Case of India : Transmission Evolution and growth drivers

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ESMAP Energy Sector Management Assistance Program

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MARKET PRICES – METHODOLOGY?

An efficient short-run electricity market determines a market clearing price based on conditions of supply and demand balanced in an economic dispatch. Everyone pays or is paid the same price. The same principles apply in an electric network. This is the familiar starting point, with many implicit assumptions.

Simpler to have a single liquid market that covers a large proportion of total power production?

Region or Nation-wide one Platform
Online
Automated Double-sided closed auction system
15-min block day-ahead contracts(MWh)
Physical delivery based

Locational Marginal prices (LMP) arise from the standard formulation of security constrained economic dispatch (SCED) to balance generation and load at each location

- **The true locational marginal cost of meeting load can be both higher and lower than the marginal costs of any of the operating generators.**
- **Single or zonal pricing models differ from the LMP model only under conditions of congestion**
  - The single and zonal pricing models require reliance on command and control or constrained-on and –off payments
- **Optimizing problem is a Stochastic problem - we take the most conservative solution we can, like N-1**

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Development of Transmission

The practice of ignoring the critical functions played by the transmission system in many discussions of deregulation almost certainly leads to incorrect conclusions about the optimal structure of an electric power system

Paul L. Joskow and Richard Schmalensee
Markets for Power: An Analysis of Electric Utility Deregulation, MIT Press, 1983, p. 63

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Where my dreams take me

Where my work takes me

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Challenges are not specific to Africa.

PLANET

Unfortunately, I Care About Power Lines Now

If America wants to fight climate change—or enjoy the benefits of a modern economy—it must get much better at building electricity transmission. Yikes.

By Robinson Meyer

Scaling up transmission investments through private sector; High-level thoughts

T&D are at the center of the **energy transition and access** agendas - **"No transmission, no transition"**. Renewable energy penetration, technological change, and grid **climate adaptation** (grid resiliency & decentralization) underpin the need to drastically step-up T&D investments.

T&D investment in emerging markets (excluding China) has decreased over the last decade leading to a **growing investment gap.** As such, **private sector participation** in addition to investment from the public sector in power grids is a must.

Context is key – unfortunately, there is not one recipe to successfully pull in private sector investment. Systems require **consistent policy, flexible regulation** and **some central planning**. **Consistency & transparency** promote competition and better outcomes from the public standpoint.

Time is of the essence! Planning, permitting and completing grid infrastructure can take up to 10 or more years to deploy – significantly more than implementing other greenfield power projects (e.g. 1-5 years for non-conventional RE power generation).

Indian Power Sector

~466 GW
generation capacity

250 GW+
peak demand

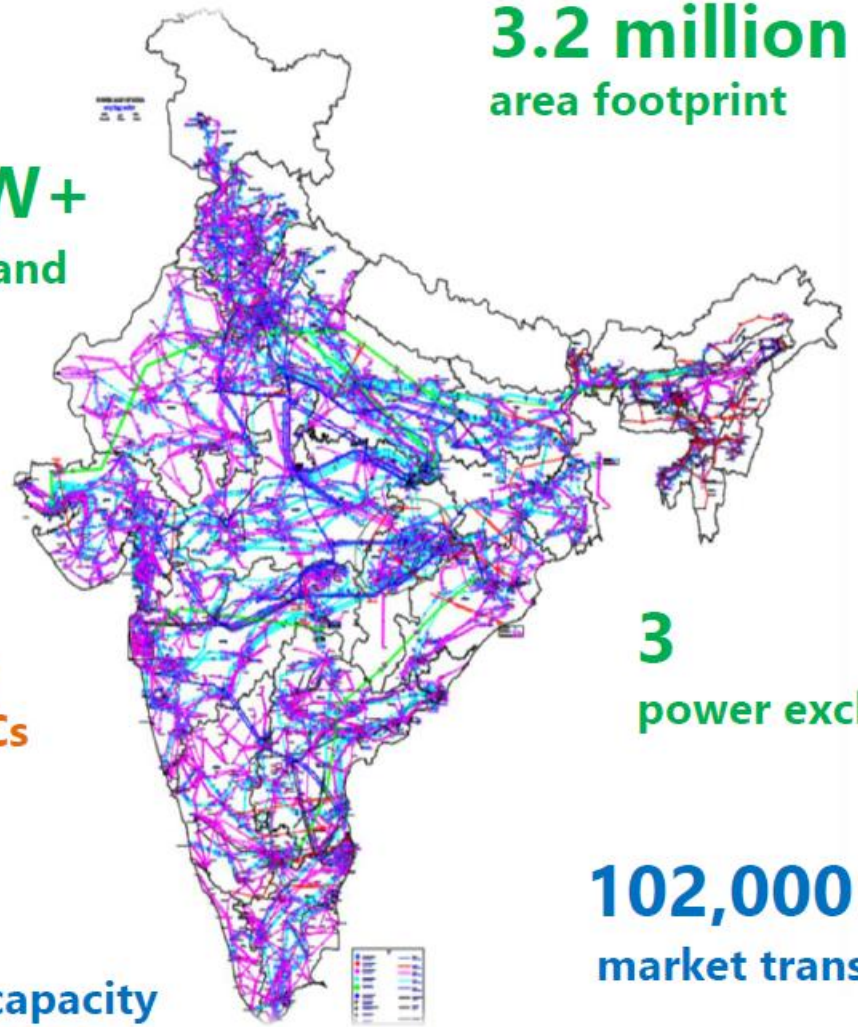
> 5 TWh
daily energy met

491871 ckm+
EHV transmission

~206 GW
renewables
(including large Hydro)

