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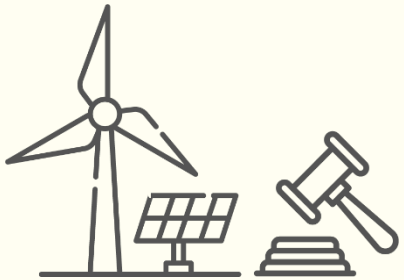

Successful Renewables Auctions, Uncertain Outcomes:

A Technoeconomic Assessment of K-Electric's 640MW Renewables 2026

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Acknowledgement

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Disclaimer

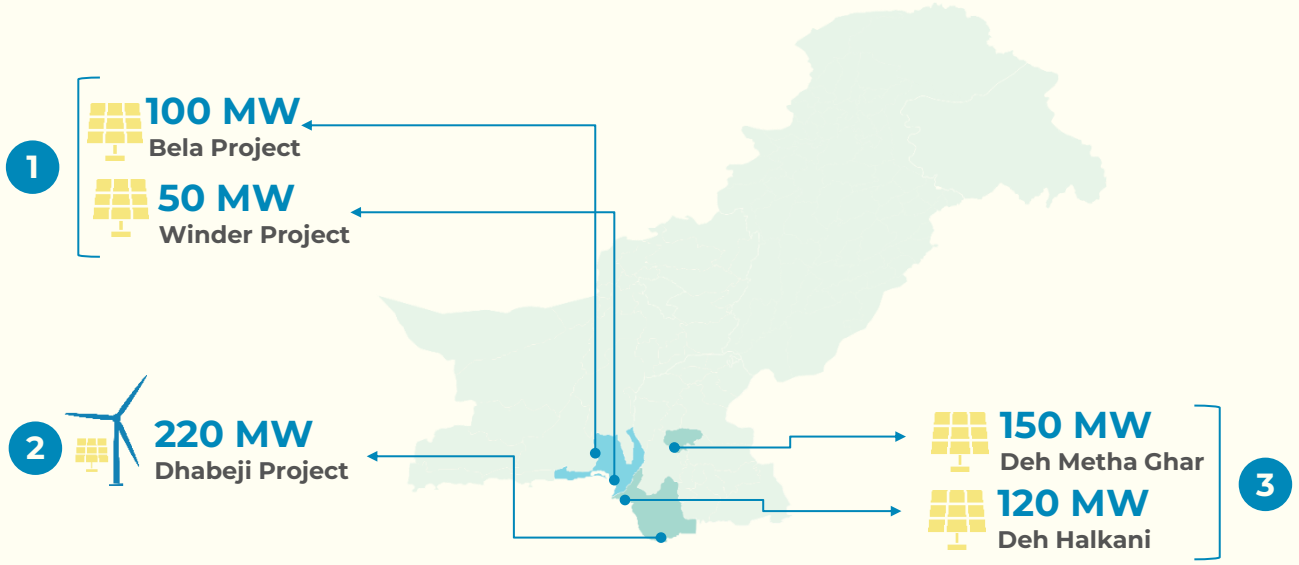
All the information and analysis provided in this document are accurate and to the best of our knowledge and understanding, in case you identify any error, feel free to reach out to us at: info@renewablesfirst.org or info@priedpk.org

Executive summary

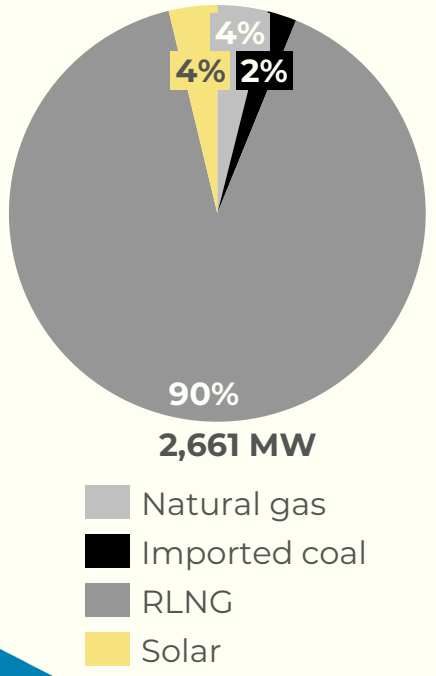
Exclusion of K-Electric's (KE's) Renewable Energy (RE) Projects in IGCEP	Despite completing all formal competitive bidding procedures, KE's three least-cost 640 MW RE projects were not recognized in the draft IGCEP 2025 base case and were evaluated only as a scenario. This is despite their optimization under the least-cost criteria of NEPRA-approved IGCEP 2021–2022 and subsequent incorporation into KE's Power Acquisition Programme (PAP), submitted under NEPRA (Electric Power Procurement) Regulations 2022 and approved by NEPRA.
Long-Term Generation Expansion Planning Assessment of KE's 640MW RE Projects	A scenario-based assessment evaluates the feasibility of KE's 640 MW RE projects across three scenarios: • **Scenario 1:** Base case with KE's existing fleet • **Scenario 2:** 640 MW of RE added as optimization candidates, with a sensitivity on enabling/disabling KE-NGC tie-line expansion • **Scenario 3:** 640 MW alongside new solar and wind candidates capped at 10% and 15% respectively, plus BESS, with two sensitivities allowing free optimization of solar and wind.
Total Cost and Basket Price Impacts of RE Integration	The model optimizes the 640 MW RE projects in FY27 under Scenario 2, cutting total cost from **~USD 14.3 billion** (base case) to **~USD 13.9 billion** over the planning horizon, falling further to **~USD 12.7 billion** in Scenario 3 sensitivities. With addition of 640 MW RE projects basket price drops from **13 cents/kWh** to **12.58 cents/kWh** by FY27, declining further thereafter. In Scenario 3 sensitivities, higher renewable penetration yields the lowest basket prices.
Renewables' Generation and NGC Tie-line Imports	In Scenario 2, RE generation starts at 200 GWh in FY25. From FY27 onwards it reaches nearly **1,605 GWh** per year, lowering NGC electricity imports from 60% to 54%, and supplies **14,842 GWh** in total over the FY25–FY35 horizon. In Scenario 3, RE supply **33,486 GWh** from FY25 to FY35, raising KE's RE generation share to 15% and cutting NGC imports to 46%. In the Scenario 3 sensitivities, RE and BESS supply **55,486 GWh** from FY25, further raising RE share to 25% and reducing reliance on NGC to 37%.
Acceleration of KE's RE integration to lower long run generation costs	Due to the Strait of Hormuz crisis, KE's heavy reliance on RLNG plants and the NGC tie-line is a serious energy security risk. With a significant share of the National Grid also dependent on RLNG, **KE urgently needs to diversify its generation mix with low-cost, reliable alternatives.** In the latest KE Multi Year Tariff Determination FY24-FY30 (October 2025), NEPRA reduced KE's tariff from **39.97 Rs/kWh** to **32.37 Rs/kWh**, calling for cost reduction to ensure financial sustainability. KE's 640 MW RE projects reduce its basket price and deliver potential savings of at least **USD 0.4 billion** in total cost if operational as early as FY27. Additionally, 2,408 MW solar and 1,232 MW wind by FY35 with 200 MW BESS can further cut KE's basket price and save **~USD 1.5 billion** in total cost.

KE marked a milestone with successful RE auctions in 2024 allowing it to integrate 640 MW of renewables in its pre-dominantly thermal-based system

Geographical Distribution of KE's 640 MW RE Projects



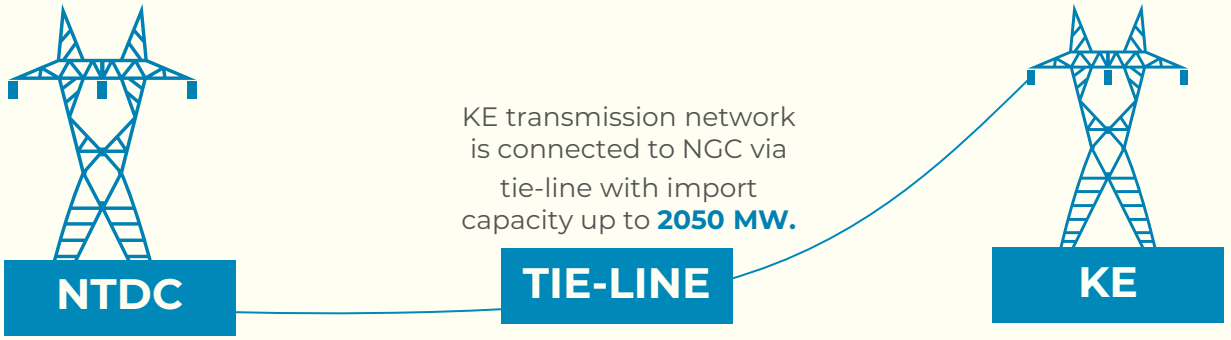
KE's Installed Capacity FY25[1]



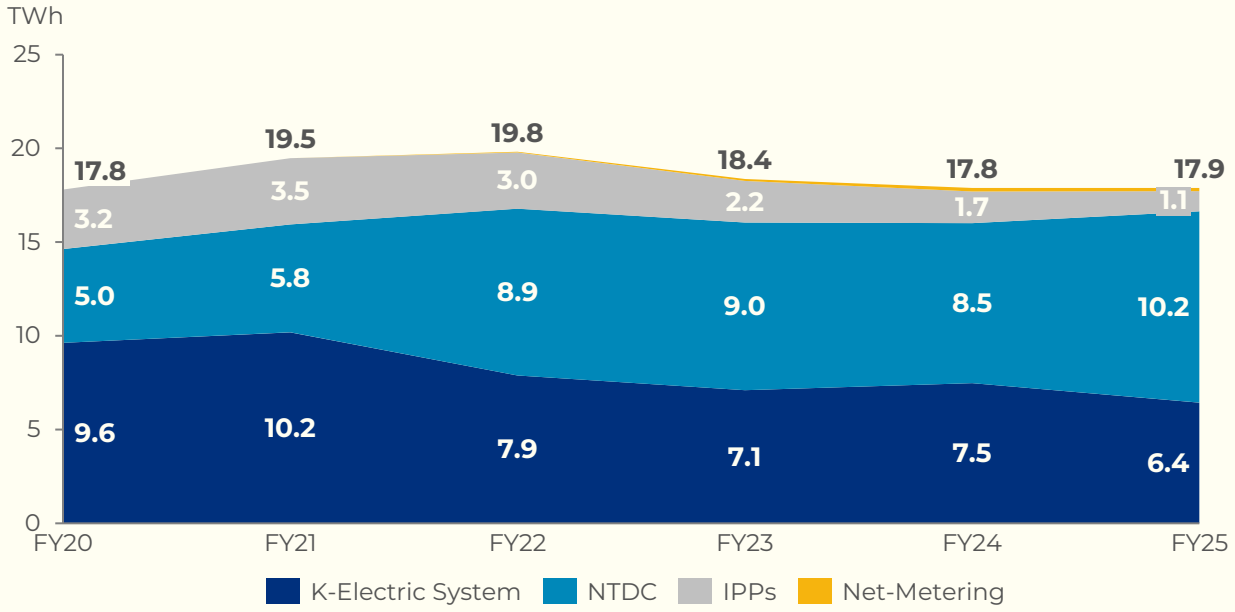
July 2024	August 2024	September 2024
Tranche 1: 150 MW	**Tranche 2: 220 MW**	**Tranche 3: 270 MW**
Solar	**Hybrid (Solar + Wind)**	**Solar**
Bidding closed at PKR 11.2 per unit (3.9 cents) won by Master Group	Bidding closed at PKR 8.9 per unit (3.1 cents) won by JCM	Bidding closed at PKR 9.8 per unit (3.4 cents) won by KAPCO

[1] In FY25, over 90% of KE's generation fleet comprised of thermal power plants with 2396MW of KE's own RLNG plants alone, IGCEP 2025, SOI Report NEPRA 2025

While NGC tie-line meets a large share of KE's demand, its reliability remains vulnerable to external shocks



