Research on Integrating of Wind Power and Power System

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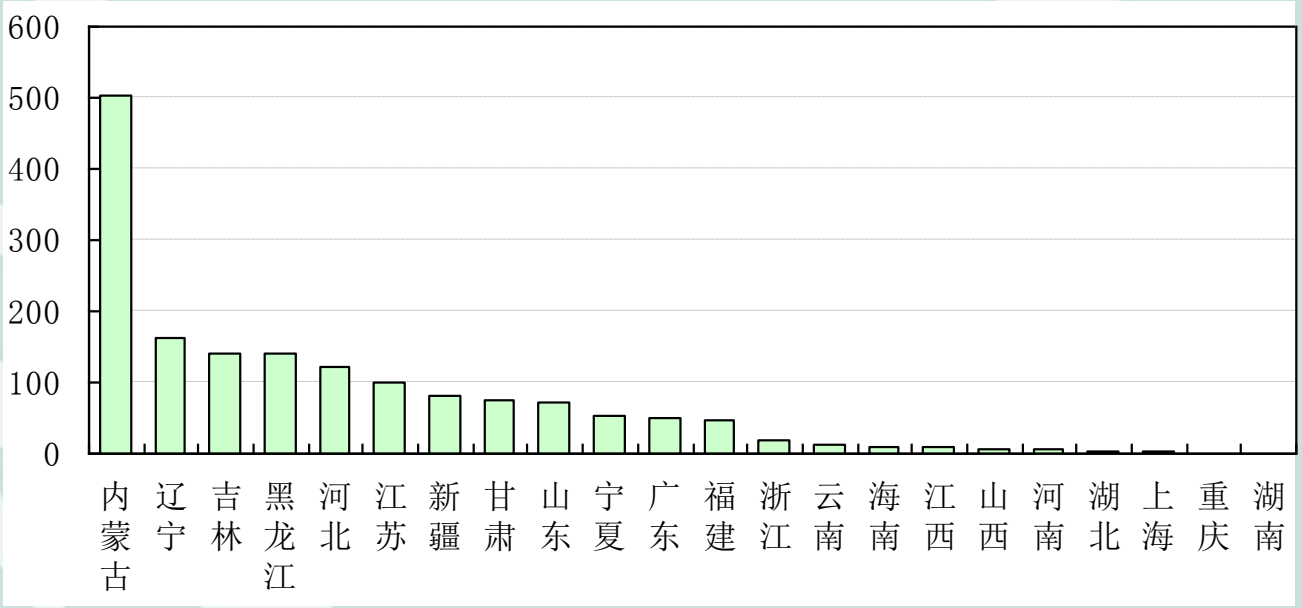
Ⅰ、Current situation and problems of wind power

（一）current situation of wind development in our country

Wind installed capacity developing fast, distribution concentration; from 2005 to 2009，the yearly growth rate is over 90%. At the end of 2009, the integration installed capacity is 16130 MW，distributing around "Three-bei" area and the the littoral province.



integration installed capacity of 2009（**10MW**）

（二）Main planning and operation problem of wind development

（1）disable of system peak regulation

The peal-valley difference is large, the system power peak regulation is difficult, there are output-limiting problems in the low load period in some places.

In the winter of 2009, the west Inner Mongolia grid had "abandoned wind every night". For the fast development, but the system peak regulation is limited, which makes the west Inner Mongolia grid having abnormal development. The abandoned wind affects badly.

In 2008，Ji-lin Grid had three times of wind output-limiting operation, and the maximum output limit is 80MW, Mengdong Grid had 7 wind output operation, the maximum output limit is 100 MW.

（2）The construction of grid is laging behind the power source, especially the inter-grid scale is small, is against wind distribution.

The wind exploitation is concentrating around "Three-bei" area,the scale is small, the consumption is less, considering the limiting of inter-connection, the wind power can not consume in large area.

The power transportation from Inner Mongolia to North China,the North China grid has difficulty in peak regulation. In the future, with the wind development, Inner Mongolia is enlarging the output capacity, and considers the Hebei wind power base develpment, integrates the power peak regulation.

Ⅱ、Means of promoting wind sustainable development

（一）Optimize the power structure, enlarge the power peak regulation and construction

The power structure in our country is mainly thermal power, and this condition will not be changed in long period of time. The percentag of thermal power in "Three-bei" area is large, peak regulation is difficult. In the future, nuclear power will have good development, the prediction of 2020 will be 7000-8000 MW.

In order to promote the wind power development, we must optimze the source structure and enlarge the peak regulation.

（1）Accelerate pumped storage power sation checking of north-west,inner Mongolia,north-east, push the power station construction, promote wind exploitation.