14+
HVDCs

~ 118 GW
inter-regional capacity



3.2 million km²
area footprint

1.4 Billion+
people served

4.5 GW+
international exchanges

160 TWh+
annual market trades

3
power exchanges

6000+
market participants

102,000+
market transactions

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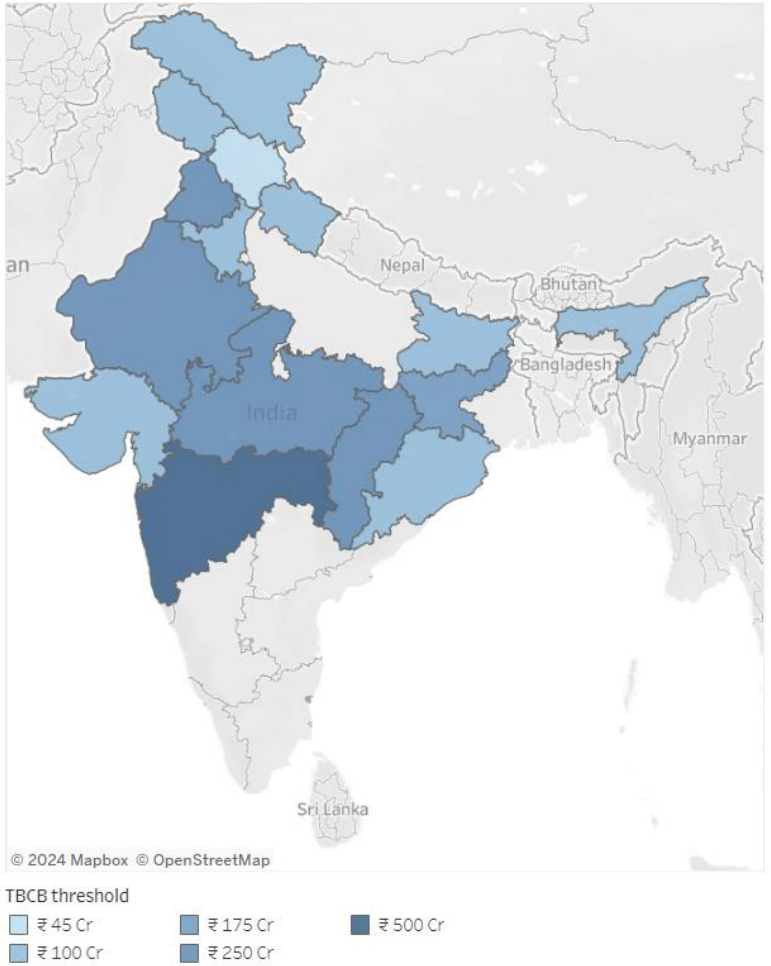
Creating Markets, Creating Opportunities

Evolution: Introduction to Private Participation

- **Electricity Act, 2003: competition** in transmission and provisions for **grant of transmission licenses** by the Central Electricity Regulatory Commission (CERC) as well as State Electricity Regulatory Commissions (SERCs);
- Tariff of all new generation and transmission projects of company owned or controlled by the Central Government shall continue to be **determined through competitive bidding**
- InSTS projects shall be developed by State Government through competitive bidding process for projects costing above a **threshold limit** (decided by SERCs).
- All future ISTS shall, ordinarily, be developed through competitive bidding process, the Central Government may give exemption from competitive bidding for (a) specific category of projects of strategic importance, technical upgradation etc. or (b) works required to be done to cater to an urgent situation on a case to case basis"
- MoP in 2021 has delegated NCT powers for approval of ISTS system costing between US$ 12m to 60m to NCT and for ISTS schemes costing up to US$12m to CTU. The ISTS schemes costing above US$60m would require approval of MoP.



Regulatory Framework

Advisory

- Central Electricity Authority of India
- Advisory arm of MoP on matters relating to the National Electricity Policy and formulating plans for the development of the sector

Regulatory

- Central Electricity Regulatory Commission (CERC)
- State Electricity Regulatory Commission (SERC)

Developers

- Private / Public Private Partnerships
- Develops Power generation plants on a BOOM basis
- Recovery of revenue as per PPA entered with bilateral users

Statutory Bodies

- National Load Dispatch Center (NLDC) / Regional Load Dispatch Center (RLDC)
- State Load Dispatch Center (SLDC)

Regulatory Stability

- Stable and Established regulations with long history
  - Current Electricity Act, 2003
  - Grid stability by statutory bodies
- No dependence on non-utility income
- Proven contractual stability

Regulatory Framework - Introduction to Private Participation

Electricity Act (2003)

- The establishment of regulatory bodies such as the Central Electricity Regulatory Commission (CERC), State Electricity Regulatory Commissions (SERCs), Central Electricity Authority (CEA) and Central Transmission Utility of India Ltd (CTUIL) has provided a regulatory framework for the transmission sector.
- Clear regulations and guidelines – started through the Electricity Act – ensure a level playing field for private players and promote investor confidence.

De-licensing of Transmission Sector (2003)

- The Electricity Act allowed private companies to enter the transmission market creating increased competition and efficiency.
- This enabled private players to build, own, and operate transmission lines, reducing the monopoly of centre / state-owned transmission companies.

Public-Private Partnership (PPP) Model

- New models and mechanism for private sector participation in transmission projects were developed.
- Private companies partnered with government agencies to develop transmission infrastructure, sharing the risks and rewards of the project.

Tariff-based Competitive Bidding (TBCB) (2006)

- The adoption of TBCB for the award of transmission projects has been instrumental in promoting transparency and efficiency in project execution.
- Allows private players to bid for projects based on competitive tariffs, ensuring cost-effective solutions and encouraging private investment.