KE Generation Mix, FY20 - FY24

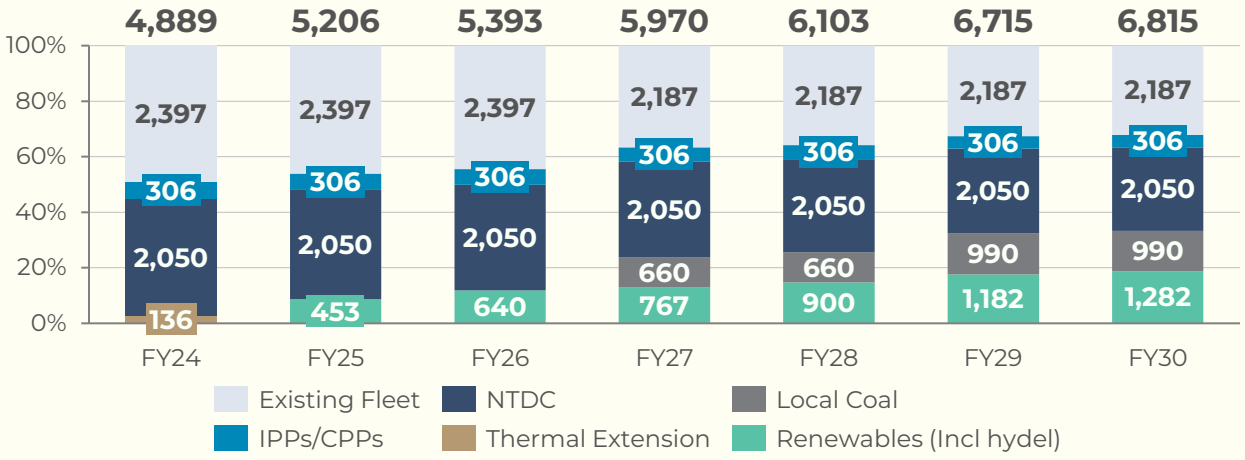


- Nearly 50% of KE's total electricity demand is met through imports from the National Grid (NGC) via the KE–NGC tie-line; 10.2 TWh in FY25 meeting up to 57% of KE's total demand in that year.
- Recent geopolitical developments—particularly the US–Israel war on Iran and the temporary disruption of RLNG trade routes through the Strait of Hormuz—have highlighted the vulnerability of Pakistan's RLNG-based power supply. Hence, any disruption in RLNG imports simultaneously affects both KE's local RLNG generation and NGC-imported electricity. As a result, continued reliance on the NGC system poses a growing risk to KE's energy security and financial sustainability.
- The addition of competitively procured RE projects would address this challenge directly by not only displacing higher-cost generation sources in the merit order dispatch but also lowering reliance on the NGC tie-line and enhancing KE's energy independence.

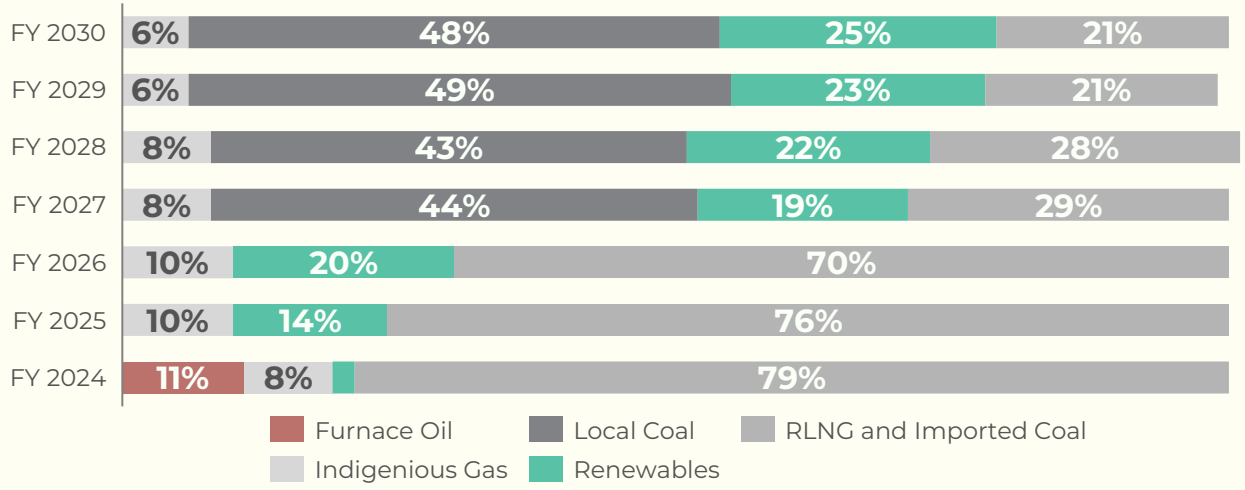
Data Source: NEPRA State of Industry Report, Pakistan Electricity Review (PER) 2025, Renewables First

NEPRA approved KE's PAP FY24-FY30 which integrated 1,282 MW of RE by FY30, increasing KE's RE share from only 3% in FY24 to 30% by FY30

Year-wise installed Capacity Additions



Generation Mix

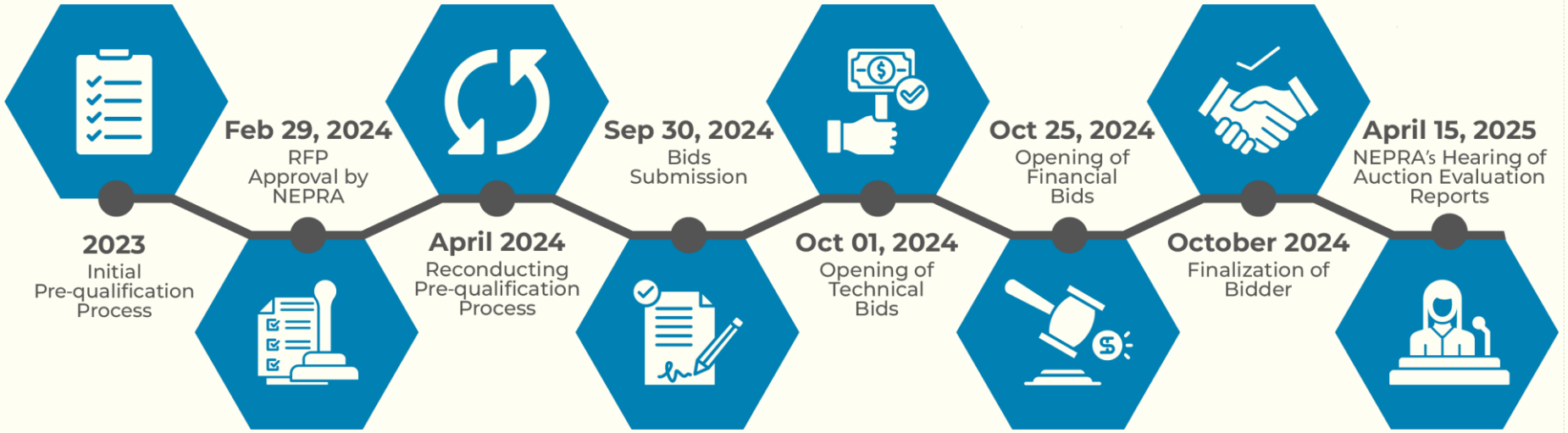


- Under NEPRA's Grid Code and planning requirements, Distribution Companies are mandated to prepare PAP which sets out their projected demand, procurement pathway, and contracting strategy in alignment with the IGCEP.
- KE's approved PAP FY24–FY30, in line with NEPRA approved IGCEP 2022-31, incorporates a growing share of RE additions, totaling 1,282 MW by FY30, including 640 MW in FY26.
- The inclusion of RE in the supply mix is expected to reduce KE's cost of generation, lowering the basket price from 8.7 cents/kWh in FY24 to 7.9 cents/kWh by FY30.
- Although NEPRA approved KE's PAP and oversaw RE auctions, the draft IGCEP 2025 omits these 640 MW RE projects, revealing a critical disconnect between procurement outcomes and national system planning.

Data Source: KE Power Acquisition Programme (FY 2024 – FY 2030)

Despite compliance with all the competitive bidding procedures under NEPRA's approvals, the status of KE's 640 MW RE projects remains unclear

Bidding Process Timeline of 120 MW (of Sindh Solar) Deh Halkani Solar Project



Note: The NEPRA hearings for the approval of the Auction Evaluation Reports were held on 11 December 2024 for the Winder and Bela projects, and on 4 February 2025 for the Dhabeji Hybrid project

Data Source: 120MW Deh Halkani Solar Project Bid Evaluation Report (BER), NEPRA

Study Methodology & Scenarios

A scenario-based assessment of KE's 640 MW projects to evaluate their feasibility for KE

The analysis aims to evaluate the feasibility and impact of KE's 640 MW RE projects in PLEXOS and PyPSA through:

- **Least Cost Generation Planning Framework**
- **Projects' impact on Installed Capacity, Generation Mix, Total Cost, & Basket Price**
- **KE's Reliance on the National Grid**
- **Opportunity Assessment of Affordable and Sustainable Electricity**

Scenario 1

Base case

No.	Name	Enabled options
1	Base case	• Candidate NGC tie-line

Scenario 2

640 MW RE projects as candidates

No.	Name	Enabled options
2	Main run	• Candidate 640 MW RE • Candidate NGC tie-line
2.1	Sensitivity	• Candidate 640 MW RE

Scenario 3

RE expansion with BESS

No.	Name	Enabled options
3	Main run	• Candidate 640 MW RE • Candidate NGC tie-line • Other candidate RE options as per IGCEP 2025 • BESS for Optimization
3.1	Sensitivity	
3.2	Sensitivity	

- In Scenario 3, solar and wind are capped at 15% and 10% capacity share respectively by the end of the planning horizon.
- In Sensitivity 3.1, solar and wind are open for the model to optimize.
- In Sensitivity 3.2, solar and wind are open for the model to optimize and the annualized integration cost for solar and wind post FY30 is also added as $25,000 per MW..

[1] Integration cost refers to the additional system and network costs associated with renewable energy integration, including balancing requirements, transmission upgrades, power electronic devices, and related grid infrastructure.

Key inputs and assumptions in the model

Following are the key assumptions used to build KE's generation system:

Planning horizon
FY25-FY35

NGC-KE Tie-line Capacity
Modelled as a 2,050 MW Generator

Candidate tie-line
Candidate tie-line with capacity up to 2,000 MW

Lead time for candidate plants
Solar & wind: 2 years

Plant parameters
Marginal costs, installed & dependable capacities and other parameters as per IGCEP 2025 given in Annexure

Capacity Obligation of Plants:
SNPC-1: 75% |**SNPC-2**: 50% |**BPSQIII**: 50%

NGC Average/Marginal Cost
From Power Purchase Price (PPP) Document (FY26).

Plant Retirement Schedule
BQPS1 U5 in FY27 | **BQPS1-U6** in FY33

Candidate BESS Parameters
A **200 MW BESS** with up to 800 MWh **capacity** having **150$/kWh** CAPEX

FO&Ms:
Solar candidate: 10.37 $/kW-Yr
Wind candidate: 25.3 $/kW-Yr

Annualized Cost of Energy
Solar candidate: 63.17 $/kW-Yr
Wind candidate : 136.88 $/kW-Yr

