

Applied Superconductivity in China

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电荒, 2004年中国仲夏夜之恶梦

Electrical power shortage (30GW),
the **midsummer nightmare** of 2004 .

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Outline

1. Power Application of HTS
2. National Applied Superconductivity Program (a key program of “863”) in China
3. Some facts about Chinese Power Industry



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Applied Superconductivity Research Center (ASRC), Tsinghua University

Established in 2000,

A multidisciplinary research center ,

11 full-time staff (4 Postdoc) and 14 graduate students.

- PIT BSCCO wires,
- Coated Conductors,
- Characterization,
- New methods, new applications.

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HTS filter subsystem is working at CDMA
mobile communication base station
of China Unicom Company



Apparatus of base station

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Tower of base station

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Close relation with InnoST and Innopower



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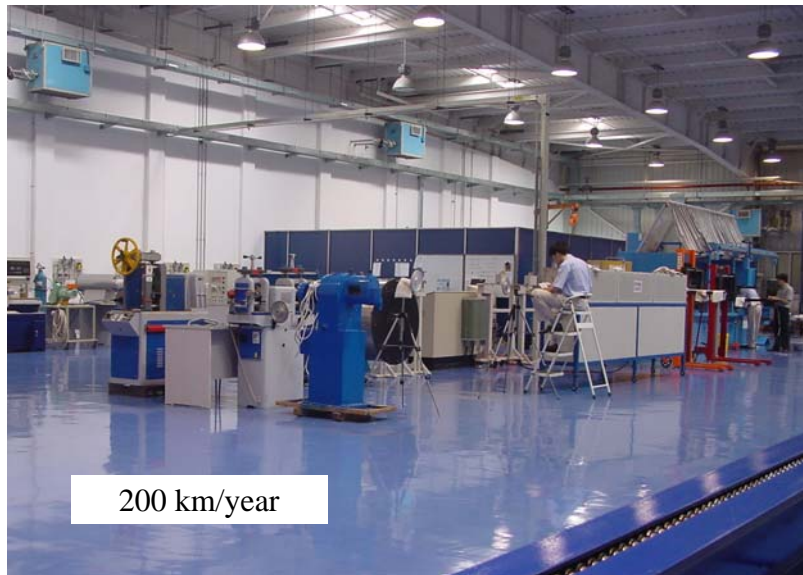


Innova Superconductor Technology Co., Ltd. (InnoST) 英纳超导公司

- **THE FIRST SUPERCONDUCTOR COMPANY IN CHINA**
- **Founded in September, 2000**
- **Located in Beijing Economy and Technology Development Area, China**
- **>30 employees,**

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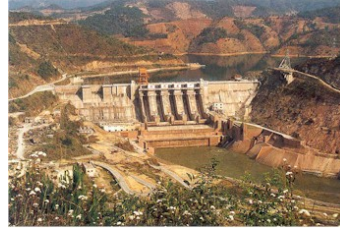
200 km/year

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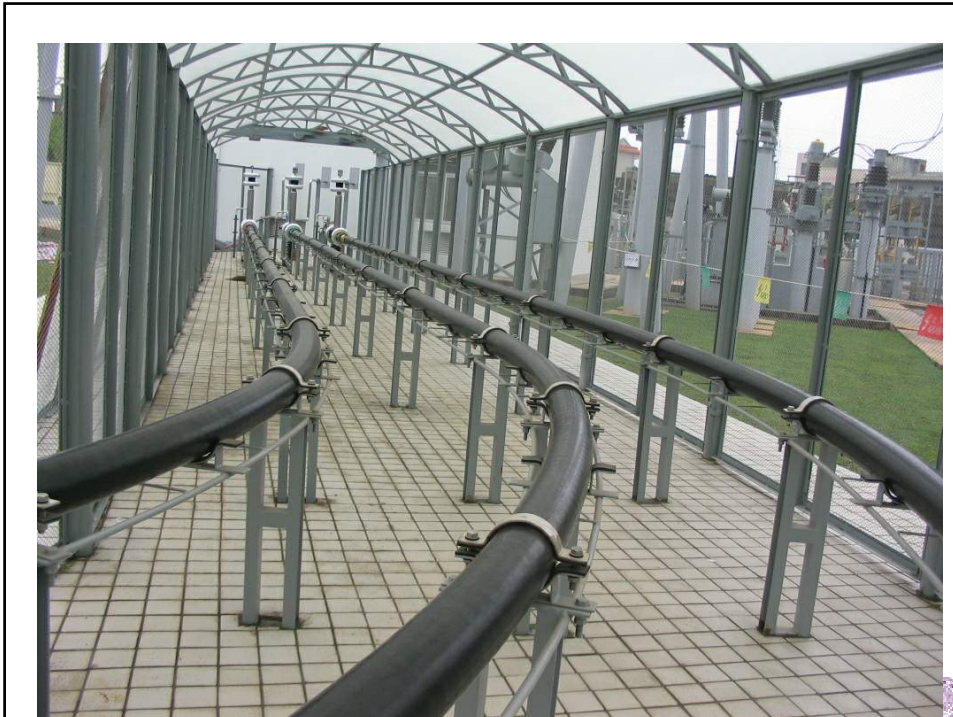
Innopower Superconductor Cable Co., Ltd. 云电英纳超导电缆公司