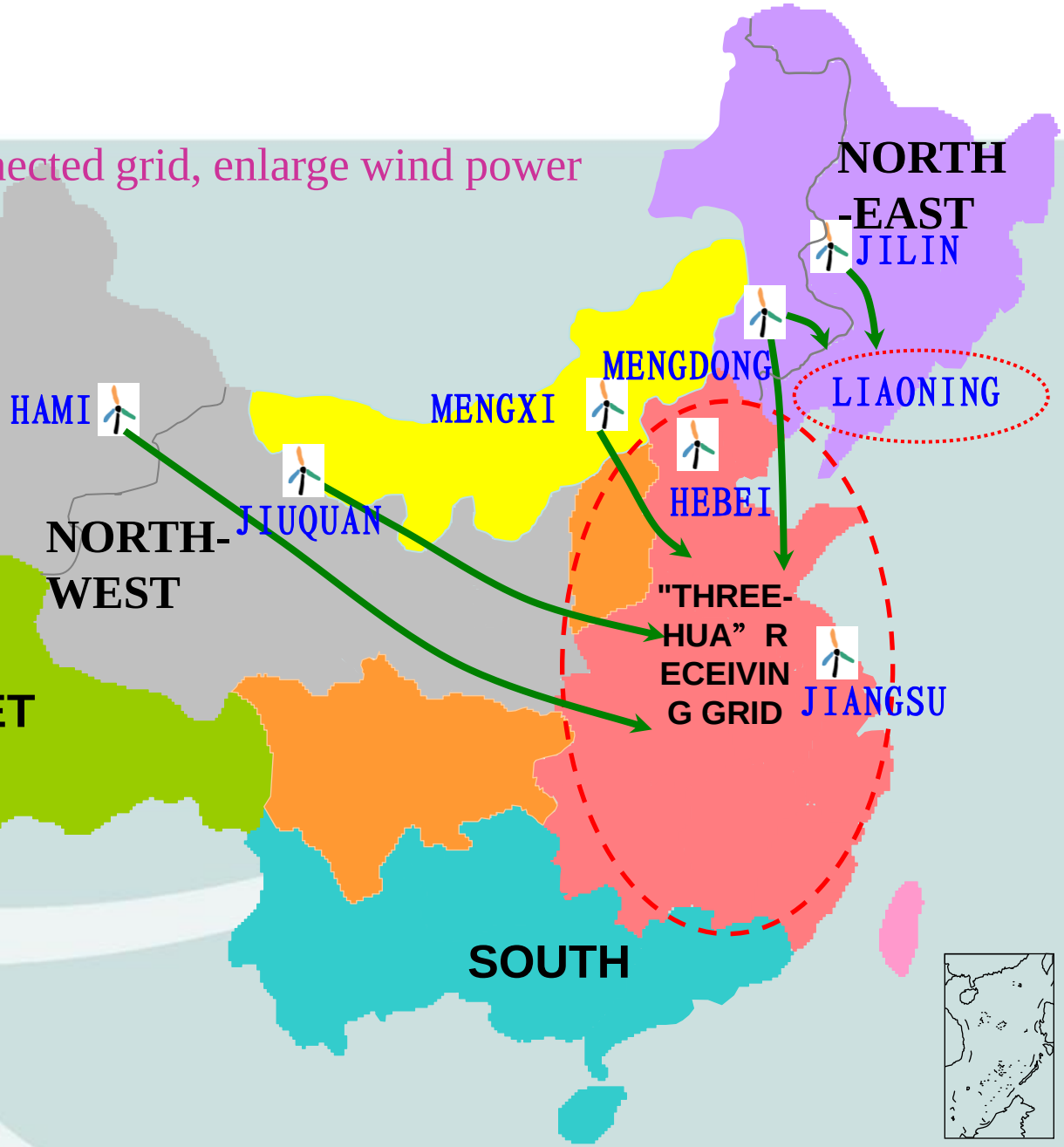
（2） Accelerate pumped storage power sation construction of north china and east chinas' recieving areas, promise operation of wind power, nuclear power and input powers's coordnation.

Power transportation curve is closely related with input/receive peak regulation, power planning considers peak regulation source distribution, curve, wind power development.

the transportation curve affect the peak source distribution

（二）Construct the interconnected grid, enlarge wind power consumption market and scale

	consumption
GANSU	MAIN GRID OF NORTH-WEST、THREE-HUA
XINJIANG	XINJIANG、THREE-HUA
MENGXI	MENGXI, THREE-HUA
MENGDONG	DONGBEI、THREEHUA
JILIN	NORHT-EAST
HEBEI	THREE-HUA
JIANGSU	EAST CHINA