Growth Drivers

- Indian Transmission Sector Poised for Significant Growth
- Well defined regulatory framework

India to be a 5 Trillion USD economy.

Rapid Industrialization, Urbanization,

E-mobility etc.

Non-fossil capacity by 2030.

500 GW Installed capacity

H_2

Green Hydrogen Mission

Power requirement of ~125 GW for producing Green H_2

Energy Storage

Battery storage, Pumped hydro, etc.

International Interconnection

One Sun One World One Grid

aspirations

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National Electricity Transmission Plan 2032 | India

US$ 106b

	As on 30.09.2024	By Mar 2027	By Mar 2032
Peak Demand (GW)	249.85*	296	388
Installed Capacity (GW)	452.69	669	997
RE Capacity (GW)	201.45	537 *(by 2030)*	613
Transmission Lines (ISTS) (ckm)	2,11,805	2,51,221	2,94,545
Transmission Capacity (ISTS) (MVA)	5,29,065	9,33,190	12,81,355
Transmission Lines (InSTS) (ckm)	2,77,047	3,20,182	3,53,645
Transmission Capacity (InSTS) (MVA)	7,47,705	9,48,590	11,30,530
Inter-Regional Capacity (MW)	1,18,740	1,42,940	1,67,540

ISTS: Inter State Transmission System; InSTS: Intra State Transmission System

** Peak demand met in May'24 was 249.854 GW*

A total of **191,474ckm** of transmission lines and **1,307,435 MVA** of transformation capacity (including HVDC bi-pole/BTB) is planned for addition in ISTS and InSTS from **2022 to 2032**

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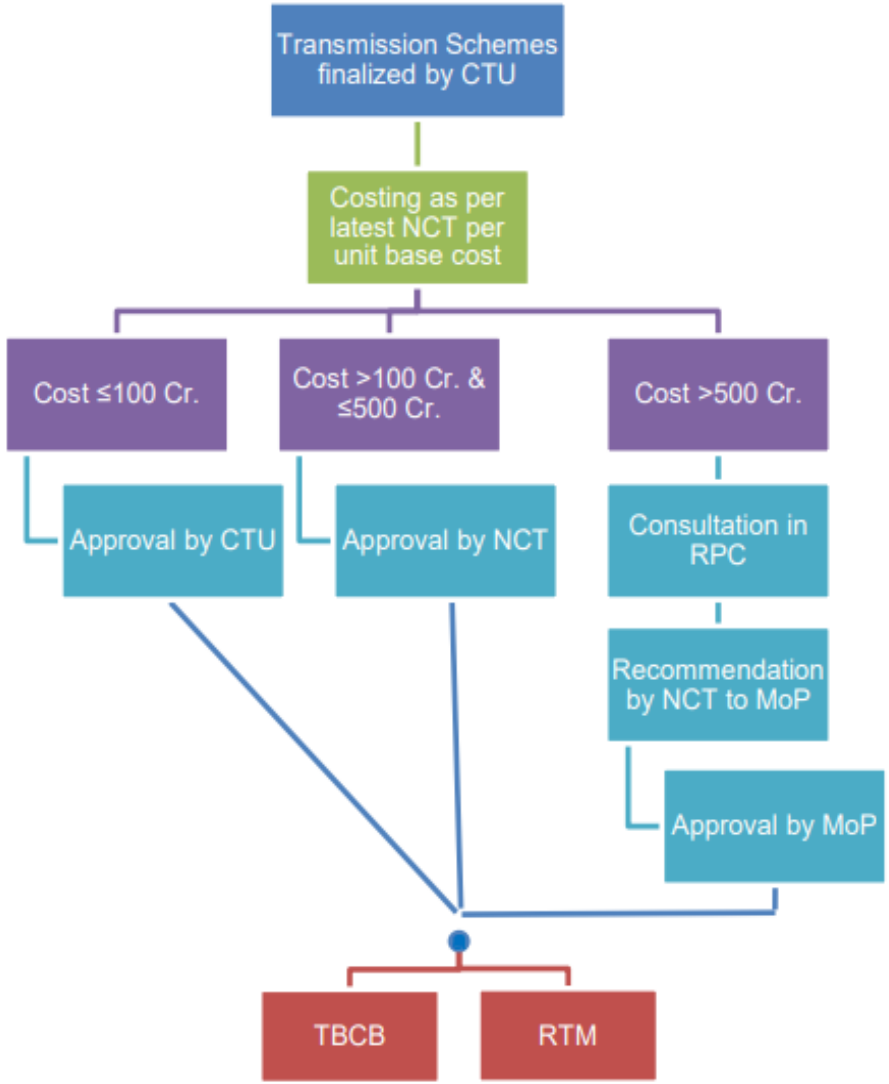
Transmission Planning Philosophy in India

- **Section 73(a), Electricity Act 2003:** CEA advises the central government on National Electricity Policy, formulates **development plans, and coordinates planning agencies for optimal resource utilization.**
- **Section 3, 38, 39, Electricity Act 2003:Section 3:** CEA is the Central Planning Agency
  - **Section 38:** CTU responsible for planning and coordinating the inter-state transmission
  - **Section 39:** STUs responsible for planning and coordinating the intra-state transmission
- **The CEA Manual on Planning Criteria** provides **guidelines for the optimal planning** of Inter-State Transmission Systems (ISTS), Intra-State Transmission Systems (Intra-STS), and dedicated transmission lines down to the 66 kV level
- **Inter-STS** transmission schemes are finalized **after discussions among CTUIL, CEA, GRID-INDIA, STUs, and other stakeholders** through meetings like CMETS and Regional Power Committee, before being **reviewed by the National Committee on Transmission**
- **Intra-state** transmission schemes are evolved by STUs and are finalized after discussions in Standing Committee on Short Term and Perspective Power System Planning (SCSTPPSP) meetings of respective regions.