- Invested by YEPG and InnoST.
- Short term objective
to develop the first HST power
cable in China.
- The cable will be installed in
YUNNAN power network in
the beginning of year 2004.



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Applied Superconductivity Program

2002-2005, (863 超导专项)

**Department of High and New Technology and Industrialization,
THE MINISTRY OF SCIENCE AND TECHNOLOGY OF CHINA (MOST)
Open to European 6th Frame Programme**

Executive group members: 专家组成员

Dr. Z. Han, group leader, Tsinghua University,
Dr. H. Wen, vice group leader, CAS Institute of Physics,
Dr. P. Zhang, vice group leader, Northwest Institute for Non-ferrous Metal
Research
Dr. H. Gu, General Research Institute for Nonferrous Metals
Dr. L. Xiao, CAS Institute of Electrical Engineering
Dr. Y. Tang, Huazhong University of Science and Technology
Dr. F. Wang, Peking University

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Three areas:

- **Superconducting materials.**
- **Power applications.**
- **Electronic applications.**

- **31 projects, 31个项目**
- **RMB 100 millions for 3 years supported by MOST.**
- **> RMB 300 millions supported by local governments and Industries.**

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Superconducting Materials Projects

- Long BSCCO tape,
- MgB₂ wires,
- Low T_c wires,
- Large Area YBCO Thin Film,
- Coated Conductor.

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Power application projects:

- Power cable,
- Current limiter,
- Transformer,
- Magnets,
- Motor,
- SMES,
- MRI,
- MAGLEV.

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Electronic application projects

- Microwave filter,
- Microwave receiver,
- SQUID and application,
- Junction and device.

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10m、10.5kV/1.5kA三相交流高温超导电缆,

75m、10.5kV/1.5kA三相, 预计今年完成并进行挂网示范运行。

中国科学院电工研究所
甘肃长通电缆科技股份有限公司
中国科学院理化所



图3 三相高温超导电缆整体装置

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(1) 高温超导限流器小型样机

已研制出的400 V/25 A的新型三相高温超导限流器样机，其短路电流缩减率达到了80%。




(2) 四象限换流器

新研制的四象限换流器是限流装置中的重要环节，通过变压器接入电力系统，能完成限流、DVR等各种功能。



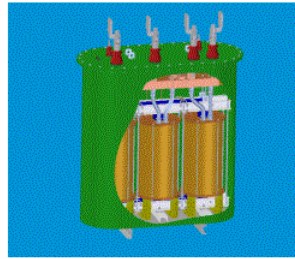
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中国科学院电工研究所与新疆特变电工股份有限公司及河北大学, 从2002年起共同开展三相630kVA/10.5kV高温超导变压器的基础研究与开发, 作为阶段性研究开发成果, 2003年11月完成26kVA/400V高温超导变压器的研制,

三相26kVA/400V高温超导变压器参数如下:

额定电压(V): 400/16
额定电流(A): 37.5/938
短路阻抗: 2.793
空载电流: 1.6%
变比: 25/1



Applied Superconductivity in Huazhong University of Science and Technology (HUST)

Prof. Tang Yue-Jin

Tel: 86-27-87544755, E-mail: tangyj@mail.hust.edu.cn



Testing SMES with Electric power system dynamic simulator



HT-7U Superconducting Tokamak
Institute of Plasma Physics, Chinese Academy of Sciences