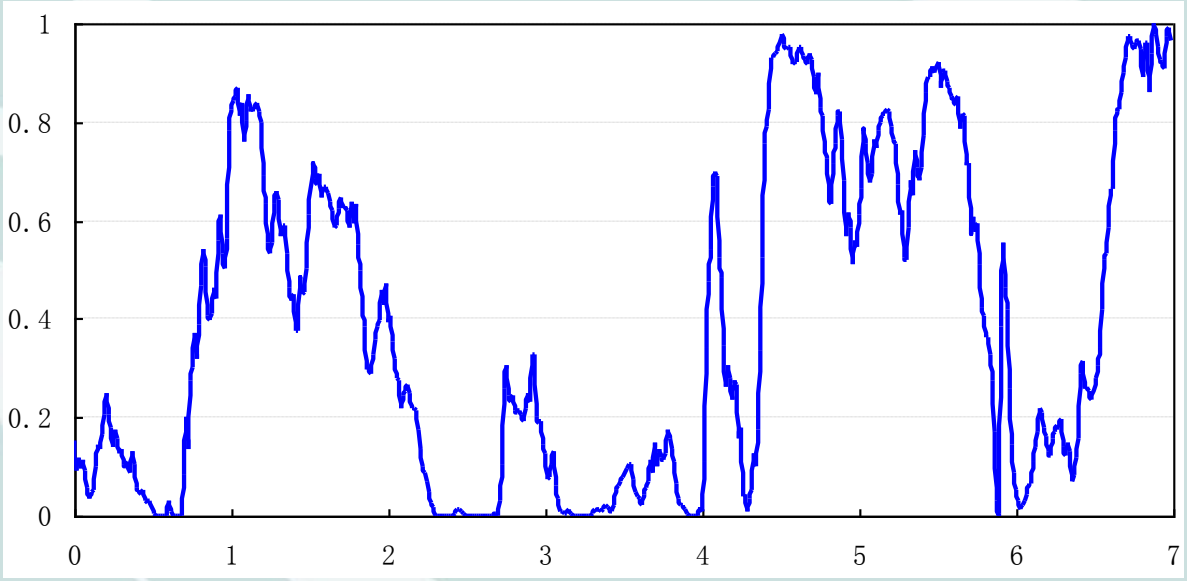


（三）Wind power, thermal power, hydropower coordination operation, bunch output of the wind and thermal power

（1）Technical and economical problems of wind power transmission alone

economy：wind utilization hours is low,transportation ecnomy is bad, power price from north-west to middel-east is two times of thermal power normal price.

technique：wind tranportation power fluctuate affects the power system safety.。



（2）background of the joint of wind power and thermal power

The electricity demand will grow fast in future, the expected electricity consumption by 2020 will reach 699 ~ 767 GWh.

The expected electricity consumption (10^8kWh)

	2005	2010	2015	2020	2030
High scheme	**24781**	**39889**	**59742**	**76735**	**103700**
Growth rate		**10.0**	**8.4**	**5.1**	**3.1**
Low scheme	**24781**	**39523**	**56514**	**69881**	**91957**
Growth rate		**9.8**	**7.4**	**4.3**	**2.8**

The total installed capacity will reach 1714GW by 2020, while the coal fired power occupy more than half.

10^8kW

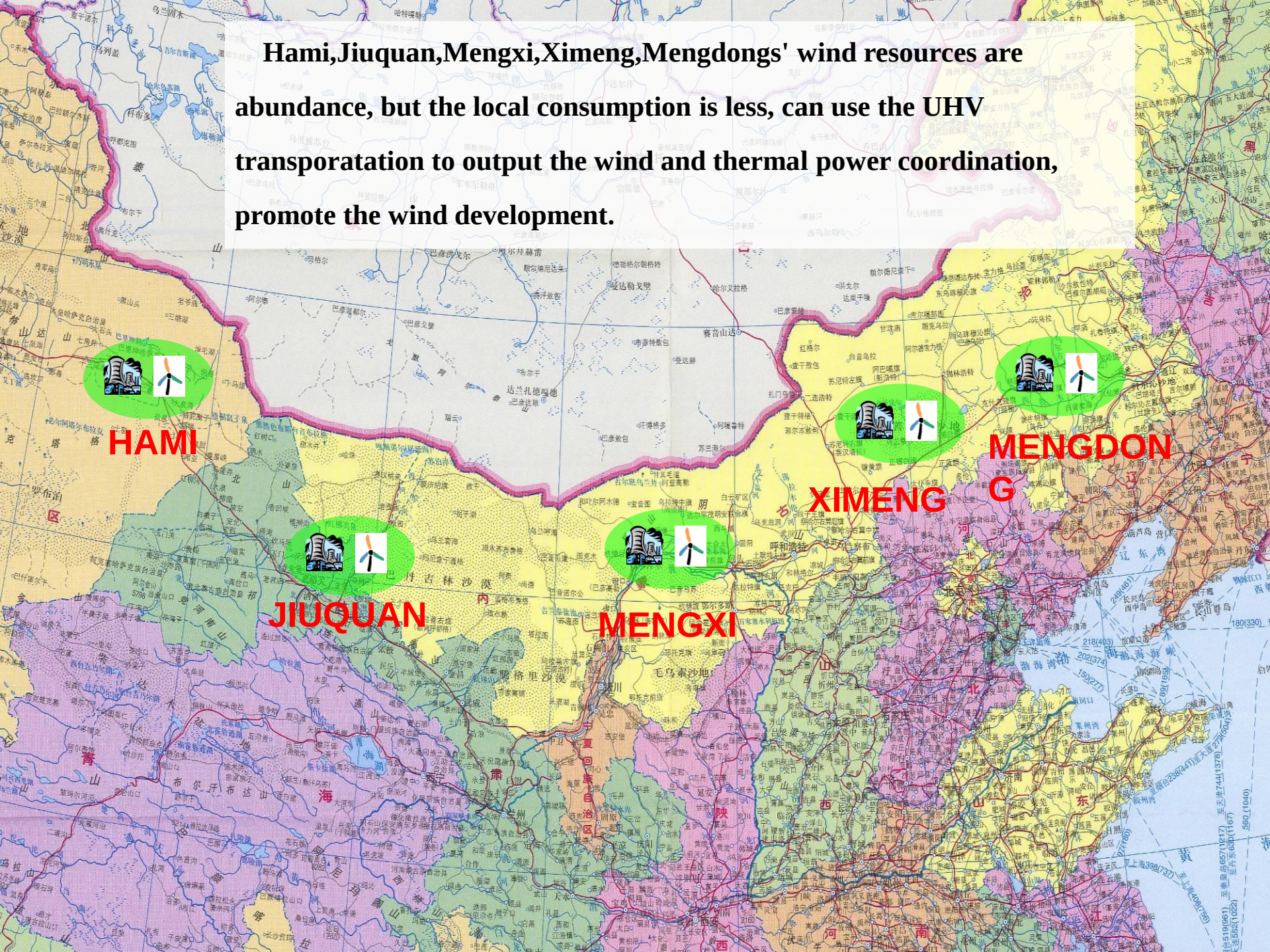
	2009	2010	2015	2020	2030
Total	87406	95424	134705	171436	234693
Hydropower	18254	18428	28773	34801	43160
Pumped Storage	1424	1694	2823	5319	8414
Coal fired power	62438	68311	87580	104396	134726
Gas turbine	2568	2935	3567	5168	7260
Nuclear power	908	1008	4284	8030	16055
Wind power	1613	2748	6309	10223	16079
Biomass energy	185	276	870	1500	2000
Solar energy	16	23	500	2000	7000

