

Comments on Alternative Power Mix Scenarios

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The Challenges

- Energy Security
 - Secure the supply, including transportation
 - Real-time stability of electricity supply
- Environmental Protection
 - Air pollution: SO_2 , NO_x , PM_{10} , $\text{PM}_{2.5}$, volatile heavy metals
 - Global Warming: CO_2
- Economic prosperity
 - Cost of purchasing fuels from abroad
 - Low electricity tariff to maintain competitiveness

GOAL: Balanced mix of fuels for power generation

The IDEAL life of a bureaucrat

- Good energy statistics to support analysis
- Appropriate energy models are available and trusted to predict the future
- Decision based on analysis with all-agreed criteria, e.g. lowest cost of power generation
- Longer-term (e.g. 50 yrs) planning to allow for timely replacement of infrastructure
- Well-informed populace to consider the future
- Rationality and expertise rule the decision process

But, the REALITY is

- Formidable task to develop sound energy knowledge for everyone
- Irrationality due to ignorance and prejudice
- Ill-informed populace rules in democratic process
- Mis-match in time-scale
 - e.g. 50 yrs for energy planing vs. 5 yrs for election
 - Source of disaster!



TIME FRAME

*Policy Engineering
Required*

NOT IN MY TERM

Global Warming
CO₂, CH₄, N₂O

Acid deposition
SO₂, NO_x

Photochemical smog
Unburned hydrocarbons

Soot

Noice

INCOGNITA

SPATIAL EXTENT

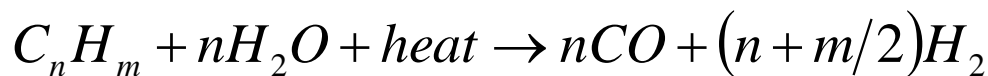
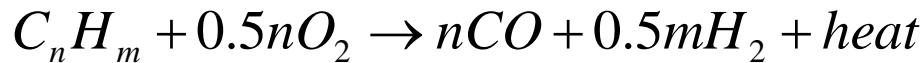
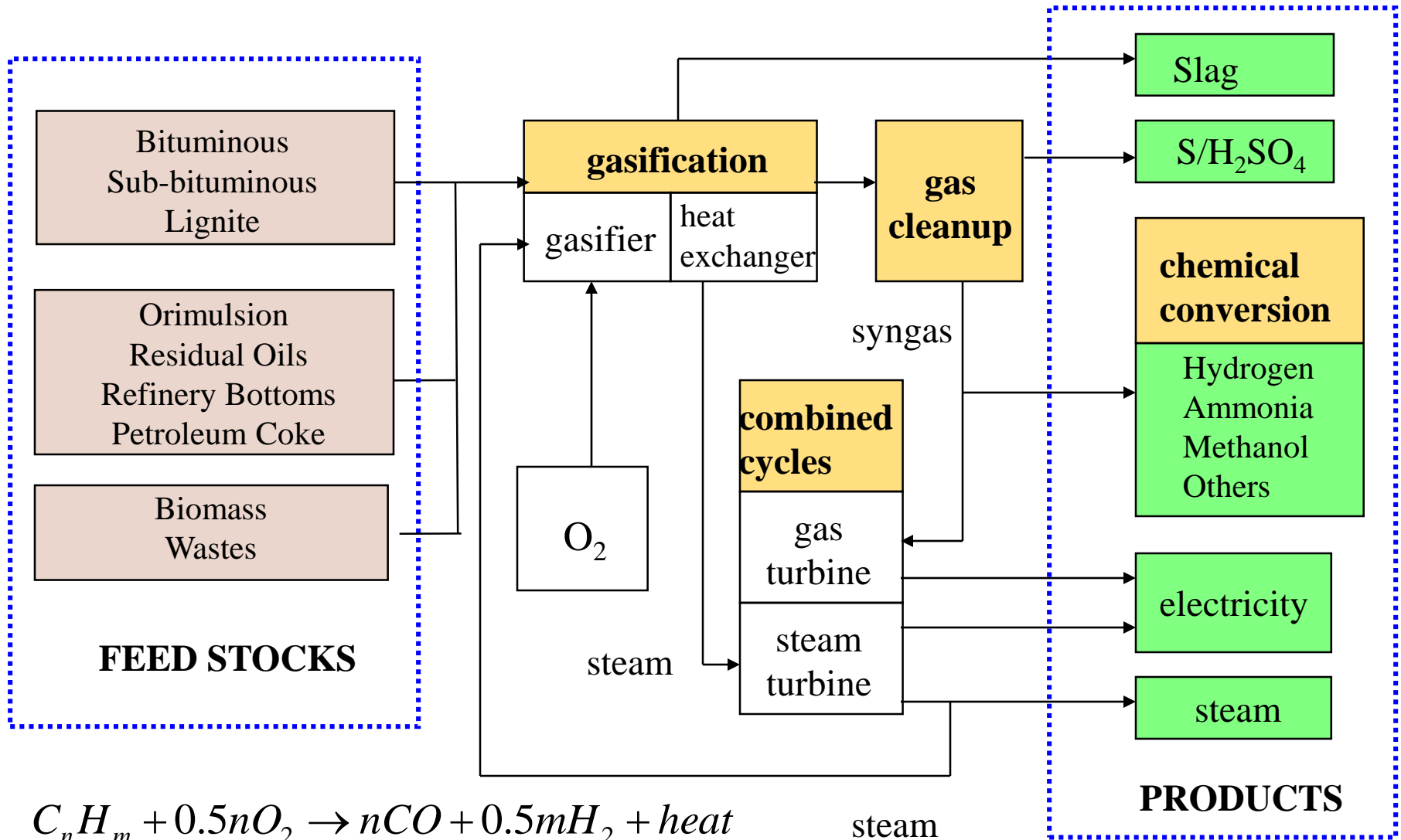
Natural gas