Two Key Frameworks for Transmission Projects

*India's transmission sector operates under two main models: the **regulated tariff mechanism (RTM)** and the **tariff-based competitive bidding (TBCB)** process. These shape how TSAs are structured and how payments flow, which could be interpreted as phases in a broader sense.*

1. **RTM**: Regulator determine tariffs based on a **cost-plus approach**. The transmission service provider recovers costs (capital expenditure, operating expenses, etc.) plus a r**egulated return on equity.**

2. **TBCB -** The winner (TSP) quotes a **levelized annual transmission charge**, locked in for the TSA's term, usually 35 years, unless renegotiated or adjusted for specific "**change in law**" events.

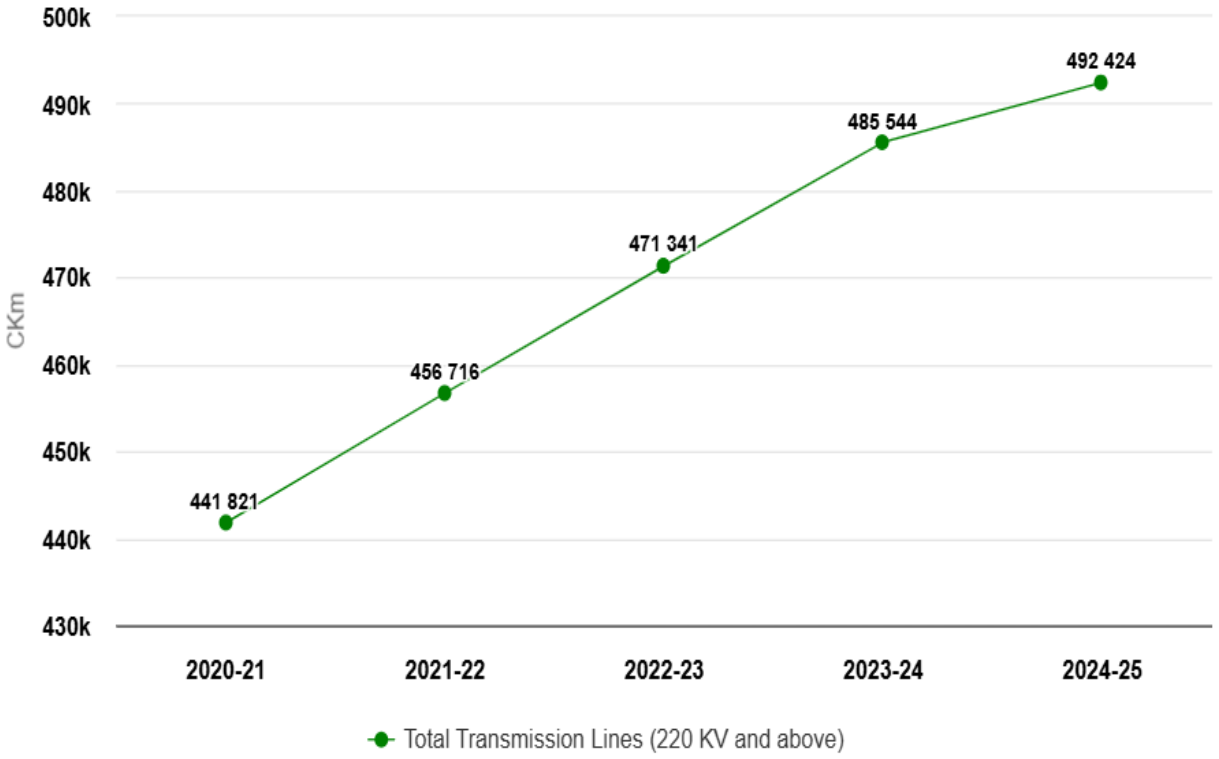
- **TSA Role**: The TSA is signed between the TSP, a Special Purpose Vehicle (SPV) acquired post-bidding, and the long-term transmission customers (e.g., DISCOMs or the Central Transmission Utility).