Comprehensive compare of coal transportation and power transmission

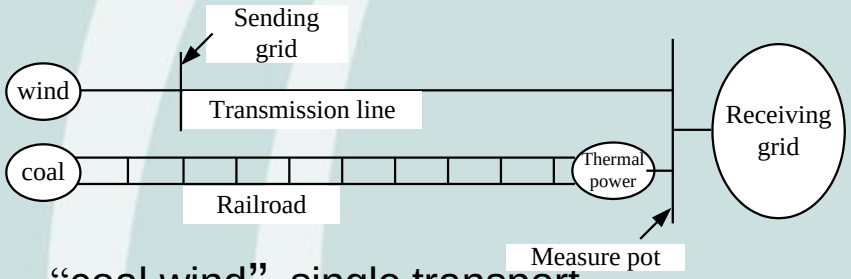
- Economy of power transmission is better than coal transportation;
- Transportation efficiency of the two means is similar;
- Power transmission is better for environmental protection;
- Power transmission is better for the development coordination of regional economic;
- Power transmission occupies less land.

The rational distribution of coal fired power in future:

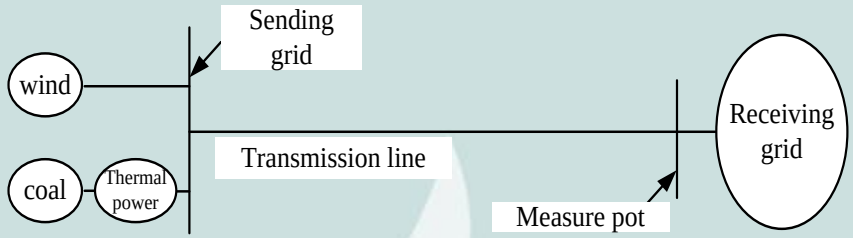
Build coal fired power base in west and north China, and transmits power to east and central China.


Hami,Jiuquan,Mengxi,Ximeng,Mengdongs' wind resources are abundance, but the local consumption is less, can use the UHV transporatation to output the wind and thermal power coordination, promote the wind development.
HAMI
JIUQUAN
MENGXI
XIMENG
MENGDONG