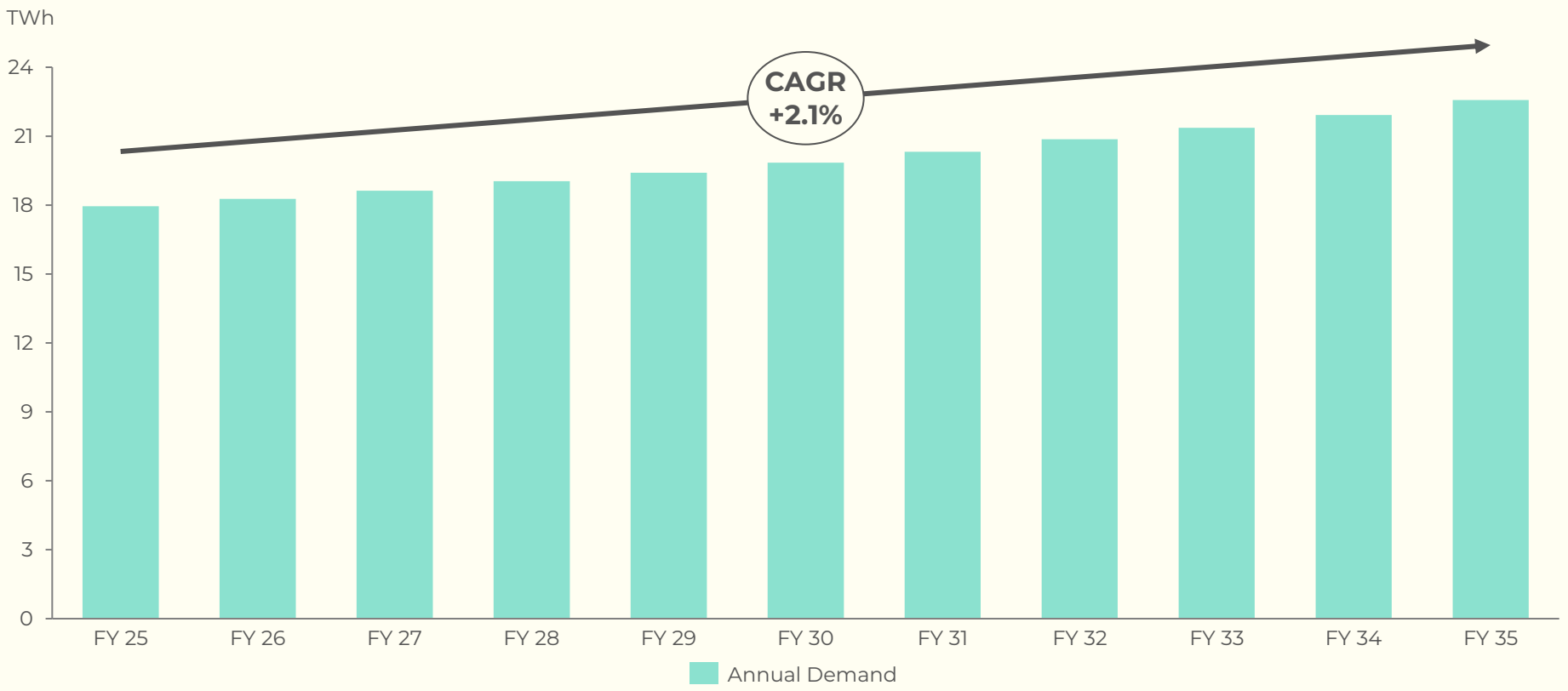
Build Costs
Solar candidate : 489.04 $/kW
Wind candidate : 995.71 $/kW

Plant Capacity Factors
Solar candidate : 22.8%
Wind candidate : 42%

Data Sources| NTDC Power Purchase Price Projections | IGCEP 2025 | PRIED & Renewables First Calculations

As per IGCEP 2025, KE's demand is projected to grow in the coming years

KE's Demand Forecast FY25-FY35



The IGCEP demand for KE incorporates a projected cumulative 900MW[1] of net-metered solar quantum by FY35 as given below

FY	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Annual (MW)	135	125	115	105	95	85	75	65	55	45	0
Cumulative (MW)	135	260	375	480	575	660	735	800	855	900	900

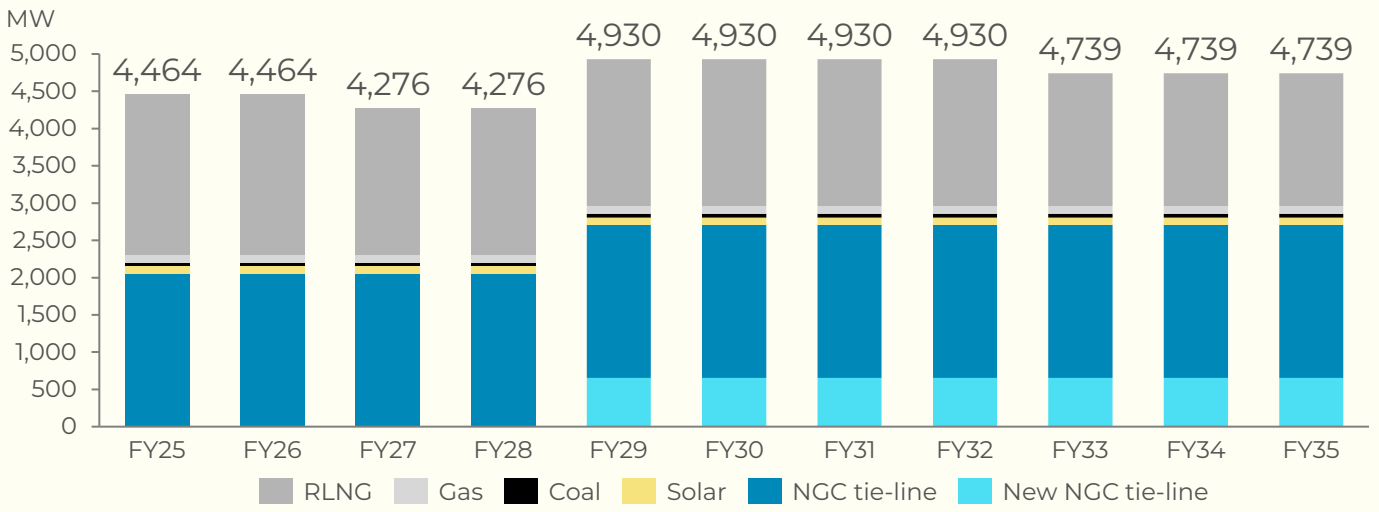
Data Sources: IGCEP 2025 | ISMO

[1] Low BAU demand forecast is used in the model.

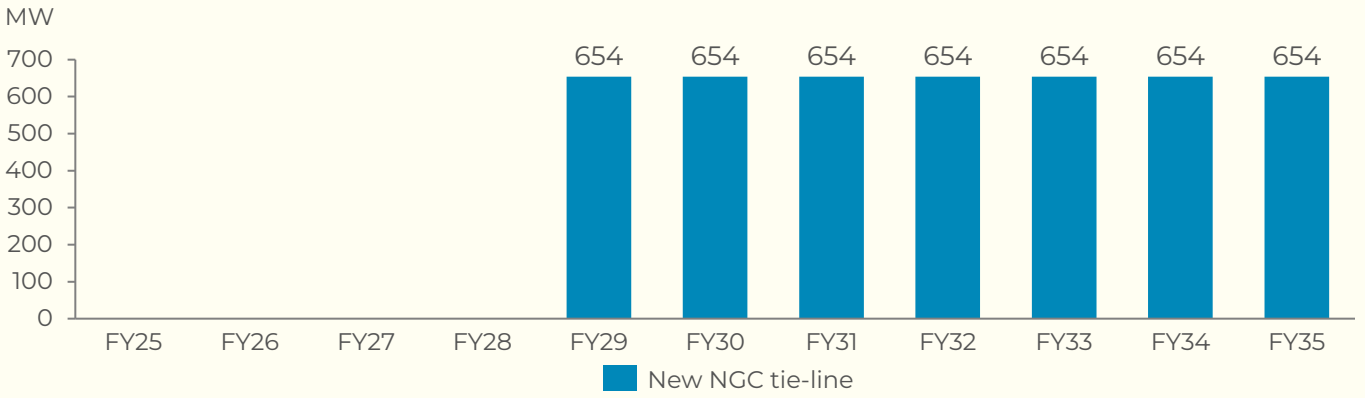
Study Results

In our base scenario, the model enhances the NGC tie-line capacity by 654 MW in FY29

Installed Capacity



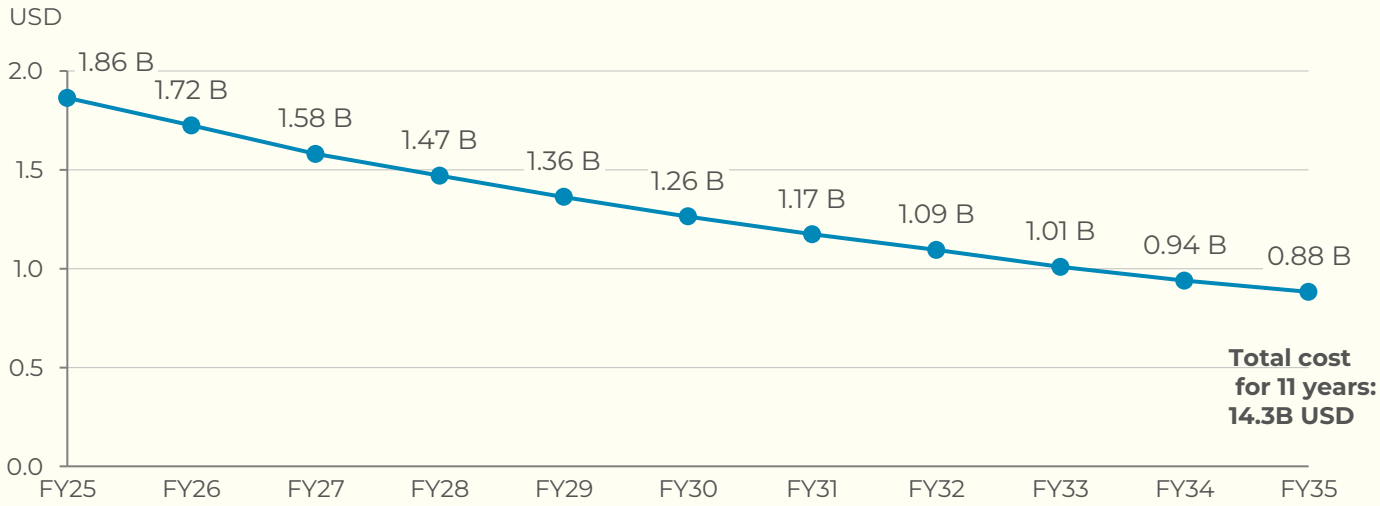
Total Optimized Capacity



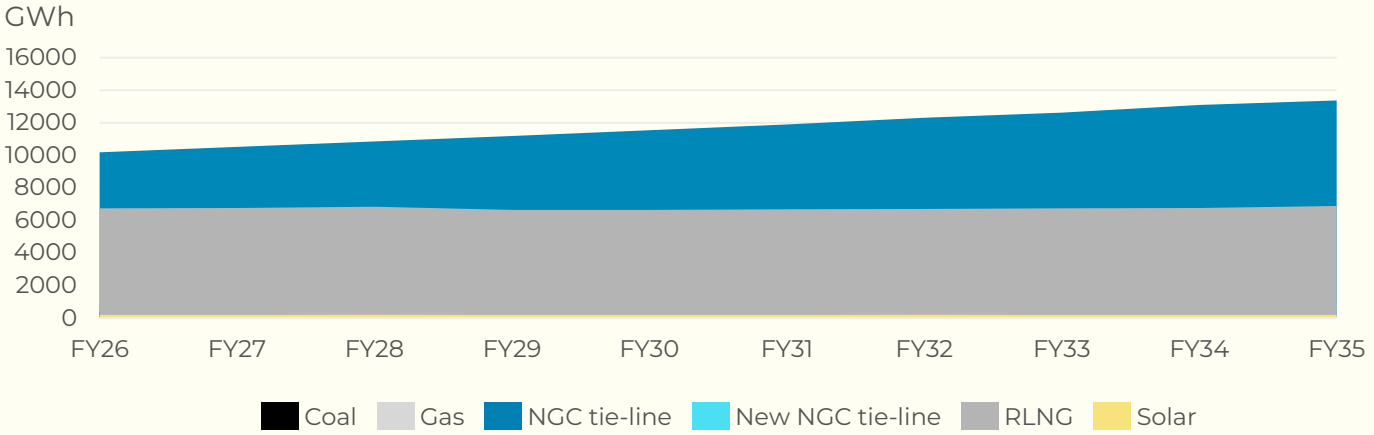
- As no new candidate RE generation options are enabled for optimization, the model optimizes **654 MW candidate NGC tie-line** in **FY29** to meet the demand
- The drop in installed capacity from 4,464 MW in FY26 to 4,276 MW in FY27 occurs due to the retirement of BQPS1-U5.
- A similar drop from FY32 to FY33 is due to the retirement of BQPS1-U6 in FY33.

