

CPD Power and Energy Study on

Opportunities and Challenges for Overseas Investment in the Renewable Energy Sector of Bangladesh: The Case of China

Session I: China's Success on Renewable Energy Development

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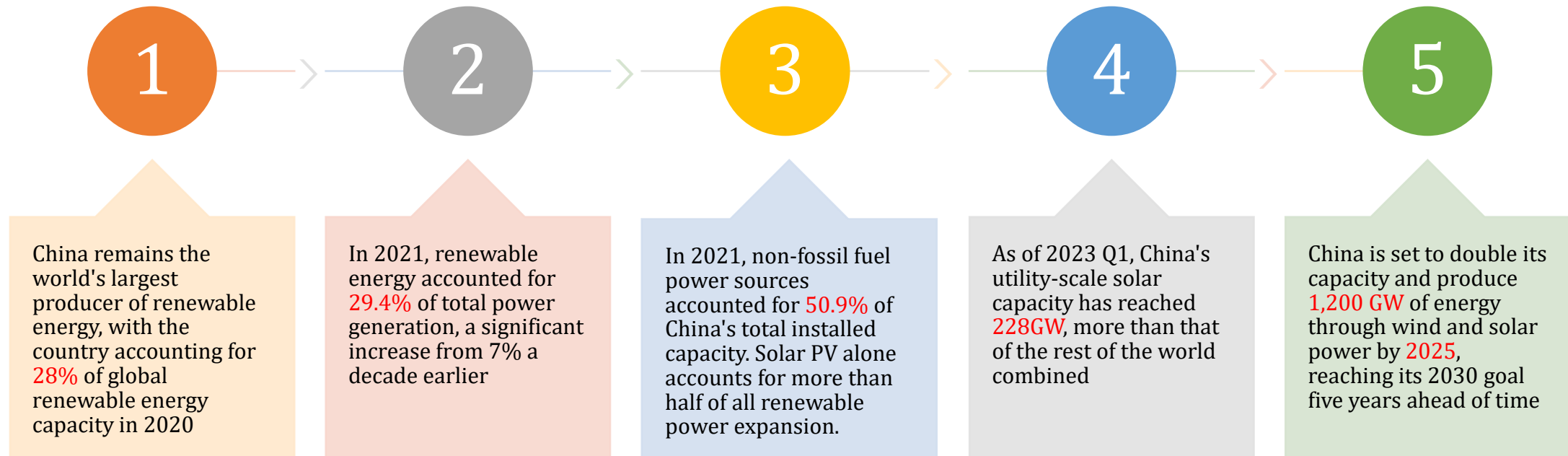
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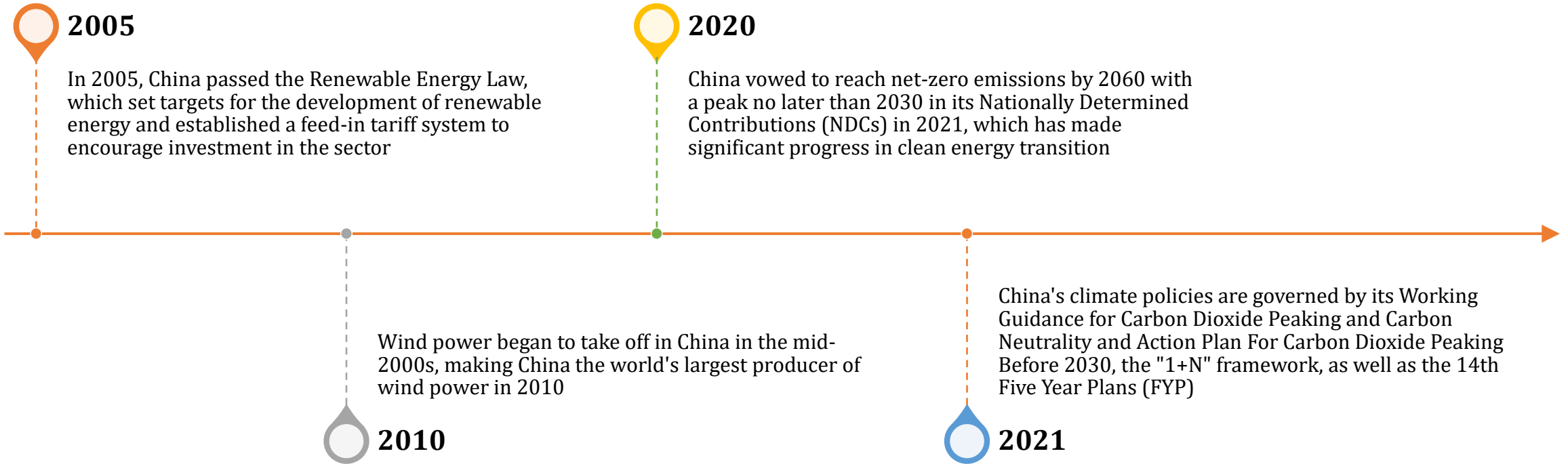
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1. Introduction

China has become one of the frontrunners in renewable energy-based economy in the world



1. Introduction



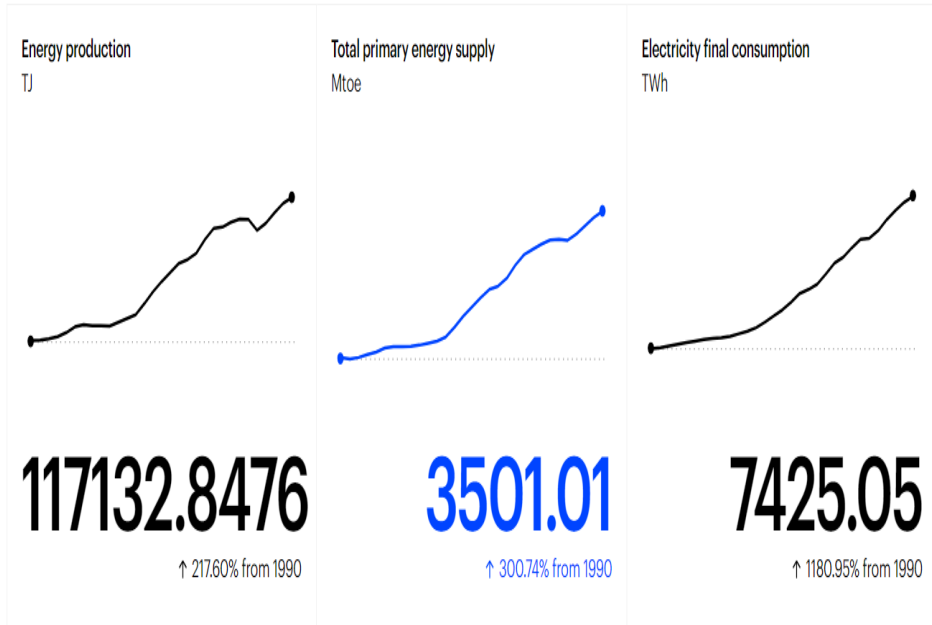
2. Objectives

- Since Bangladesh aims to achieve 40% renewable energy by 2041, China's investment and development experience in the renewable energy sector can help Bangladesh achieve this goal
- CPD intends to analyze how China became the global leader in the renewable energy sector from being one of the biggest fossil fuel consumers by strengthening its institutional, legal, financial, technical, and operational aspects of the renewable energy sector