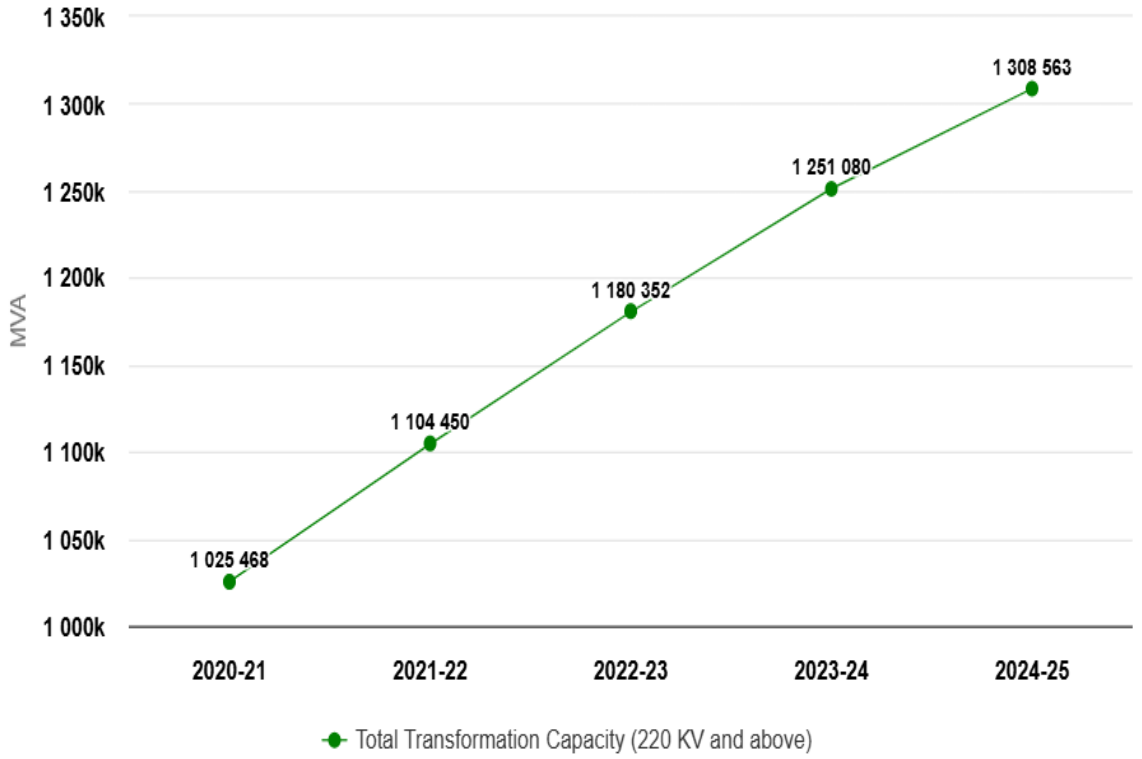
- **Payment Dynamics**: Payments are "fixed" in the sense that the bid tariff—say, $6 -18m annually for a 400 kV line—is what beneficiaries pay, regardless of the TSP's actual costs. Adjustments only kick in for force majeure or legal shifts (e.g., new taxes), as per TSA clauses.

- **Risk Allocation** – risks such as **scheduled delay, over run of cost etc. is to the account of developer** except Force Majeure events.

Indian Power Transmission System

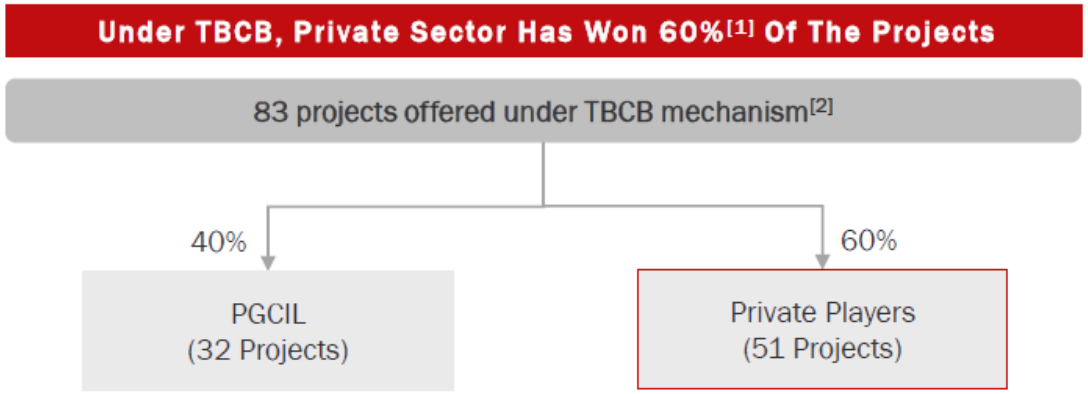
The transmission system has evolved over the years and capacity addition has been quite significant.





Private Participation in the Sector - Post 2011

- Procurement of transmission services for transmission of electricity through: 'tariff based competitive bidding', select the bidder who will acquire SPV for a new interstate / intra state transmission system on **BOOT basis** for the specified transmission system elements;
  - The project assets along with **substation land with rights**, **RoW** and **clearances** to be compulsorily transferred to CTU or its successors or an agency as decided by the Central Government **after 35 years from COD of project**, i.e. expiry of contract period, at zero cost and free from any encumbrance and liability
  - CEA and the CTU (both being the planning agencies) in 32nd year of COD of project examine the **need for upgradation of the system or renovation and modernization** of the existing system depending on technological options and system studies at that time.
  - The project may then be awarded to successor bidder selected through a competitive bidding process for renovation and modernization, if required, and operation and maintenance after 35 years from COD of the project.



Till 31st March, 2024, 144 number of ISTS schemes have been identified for implementation through TBCB route.

Out of these, 106 ISTS transmission schemes have been awarded through TBCB route and 38 ISTS schemes are currently under bidding

Private sector has been awarded a larger share of projects (in #), though the percentage share of overall transmission capex is c.10%.

Private Sector development in Transmission Projects

- Since January 2011, ISTS transmission schemes are being implemented either through the Tariff based Competitive Bidding (TBCB) process or under cost-plus mechanism with Regulated Tariff Mechanism (RTM) by POWERGRID.

- More than ten private companies are involved in provision of transmission in India. Some are transmission specialists, but others are integrated power companies or part of broader industrial conglomerates.

- Some have wrap**ped their assets into investment trusts** to reduce the cost of borrowing. Sterlite is an independent power transmission company operating in the private sector in India with experience of having developed **30 projects spanning 14,602 circuit kms** in India and Brazil.

- Recently initiated Kohlberg Kravis Roberts & Co. L.P. or KKR-sponsored **Infrastructure Investment Trust (InvIT)** , India Grid Trust (IndiGrid), aims to support the modernization and upgrading of India's transmission sector.

- IndiGrid is India's first transmission **YIELDCO** with 15 operating transmission projects, comprising **49 Extra High Voltage** overhead power transmission assets with 8,700 circuit kilometers and 15 substations with 22,550 MVA of transformation capacity.