The NGC tie-line alone adds USD 7.7 billion in the USD 14.3 billion total cost

Total Cost[1]



Generation Mix

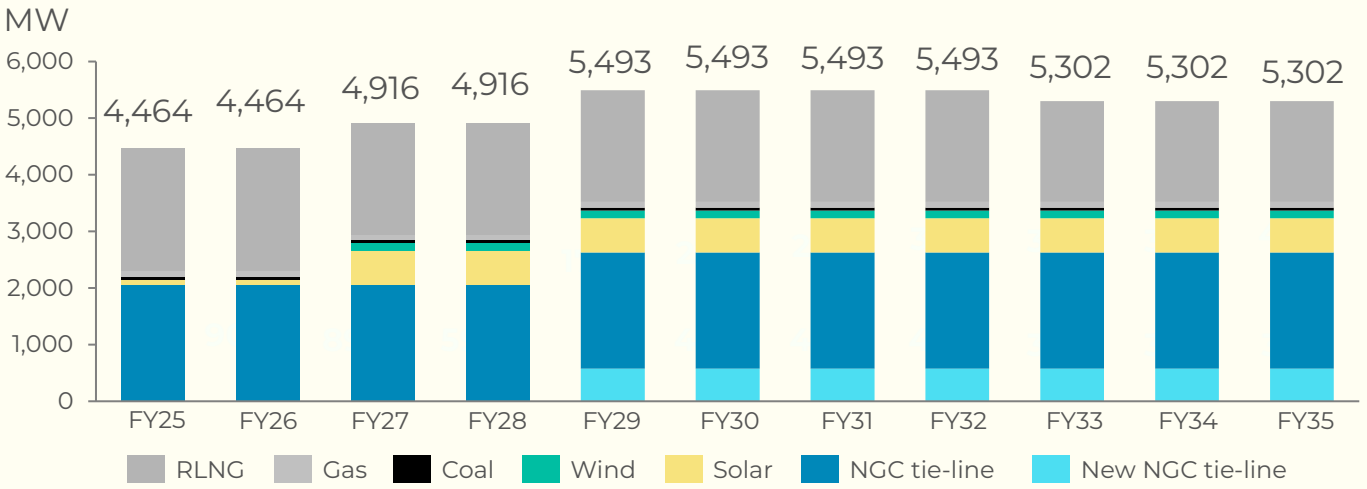


- The total cost equals USD 14.3 billion by FY35, with over half (USD 7.7 billion) driven by NGC tie-line (existing and new), while RLNG plants make up to USD 5.7 billion of this cost.
- The generation mix almost evenly spreads across NGC tie-line and KE's RLNG plants.
- Amid the ongoing imported fuel price hikes resulting from the US-Iran war, the NGC tie-line and KE's RLNG plants have become the two most costly and unreliable options for consistently meeting KE's growing electricity demand in the long run.
- In addition, grid congestion and transmission bottlenecks within the National Grid may limit the consistency of supply from the NGC for KE.

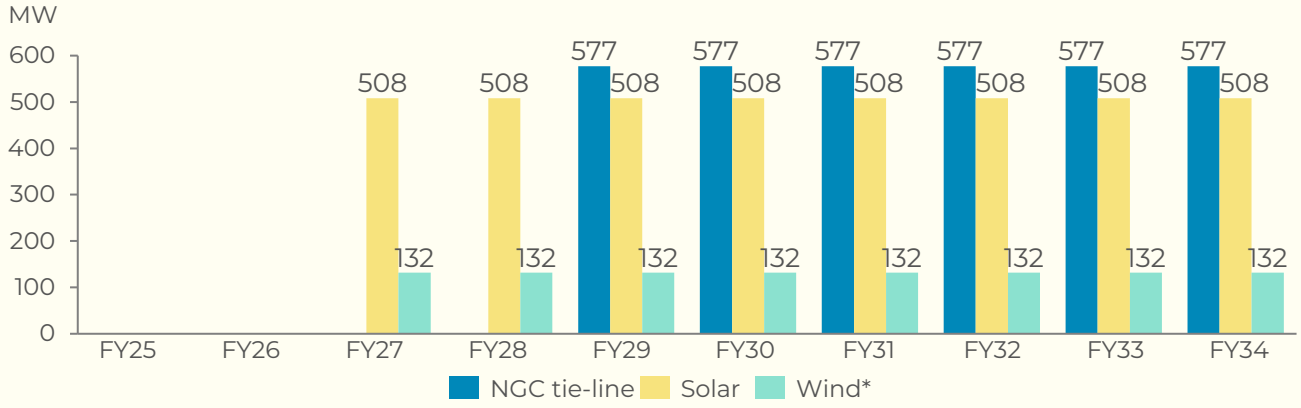
[1] The total costs are discounted at 10% interest rate

The model optimizes KE's least-cost 640 MW RE projects in FY27, and also enhances the NGC tie-line capacity by 577 MW in FY29

Installed Capacity



Total Optimized Capacity

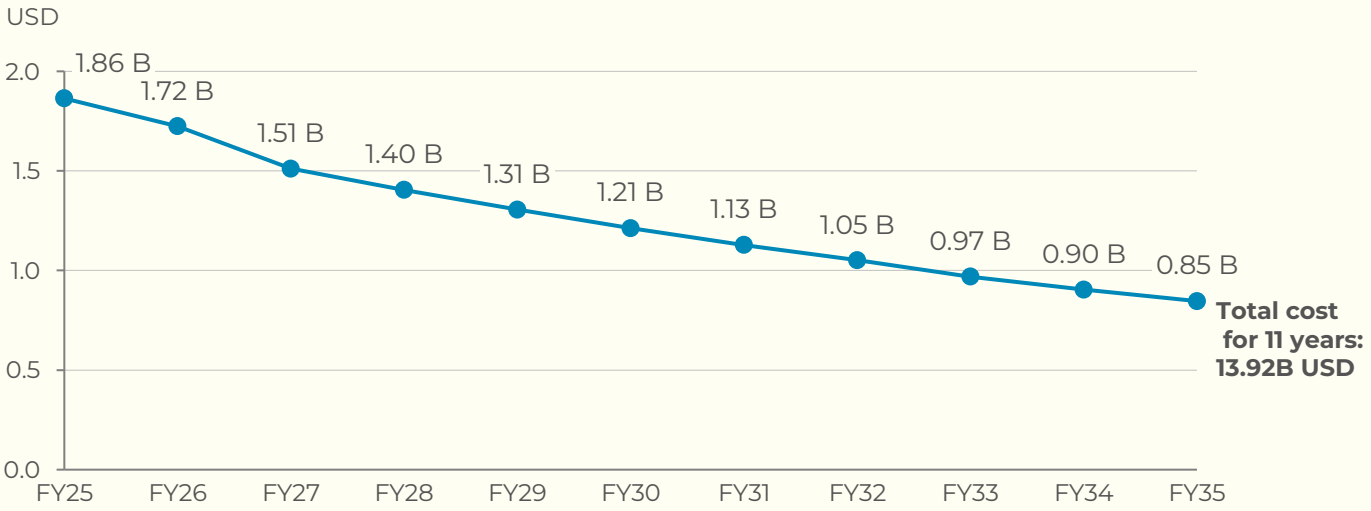


When offered as candidate options, the model selects the 640 MW RE projects in FY27 on least-cost merit, raising KE's cumulative RE installed capacity from 100 MW to 740 MW.

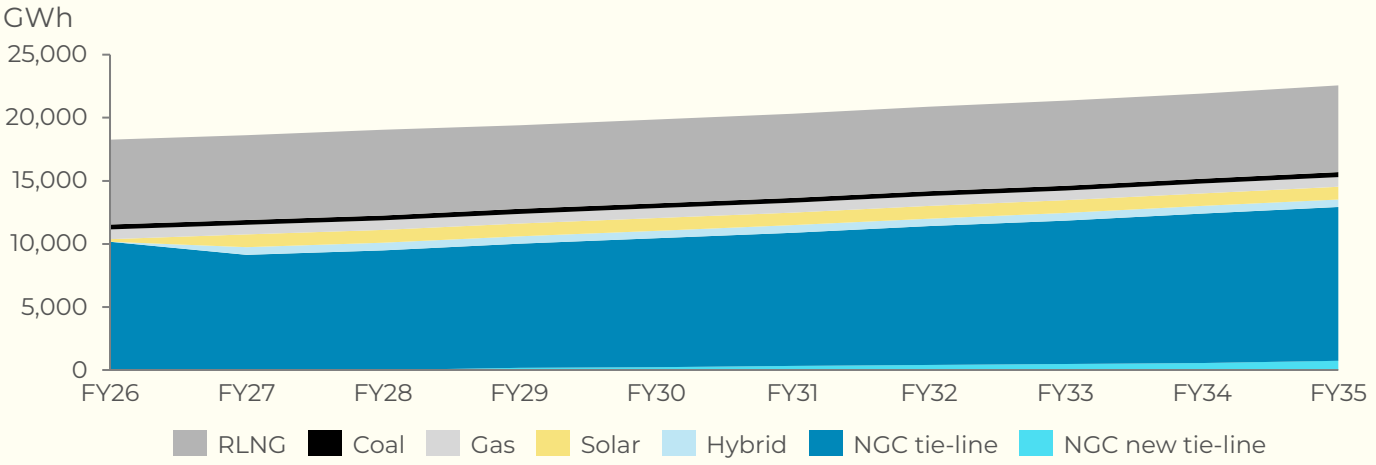
* 132MW optimized wind capacity represents the 60% share of wind in Dhabeji Hybrid project

With the integration of 640 MW RE, the total cost reduces by USD 0.4 billion

Total Cost



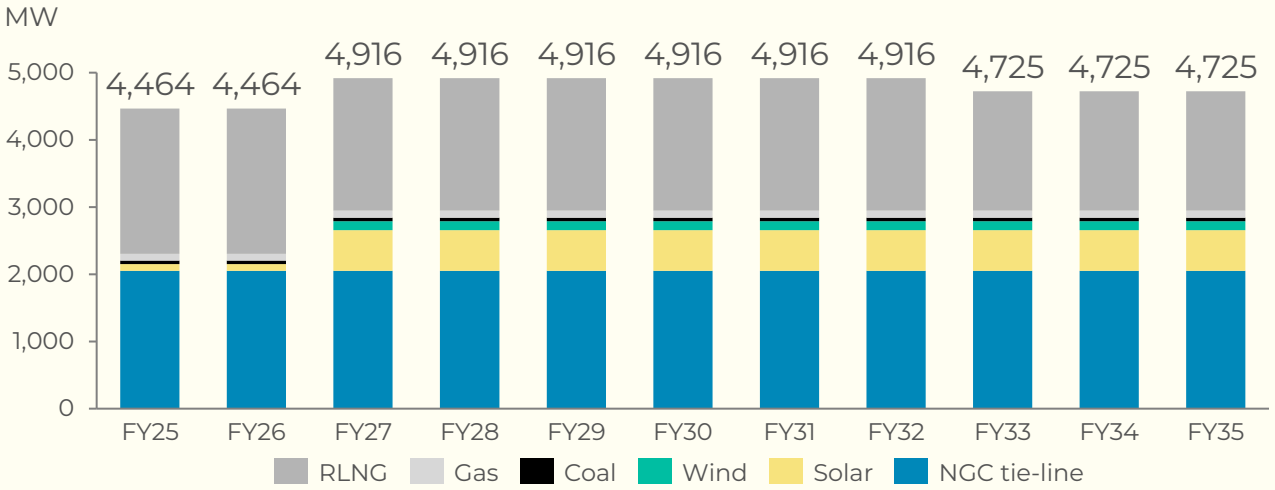
Generation Mix



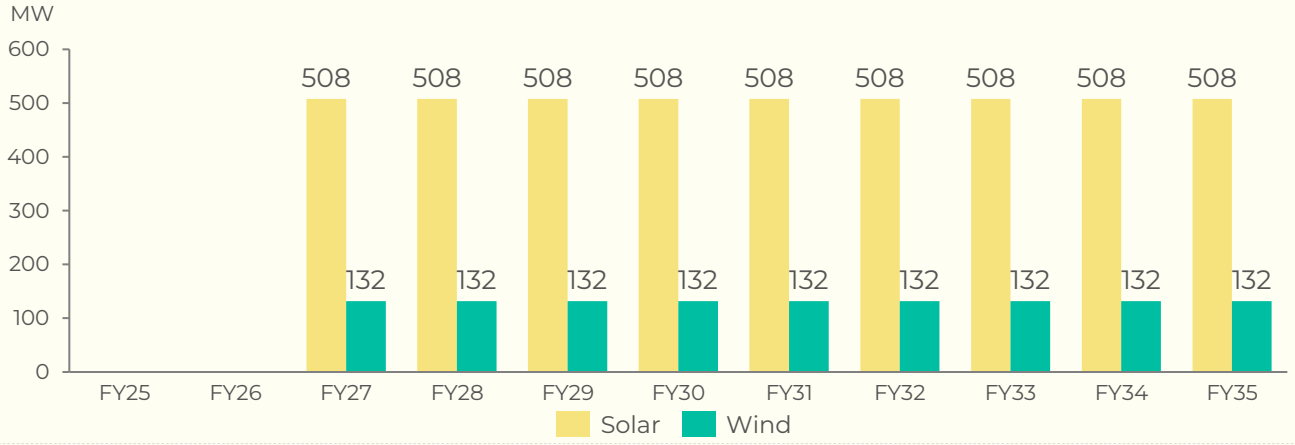
- The total system cost over the planning horizon is reduced from USD 14.3 billion to USD 13.92 billion, resulting in overall savings of USD 0.4 billion (USD 432 million).
- The contribution of KE's renewables in meeting the demand increases from nearly 200 GWh, previously met by 50 MW Gharo and 50 MW Oursun alone in FY25, to 1,605 GWh FY27 onwards with the addition of new 640 MW RE.

