

## POLICY, REGULATION, AND INNOVATION IN CHINA'S ELECTRICITY AND TELECOM INDUSTRIES

The scale of China's innovation ambitions inspires worldwide commentary, much of it poorly informed. Focusing on electricity, telecommunication, and semiconductors, this book offers a focused and detailed account of China's effort to promote innovation. Massive application of human, policy, and financial resources shows great promise, but institutional obstacles, conflicting objectives, ill-advised policies, and Soviet-era legacies inject inefficiencies, resulting in a complex mosaic of success and failure in both technical and commercial dimensions. Thus, State Grid leads the world in high-voltage power transmission, while domestic semiconductors remain far behind the international frontier. China's electricity and telecom providers record impressive technical advances, but excess investment and inefficient operation contribute to high costs and prices. Nuclear power displays an unexpected combination of technical excellence and commercial weakness. Cost reduction rather than technical advance underpins commercial success in solar materials. These granular studies look beyond specific technologies to incorporate the policy matrix, regulatory structures, and global technical developments into the appraisal of China's innovation prospects.

**Loren Brandt**, a China specialist, is the Noranda Chair Professor of Economics and International Trade at the University of Toronto. His current research focuses on issues of industrial upgrading and development, China's long-run economic growth, and inequality dynamics.

**Thomas G. Rawski** is Emeritus Professor of Economics and History at the University of Pittsburgh. His research focuses on the development and modern history of China's economy. His publications include a 2008 volume, *China's Great Economic Transformation*, co-edited with Loren Brandt.

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# Policy, Regulation, and Innovation in China's Electricity and Telecom Industries

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**L. B. and T. G. R.**  
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Abbreviations

|       |  |
|-------|--|
| 3GPP  | Third Generation Partnership Project   |
| A&T   | assembly and testing   |
| AC    | alternating current  |
| AI    | artificial intelligence  |
| ARM   | a UK-based semiconductor design house  |
| ARPU  | average revenue per use  |
| ASME  | American Society of Mechanical Engineers   |
| AUSC  | advanced ultra super-critical  |
| BTU   | British thermal unit   |
| CATT  | China Academy of Telecommunications Technology                                   |
| CCTV  | China Central Television   |
| CDB   | China Development Bank   |
| CDM   | (United Nations) Clean Development Mechanism                                     |
| CDMA  | one of several technical interconnect standards for 2G wireless telecom networks |
| CEC   | China Electricity Council  |
| CFIUS | Committee on Foreign Investment in the United States                             |
| CGN   | China General Nuclear Corporation, formerly China Guangdong Nuclear              |
| CHFI  | China First Heavy Industries   |
| CIC   | China industrial classification  |
| CIGRE | International Council on Large Electric Systems                                  |
| CMOS  | complementary metal oxide semiconductor  |
| CNNC  | China National Nuclear Corporation   |
| CPI   | China Power Investment Corporation   |
| CPU   | central processing unit  |
| CSMC  | Central Semiconductor Manufacturing Corporation                                  |



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|        |   |
|--------|---|
| DC     | direct current  |
| DRAM   | dynamic random-access memory  |
| DRC    | Development Research Center of the State Council                          |
| EDA    | electronic design automation  |
| EDF    | Électricité de France   |
| EED    | energy-efficiency dispatch  |
| EIA    | US Energy Information Administration                                      |
| EPRI   | Electric Power Research Institute   |
| ERCOT  | Electricity Reliability Council of Texas                                  |
| EV     | electric vehicle  |
| FCC    | Federal Communications Commission (United States)                         |
| FDD    | Frequency Division Duplexing  |
| FDI    | foreign direct investment   |
| FIT    | feed-in tariff  |
| FYP    | Five-Year Plan  |
| GCE    | grams of coal equivalent  |
| GDP    | Gross Domestic Product  |
| GDSII  | Gerber Data Stream Information Interchange                                |
| GEI    | Global Energy Interconnection   |
| GEIDCO | Global Energy Interconnection Development and<br>Cooperation Organization |
| GMS    | Google mobile services  |
| GNI    | Gross National Income   |
| GPU    | graphics processing unit  |
| GSM    | one of two technical standards for China's 2G telecom<br>networks         |
| GVC    | global value chain  |
| GW     | gigawatt  |
| GWe    | gigawatt electrical   |
| GWh    | gigawatt hour   |
| HHNEC  | Huahong-NEC, a Sino–Japanese joint venture firm                           |
| HS     | Harmonized Commodity Code and Classification<br>System                    |
| HTDZ   | high technology development zone  |
| HTGR   | High Temperature Gas-cooled Reactor                                       |
| HVAC   | high-voltage alternating current  |
| HVDC   | high-voltage direct current   |
| IAEA   | International Atomic Energy Agency  |
| IC     | integrated circuit  |
| ICT    | information and communications technology                                 |

