

Electricity Sector Restructuring in China: The Difficult Path to Competition in Generation



Russell Pittman

Antitrust Division, U.S. Department of Justice, and

New Economic School, Moscow

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The views expressed are not those of the U.S. Department of Justice.



Plan of Presentation

- Competition issues in electricity restructuring
- Competition issues in electricity restructuring *in China*
- Analysis of specific wholesale regional markets in China
- Conclusion: Some difficulties ahead
 - (This reflects joint work with Dr. Vanessa Yanhua Zhang of LECG, LLC.)
 - (This also reflects the work of an American who knows something about electricity but is not an expert on China. Advance apologies for errors.)



Vertical Separation to Create Competition

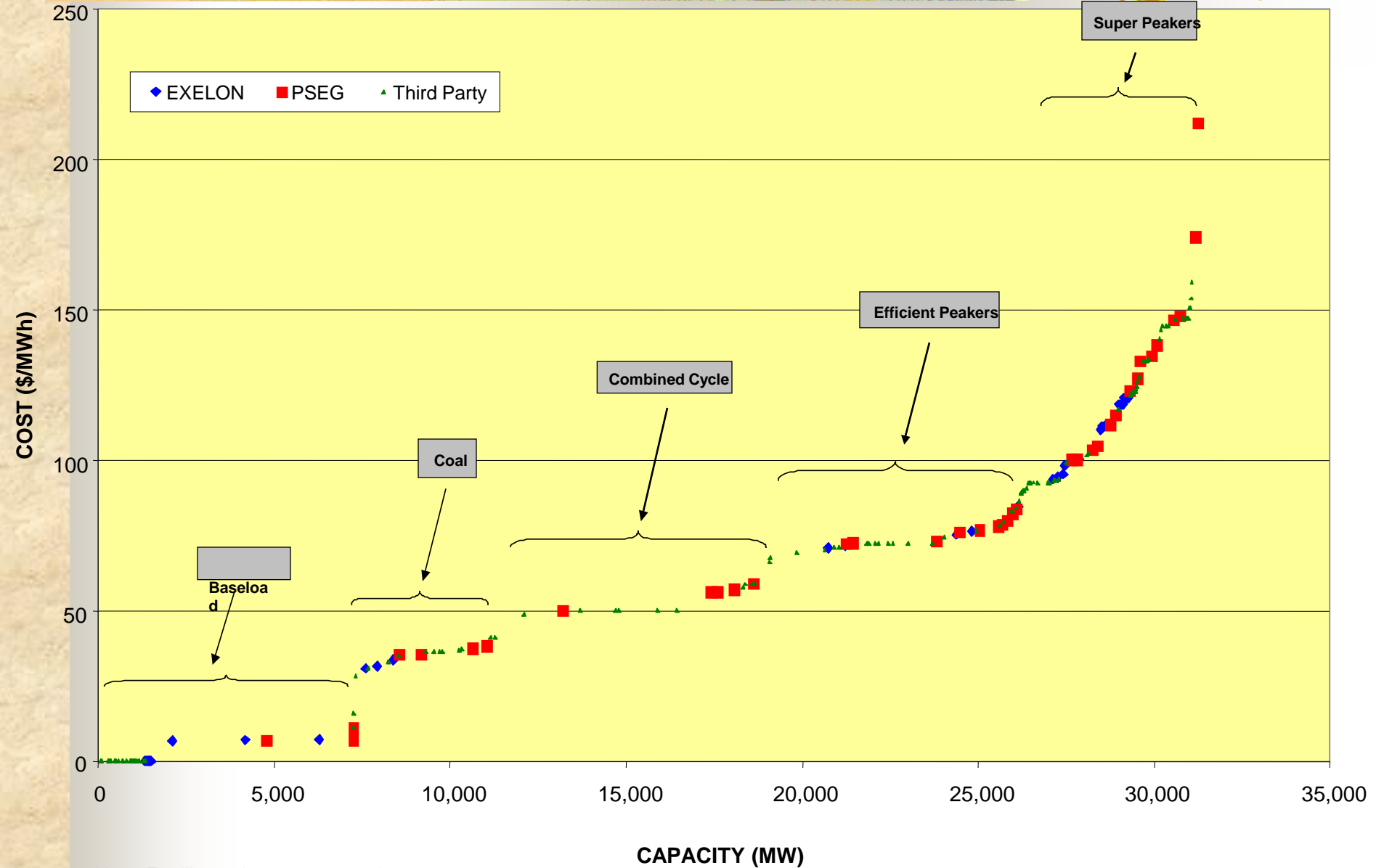
- Common restructuring strategy – the “default option” – for “natural monopoly” sectors
 - Create competition where possible, scale back or eliminate regulation
 - Continue regulating “grid”
- Experience mixed
 - Generally successful in telecommunications, less so in railways
 - Electricity somewhere in between