The least cost 640 MW RE projects are optimized in FY27, and no NGC tie-line capacity enhancement takes place

Installed Capacity



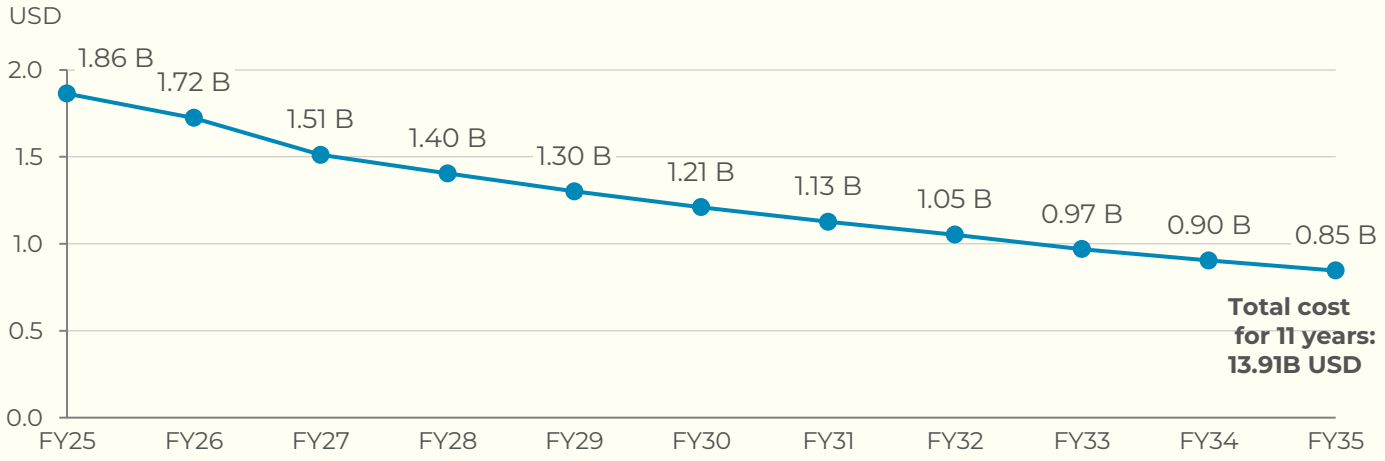
Total Optimized Capacity



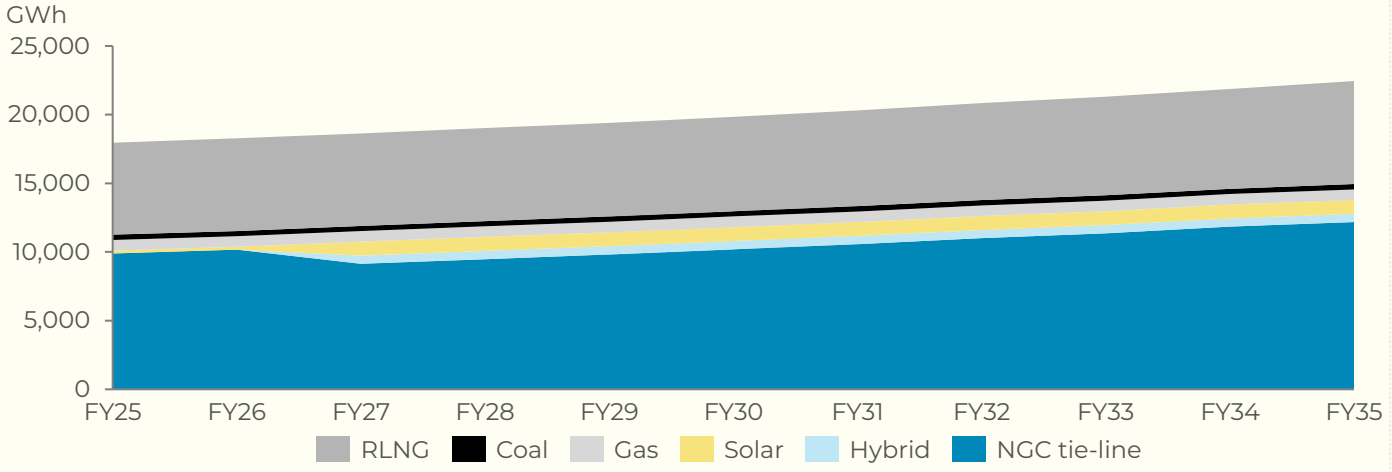
- The installed capacity by FY35 is 4,725 MW compared to 5,302 MW in Scenario 2 since no new NGC tie-line capacity enhancement has taken place in the sensitivity case of this scenario.

Restriction of NGC tie-line capacity enhancement reduces the total cost to USD 13.91 billion, but the dispatch of RLNG plants rises

Total Cost



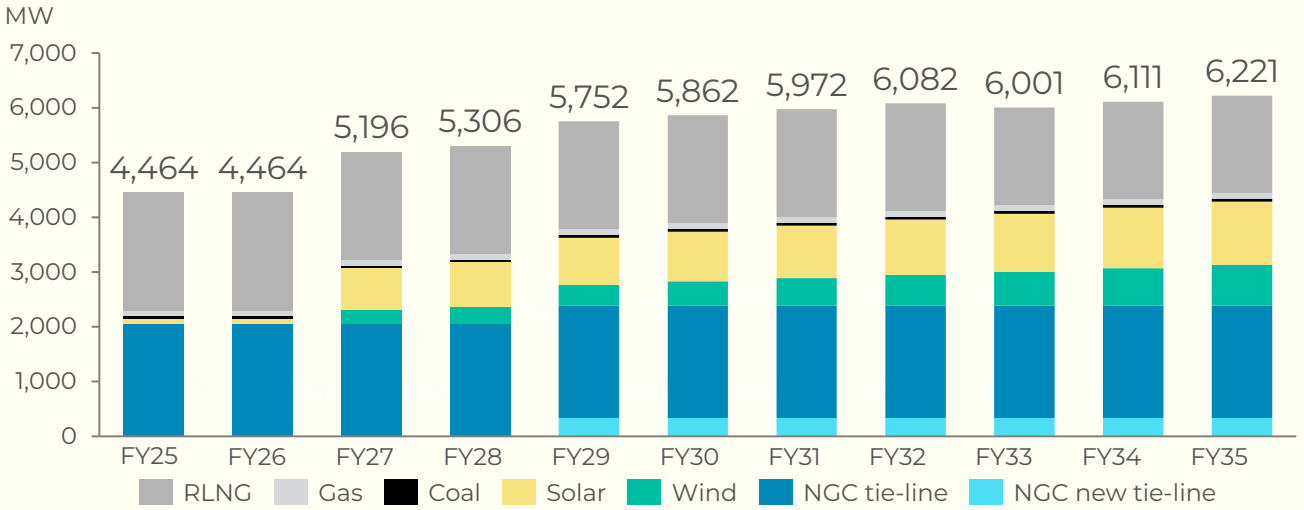
Generation Mix



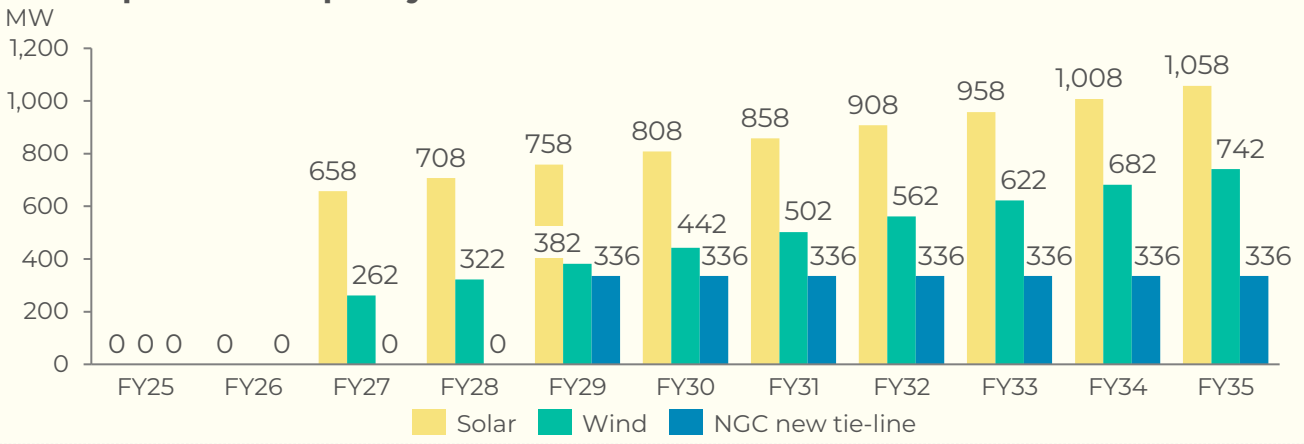
- The overall total cost reduces to **USD 13.91 billion**.
- The dispatch of KE's renewables and the existing NGC tie-line remains the same, but the model increases the dispatch of KE's RLNG plants to adequately meet the demand.
- Total electricity supplied by RLNG plants rises from 6,685 GWh in FY25 to **7,496 GWh** in FY35 in this scenario, compared to an increase from 6,685 GWh to **6,878 GWh** over the same period in Scenario 2.

The model successively optimizes more renewables and enhances the NGC tie-line capacity by 336 MW in FY29

Installed Capacity



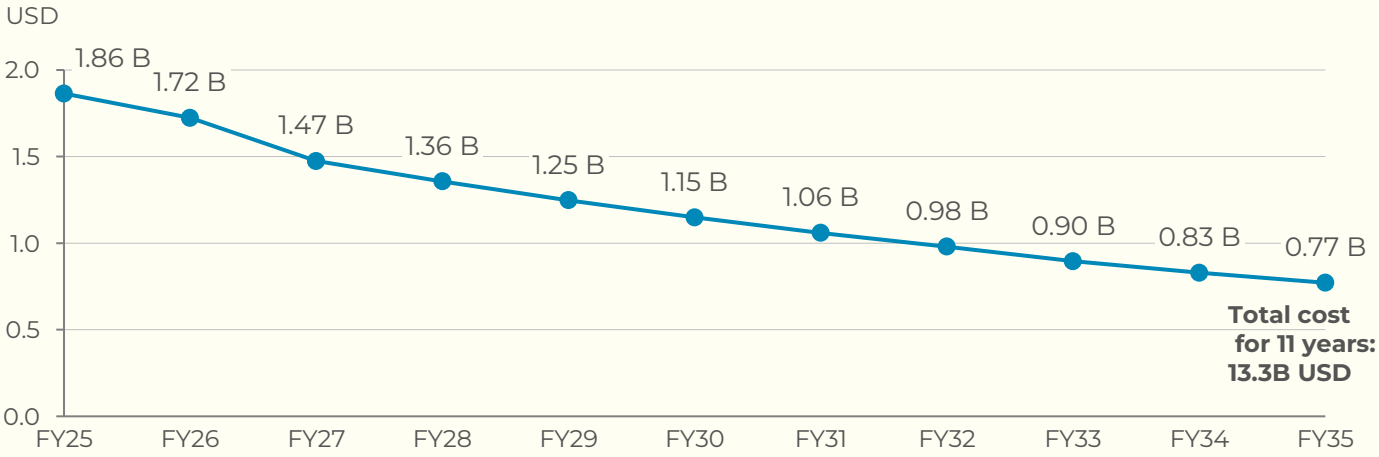
Total Optimized Capacity



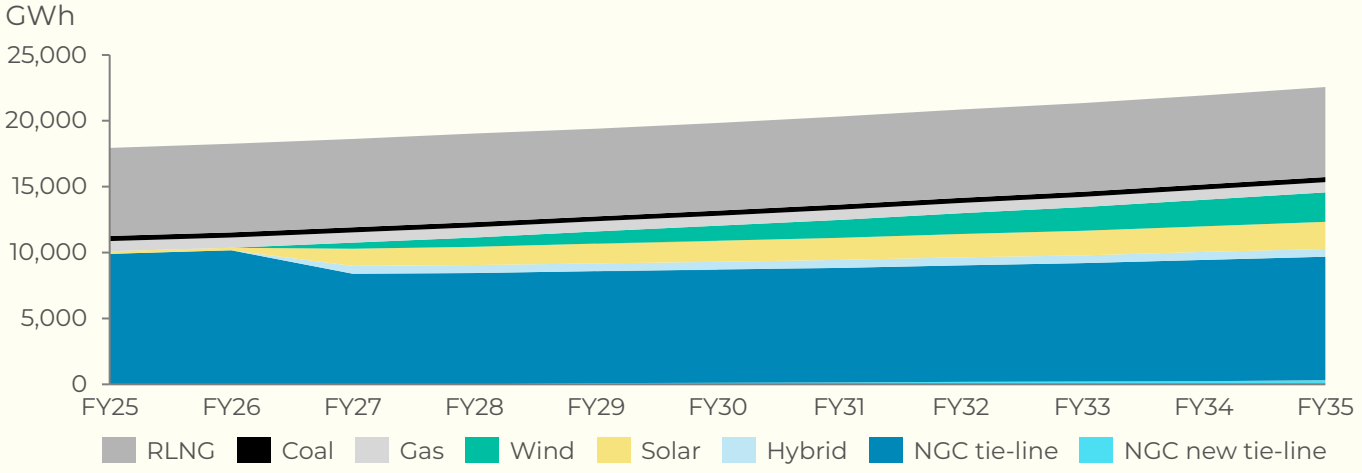
- The enablement of candidate RE options allows the model to optimize solar and wind as per the system's need and thereby diversifies KE's generation mix.
- A total of **1,058 MW** solar and **742 MW** wind is optimized by FY35.
- The tie-line capacity enhances by **336 MW** in FY29.

