCC History

- **Developed by Dr. Dah Yu Cheng**
- **200 in operation**
- **Significant existing plant upgrade potential**

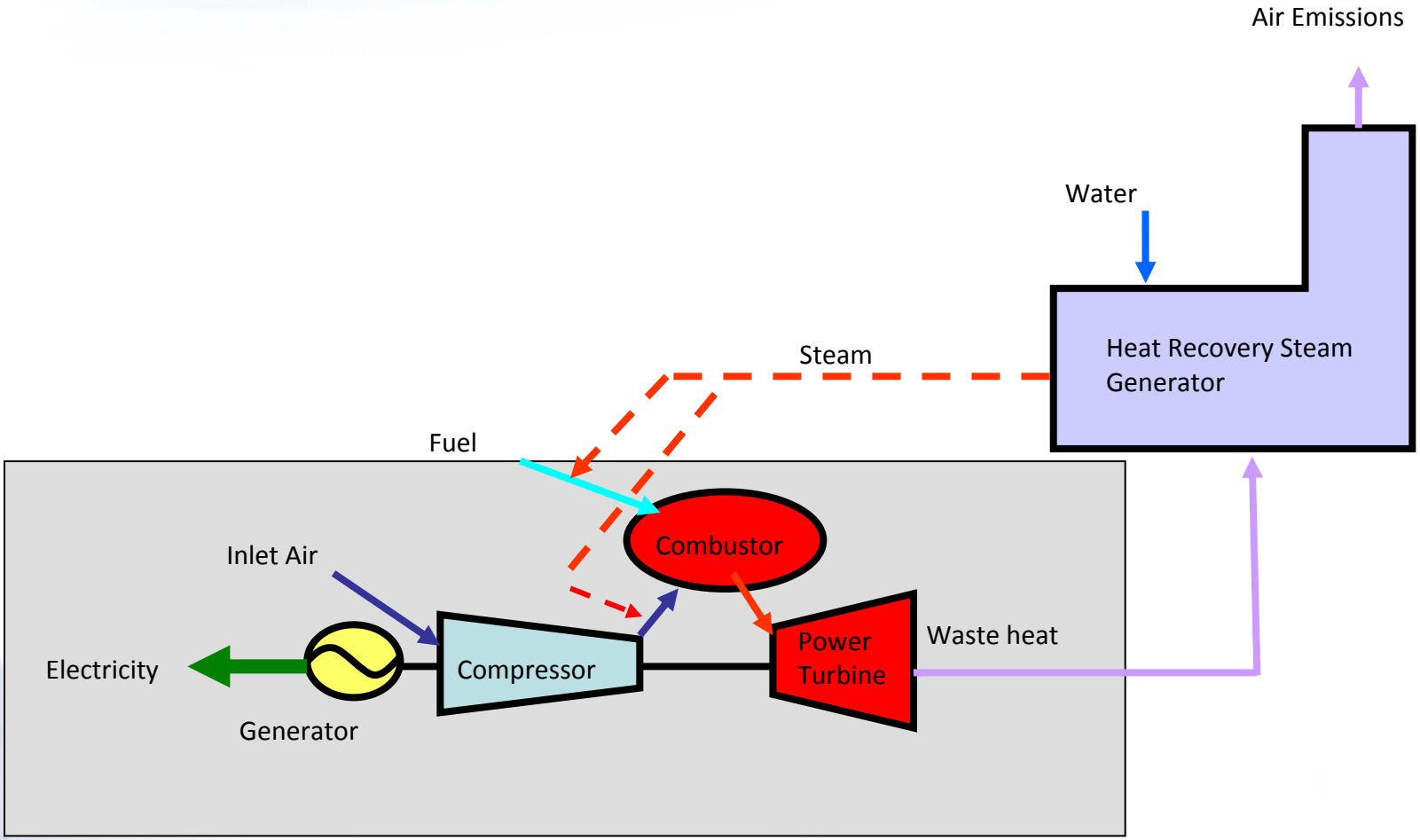
Simple Cycle



Combined Cycle



Simplified Combined Cycle



Back-up Characteristics Needed

- **Highly dispatchable**
- **50% Capacity Factor**
- **Low installed cost**
- **Efficient**
- **Clean**

Back-up Options

- Coal and Nuclear
  - High first cost, requires base load use
  - Slow to start
  - Poor dispatchability
- Combined Cycle Gas Turbine
  - Efficient
  - Slow to start
  - Poor dispatchability
- Simple Cycle Gas Turbine
  - Low first cost
  - Good dispatchability
  - Inefficient