- Versatile, good for both peak and base loads
- The premier choice but NOT for everyone!
 - Regional imbalance, NE Asia is major consumer
 - Liquefied natural gas is expensive and limited in capacities
 - Rigidity in LNG trade hinders further utilisation and investment
 - From buyers market to producers market, and reverse, changes quickly
- Insufficient storages, potential source of energy insecurity!
- Geo-political concerns, especially for pipeline gas

Cleaner use of coal

- Efficiency is not the concern, but pollutants!
- Bad publicity forbids its political support for R&D and implementation; Demos are not well propagated
- Reluctance of utilities to adopt new cleaner technologies of coal
 - Turn-key Operators without in-house technologies
- Environmental authorities favour end-of-pipe technologies to curtail pollutant emission
- Which cleaner use of coal?
 - PFBC, IGCC, IGFC? SC/USC?
 - Availability of coals with high ash fusion temperature?
 - Highly specialised fields involving multi-disciplines, even energy authorities are not familiar

Integrated gasification combined cycle



Nuclear

- Could reserve meet future need? The open fuel cycle is not sustainable , but closed fuel cycle prompts dangers of proliferation
- Good for base load only, requires measures for peak load management
- Bad publicity, due to Chernobyl and Fukushima
- Urgent issue: Safety culture for newly nuclear-powered nations
- The next generation, GEN-IV, reactors are needed to rebuild confidence
 - Passive design of safety
 - Modularity to reduce costs

A personal, tentative conclusion

- Cleaner technologies of coal
 - Do it aggressively! But, not to say it!
 - CCS may be a false promise, especially for countries with active seismic activities!
 - Gasification should be the key! Traditional pf boilers are cost-prohibitive for further reducing of pollutants
- Greater use of (liquefied) natural gas with care
 - Heavy investment in infrastructure
 - More flexible trading practices are needed
- Nuclear could be a longer-term option, the current issue is ensuring safety, not expanding.

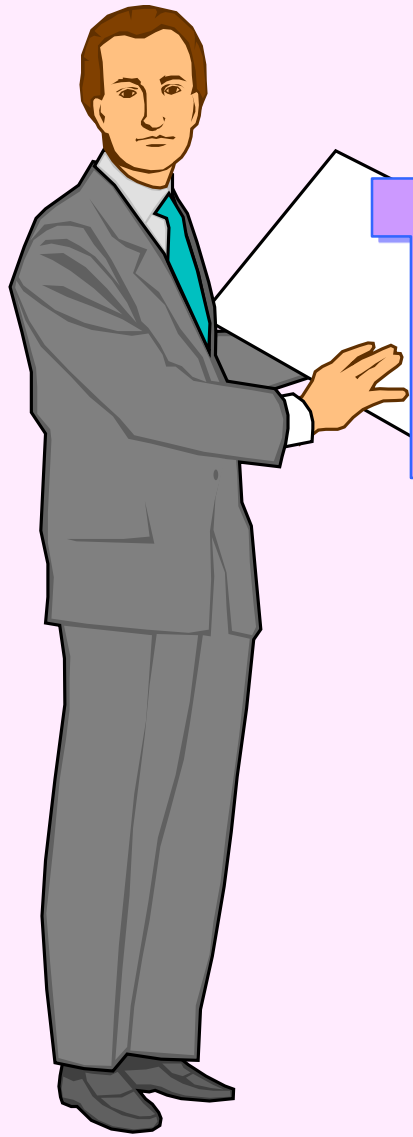
For the foreseeable future, IGCC + NGCC should be the optimal choice for many, if not for all!

Uncertainties

- China is the most unpredictable factor
 - Government makes decision, no influence from ignorant politicians
 - Security of supply plays more important role, but pollution becomes an emerging issue
- Possibilities
 - 1: Huge pipeline gas from Russia, strategic partnership
 - 2: More nuclear, good news for many
 - 3: More LNG, disaster for many
 - 4: BAU, severe air pollution from coal may cause large-scale unrest
- Neighbouring countries will be affected heavily

More challenges ahead!

- Procurement process may alter any rational plan
 - Asymmetric, distorted knowledge on the available options
 - Lowest cost win the bid, either equipment/fixed cost or total cost; security and environmental cost have no role
- The available policy tools in liberalised power market?
 - Private-owned power producers rely on project financing and are profit-centred
 - Responsibility of stable, clean supply?
- Communication and persuasion to seek support



Thank You