The total cost FY25–FY35 reduces to USD 13.3 billion with the diversification of KE's generation mix through more renewables

Total Cost



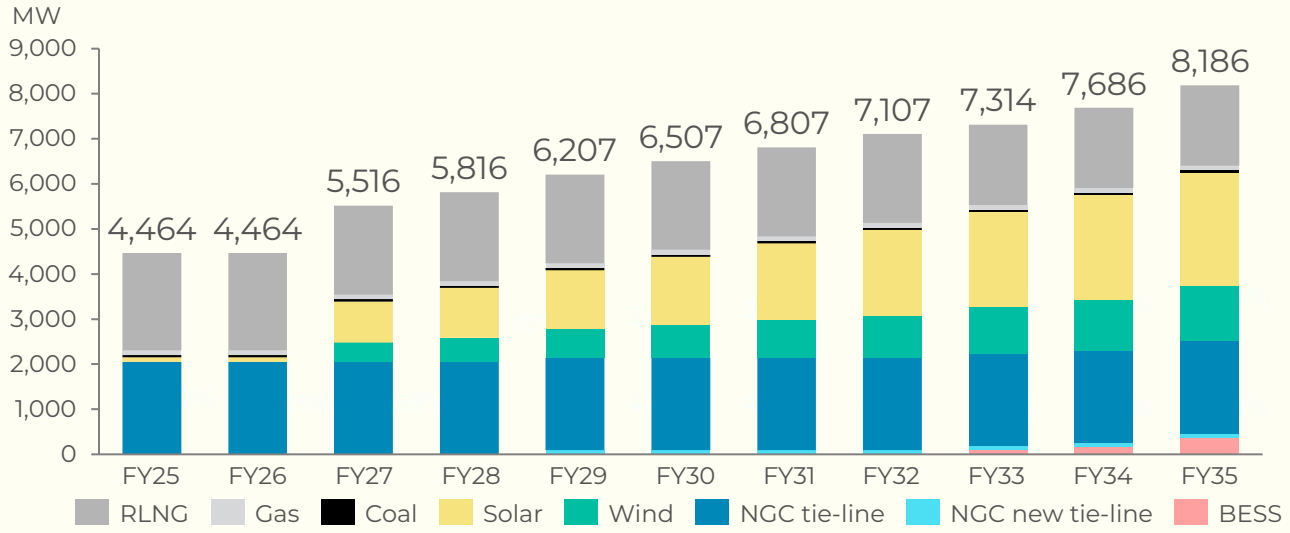
Generation Mix



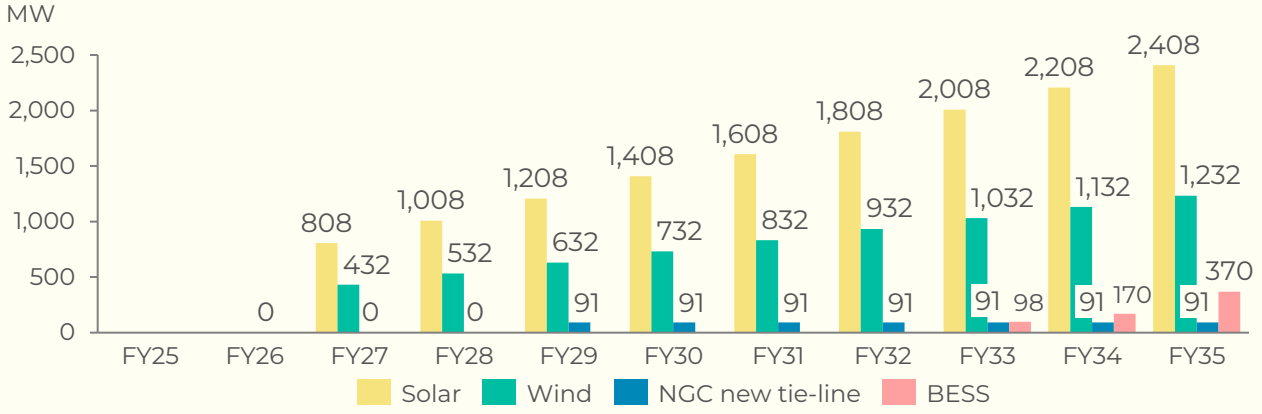
- The total cost drops by **USD 536 million** compared to Scenario 2.1, driven by the newly optimized quantum of solar and wind meeting a significant portion of KE's electricity demand, highlighting the appetite for renewables in KE's power system.
- However, BESS is not optimized in this scenario, and the model increases the dispatch from NGC thereby increasing NGC's share in the total cost and inflating the overall total cost to **USD 13.3 billion.**
- The average capacity factor of the NGC tie-line over the horizon is **50.16%** and that of the new NGC tie-line is **3.92%.**
- Renewables supply a total of **33,136 GWh** into the system over the planning horizon in this scenario.

The model substantially optimizes renewables across the planning horizon, and BESS in the later years

Installed Capacity



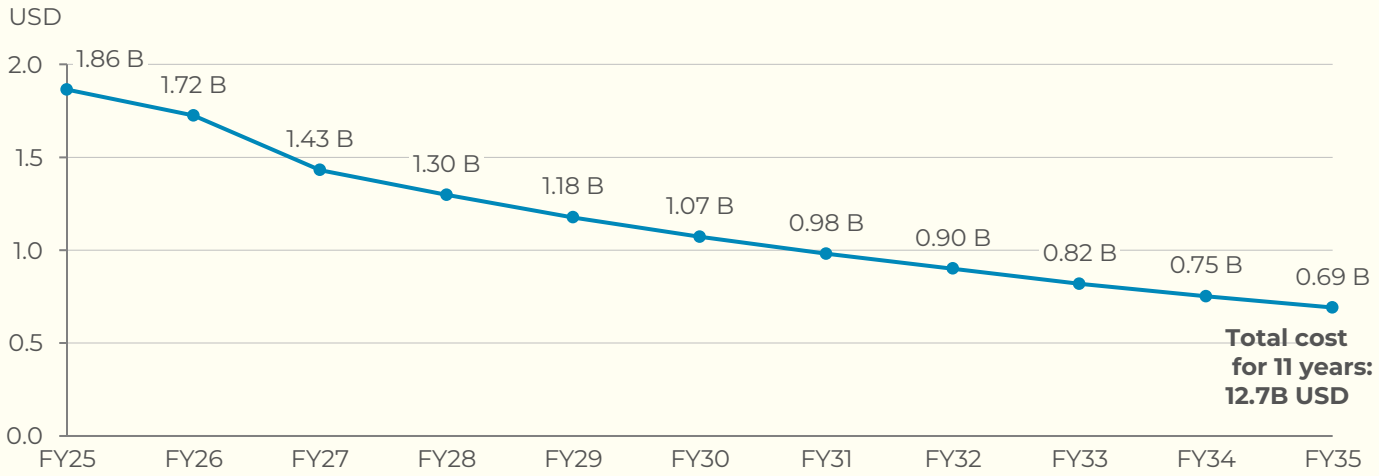
Total Optimized Capacity



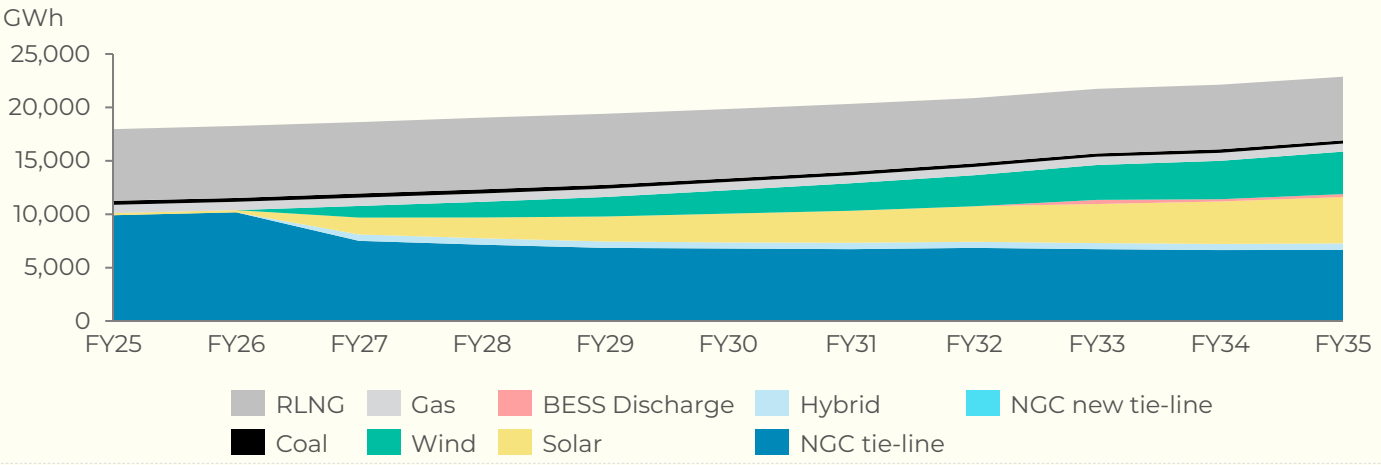
- With no bounds on renewables optimization, the model optimizes 200MW solar and 100MW wind each year FY27 onwards adding a cumulative of **2,408MW** solar and **1,232MW** wind by FY35, respectively.
- 98MW, 73MW, and 200MW of BESS capacity is optimized in FY33, FY34, and FY35, respectively.
- The model enhances the tie-line capacity only by 91MW in FY29.
- The BESS parameters are given in Annexure.