Electricity Generation (1)

- Multiple technologies: nuclear, coal, hydro, gas, oil
- Each technology has its expected place on the industry cost curve:
 - Baseload: nuclear, coal, hydro
 - Mid-level: hydro, gas
 - Peaking: hydro, gas, oil

PJM East Cost Curve Pre-Merger



Note: For illustrative purposes only – not an actual representation of market conditions.



Electricity Generation (2)

- Coal plants have low marginal costs and flexible output, but with firm capacity limits: cost curve a reverse “L”
- Hydro plants have even lower marginal costs, but their flexibility gives them an “opportunity cost”: water not released now can be released later
- Hydro raises important issues
 - Different outputs in flood and non-flood seasons
 - Loss of flexibility of output in flood season?
 - Incentives to exercise market power?
 - Other constraints on water release, e.g. irrigation



Challenges to Creating Competition in Electricity (1)

- Inelasticity of demand
 - Few substitutes
 - Little real-time metering
 - No storage
- Inelasticity of supply
 - Little storage (other than hydro ponds)
 - Strict capacity limits
 - Peaking plants become very high cost as 100% capacity utilization nears
- Hence potentially high returns to restricting output



Challenges to Creating Competition in Electricity (2)

- Competition is a “repeat game” among the generation companies, played thousands of times: companies may learn to coordinate for profit-maximization
- Inframarginal incentives for firms that own both base-load and peaking plants (see cost curve)
- Hence generation companies may have both incentive and ability to manipulate outputs and prices



Lessons from these Challenges

- A generation market that appears competitively structured may not operate competitively. (Cf. California.)
- Many of the benefits of liberalization and vertical separation will accrue only if prices are free.