(3) Economy comparison



“coal,wind” single transport



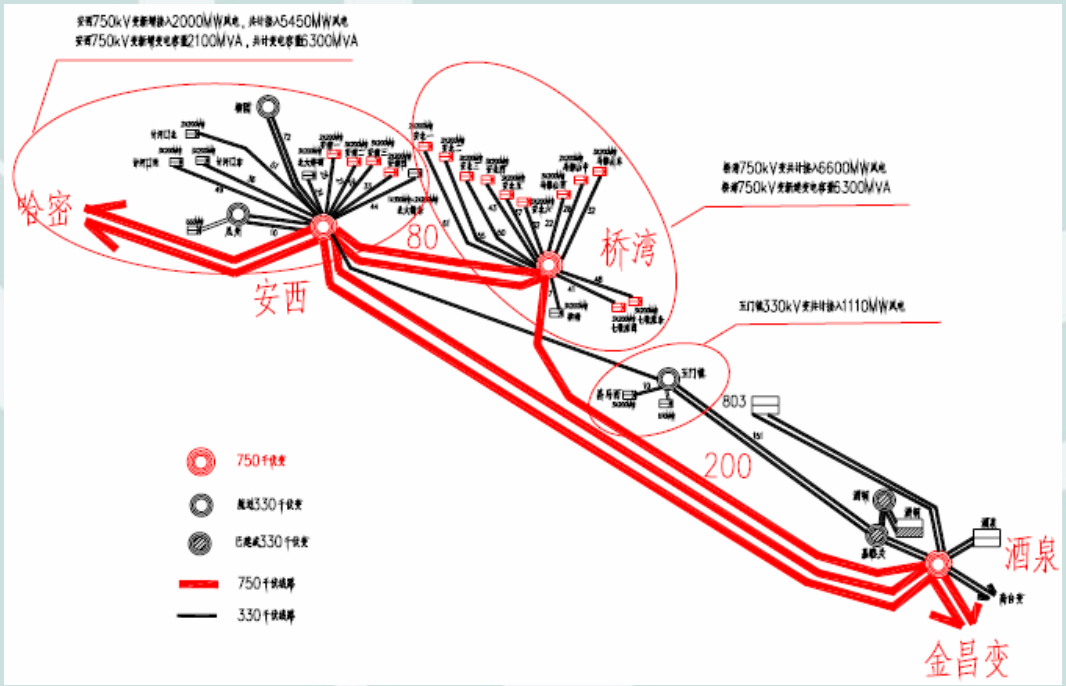
“coal+wind” coordination transport

make Jiuquan—central china±800KV DC as example：

	single transport	coordination transport
transport	±800**KV DC,capacity** 760MW	±800KV DC，capacity760MW
distribut	sending wind power 1190 MW，receiving thermal power 1900MW，wind:thermal=1:1.6	sending wind power 475MW，receiving thermal power 760MW，wind:thermal=1:1.6
electrical quantity	wind 259 billion kilo-hours	wind 100 billion kilo-hours, thermal power 390billion kilo-hours
hourly	3410 hour	6500 hour
receiving average price	0.49yuan/kilo-hours，higher than receiving price	0.43yuan/kilo-hours，equal to receiving price

(4) Technical feasibility

Make Jiuquan wind base as example, at the period of little amount of wind power ouput fast change, with eht aid of 750 KV grid, we can distribute the hydropower,thermal power,pumped storage power of north-west, stress wind power fluctuate, stable the system safety.



plan of Jiuquan Kilo-KV wind input

Jiuquan 750 KV main grid

Ⅲ、Wind exploitation, consumption, transportation

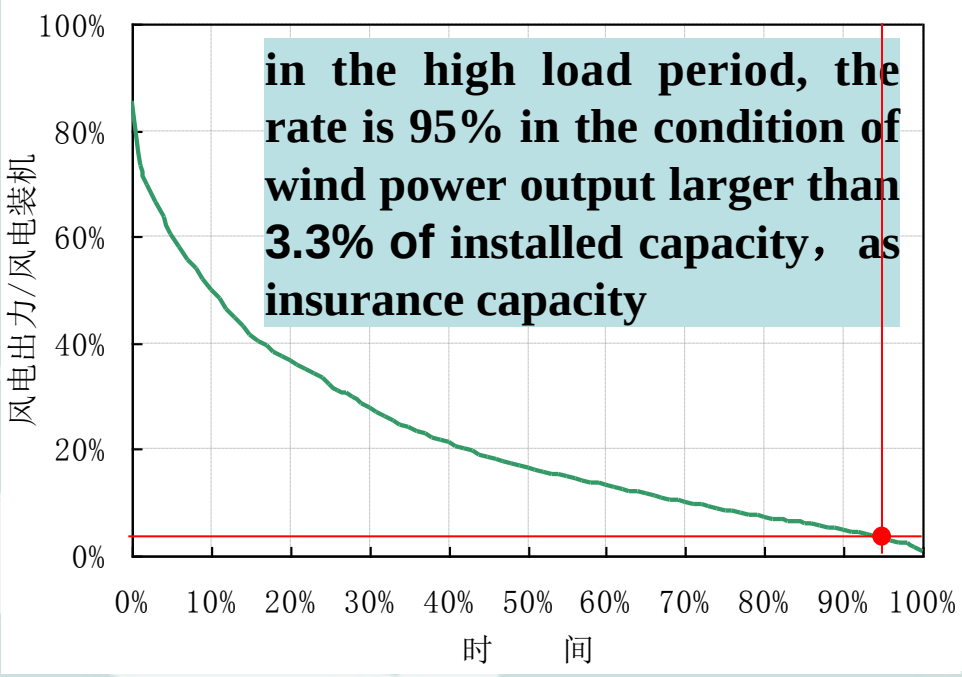
（一）Analysis of wind output characteristic