Evolution in Transmission Pricing

Transmission Pricing: (i**) determination of the total charges** that the transmission system owner would receive; and (ii) **sharing of these charges amongst the beneficiaries** of the transmission system.

- Initially, the **implicit transmission pricing model** was followed in which transmission charges were clubbed with the generation charges.
- Subsequently, with the **unbundling** of generation and transmission, the transmission pricing model was changed from implicit to **explicit**, wherein the charges were apportioned on basis of net energy drawn.
- **Postage Stamp.** In 2002-03, the usage-based sharing mechanism was replaced by access-based method, in which **charges were apportioned based on the quantum of transmission access**. Transmission charges of interstate transmission system in a region (comprising of a few contiguous states) were pooled and shared by the beneficiaries, as per regional postage stamp method
- **Point of Connection Method** (2011). Billing based on **approved drawal/injection of power** which is based on **distance, location and quantum**.
- **General Network Access** (2022). Implementation of GNA w.e.f. 1st Oct 2023 (GNA reform aims to provide flexibility in power procurement by **merging long-term, short-term, and medium-term open access into a unified** GNA framework. Provides more flexibility and does not suffer from the rigidity of the point-to-point open access mechanism.
    - Infinite Bus Concept.

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Both concession models provide significant visibility on cash flows with limited operational risk

Fixed Return Based Projects

Annual Transmission Revenue for Each Project

- O&M Costs Based on Regulations *
- Recovery of 90% of Asset Value
- Interest on Normative Debt
- Working Capital Norms as Specified
- Equity Base 30% of Project Cost
- Tax Based on Actual

=

Annual Fixed Costs

- O&M Costs
- \+ Depreciation
- \+ Interest on loan
- \+ Interest on WC
- \+ RoE → 15.5%/17.5% **
- \+ Tax on ROE

\+

Incentive/(Penalty)

Incentive on Actual Availability vis-à-vis Normative Availability

Helps offset O&M Expenses

◆ True Up Applies

Fixed Tariff Based Projects

Revenue Components

=

Fixed Annual Tariff

(Fixed for life of the concession based on bid assumptions)

\+

Escalable Tariff

(Linked to Inflation)

(Initial Year Fixed as per Bid)

\+

Incentives

(Linked to Actual vis-à-vis Normative Availability)

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Terms: Standard Bidding Document

- **Liquidated Damages:** If the Transmission Service Provider (TSP) fails to achieve COD of any Element of the Project or the Project, by the Element's / Project's Scheduled COD, then the **TSP shall pay to the Nodal Agency, a sum equivalent to 3.33%** of Monthly Transmission Charges applicable for the Element of the Project, for **each day of delay up to sixty (60) days** of delay and beyond that time limit, at the rate of five percent (5%) of the Monthly Transmission Charges applicable to such Element / Project, as liquidated damages.
- **Lender Rights:** With the approval of the Regulatory Commission, **assign** the transmission license to the nominee of the lenders.
- **Equity Lock-in Commitment:** TSP to hold not less than 51% up to a period of one year after COD.
- **Late Payment Surcharge Rules:** Clubbing of all outstanding dues (as on 03.06.2022) including principal, surcharge etc. into a consolidated amount which can be paid in interest free Equated Monthly Instalments (up to 48). Further, non-payment of current dues by DISCOMs, **one month after the due date of payment attracts regulation of power supply**.
- **Compensation for Direct Non-Natural Force Majeure Event or Indirect Non-Natural Force Majeure Event or Natural Force Majeure Event** (affecting the Nodal Agency).

  - In case of delay due to Direct Non-Natural Force Majeure Event (nationalization, unlawful and discriminatory revocation of consents, clearances or permits), **TSP is entitled for Transmission Charges** calculated on Target Availability for the period of such events in excess of **three (3) continuous or non continuous Months**; and

  - In case of delay due to Indirect Non-Natural Force Majeure Event (act of war, industry wide strikes or labor disturbances) or Natural Force Majeure Event (act of God, epidemics) affecting the Nodal Agency, **TSP is entitled for payment for debt service** which is due under the Financing Agreements, subject to a maximum of Transmission Charges calculated on Target Availability.

Bid Process Coordinator (BPC)

A BPC, is responsible for conducting the bid process for procurement of transmission services for each inter-state transmission project to be implemented under tariff-based competitive bidding. The bid package would typically include:

- **Project Profile:** data regarding the line i.e. voltage level, line configuration i.e S/C or D/C, functional specifications of conductor etc. and functional specifications of the substations or converter stations
- **Survey Report:** one suggested route with approximate route length, type of terrain, max. altitude, snow zones, wind zones, forest / wildlife infringement, infringement of endangered species habitat, vicinity to civil and defence airports, major river/sea crossings & coal/ mineral mine areas likely to be encountered and location of substations or converter stations;
- **Standard Bid Document**

Illustration from Bid Document: Selection of Bidder as 'Transmission Service Provider' for the Project.

Single Stage Two Envelope.