Backed with BESS, KE's renewables meet a greater share of KE's electricity demand and lead to an increased reduction in total cost

Total Cost



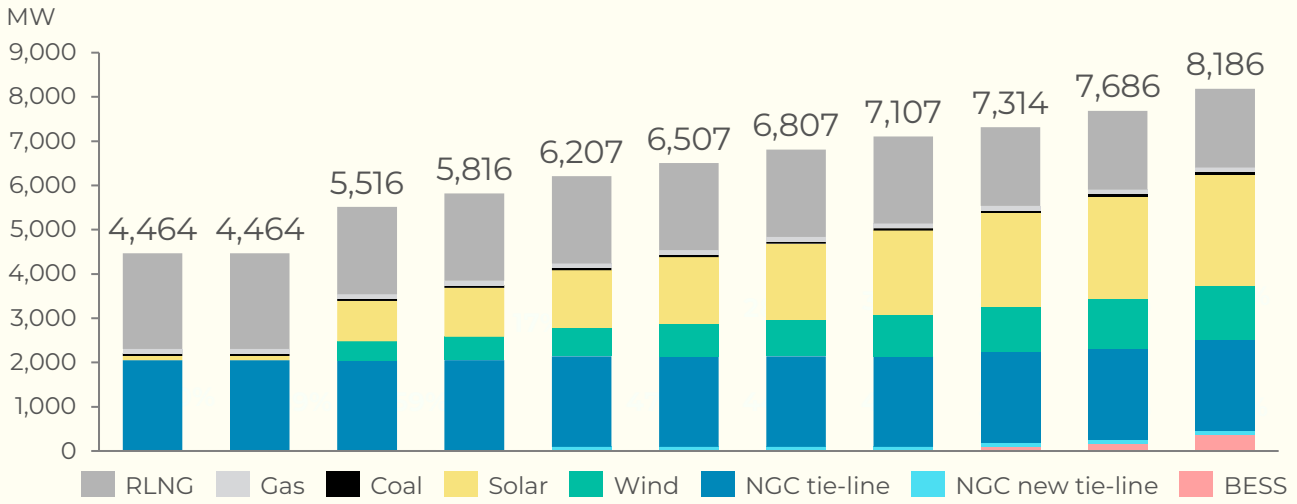
Generation Mix



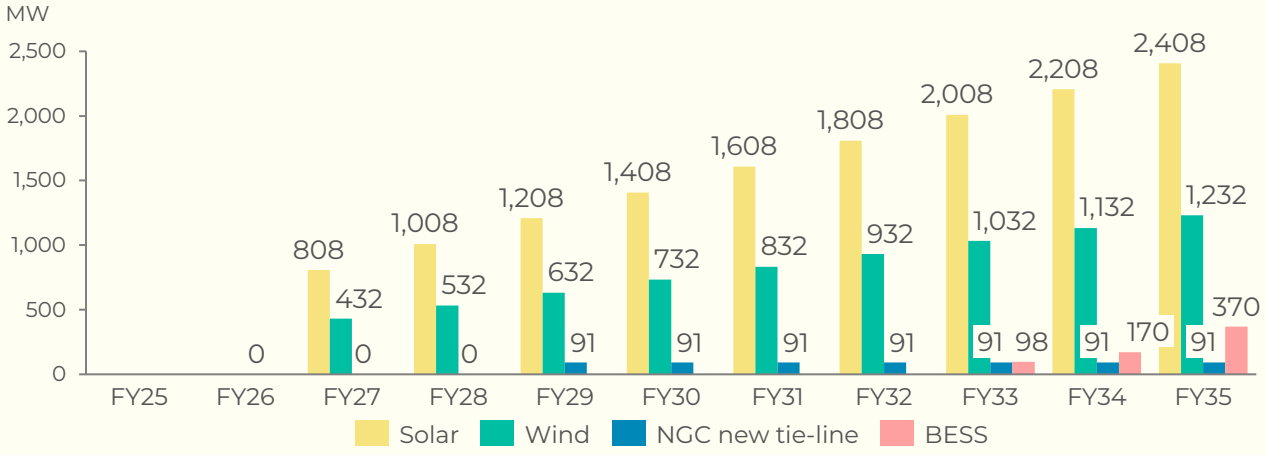
- The overall total cost reduces to **USD 12.7 billion.**
- Backed with BESS, the total energy supplied (FY25-FY35) into the system by renewables is **55,486 GWh.**
- As 640 MW RE is integrated in KE's system, the capacity factor of the NGC tie-line falls from 56.6% in FY26 to **41.75%** in FY27 and continues to fall over the period reaching to 36.93% in FY35.
- The average capacity factor of the NGC tie-line over the horizon is **40.34%** and that of the new NGC tie-line is 3% owing to the ability of renewables to meet a significant share of KE's demand.
- BESS discharges 386 GWh, 192 GWh, and 261 GWh in FY33, FY34, and FY35, respectively, into the system.

The same share of renewables is optimized, even with the incorporation of integration cost of renewables

Installed Capacity



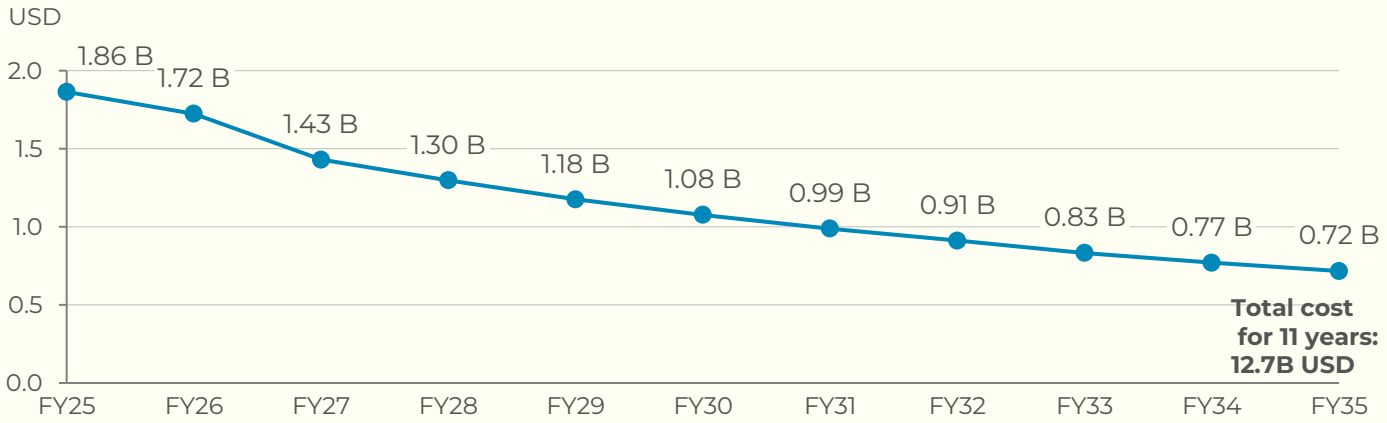
Total Optimized Capacity



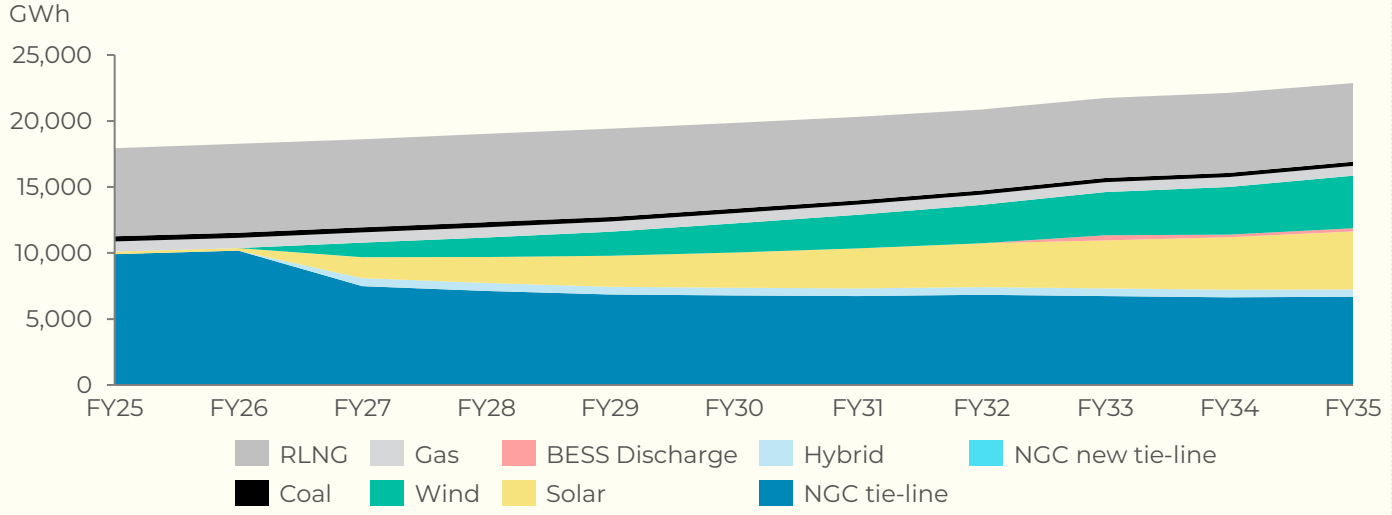
- The model optimizes the same solar, wind, and NGC tie-line capacity every year as in Scenario 3.1.
- The BESS discharged units are the same as in Scenario 3.1.

Renewables deployment remains economically favorable despite additional integration cost

Total Cost



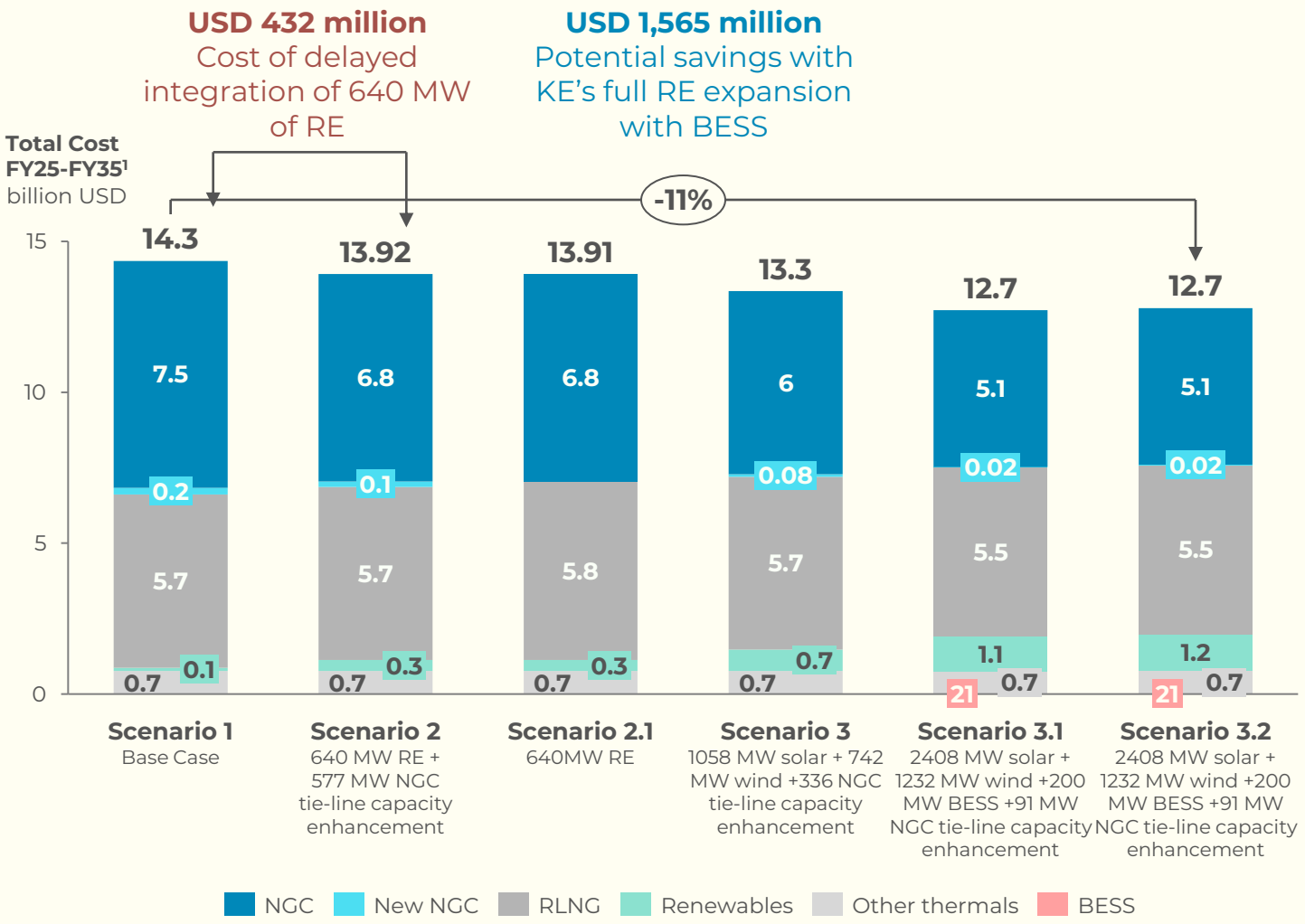
Generation Mix



- The capacity factor of the NGC (existing and new) tie-line remains the same as in Scenario 3.1, 40.34% and 3%.
- In both Scenarios 3.1 and 3.2, higher renewable capacity and BESS is optimized in line with the system needs, thereby reducing overall NGC dispatch and its share in the total cost