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HT-7U Major Parameters

• Major radius	1.7 m
• Minor radius	0.4 x 0.72 m
• Toroidal field on plasma axis	3.5 T
• Peak field at TF winding	5.8 T
• Total Ampere-turns of TF coils	30 MAT
• Stored energy in TF coils	300 MJ
• Cold mass at 4 K	170 tons
• Plasma current	1 MA
• Flux swing of PF coils	10 Vs



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Test Facility for Big SC Magnet



Dewar dimensions: 3.4m OD/ 6.2m height

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SET

US Plan for National Grid Innovation

National Energy Policy

May, 2001: VP Cheney to President Bush
High Temperature Superconductivity (HTS) is one of Key Tech

Office of Electric Transmission and Distribution

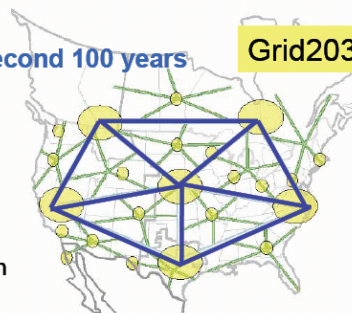
Established in DOE in April, 2003 to create a more prosperous, efficient, clean, and secure electricity

A National Vision for Electricity's Second 100 years

April, 2003: Start to study
2010• Multiple 10 mile of HTS cables
2020• Long distance HTS cables
2030• HTS cable Backbone

Grid2030

-  Backbone
-  Regional Interconnection
-  Local Grid



K. Sato, SEI

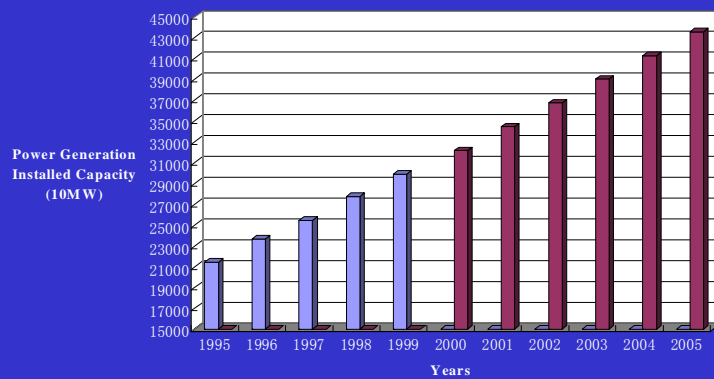
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What about in China?

7%/year increasing (now > 380 GW)

根据预测，2010年将达到6.5亿千瓦左右，2020年达到9.5亿千瓦左右。



- **Total installed capacity, China ranks second only after U.S.A.**
- **In 2000, capacity/population in China < 1/3 of world,.**
- **Capacity / population will be 1kW in 2050, the middle level of current developed country.**
- **Power consumption increased 15% past half year; 8 GW in Beijing and 15GW in Shanghai this summer.**

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电荒, 2004年中国仲夏夜之恶梦
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2月全国发电量1581.77亿千瓦时（日均发电量54.54亿千瓦时），比上年同期增长31.36%。

全国发电装机容量已达3.85亿千瓦，在建电力项目1.3亿千瓦。

Capacity 385GW,

Shortage 30GW,

线损率 line losses 7% (Three Gorges Project: 18 GW)

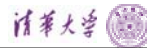
130GW under construction

It is said that 2006 could be better

Could be worse

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Population: 1.3 Billion

Basic requirement, food, cloth. 1980s

Better life, TV, washing machine, refrigerator,
US\$ 200-400, low energy consuming.

Easy life, air conditioner, car, high energy consuming.

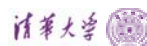
But 1kw air conditioner only cost about US\$ 200,
affordable for many Chinese now!