Challenges to Creating Competition in Electricity *in China*

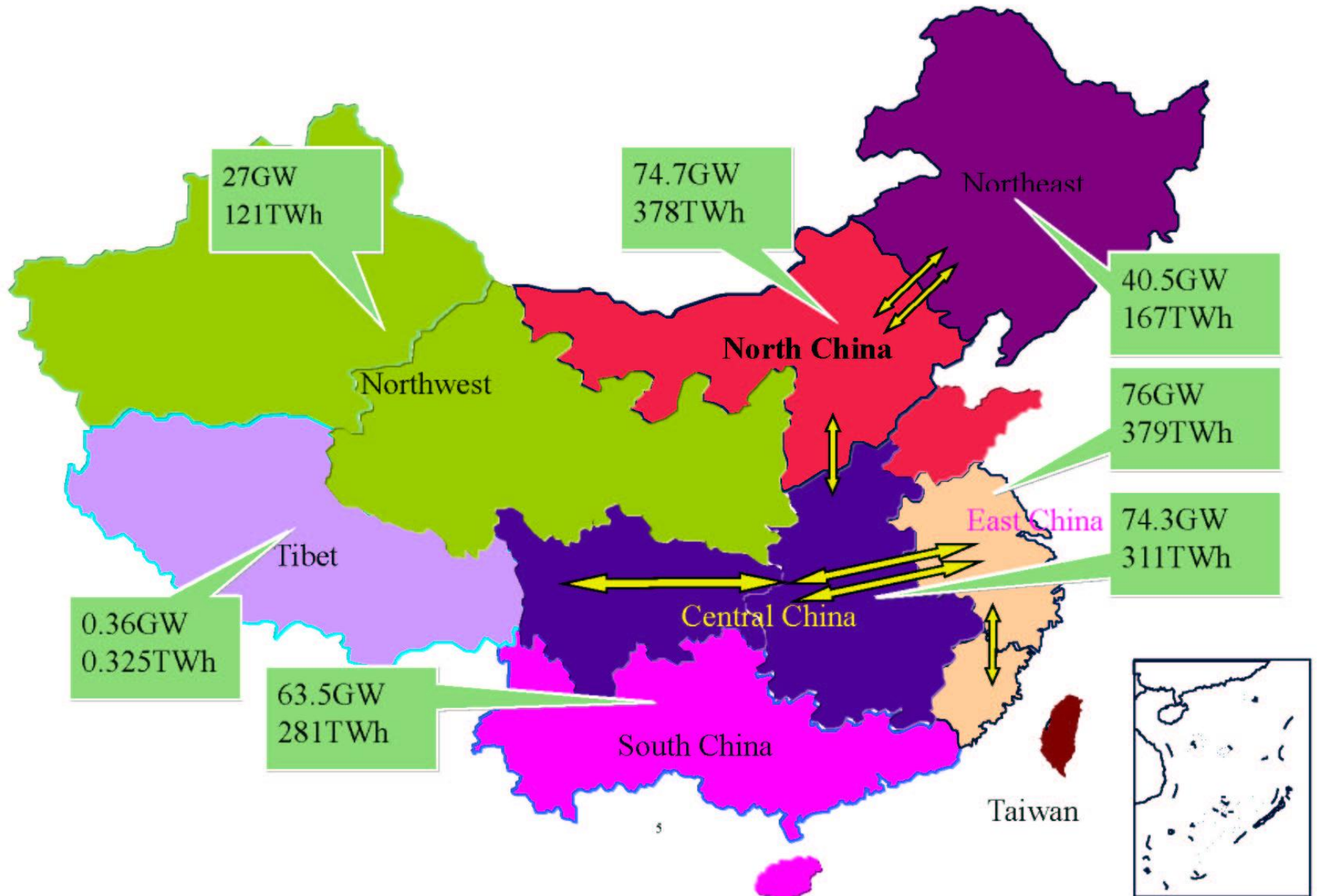
- Demand generally greater than supply – a legacy of successful economic reform and growth
 - Free prices may increase significantly » income distribution issues (including regional)
- Unusual generation technology mix
 - Great reliance on coal and hydro
 - Most systems rely on gas and oil for flexibility (though Scandinavia and S. America rely on hydro)
- Past reluctance to allow rate increases (e.g. when coal prices increased)
 - Will distribution companies be squeezed by wholesale price increases? (Cf. California.)



Geographic Markets in China for Electricity Generation

- 6 broad regional “markets”, excluding Tibet
- Good transmission capacity within these, not so good between them
- Still, there may be intra-market transmission congestion at times of peak demand. Actual geographic markets may be smaller.
- Thus following competitive analysis may be optimistic.