The Cost of Delay

Renewables integration coupled with storage is more economical for KE's system than the NGC tie-line and KE's RLNG plants

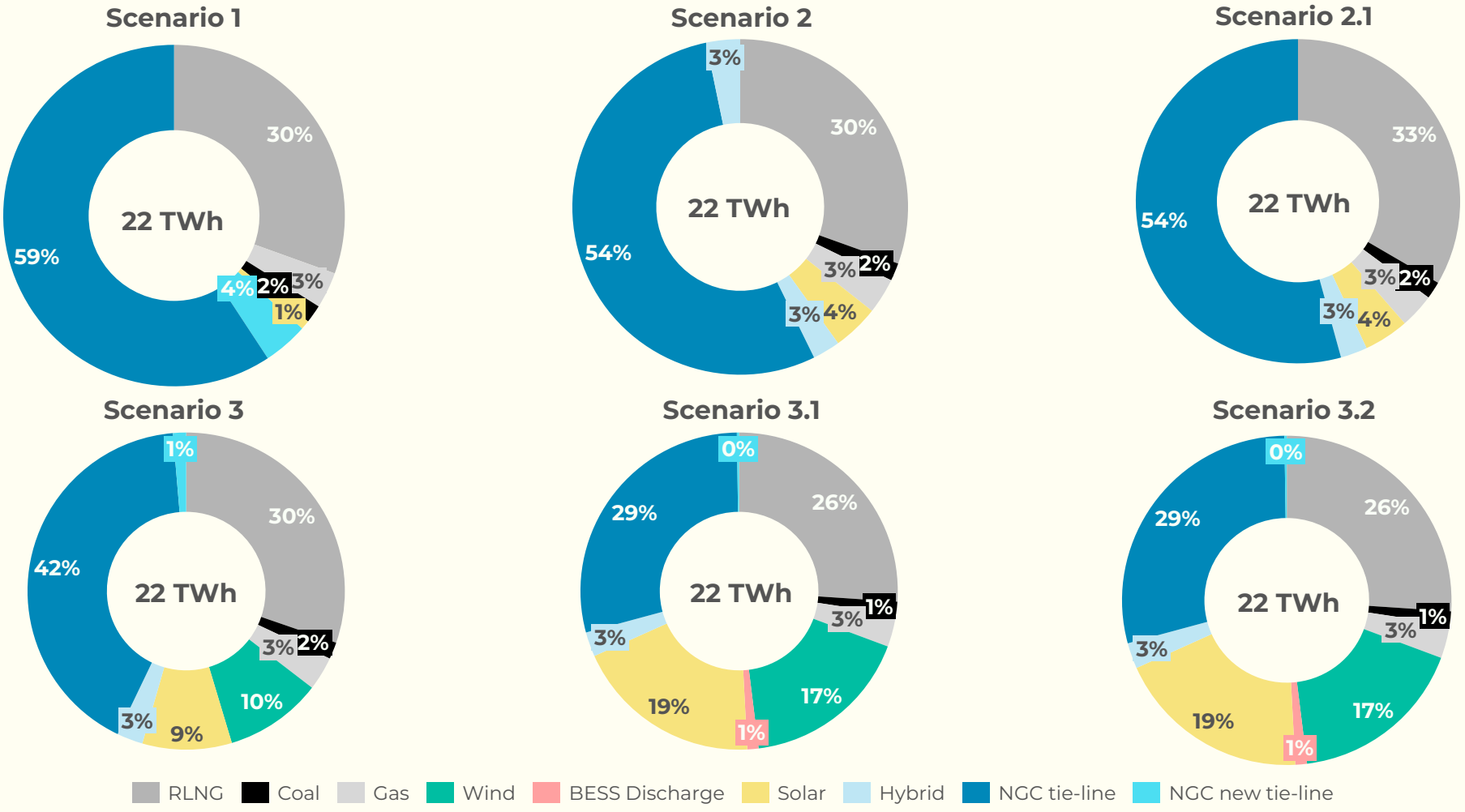


- 2408 MW solar and 1232 MW wind coupled with 200 MW BESS and the existing NGC tie-line with a 91 MW capacity enhancement saves KE **USD 1.5 billion** (USD 1,565 million) in total cost.
- However, KE's massive reliance on its RLNG plants and the existing NGC tie-line to continuously meet its demand exacerbates the total cost.
- **USD 0.4 billion (USD 432 million)** is the cost of delaying the integration of the competitively procured 640 MW of RE.

[1] These total costs do not account for the cost lost due to the transmission bottlenecks and reliability issues of the National Grid.

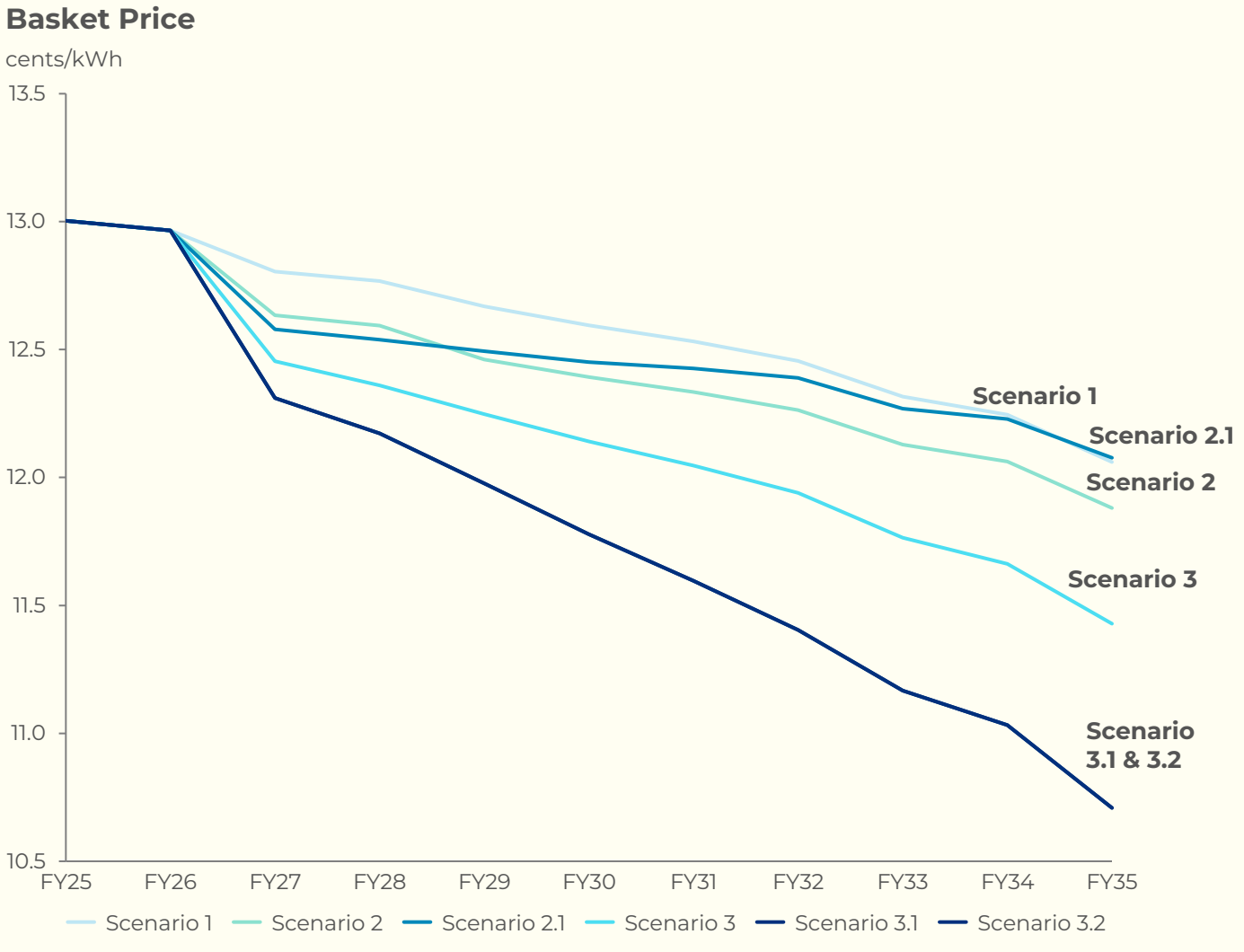
Increased integration of renewables coupled with storage can enable KE to adequately and efficiently meet its electricity demand

Scenario-wise Generation Mix FY35



Note: These charts demonstrate the potential contribution of higher RE integration to meeting KE's electricity demand. Realizing such integration at scale would need to be supported by adequate storage and system flexibility to effectively manage variability and ensure secure system operation for KE.

The integration of 640 MW RE projects in KE's system reduces its overall basket price

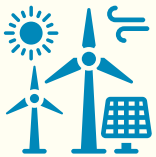


- The average basket price in Scenario 2.1 is 12.4 cents/kWh.
- Scenarios 3.1 and 3.2 result in the lowest basket prices with an average of 11.8 cents/kWh.

It is imperative for KE to accelerate its RE integration amid the ongoing RLNG price hikes and NEPRA's recent tariff reduction determination for KE

Tariff Context and Regulatory Shift

- Prior to May 2025, KE's base tariff was Rs 39.97/kWh vs. national uniform tariff: Rs 34/kWh.
- The difference for KE was bridged with PKR 5.97/kWh Tariff Differential Subsidy (TDS) by the government.
- NEPRA's latest Multi-Year-Tariff Determination on 27 March 2026: Rs 7.6/kWh base tariff reduction—from Rs 39.97/kWh to Rs 32.37/kWh.



RE Integration as Tariff Reduction Pathway

- Historical subsidy arrangement bridged Rs 7.6/kWh gap, eliminating cost-reduction incentives for KE for displacing its expensive thermal plant-based generation.
- Subsubsidy cushion reduced; KE now faces direct financial pressure to reduce its generation cost.
- Uniform tariff alignment creates commercial imperative for least-cost generation optimization.
- 640 MW RE integration results in basket price reduction complying with the regulatory tariff expectations while maintaining financial sustainability. Higher RE integration as shown in Scenario 3.1 and 3.2 further lowers KE's basket price.

Cost of Delayed Implementation

- ~USD 432 million (accumulated savings in total cost).
- Transference of cost burden to KE's 3.4 million consumers and dependency on the National Grid increases.
- Delayed RE integration not only compounds total systemic costs, but wastes KE's RE potential and threatens its energy security amid the RLNG price shocks and supply chain disruptions.

Annexure

Plant Parameters

S. No	Generator	Fuel	Installed Capacity (MW)	Dependable Capacity (MW)	FO&M ($/kW-yr)	Marginal cost ($/MWh)
1	SNPC-I	Gas	52	51	118.86	36.908
2	SNPC-II	Gas	52	52	150.67	36.701
3	BQPS2	RLNG	573	493	143.42	127.5694
4	BQPS3-U1	RLNG	485	445	114.08	82.9256
5	BQPS3-U2	RLNG	485	446	114.08	82.9256
5	KCCPP	RLNG	248	212	157.13	131.7056
6	KTGTPS	RLNG	107	92	77.19	130.0748
7	SGTPS	RLNG	107	93	86.20	132.4166
8	BQPS1-U5	RLNG	210	188	97.85	140.7173
9	BQPS1-U6	RLNG	210	191	98.07	156.3695
10	FPCL	Imported Coal	60	52	613.84	83.703
11	Gharo	Solar	50	50	118.6	0
12	Oursun	Solar	50	50	182.7	0
13	NGC	Mix Fuel	2050	2050	3	93

Scenario-wise BESS Parameters

Scenario 3.1

Build Year	Lifetime (years)	Existing Power (MW)	Built Power (MW)	Max Hours	Built Energy (MWh)	Discharged Energy (MWh)	Capacity Factor (%)
FY33	15	0	97.86	4	391.439	386988.62	4.102
FY34	15	0	72.846	4	291.383	192620.314	2.743
FY35	15	0	200	4	800	261858.167	1.358

Scenario 3.2

Build Year	Lifetime (years)	Existing Power (MW)	Built Power (MW)	Max Hours	Built Energy (MWh)	Discharged Energy (MWh)	Capacity Factor (%)
FY33	15	0	97.86	4	391.439	387930.605	4.112
FY34	15	0	72.846	4	291.383	192447.869	2.74
FY35	15	0	200	4	800	261088.628	1.354

Renewables First (RF) is a think and do tank for energy and environment. Our work addresses critical energy and natural resource issues with the aim to make energy and climate transitions fair and inclusive.

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