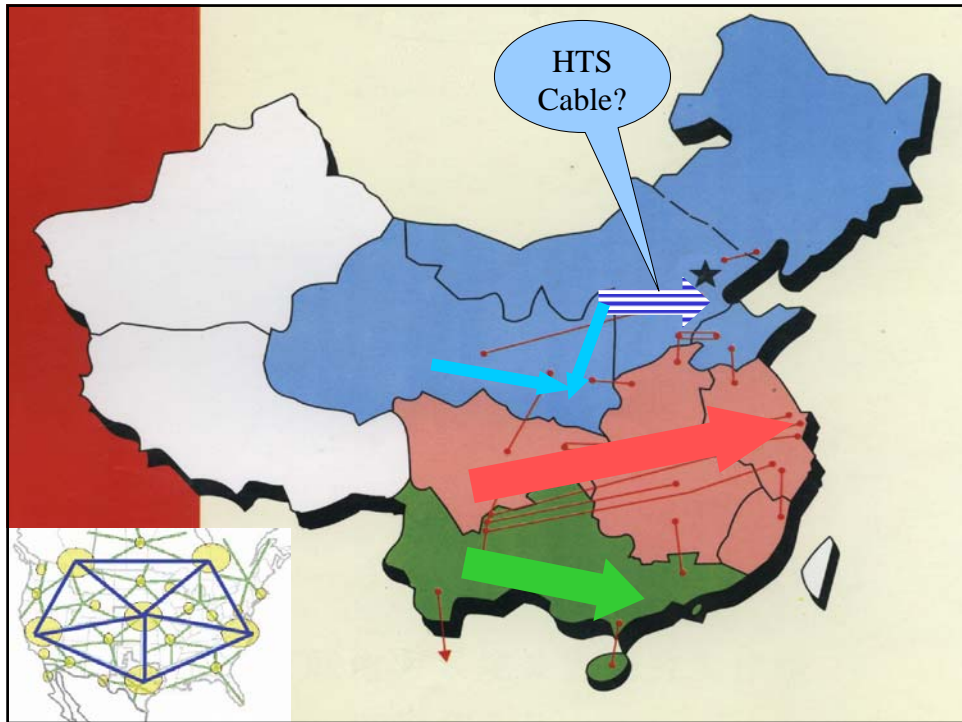
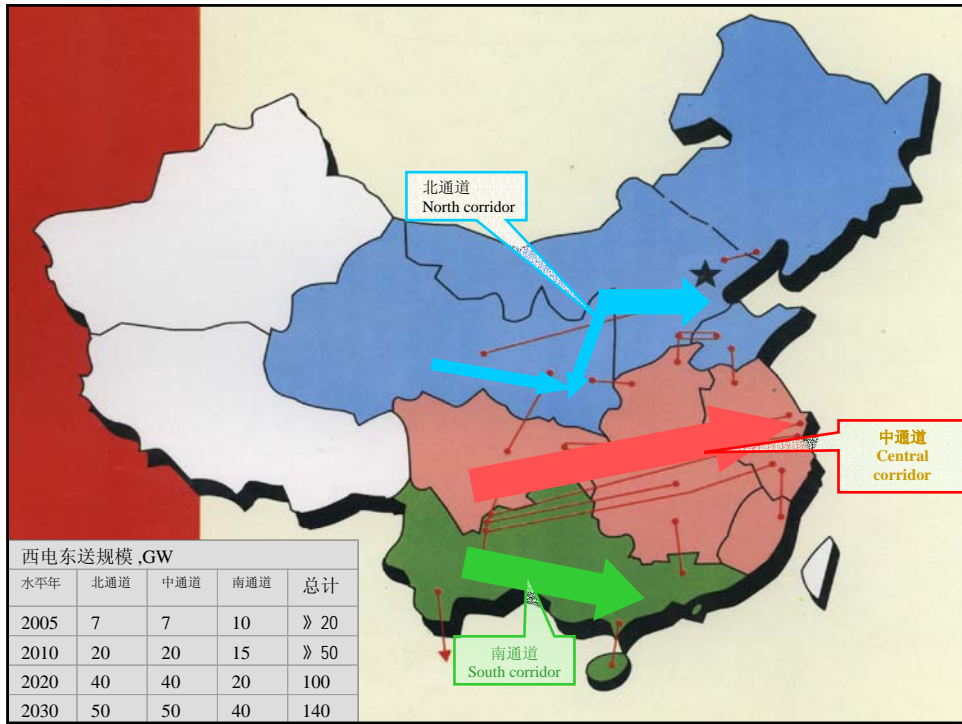
So, to reach 1000GW is easy!!

HTS could be a solution

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A HTS Power Application Project by International Collaboration in China?

The project could be a Cable,

Could be a demonstration site:

HTS generator + transformer + cable,
+ SMES + and motor +

A Show Case

Summary

- Recently, applied superconductivity activities are increasing significantly in China.
- The potential HTS applications in China could be big.
- International collaboration is a good way to promote HTS applications.



Thanks
谢谢