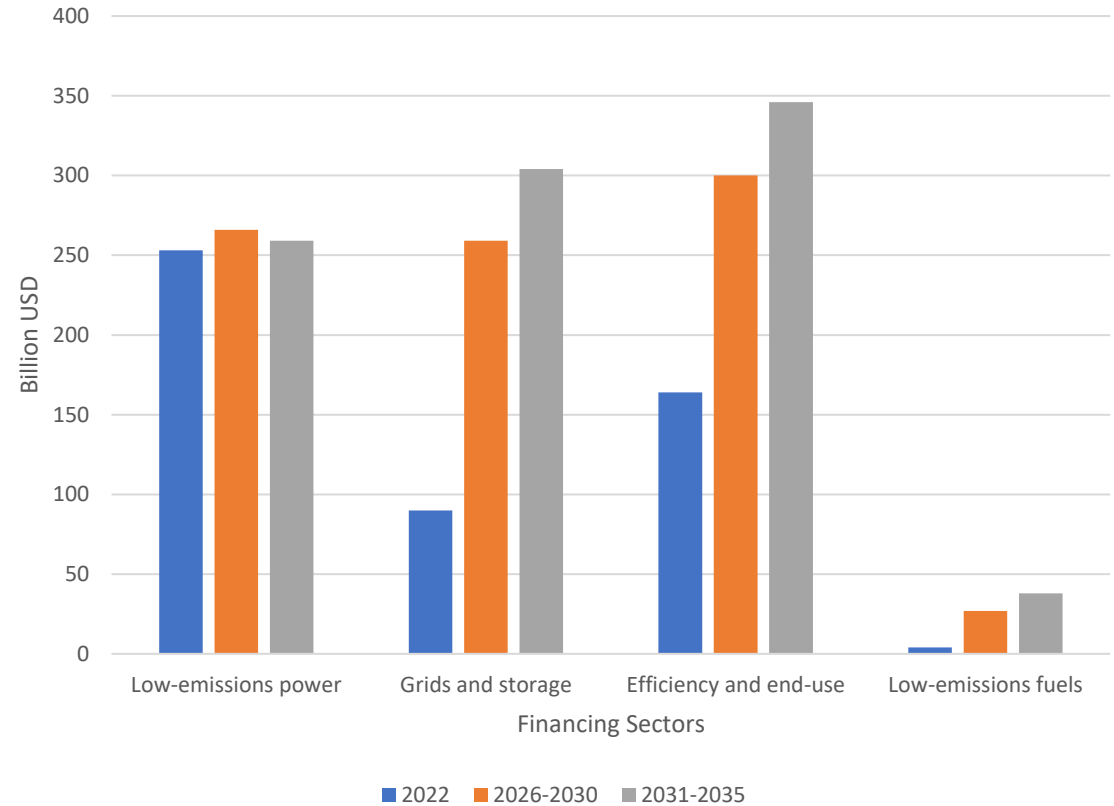
3. Overview of China's Renewable Energy Sector

China's Energy Consumption in 2020



Source: IEA

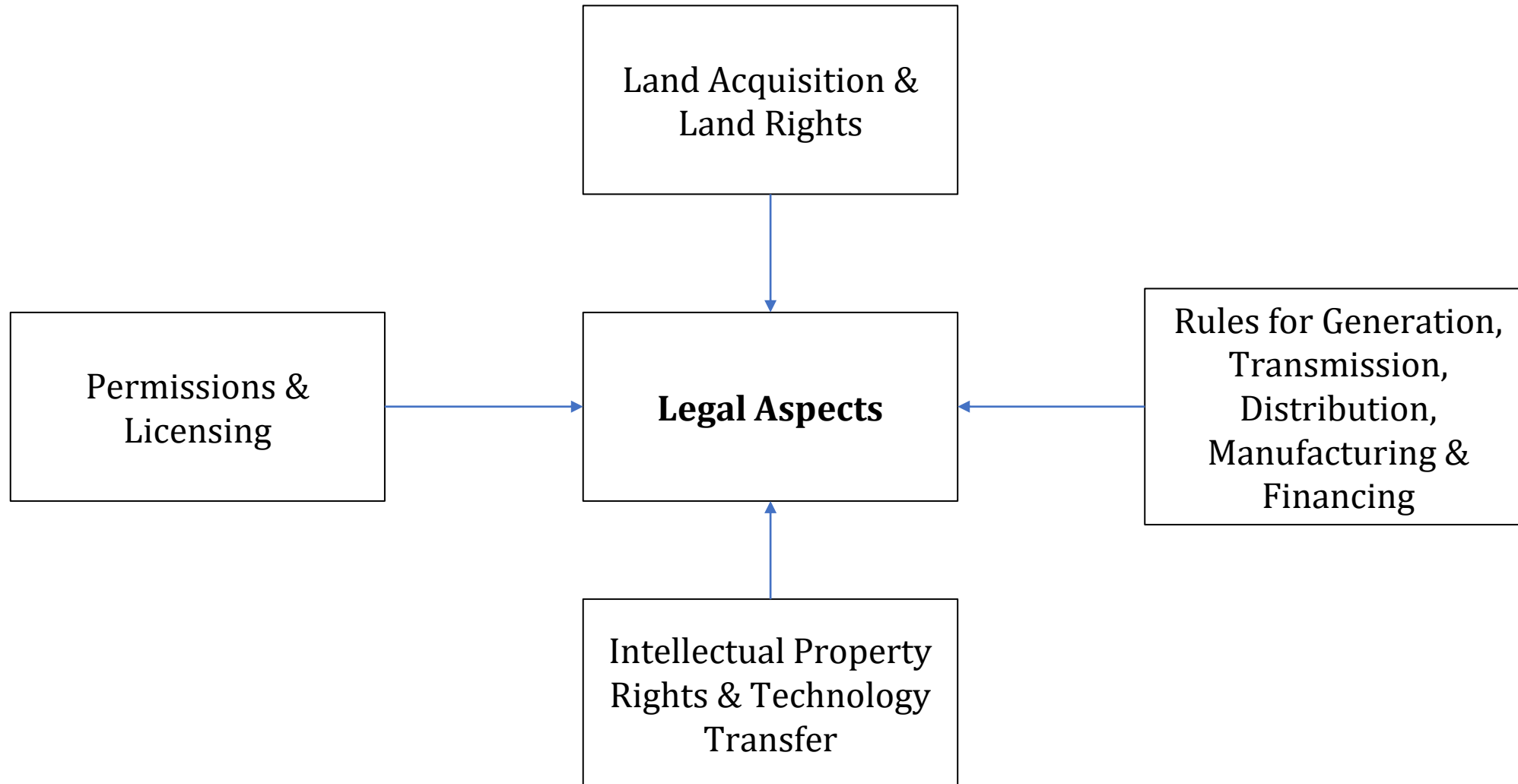
Clean Energy Investment by Sectors in China in the Net Zero by 2050 Scenario



Source: IEA

4. Legal Aspects of the Renewable Energy in China

Figure: Legal Aspects of the Renewable Energy in China



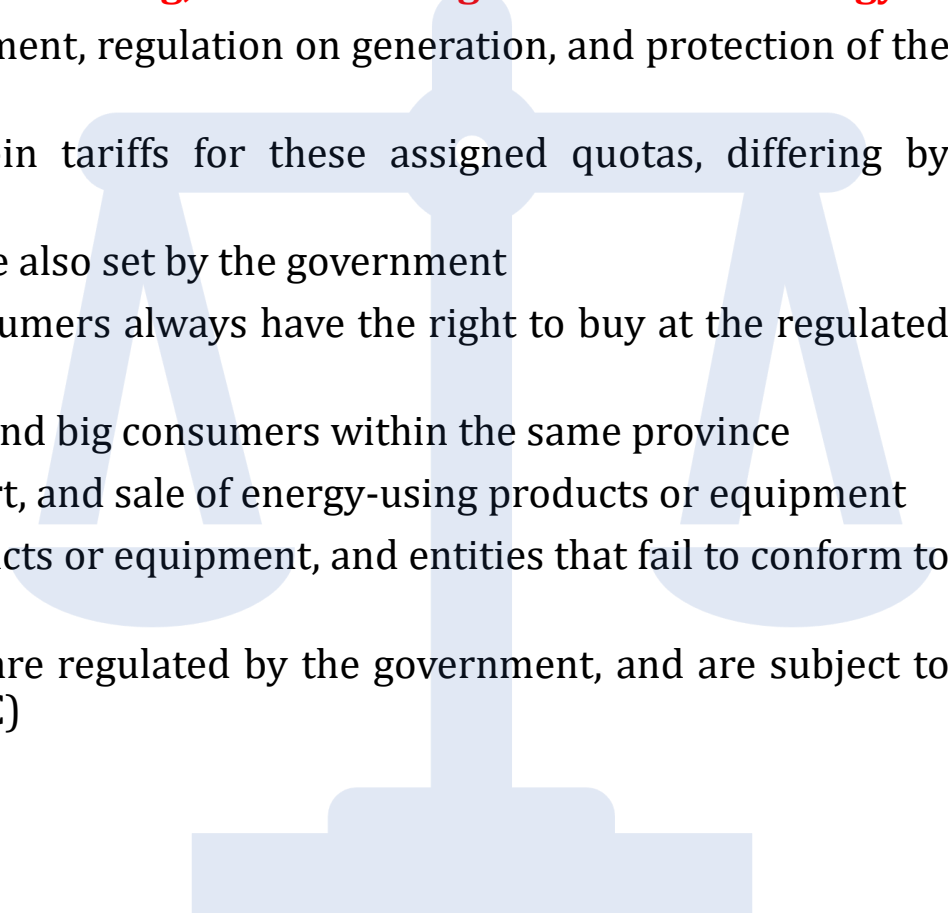


4. Legal Aspects of the Renewable Energy in China

- **4.1 Major Laws Dominating China's Renewable Energy Sector**
 - **Renewable Energy Law of the People's Republic of China**
 - A framework policy that lays out the general conditions for renewable energy to become a more important energy source in China
 - **Draft Energy Law**
 - Stipulates that renewable energy development will be prioritized
 - **Supporting Policies**
 - Policies like the new 14th Renewable Energy Five-Year Plan (FYP) sets a goal for **50%** of China's incremental energy consumption to come from renewables, establishes a 2025 renewable electricity consumption share of **33%**, and directs that **50%** of China's incremental electricity and energy consumption shall come from renewables over the period 2021-2025