Best Option - SCC

- **Low first cost**
- **Good dispatchability**
- **Efficient**
- **Clean**

The perfect complement to wind

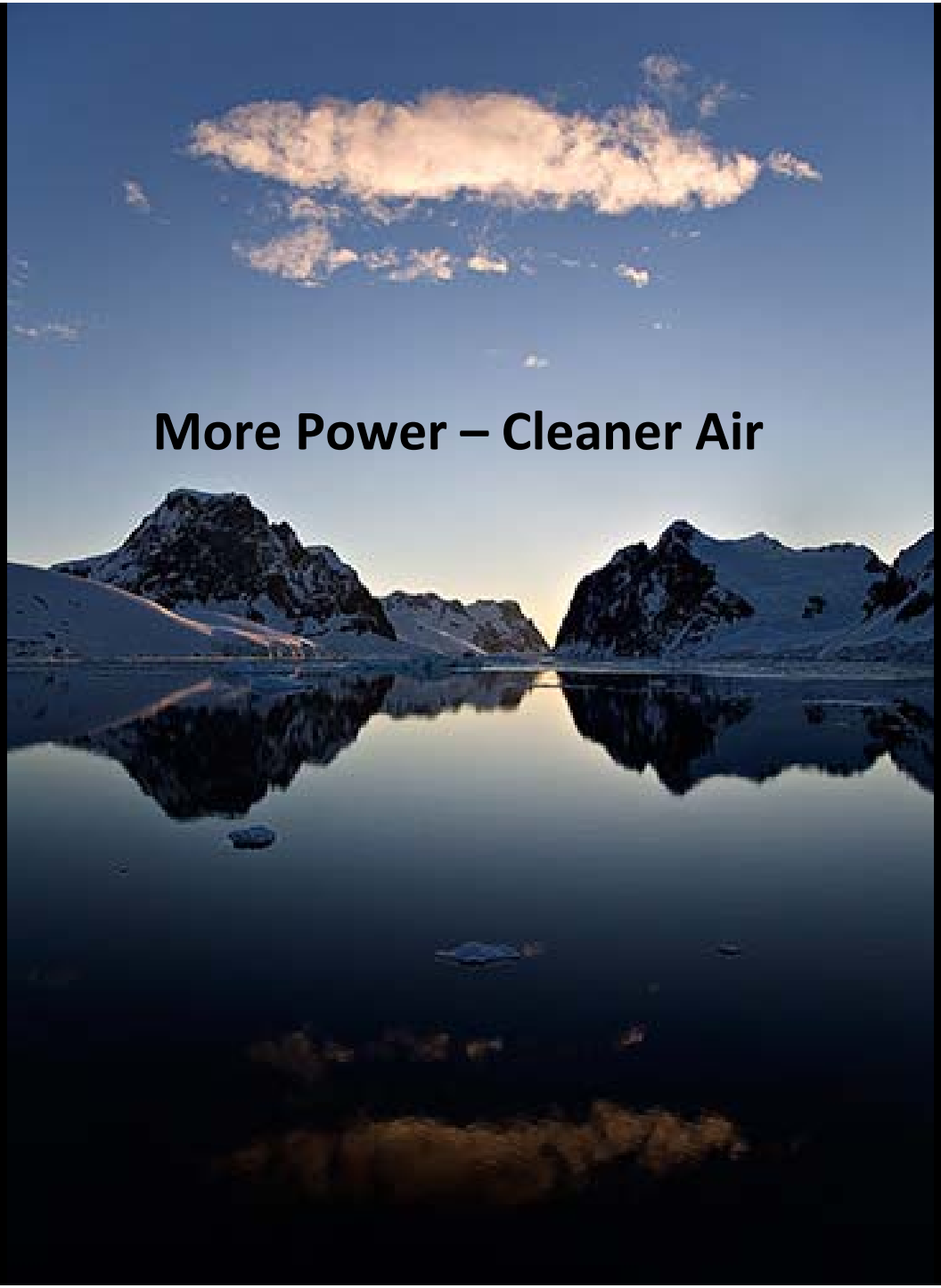
Wind plus SCC

Example

- 300 MW need in Midwest
- 142 Wind turbines
- 5 GE LM6000 gas turbines with SCC
- Cost becoming competitive with coal plant
- GHG emission ‹ half of a coal plant

Conclusions

- **Clean wind energy's role will grow**
- **SCC is the best way to back up wind and supply the required 24,000 MW/year**
- **Wind and SCC reduces imported oil**
- **Wind and SCC reduces emissions**


More Power – Cleaner Air