S. No	Transmission System for ..... [Insert Name of Project] [Table to be filled in by BPC with details as applicable]	
	Name of Transmission Element	Scheduled COD in months from Effective Date
1.	Transmission Lines	
2.	Sub-stations	
3.	Switching-stations	
4.	HVDC links including terminal stations	
5.	HVDC transmission line	

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Bid Process Coordinator (BPC)

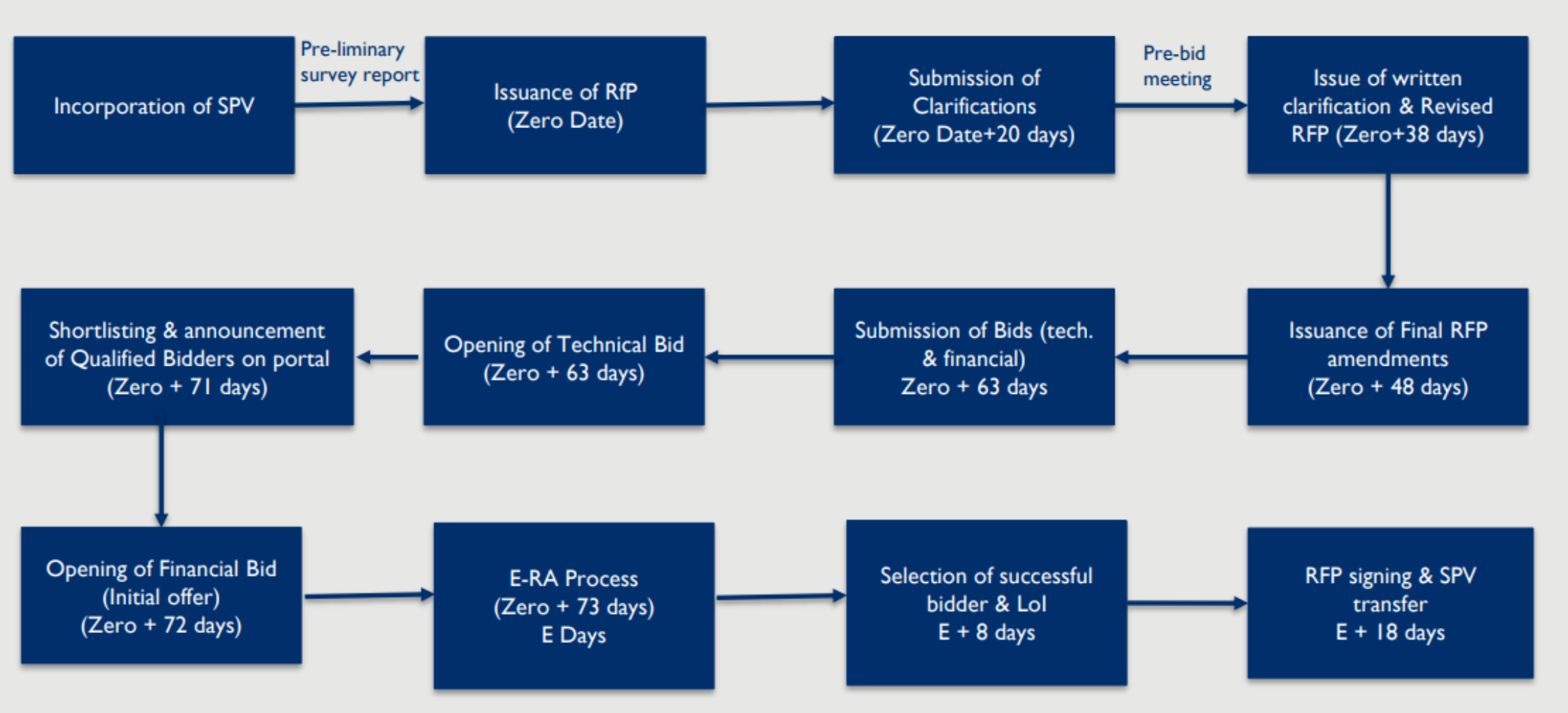
- **Consulting arms of State-owned enterprises** – PFC Consulting and REC Power Development & Consultancy Limited are the BPCs.

- The successful bidder - designated as the **Transmission Service Provider (TSP)**, after executing the TSA and acquiring the SPV (Special Protection Vehicle). The TSP seeks transmission license from the appropriate Regulatory Commission.

- An **indicative time-line** for the bidding process is given below. The BPC may give extended time-frame indicated herein and such alterations shall not be construed to be deviation from TBCB guidelines.

Event	Elapsed Time from Zero date
Publication of RFQ (Request for Qualification)	Zero Date
Submission of Responses to RFQ	30 days
Short listing based on responses and issuance	60 days
Bid clarification, conferences, Final clarification	85 days
Technical and price bid submission	120 days
Short listing of bidder and issue of LOI (Letter of Intent)	135 days
Signing of Agreements	145 days

TBCB Bidding - Process



RoW Guidelines – Determination of compensation

MoP latest guidelines mark a significant shift in the government's approach to addressing the concerns raised by landowners regarding inadequate compensation due to development of ISTS lines.

Key highlights from the guidelines:

- Market rate of land shall be **determined** by the Market Rate Committee (MRC) based on the valuation by **independent** land valuers, consisting of DC/DM/ Landowners/ TSP etc.
- MRC shall appoint two valuers-one **nominated** by the TSP and the other by the **representative** of landowners. The valuers will determine the reference market rate, which will serve as the basis for determining the market rate.

Compensation Rates:

- Tower Base : 200% of the land value (same as per earlier guideline)
- RoW Corridor : The compensation rates will be 30% of the land value in rural areas, 60% in municipal corporations & metropolitan areas and 45% in other urban planning areas.

Pass through by Central Regulator:

- Any differences in the actual RoW compensation paid by the TSP and the base RoW compensation determined for the ISTS Scheme (TBCB), will be eligible for pass through under **change in law** (CIL) by the CERC.