4. Legal Aspects of the Renewable Energy in China

- **4.2 Rules for China's Generation, Transmission, Distribution, Manufacturing, and Financing in Renewable Energy**
- **Electricity Law:** Its main provisions include prior approval for investment, regulation on generation, and protection of the interests of investors, enterprises, and users/consumers
- **Fair Dispatch Rule:** Provincial governments set benchmark feed-in tariffs for these assigned quotas, differing by generation technology
 - Transmission and distribution fees and retail electricity prices are also set by the government
- **Feed-in Tariff:** Generators are guaranteed the feed-in tariff, and consumers always have the right to buy at the regulated retail price and will only accept a lower contract price
- **Forward Contracts:** These are contracts between eligible generators and big consumers within the same province
- **Energy Conservation Law:** This law regulates the manufacture, import, and sale of energy-using products or equipment
 - It also sets mandatory energy efficiency standards for such products or equipment, and entities that fail to conform to these standards may face fines and other penalties
- **Regulation by the NDRC:** The transmission and distribution prices are regulated by the government, and are subject to approval by the National Development and Reform Commission (NDRC)



4. Legal Aspects of the Renewable Energy in China

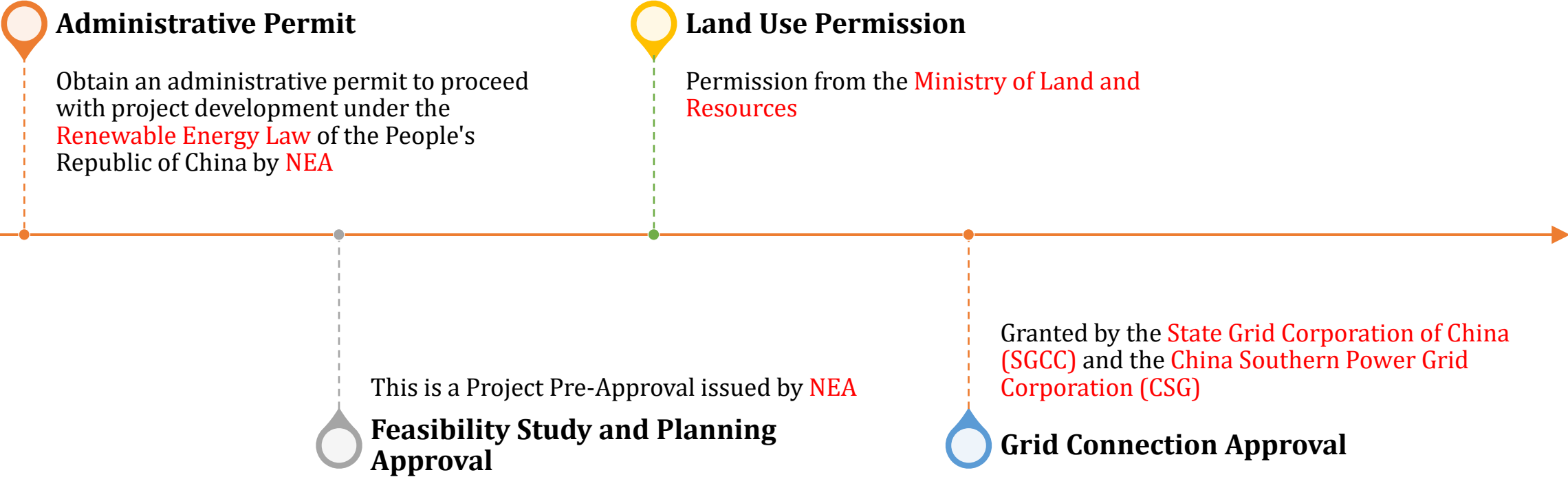
- **4.3 Handling Legal Issues Related to Land Acquisition and Land Rights**

- **Renewable Energy Scale-Up Program (CRESP):** Project to include a resettlement action plan that aims to replace land for farmers, promote employment opportunities, and provide social assistance to help maintain or raise the livelihoods of those affected by renewable energy projects
- **Land Use Rights:** Individuals and entities can obtain land use rights through leases or allocations
- **Land Zoning and Planning:** China is streamlining its land use policy to make space for large-scale solar PV installations (e.g. Desserts)
- **Land Requisition and Compensation:** When land is requisitioned for renewable energy projects, the government is required to provide compensation to landowners or land users based on the assessed value of the land and the potential income loss