From the power system planning and operation，construct wind power output characteristic evaluation：

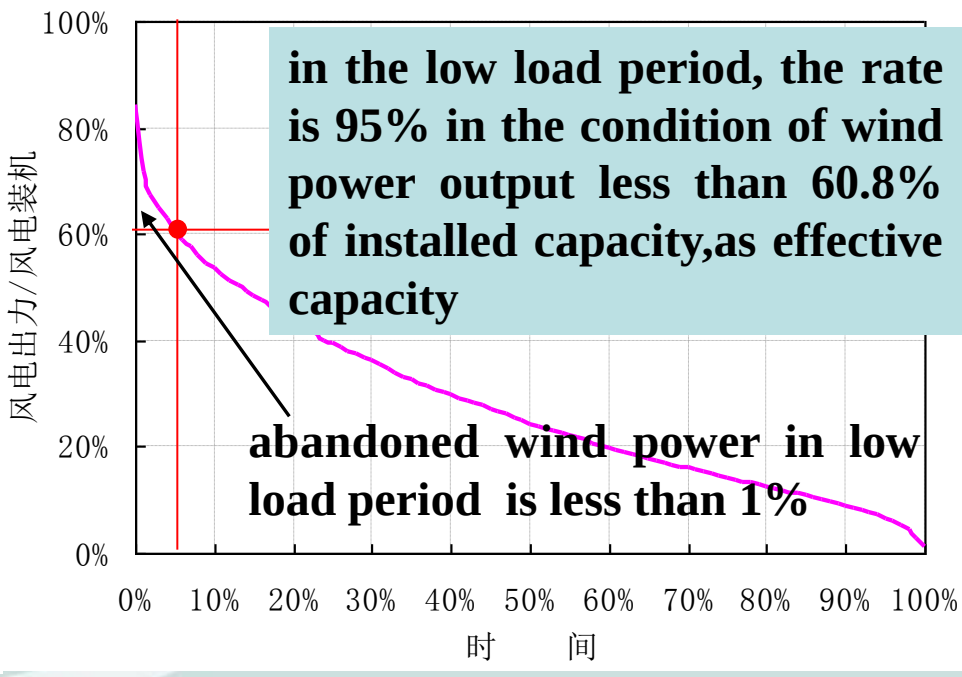
（1）insurance capacity：arrange the high load period outputs. Make the insurance of wind minimum ouput.Wind insurance capacity is mainly used to balance the wind power supplying to the system of power balance.

（2）effective output：for the rate islow of wind full sending or nearly full sending.Insure most of wind connecting the grid,restrict the low load period little amount of wind peak output quantity,especilly under5% condition, then can accelerate the wind efficiency.Wind power is mainly used as balance the low load period's peak regulation requirement.