ROW compensation is based on 85%/15% adopted by most of the states wherein 85% land cost is paid for Tower and 15% for corridor compensation

It was not all well and challenges persists

From July 30 and 31, 2012, when India suffered the world's largest power outage after the Northern and Eastern Grids collapsed due to overload, plunging **620-700 million** people or 9% of the population at that time into darkness for **over 13 hours**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Environment Climate crisis Wildlife Energy Pollution

India

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India blackouts leave 700 million without power

Power cuts plunge 20 of India's 28 states into darkness as energy suppliers fail to meet growing demand

Helen Pidd in Delhi

Tue 31 Jul 2012 15.48 BST

The status of the transmission schemes

Stalled projects	04
Project cancelled by CERC	01
Projects not taken up & CERC cancelled license	01
Projects under litigation	02

The delay in execution of transmission projects are primarily due to RoW, compensation issues, forest issues, contractual issues, poor financial condition of the executing agencies, land acquisition for substation, delay in getting statutory approval from various agencies like Railways & State / National Highway Authority etc and law and order problem.

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Execution	Competitive (Auctions) No price cap	Competitive (Auctions) No price cap	Competitive (Auctions) Price cap	Competitive (Auctions) Price cap	Initially JV and later Competitive
Renumeration	Offer = Annuity (investment + O&M) Lowest bid win				
Transaction structure	BOO 25 years	BOO 20 years	**BOOT** contracts 30 years	**BOOT** contracts 30 years	**BOOT** contracts 35 years
Selection Criteria	NO Price Cap Tariff - Reviewed every 5 years	NO Price Cap	Price Cap (published) Initial tariff for 20 years subject to indexation; thereafter review of tariff every 4 years	Price Cap (published) Reviewed every 5 years for cost of capital, efficiency adjustments	Price Cap (published) But tendering is different – bidders bid to get additional payment above the defined tariff
Legal Support	Resolution: no contract	Decree: not contract	BOOT contract with concession grantor	BOOT contract with concession grantor	BOOT contract with concession grantor
Outcome	Most transmission privatized now	Almost all transmission (~90%) has been privatized	GoP organized 18 transmission tenders between 1998 and 2017 resulting in US$2.6 billion of investment and more than 7,560 km of transmission infrastructure, and a total annual saving of $200m or 31% compared to the price cap*	38 public auctions of multiple lots since 1999 resulting in the award of 211 lines, with a total combined length of 69,811 km.	Privately financed and owned lines at 220 kV and above

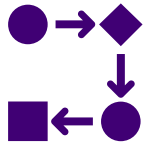
POLICY DEVELOPMENT

Development of public policy occurs through strong interactions – compromise is necessary but not sufficient for policy improvements

Market Development

- **Efficient operations of transmission system**
- **Efficient dispatch based on marginal conditions- Constrained on and off payments**
- **Successfully implementation of open access which is non- discriminatory | Rent seeking**
- **Volatile and high prices & resource adequacy | socialized capacity cost preferred over higher prices**
- **Transmission Expansion through regulated hybrid market – Merchant investment would be insufficient | Tough choices for regulatory in implementation**

Approach



- Seek to create markets via a **sectoral or market-wide intervention** that will facilitate private sector investment
- **Seek to develop projects that will provide wider demonstration or set broader market precedent**
- **Good Idea ? The Uncertainly looms on what is the future**
- **Innovation, allow new ideas and do a good job in opening opportunities**

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South Africa's Investment Roadmap for Expanding & Modernizing Transmission Infrastructure

Changing gears from IPT to ITP

Progress since Cabinet Decision

GOVERNANCE/REGULATION

1 Regulations

Draft Transmission Regulations (under the ERA Amendment Act) will be published for public comment in March 2025.

2 Ministerial determination

Ministerial determination for Transmission Pilot Lines will be issued in March 2025.

3 MOEE/DBSA

Work underway to establish the ITPO, determine the funding model and organisational structure being finalised between DEE and DBSA.

FINANCING

4 Market Sounding

ITP Market Sounding jointly issued by DEE and NT (globally) on 11 December 2024 and will close on 28 Feb 2025.

5 Credit Guarantees

A Credit Guarantee Vehicle intended to substitute for sovereign guarantees to be piloted and released in parallel with ITP Pilot (jointly between DEE/NT).

TECHNICAL PREPARATION

6 Line identification & a long-term pipeline

Lines for the pilot tender are currently undergoing technical due diligence with the NTCSA based on the TDP, but be structured to address the transmission capacity gaps. 500km/year to be tendered.

7 ITP Pilot Tender

Pre-qualification and RFP to be issued to market before end of the calendar year. Value USD400-550 million.

8 Three ITP Workstreams

Focussing on the strategic direction of the ITP programme, the regulatory and legal framework and procurement design.

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ITP Pilot and Next Steps

Request for Qualification (RFQ)

Request for Proposals (RFP)

Released in December 2024 to gather insights on alternative models for transmission infrastructure development, potential delivery mechanisms, and private sector interest and readiness. Closed for comment on **28 February 2025**.

Request for Qualification (RFQ) released **by July 2025**

Request for Proposals released **by November 2025**

Selection Criteria applied for the ITP pilot

01

Commercial viability

A package of lines (and substations) worth around USD100-200million in CAPEX to be able to attract both international and local developers (ideally in partnership)

02

SA's Transmission Development Plan (2024-2033) & IRP 2024

Priority projects must emanate from the country's Transmission Development Plan

03

Late-stage tender

Late-stage tenders are much easier to organize

ROWs have been acquired, EIA study completed as well as the feasibility study.

Reduces uncertainties on the package and developers can start due diligence to bid competitively

04

New RE capacity

The amount of new Renewable energy capacity each line would be able to evacuate

05

Strong institutions & robust implementation capacity

The need for robust technical & engineering skills have resulted in infrastructure degradation

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Partnering with the private sector

Addressing today's greatest challenges

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