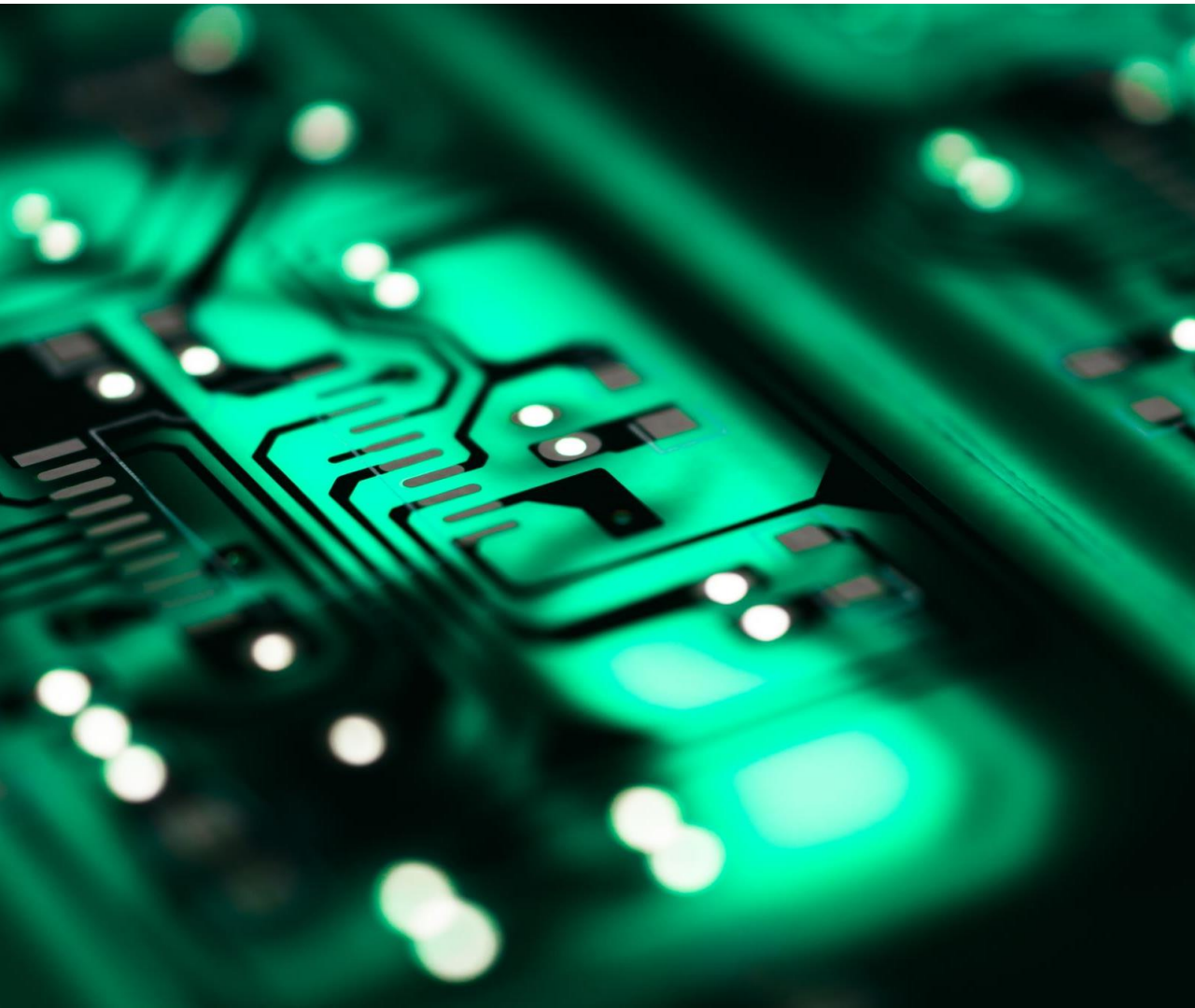


4. Legal Aspects of the Renewable Energy in China

4.4 Permissions and Licensing for Renewable Energy Installations



4. Legal Aspects of the Renewable Energy in China

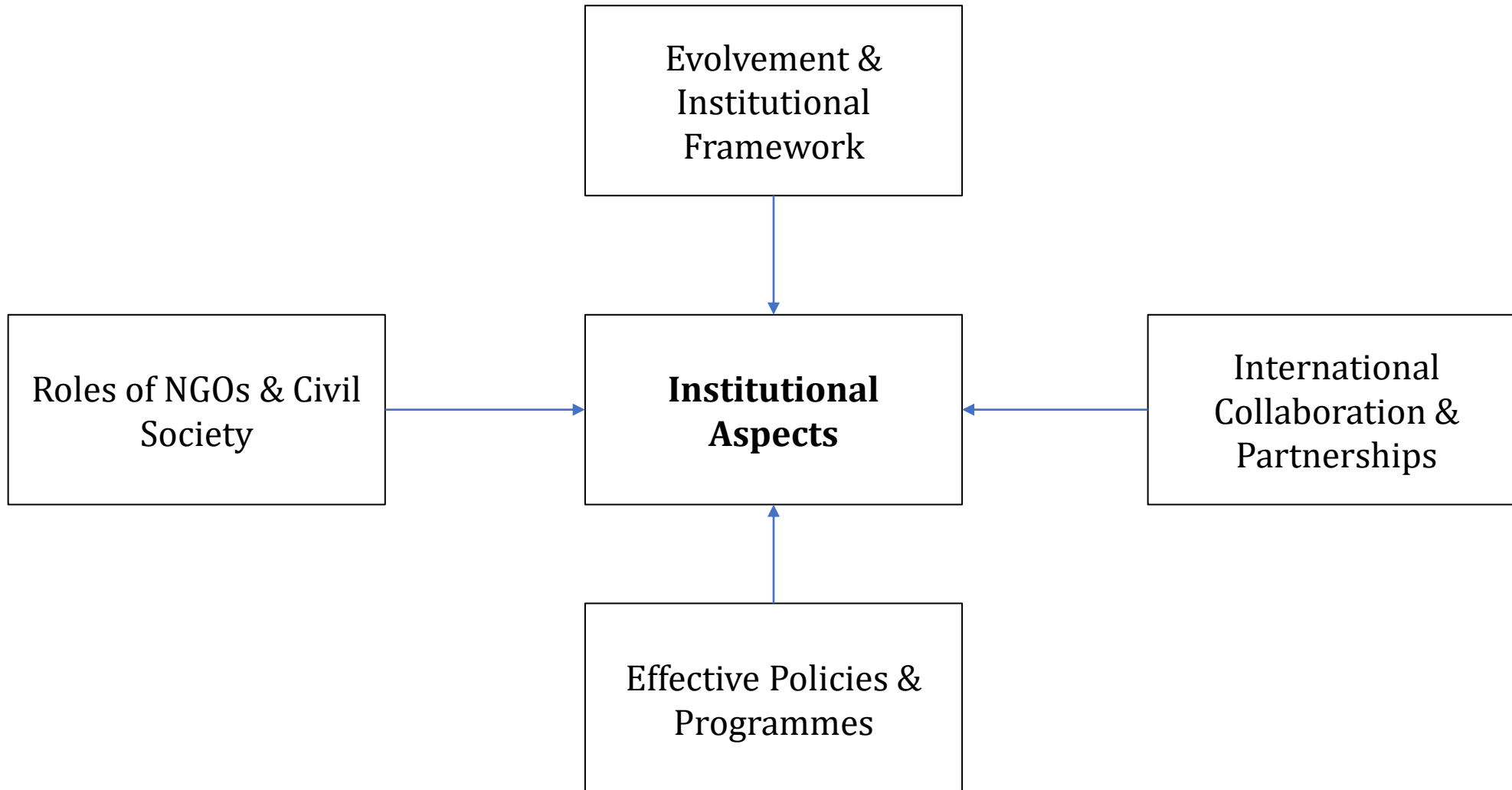


4.5 Handling Intellectual Property Rights and Technology Transfer

- China has taken steps since the **1990s** to improve its protections for intellectual property rights (IPR), including legal reforms and developments
- Technology transfer agreements are made with foreign companies and governments to acquire advanced renewable energy technologies
 - These agreements often involve the transfer of proprietary technologies, know-how, and technical expertise to Chinese firms
 - In some cases, technology transfer has been a condition for market access in China
- China has at times, imposed restrictions on foreign ownership and control in certain parts of its renewable energy sector
 - These restrictions have been eased in some cases to encourage foreign investment and technology collaboration (e.g. Germany)

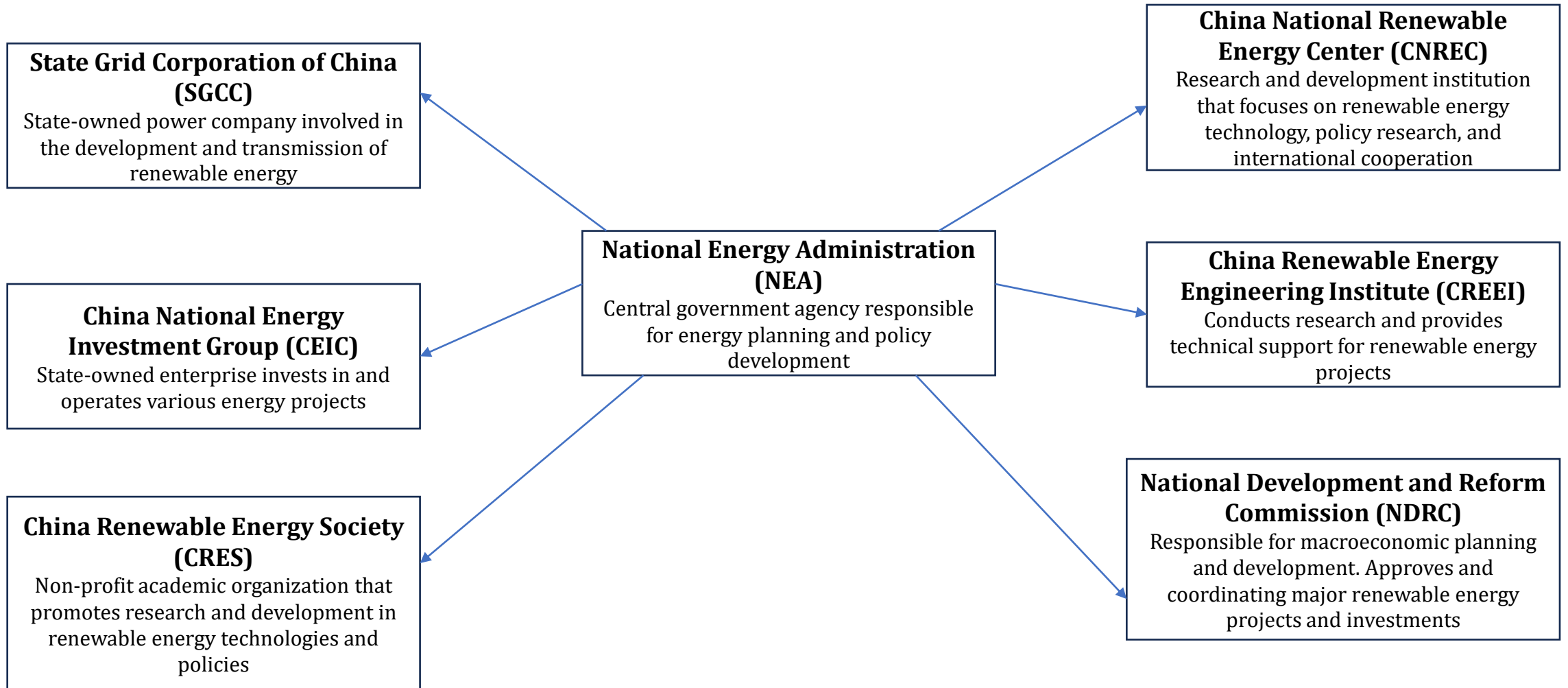
5. Institutional Aspects of the Renewable Energy in China