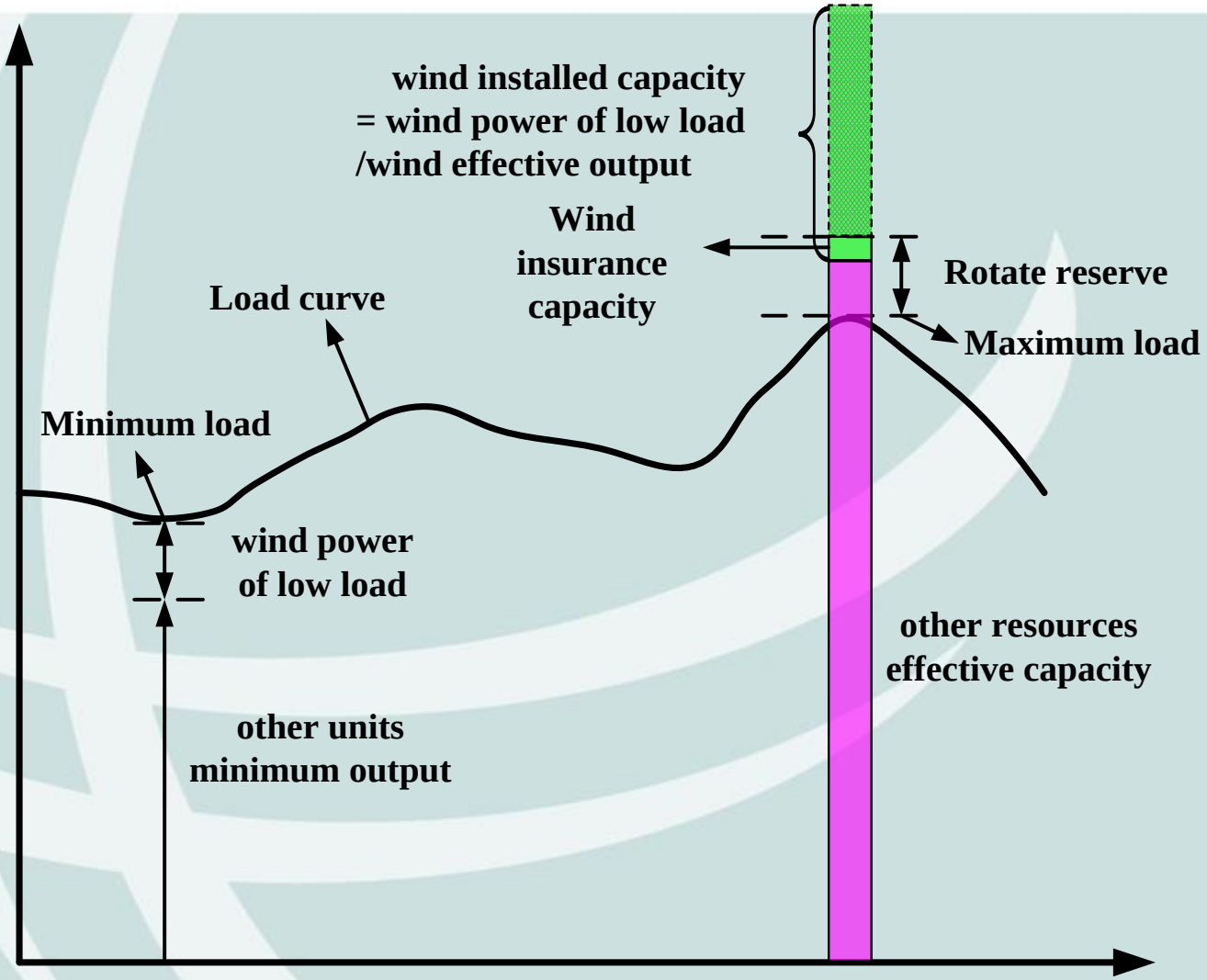
Make Jilin as example：



high load period wind continuance output curve



low load period wind continuance output curve



power and peak balance with wind power

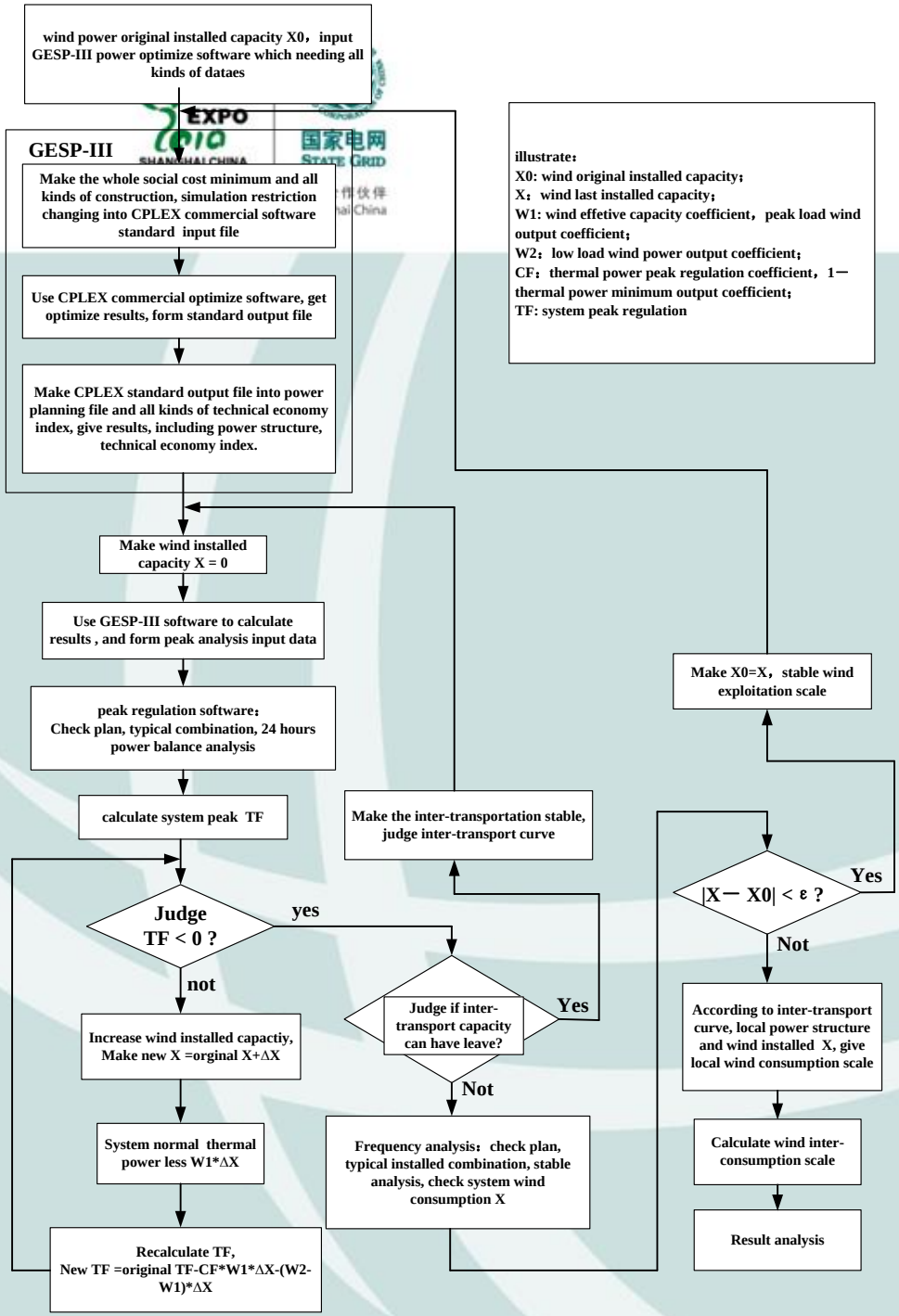
main wind bases output

characteristic	insurance capacity	effecitive output
HAMI	0.1%	80.2%
JIUQUAN	1.4%	62.9%
MENGXI	4.6%	68.5%
MENGDONG	3.8%	62.6%
JILIN	3.3%	60.8%
MENGDONG+JILIN	5.9%	58.2%
HEBEI	1.0%	63.2%
JIANGSU	0.7%	81.3%

analysis according to 2008 whole year wind data

wind power insurance capacity is low, can replace small amount of thermal power installed capacity. with the development of wind, wind intergating to grid will accelerating the installed capacity and invest.

in the same power grid, wind distribute separately,can promote wind insurance capacity, reduce effective output, improve system wind consumption.



Analysis of wind consumption

Includ the power optimization, production simulation,peak analysisi, frequency check .

firstly **set the borderline** （power requirement, preparation source,inter-area power **transpo**rtation, technical economical condition）

secondly **optimize power structure and distribution** （confirm thermal power ,clear power , peak regulation powers' scale, time,distribution and flow.）

thirdly **confirm wind consumption** （through the production simulation and peak balance analysis, compare the peak frequency, correct the wind power consumption.）

fourthly **constrigency define,alternate calculation**

fifthly **result** （include power structure, distribution, power flow, infectant and warm gas, whole cost and typical day-operation ）

Result analysis——wind development scale in 2020

Through systematic and optimize analysis,wind development scale in 2020 is 102000 MW, consumption in the inner province is 48000 MW, consumpation through the grid is 54000 MW.

wind power scale and consumption in 2020（unit:10MW）

	scale	consumption in province	consumption out of province
total	10200	4800	5500
xinjiang	1400	320	1080
gansu	1560	330	1230
mengxi	680	280	410
mengdong	1300	130	1170
jilin	750	300	450
hebei	1330	770	560
jiangsu	1080	510	570
others	2140	2140	0

Comparison