Chinese Electricity Grid





North China

Xian

Northwest

East China

Wuxi

Shanghai

Wuhan

Hangzhou

Central China

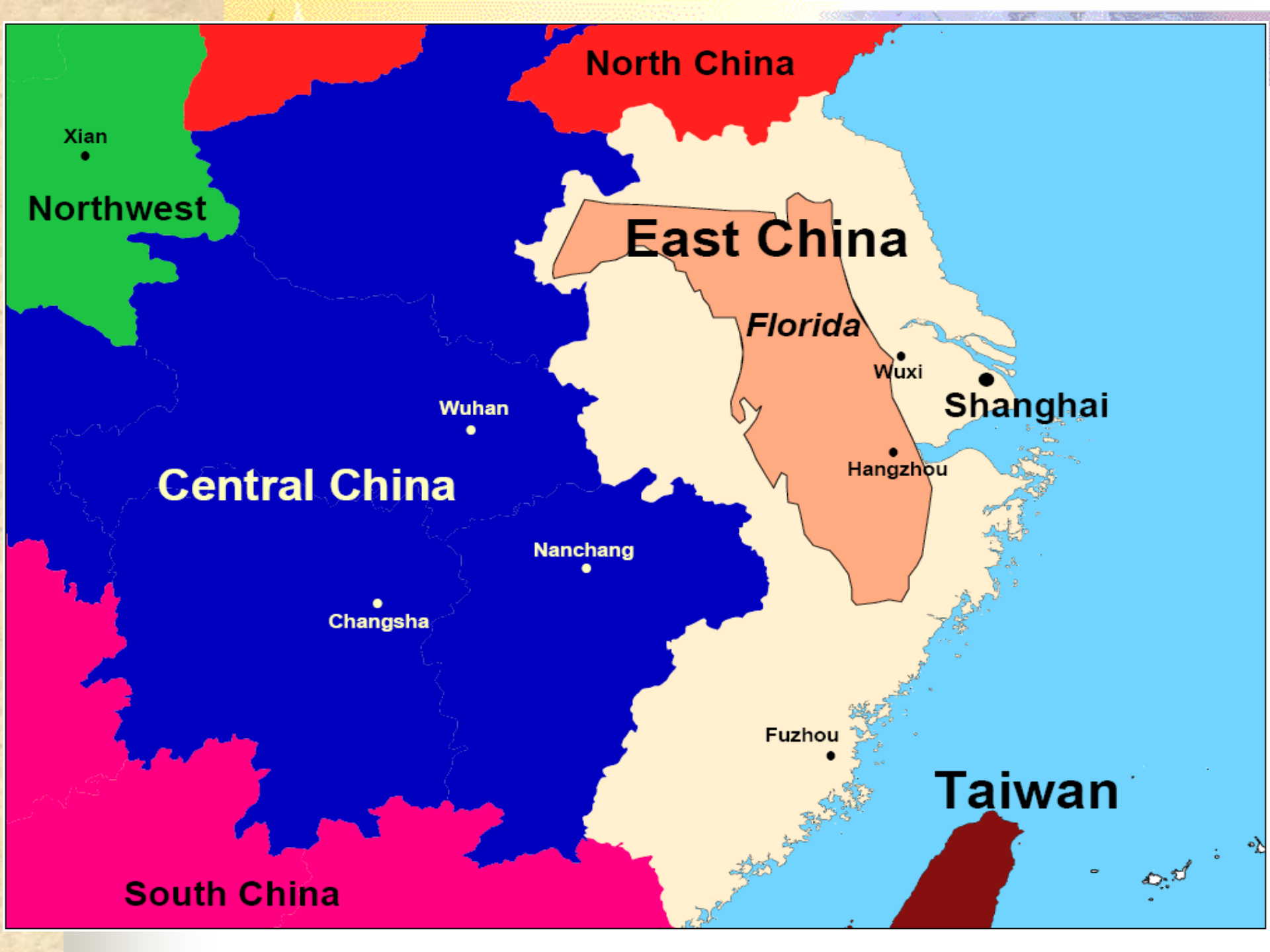
Nanchang

Changsha

Fuzhou

Taiwan

South China



North China

Xian

Northwest

East China

Florida

Wuxi

Shanghai

Wuhan

Hangzhou

Central China

Nanchang

Changsha

Fuzhou

Taiwan

South China



Regions: North and Northeast

- Almost entirely dependent on coal.
- Generation market structures moderately concentrated
- Coal plants have reverse-L cost curves; once capacity reached, further demand simply raises price.
- This may ration demand, but there is no more supply to attract in the short run.
- (Note: All generation plant information is from parent company and SERC websites.)



Regions: Northwest and Central

- Almost entirely dependent on coal and hydro
- Flexibility and incentives of hydro producers important
- Northwest: CPIC's large share may give it unilateral market power
- Central: China Guodian, China Datang, and CPIC have both coal and hydro: inframarginal incentives?
- Central: China 3G's large share in flood season may give it unilateral market power



Regions: South and East

- Both have some nuclear, some gas and/or oil
- So more diverse sources, more typical generation sectors – though gas and oil capacities small
- South: Guangdong Yudean may have incentives to withhold oil and gas to increase coal profits
- South: China Huaneng, China Datang, China Huadan, and SDIC have both coal and hydro; may have incentives to withhold hydro to increase coal profits
- East may have best competitive situation, though flexibility still limited: coal + nuclear > 90%



Regional Summary

- North and Northeast: mostly coal, little production flexibility
- Northwest and Central: coal + hydro. Some flexibility, but poor incentives?
- South and East: more varied portfolio of generation technologies, still some problems with incentives (South) and flexibility (East)



Possible Remedies for Competitive Problems

- Further demonopolization of regional generation markets. Helped in UK.
- Especially, targeted separation of plants with different technologies into different companies.
- Improve transmission capacity
- Increase share of natural gas and oil in generation mix
- Long-term contracts
- Increase use of real-time pricing for large customers



Conclusions

- Current restructuring plans may not create as much competition as reformers hope.
- Many benefits from liberalization are long-term and depend on willingness to allow free prices.
- Maintaining generation market competition places heavy demands on competition agency and energy regulator.
- Outcome is NOT “deregulation”, and only with difficulty will it be “competition”.