Figure: Institutional Aspects of the Renewable Energy in China



5. Institutional Aspects of the Renewable Energy in China

5.1 Evolvement of Institutional Framework



5. Institutional Aspects of the Renewable Energy in China

5.2 Roles of Non-governmental Organizations (NGOs) and Civil Society

- The most prominent NGOs and Civil Society concerning the renewable energy sector of China are:
 - **Friends of Nature:** This organisation advocates for legal and policy change through participation in major environmental events
 - **Global Environmental Institute (GEI):** GEI works alongside key policymakers, businesses, scientists, civil society leaders, and local communities to foster dialogue and innovative solutions to protect the environment and enhance economic opportunity within China
 - **Rock Environment and Energy Institute (REEI):** REEI provides independent policy analysis on environmental and energy issues in China, such as climate change, energy, air pollution, carbon markets, environmental law, and sustainable development



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5. Institutional Aspects of the Renewable Energy in China

5.3 International Collaboration and Partnerships

International Renewable Energy Agency (IRENA)
Cooperation on energy transition

Clean Energy Ministerial (CEM)
Collaboration with other nations to share knowledge

Asian Development Bank (ADB)
Invested \$8.5 billion in clean energy

The World Bank
Assisted Battery Storage Promotion Project

The United Nations Environment Programme (UNEP)
Has provided policy recommendations for 14th FYP

The International Finance Corporation (IFC)
Investment in ENN Solar Energy's large-scale, thin-film-based solar

5. Institutional Aspects of the Renewable Energy in China

5.4 Effective Policies and Programmes

Renewable Energy Quotas

- China targets for renewables to supply **33%** to national power consumption by **2025**, and for non-hydro renewables to contribute **18%**

Renewable Energy Auctions

- **Guangdong** province opened a competitive auction in June 2023 for **30** offshore wind projects with a total capacity of **23 GW**

Carbon Trading Pilot Programmes

- Covers roughly **7%** of China's CO2 emissions
- Empirical analysis has shown that it has reduced carbon emissions in **285** cities

Preferential Electricity Pricing

- China will continue to offer a **5%** cut in industrial and commercial electricity prices until the end of **2023** to support company operations

Tax Breaks

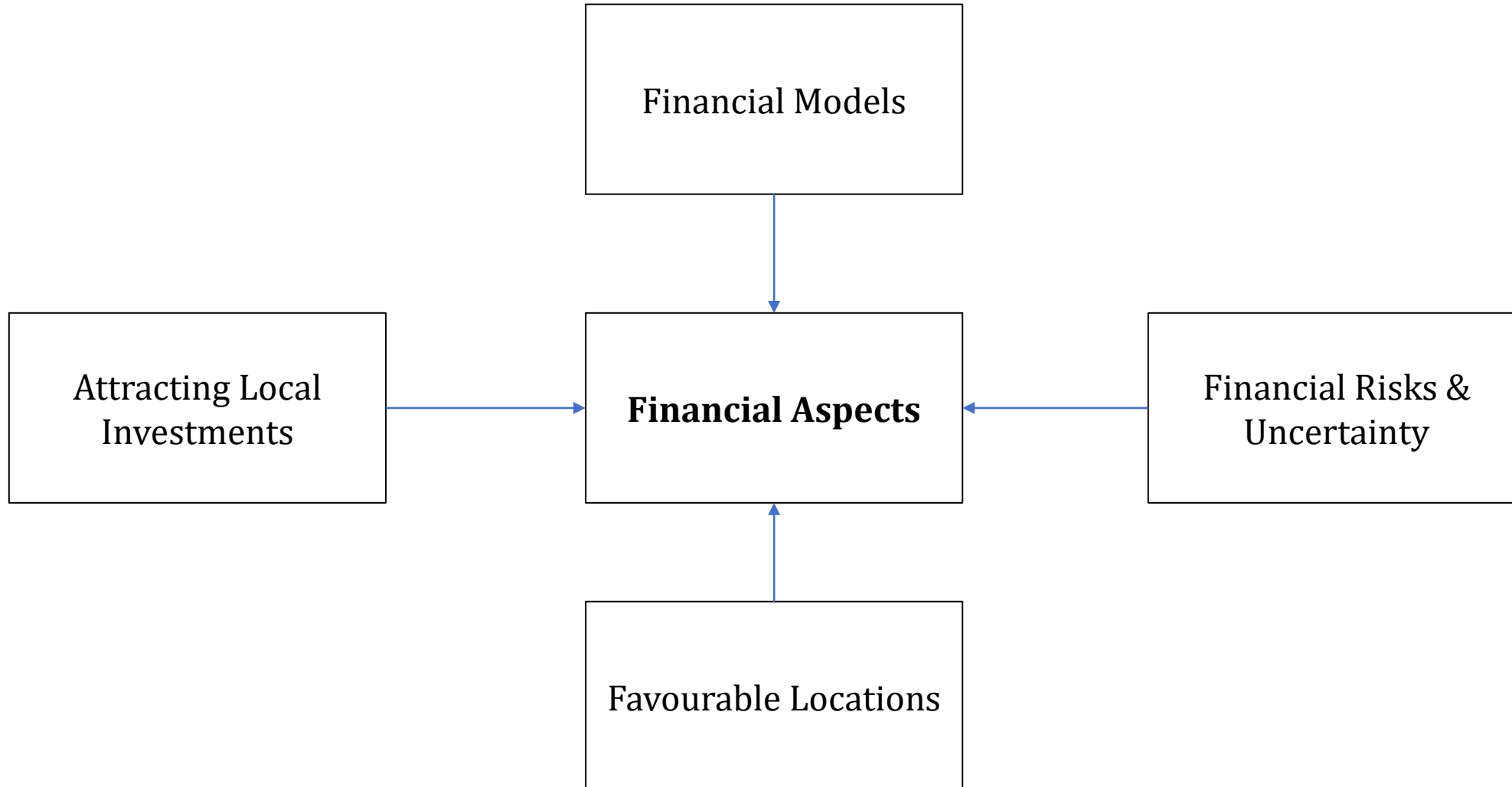
- China has extended tax breaks for consumers buying clean cars through **2027**, estimated to be worth **520 billion yuan (\$72.3 billion)** in the coming four years

Subsidies for Solar Power Stations

- China's Finance Ministry provided renewable power subsidy at **3.87 billion yuan (\$607.26 million)**, with **2.28 billion yuan** allocated to solar power stations in 2022

6. Financial Aspects of the Renewable Energy in China

Figure: Financial Aspects of the Renewable Energy in China



6. Financial Aspects of the Renewable Energy in China

6.1 Financial Models

Public-Private Partnerships (PPPs)

The China Public Private Partnerships Center (CPPPC) is China's centralized agency for all matters relating to mainstreaming PPPs

- China has invested more in PPP projects than any other country over the last two decades, with the government's role being a focal topic related to PPP projects

Build-Operate-Own-Transfer (BOOT)

Under BOOT arrangements, private companies or consortia finance, build, and operate renewable energy projects

- After a specified period, ownership is transferred to the public sector

Loan from Policy Banks

They provide large-scale loans that support massive **centralized** infrastructure

Finance from the National Development Bank

The National Development Bank of China (NDB) issued its first green financial bond in China in 2016, with an issue size of **RMB 3 billion** and a **5-year tenor**, which was the first such issuance by a multilateral development bank in China

- Provided special loans of **250 billion RMB** for renewable energy projects in Belt and Road Initiative (BRI) countries