If wind power reach 1.5 billion KV, compare with the 1.0 billiong KV condition, the investment of peak source will increase, the investment of thermal power will reduce. The investment of grid will increase, the cost of power material will be reduced, the system static operation cost will be increased, the envirnomental fee will be reduced. the 1.5 billion condition will bring whole social power supply total cost increasing 2000 billion yuan.

	1.0 billion	1.5 billion	△
total cost	**180730**	**182710**	1980
1.investment	**54005**	**56539**	2534
1.1 wind	7129	9344	2215
1.2 nuclear	7234	7234	0
1.3gas	848	920	72
1.4pumped storage	1230	1370	140
1.5hydropower	5450	5450	0
1.6thermal	16578	16292	−286
1.6 others	7400	7400	0
1.3 grid	8136	8529	393
2.fuel	**102421**	**101515**	−906
3.stable cost	17532	**17957**	425
4.environmental cost	**6769**	**6699**	−70

Ⅳ、Cooperation Prospect of Wind Power between U.S. and China

（1）Cooperation in wind power large-scale grid connection and consumption planning method research

China and U.S. both face the wind power large-scale develop, long distance transmission problem in future, the planning model and method of wind power grid connection could be researched jointly.

（2）Build clean energy combined research center

Build combined research center, to do research on clean energy large-scale connection key technologies, such as wind farm control, transmission mode, technology and economy, etc.

（3）Establish clean energy grid connection technical standards

Develop common technical standards jointly, such as <Wind farm grid connection technical regulations>, Wind power and solar power generation equipment testing, certification and inspection system, etc., for promoting wind power industry long-term cooperation and rapid growth.

（4）Establish and improve clean energy power generation assistant service pricing and compensation policy

Add renewable energy assistant serive cost to the renewable energy compensation policy, improve the investment reclaim of clean energy integrating with power system, etc.

（5）Carrying out Smart Grid related technology research, accelerate wind power development

Smart grid as a new essential public carrier in promoting energy technology revolution, is very important to wind power development. The two countries could have extensive discussion and cooperation in the smart grid development route, key technology, etc.

Thanks!

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