|          |   |
|----------|---|
| IDM      | integrated device manufacturer  |
| IEA      | International Energy Agency   |
| IEEE     | Institute of Electrical and Electronics Engineers   |
| IGCC     | integrated gasification combined cycle  |
| IP       | intellectual property   |
| IPO      | initial public offering   |
| IPTV     | Internet Protocol television  |
| IRENA    | International Renewable Energy Agency   |
| ISC      | Internet Society of China   |
| ITRS     | International Technology Roadmap of Semiconductors  |
| ITU      | International Telecommunications Union  |
| JV       | joint venture   |
| KM       | kilometers  |
| KV       | kilovolt  |
| KW       | kilowatt  |
| KWh      | kilowatt hour   |
| LED      | light-emitting diode  |
| LTE      | Long-Term Evolution (standard for high-speed wireless communication)                                      |
| LTE-FDD  | Long-Term Evolution – Frequency Division Duplexing: 4G standard evolved from Chinese 3G standard (TDCDMA) |
| LTE-TDD  | Long-Term Evolution – Time Division Duplexing: 4G standard evolved from global 3G standard (CDMA)         |
| MCI      | Microwave Communications Inc.   |
| MEP      | Ministry of Electric Power  |
| MIC 2025 | Made in China 2025  |
| MII      | (former) Ministry of Information Industry   |
| MIIT     | Ministry of Industry and Information Technology   |
| MITI     | Ministry of International Trade and Industry (Japan)  |
| MLP      | 2006 Medium- and Long-Term Plan for the Development of Science and Technology                             |
| MNC      | multinational corporation   |
| MOST     | Ministry of Science and Technology  |
| MOU      | memorandum of understanding   |
| MOX      | mixed oxide fuel  |
| MPT      | Ministry of Post and Telecommunications   |
| MSS      | Ministry of State Security  |
| MTK      | MediaTek, a Taiwan-based chip design company  |
| MVNO     | mobile virtual network operators  |

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|        |   |
|--------|---|
| MW     | megawatt  |
| MWh    | megawatt hour   |
| NAND   | not-AND memory  |
| NARI   | Nanjing Automation Research Institute                                     |
| NBS    | National Bureau of Statistics   |
| NDRC   | National Development and Reform Commission                                |
| NEA    | National Energy Agency  |
| NEC    | Nippon Electric Corporation (Japan)                                       |
| NELG   | National Energy Leading Group   |
| NEV    | new energy vehicles   |
| NNSA   | National Nuclear Safety Agency  |
| NPP    | nuclear power plant   |
| NTT    | Nippon Telephone and Telegraph Corporation (Japan)                        |
| OECD   | Organization for Economic Cooperation and<br>Development                  |
| PCT    | Patent Cooperation Treaty   |
| PHS    | Personal Handy-phone Service  |
| PLA    | People's Liberation Army  |
| PPP    | purchasing-power parity   |
| PRC    | People's Republic of China  |
| PV     | photovoltaic  |
| R&D    | research and development  |
| RDA    | RDA Microelectronics, a fabless semiconductor<br>company                  |
| RF     | radio frequency   |
| RFID   | radio-frequency identification  |
| RMB    | Renminbi  |
| ROA    | return on assets  |
| S&T    | science and technology  |
| SAIL   | Shanghai Alliance Investment Limited                                      |
| SAPFRT | State Administration of Press, Publication, Radio, Film<br>and Television |
| SARFT  | State Administration of Radio, Film and Television                        |
| SASAC  | State-owned Assets Supervisory and Administration<br>Commission           |
| SAT    | State Administration of Taxation  |
| SC     | super-critical  |
| SCDMA  | Synchronous Code-Division Multiple Access                                 |
| SEI    | strategic emerging industry   |

|                 |  |
|-----------------|--|
| SEMI            | a global electronics manufacturing supply chain industry association   |
| SERC            | State Electricity Regulatory Commission                                |
| SGCC            | State Grid Corporation of China  |
| SGCET           | China Electric Power Equipment and Technology Co. Ltd.                 |
| SIH             | Shanghai Industrial Holdings   |
| SMIC            | Semiconductor Manufacturing International Corporation                  |
| SMIT            | English name for Chinese firm, Guowei Jishu                            |
| SNPTC           | State Nuclear Power Technology Corporation                             |
| SO <sub>2</sub> | sulfur dioxide   |
| SOC             | system-on-chip   |
| SOE             | state-owned enterprise   |
| SPC             | State Power Corporation  |
| SPI             | State Power Investment Corporation                                     |
| Sub             | sub-critical   |
| T&D             | transmission and distribution (of electricity)                         |
| TDD             | Time Division Duplexing  |
| TD-LTE          | 4G iteration of time division technology                               |
| TD-SCDMA        | Time Division Synchronous Code Division Multiple Access                |
| TFP             | total factor productivity  |
| TRIMs           | trade-related investment measures                                      |
| TSMC            | Taiwan Semiconductor Manufacturing Co. Ltd.                            |
| UF6             | uranium hexafluoride   |
| UHV             | ultra-high voltage   |
| UMC             | United Microelectronics Corporation, a Taiwanese semiconductor company |
| USC             | ultra super-critical   |
| VAT             | value-added tax  |
| VC              | venture capital  |
| WANO            | World Association of Nuclear Operators                                 |
| WCDMA           | Wide Band Code Division Multiple Access                                |
| WTO             | World Trade Organization   |
| XD              | Xidian Group   |
| XMC             | Wuhan Xinxin Semiconductor Manufacturing Corporation                   |
| YMTC            | Yangtze Memory Technology Corporation                                  |

Map of China



Industries  
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