6. Financial Aspects of the Renewable Energy in China

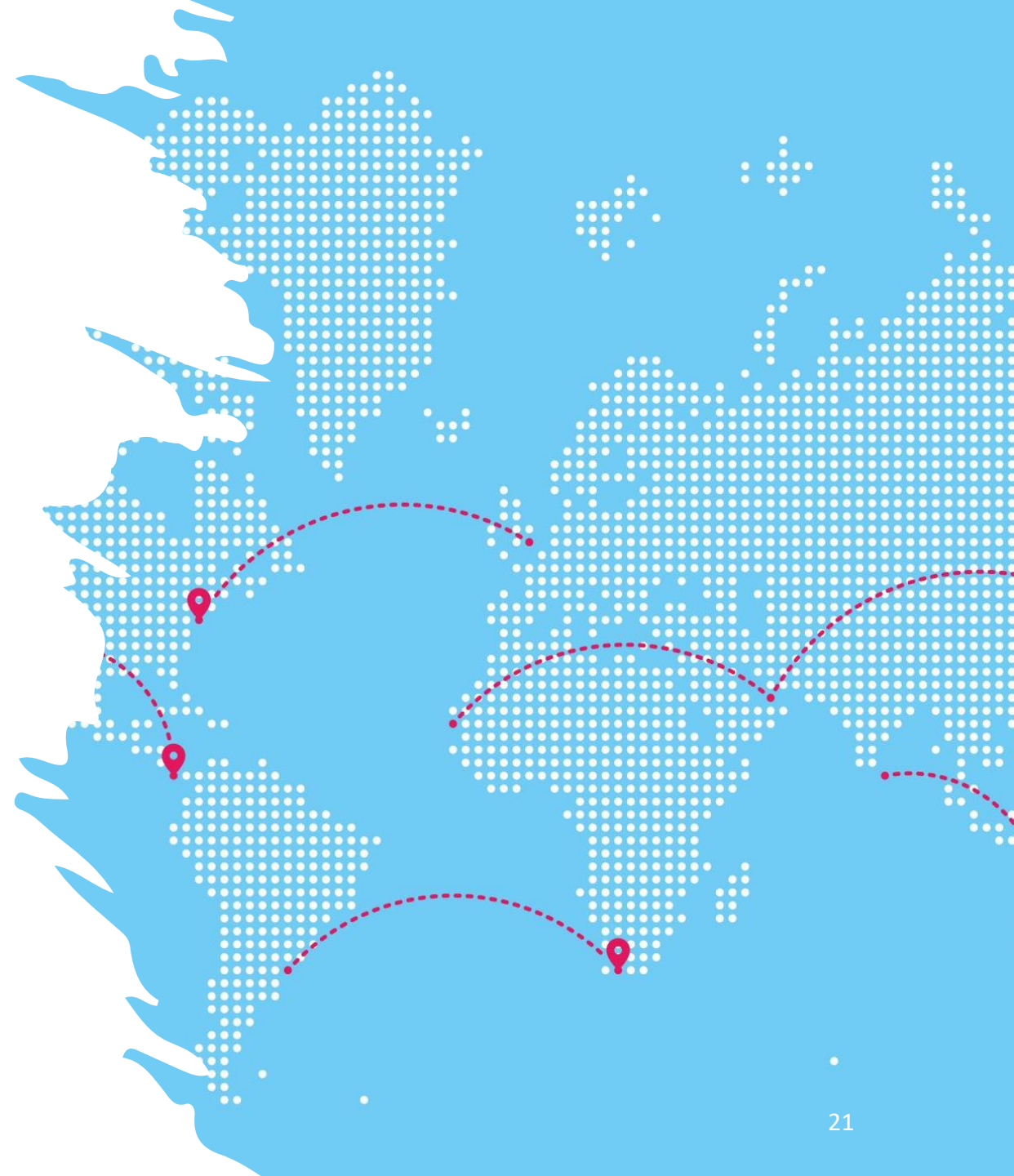
6.2 Addressing the Issues of Financial Risks and Uncertainties

- **Long-Term Power Purchase Agreements (PPAs):** Reduces market price volatility risks
 - Examples include **Air Liquide's PPA with China Three Gorges Renewables** and **China Three Gorges Corporation Jiangsu** branch for annual renewable energy supply from **200 MW** wind and solar farms in Jiangsu province
- **Risk Insurance and Guarantees:** No loans are sanctioned without mortgages
 - While asking for big loans, the borrower needs to show multiple successful completed projects
 - At least **30%** of the projects for which the loans are asked for should be self-financed
- **Market Stabilization Measures:** China's latest set of reforms, announced in 2022, envisions the establishment of a **national electricity market** by **2025** to further optimize resource allocation and improve efficiency in power generation
 - The establishment of spot markets and trade between provinces are considered a national priority

6. Financial Aspects of the Renewable Energy in China

6.3 Favourable Conditions of Countries for Investment

- For **Southeast Asia**
 - Consumption measures such as **feed-in tariffs**, **competitive bidding/auctions**, **licensing mechanisms** and **technical standards**
 - Fiscal policies such as **tax incentives**, **preferential loans** and **capital subsidies**
 - Fixed, central **target** concerning their renewable energy transition
- For **Central Asia**
 - Fewer **geopolitical conflicts** and **regional security**
- For **Africa**
 - Elimination of fossil fuel subsidies
 - Introduction of carbon pricing
 - Reduction of fossil fuel investments
- For **Latin America**
 - Practice of Competitive Auctions
 - Implementation of Feed-in tariffs
 - Establishing **Renewable Energy Quotas**
 - Use of **Net metering**





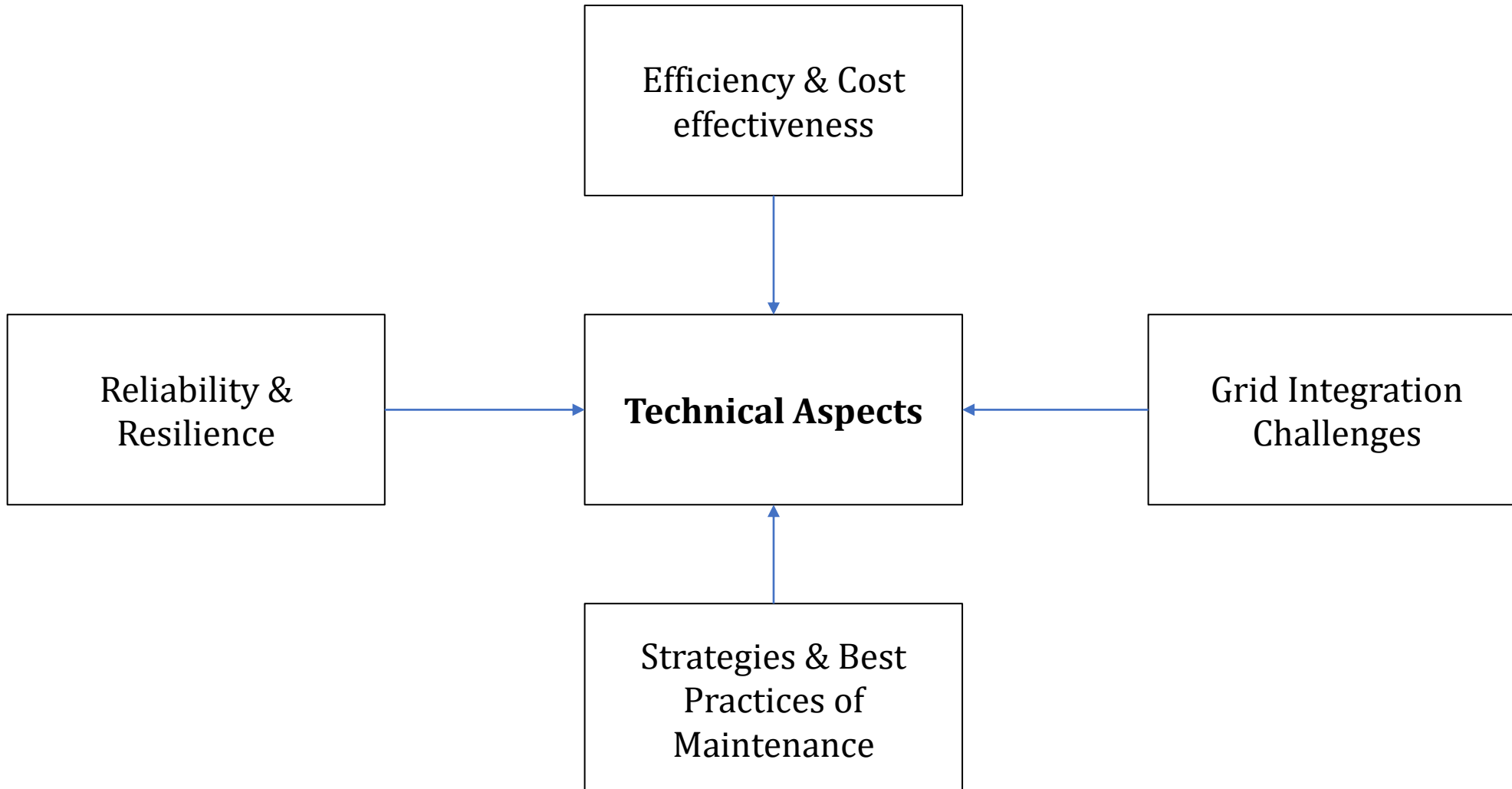
6. Financial Aspects of the Renewable Energy in China

6.4 Attracting Local Investments

- **Subsidies:** Subsidies are usually provided in the forms of **cash grants** and **tax credits**
 - The Chinese government has set the 2022 renewable power subsidy at **3.87 billion yuan (\$607.26 million)**, with **1.55 billion yuan** allocated to wind farms, **2.28 billion yuan** to solar power stations, and **38.24 million yuan** to biomass power generators
- **Tax-related Incentives:** **The Corporate Income Tax Law** and its implementing regulations provide tax incentives to enterprises engaging in the development of infrastructure, including renewable energy projects
 - The Chinese government provides an immediate **VAT rebate** of **50%** applied to selling self-produced solar and wind power equipment
 - Enterprises purchasing and using equipment specified by the state for environmental protection, energy and water conservation, or production safety purposes are eligible for a tax credit of **10%** of the investment in such equipment

7. Technical Aspects of the Renewable Energy in China

Figure: Technical Aspects of the Renewable Energy in China



7. Technical Aspects of the Renewable Energy in China

7.1 Technological Innovations which Improved the Efficiency and Cost-effectiveness

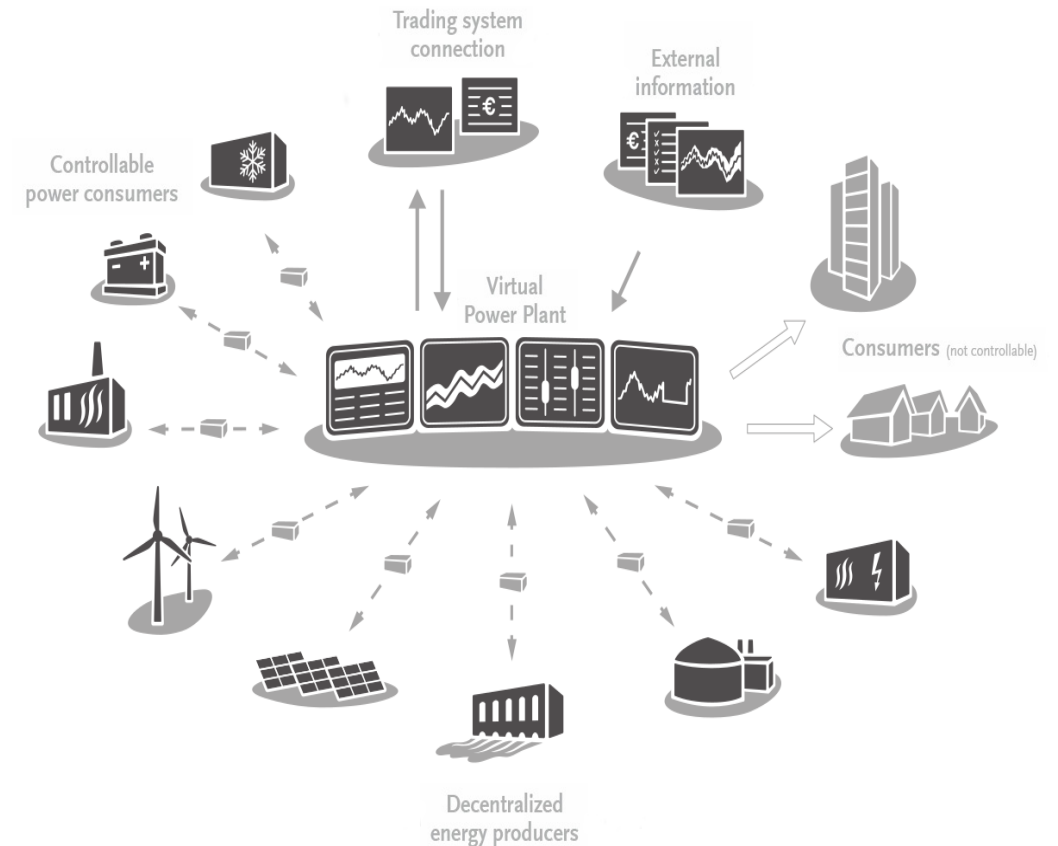
- **Bifacial Solar Cells:** This technology enhances energy generation by reflecting and capturing sunlight from surrounding surfaces, such as the ground or nearby buildings
- **Floating Solar Farms:** This approach optimizes land use, reduces water evaporation, and cools solar panels, which can enhance their efficiency
- **Concentrated Solar Power (CSP):** Uses mirrors or lenses to concentrate sunlight and generate heat for power generation
 - High-temperature CSP systems can store thermal energy for extended power generation, even after sunset
- **Low Speed Wind Turbine:** This kind of wind turbine has been set in the Central part of China where the wind speed is usually low



7. Technical Aspects of the Renewable Energy in China

7.2 Addressing the Challenges of Grid Integration

- **Smart Grid Technology:** Smart grid technology can help to balance supply and demand in real-time, manage energy storage, and reduce the impact of intermittency on the grid
- **Curtailment Reduction:** Curtailment occurs when renewable energy sources are shut down due to a lack of demand or grid capacity
 - China has implemented policies to reduce curtailment, including improving grid infrastructure, building additional transmission capacity and increasing the use of energy storage
- **Virtual Power Plants (VPPs):** VPPs aggregate distributed energy resources, including rooftop solar panels and home energy storage systems, to provide grid services and balance supply and demand
 - VPPs can respond to grid fluctuations by adjusting power output from these resources
- **Market Mechanisms:** The establishment of market mechanisms, such as **ancillary services markets**, allows grid operators to purchase services like frequency regulation and reserve capacity to stabilize the grid when renewable energy generation varies



7. Technical Aspects of the Renewable Energy in China

7.3 Enhancement of the Reliability and Resilience of Renewable Energy Systems

- **Advanced Weather Forecasting and Monitoring:** This helps renewable energy operators anticipate adverse weather conditions and take preemptive measures to minimize damage
- **Microgrids:** These localized energy systems can disconnect from the main grid during emergencies and continue supplying power to critical infrastructure like hospitals, emergency services, and shelters
- **Grid Hardening:** Strengthening grid infrastructure to withstand extreme weather conditions and natural disasters is crucial
- **Demand Response Programs:** In 2020, the **State Grid Corporation of China (SGCC)** initiated a "**Demand Response for Peak Shaving**" program where large industrial and commercial customers are encouraged to reduce their electricity consumption during peak hours in exchange for financial incentives
- **Hybrid Renewable Systems:** Hybrid renewable energy systems combine multiple renewable energy sources or technologies to enhance overall energy generation, reliability, and efficiency



7. Technical Aspects of the Renewable Energy in China

7.4 Strategies and Best Practices related to the Maintenance and Operation of Renewable Energy Installations

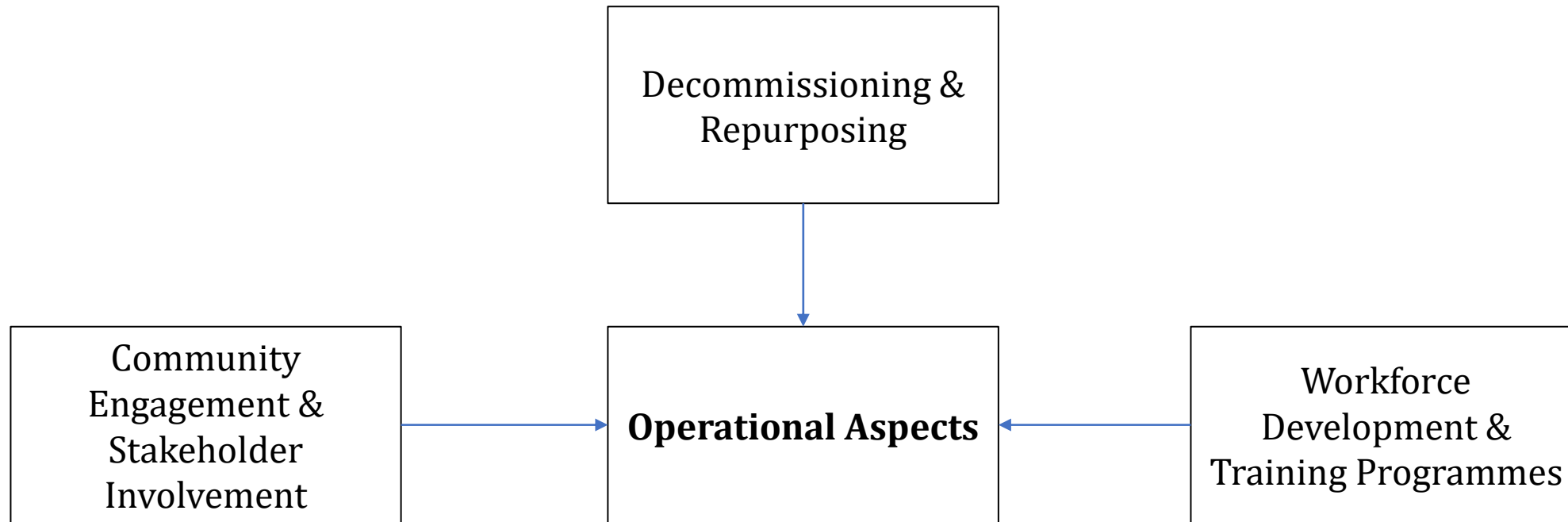
- **Regular Inspection and Maintenance:** Chinese operators often schedule regular maintenance visits to renewable energy installations, particularly in **remote or harsh environments**
- **Predictive Maintenance:** **Condition monitoring** and **data analytics** helps to identify potential equipment failures before they occur
- **Asset Management:** Tracking the **performance and condition** of renewable energy assets, **scheduling maintenance activities**, and ensuring **compliance with safety and environmental regulations**
- **Periodic Upgrades and Retrofits:** Making improvements or modifications to existing renewable energy systems to keep them up-to-date with the latest technology, address issues, and enhance overall performance
- **Digital Twin Technology:** A digital twin is a virtual model of a physical object, process, product, or service that allows for the analysis of data and monitoring of systems to prevent problems before they occur, prevent downtime, and future plans by using simulations



Figure: Digital Twin Technology

8. Operational Aspects of the Renewable Energy in China

Figure: Operational Aspects of the Renewable Energy in China



8. Operational Aspects of the Renewable Energy in China

8.1 Decommissioning and Repurposing of Renewable Energy Installations at the end of their Operational Life

- **Recycling System:** The National Development and Reform Commission (NDRC) and five other state agencies have jointly released guidelines that seek to accelerate the recycling of old wind and solar equipment
- **Technical Standards and Policies:** China has introduced technical standards and policies for the wind and solar industries to recycle their decommissioned equipment and form dedicated industry clusters across the nation by 2030
- **Full-process Recycling System:** China aims to have a "basically mature" full-process recycling system for wind turbines and solar panels by the end of the decade



8. Operational Aspects of the Renewable Energy in China

8.2 Workforce Development and Training Programmes

- The renewable energy sector employed almost **5.4 million** people in China in 2021, equating to **0.7%** of the entire labor force
- Universities like **Tsinghua University, North China Electric Power University, Shanghai Jiao Tong University** has initiated BSc, MSc in Renewable Engineering to prepare students for careers in the industry
- **China National Renewable Energy Center (CNREC)** and **State Grid Corporation of China (SGCC)** conducts training sessions on grid management and renewable energy policies on regular basis
- The Chinese government, through the National Energy Administration (NEA), has initiated **the Green Energy Talent Program**, which focuses on fostering a skilled workforce for the renewable energy sector
 - This program includes vocational training and qualifications
- Industries like **Goldwind**, one of China's largest wind turbine manufacturers, operates a training center to educate technicians on wind turbine maintenance and operation
 - **LONGi**, a major solar panel manufacturer, collaborates with universities and research institutions to offer training and education programs in solar technology
- **China Wind Energy Association (CWEA)** offers certifications for wind energy professionals in various areas, including wind farm management, wind turbine maintenance, and project development
- **The China National Institute of Standardization (CNIS)** provides certifications for solar PV installers, ensuring that they meet the required standards and skills

8. Operational Aspects of the Renewable Energy in China

8.3 Community Engagement and Stakeholder Involvement in the Planning and Operation

- The Longyuan Rudong Offshore Wind Farm, one of China's largest offshore wind projects engaged with local fishermen, addressing concerns about the project's impact on fishing activities
- Huaneng Rudong Offshore Wind Farm created a "Wind Energy University" to provide training and job opportunities for local residents in wind turbine maintenance and operations
- The Pingluo Solar Power Plant in Ningxia Province worked closely with local communities and authorities by establishing a solar park management committee comprising local representatives to oversee park operations and address community concerns
- In Guangdong Province, China Guangdong Nuclear Power Group involved local communities in the planning and operation of wind and solar projects by holding public consultations, shared project benefits, and addressed concerns
- The Yuhuan Offshore Wind Farm in Zhejiang Province collaborated with local fishing communities to minimize the impact on traditional fishing activities



9. Research and Development Aspects of the Renewable Energy in China

- **Funding and Support:** The **National High-tech Research and Development Programme** has funded 863 clean energy projects, including research on advanced photovoltaics and wind energy technologies
- **National Research Programmes:** The "**Golden Sun**" programme, part of China's National Key Research and Development Program, supported the development of solar power projects, including solar farms and distributed solar generation
- **Academic and Research Institutions:** The Institute of Electrical Engineering at the **Chinese Academy of Sciences** conducts research on advanced solar cell technologies
 - Tsinghua University in Beijing is known for its research on renewable energy and hosts the **Tsinghua-BP Clean Energy Research and Education Center**
- **Innovation Hubs:** Innovation hubs like the **Zhongguancun Renewable Energy Science and Technology Park** in Beijing serve as centers for research and collaboration
- **International Collaborative Research:** The **Sino-Danish Center for Education and Research** in Beijing conducts research on wind energy, among other topics
- **Foreign Investment:** **Vestas**, a Danish wind turbine manufacturer, has established research and development centers in China to design and develop wind turbine technologies tailored to the Chinese market

9. Research and Development Aspects of the Renewable Energy in China

- **Solar Energy R&D**
 - **Concentrated Solar Power (CSP)** is the new technology China is focusing more currently
- **Wind Energy R&D**
 - **China Wind Energy Development Roadmap 2050** foresees wind power capacity reaching **200 GW** by 2020, **400 GW** by 2030, and **1,200 GW** by 2050
- **Hydropower and Ocean Energy R&D**
 - Tidal barrages are already in commercial use, while **Tidal Stream Generation**, after almost ten years of development, is in the early stages of commercialization
 - Wave power installations are undergoing sea trials, and **Ocean Thermal Energy Conversion (OTEC)** is still in the research and development stage
- **Energy Storage R&D**
 - By 2027, China is expected to have a total new energy storage capacity of **97 GW**, with a **49.3%** Compound Annual Growth Rate from 2023 to 2027
 - With an annual cost-reduction rate of **20%–30%** in battery storage, China has an absolute advantage in producing the world's lowest lithium-ion battery price at **\$111**
 - The China energy storage market size surpassed USD **93.9 billion** in 2022 and is anticipated to grow at a CAGR of 18.9% from 2023 to 2032
- **Smart Grid R&D**
 - **China's State Grid Corporation** aims to boost its spending on distribution infrastructure by **7%** this year to **315 billion yuan (US\$46 billion)**, while its budget for smart-grid hardware and software is expected to grow to **91 billion yuan** in 2025 from 37 billion yuan of 2021

10. Concluding Remarks and Recommendations for Bangladesh

- China's success in renewable energy development can be attributed to its rigorous legal system, institutional capacities, state-of-the-art technologies, and effective policies and programs
- China has been successful for so long in the renewable energy industry for its strong legal framework
 - Bangladesh should develop a legal framework that supports renewable energy development by approving the **Renewable Energy Policy (Draft) 2022**
 - Institutions like **SREDA** should take more actions for developing and implementing the legal and administrative supports for the renewable energy development in the country
- Over the time, China has gradually strengthened its institutional capacities through multiple organisations and institutes
 - SREDA, alongside with the Department of Land, Ministry of Environment, Forest and Climate Change and Ministry of Finance should build its capacity as well as formulate plans in such a way that there are no conflicts with any relevant government entities
- China at its initial phase of energy transition sought help from the developed countries to formulate their policies and import new technologies
 - Bangladesh should seek help from countries like China, Germany, Finland to unlock its full potential in solar and wind energy sector

10. Concluding Remarks and Recommendations for Bangladesh

- China dealt with the financial risks and uncertainties through multiple initiatives which they adopted from their donor countries and perfected them after trail and errors
 - Bangladesh can address these issues by providing long-term power purchase agreements, risk insurance and guarantees, and market stabilization measures
- Grid integration is always a challenge for countries dependent on renewable energy
 - Bangladesh can resolve this issue by implementing smart grid technology, energy storage, and virtual power plants
- China's renewable energy sector has been sustainable for its evolving maintenance and operation strategies
 - Bangladesh, since its initiation of the programmes can practice regular inspection and maintenance, predictive maintenance techniques, and demand response programmes

Thank You.