

# KEPCO's Fossil Fuel Problem

Strategic options are limited in the face of an over-reliance on coal and LNG

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## Key Findings

**The Korea Electric Power Corporation (KEPCO) relies heavily on fossil fuels as renewable energy makes up only 2.4% of total capacity, so losses due to high fossil fuel prices and limited tariff hikes led the Chief Executive to resign in May.**

**For the first quarter of 2023, IEEFA estimates that KEPCO's profit margin per tonne of coal used for power was 9.0%.**

**IEEFA also estimates that over the same quarter, KEPCO's loss margin per tonne of liquefied natural gas (LNG) was 94.6%.**

**KEPCO had a power generation capacity of 39% coal and 22% LNG in 2022, producing an overall loss margin of 46%; this margin was reduced to 31% in the first quarter of 2023 after the firm boosted nuclear generation to cut losses.**



## Executive Summary

In May this year, state-owned South Korean electricity provider Korea Electric Power Corporation (KEPCO) saw the resignation of its Chief Executive Officer (CEO), Cheong Seung-il, following the company's eighth consecutive quarterly operating loss.<sup>1</sup>

He had been in office for less than three years, whereas unsound investment decisions of the company had lasted for decades, as discussed in the Institute for Energy Economics and Financial Analysis' (IEEFA) KEPCO report in October 2022.<sup>2</sup>

It is unlikely that the CEO's departure would resolve the fundamental issue of weak governance. KEPCO has limited strategic direction, as IEEFA will show in this report.

Operating losses last year totaled ₩32.6 trillion (US\$24.4 billion) from a combination of high fossil fuel prices and a lack of legislative support for tariff increases. In the first quarter of this year, the operating loss was ₩6.2 trillion (US\$4.8 billion).

What it comes down to is a fossil fuel problem. KEPCO has 39% of total power capacity anchored in coal, and 22% in liquefied natural gas (LNG), while renewable energy makes up only 2.4%, or 2.5 gigawatts.

According to IEEFA calculations, KEPCO is sustaining losses at current LNG prices. Although LNG spot prices fell in May, their lower levels will take two to three months to flow through to the company. This makes LNG a financially unviable resource until the third quarter at least — and probably after that as well, given the absence of any planned diversification from the fossil fuel generation mix coupled with the highly uncertain current forecast of LNG prices. No financial relief is in sight as fossil fuel prices are unlikely to come down anytime soon.

The need is real for KEPCO to diversify into renewable energy sources to mitigate the impact of elevated fossil fuel prices.

In fact, KEPCO used nuclear power in the first quarter of 2023 to reduce financial losses, in the process lowering coal generation to 39% from last year's 40%. The move was consistent with the Group of Seven (G7) pledge to lessen energy usage powered by coal.<sup>3</sup>

### KEPCO challenges

The CEO has quit due to substantial losses from high fossil fuel prices and limited room for tariff increases. Coal accounted for 39%, and LNG 22%, of 2022 capacity.

Plans are to increase the company's renewable energy capacity by 7.5 times from the current 2.5GW to 18.7GW by 2026. During this period, KEPCO is still vulnerable to elevated fossil fuel prices, reporting an operating loss of US\$4.8 billion in the first quarter of 2023.

<sup>1</sup> The Korea Herald. [Yoon accepts resignation of KEPCO chief amid record losses](#). May 19, 2023.

<sup>2</sup> IEEFA. [KEPCO's clean energy transition hangs in the balance](#). Ng and Ilango. October 13, 2022.

<sup>3</sup> Euronews. [G7 pledges to speed up phase-out of fossil fuels but fails to agree on new deadline for coal](#). April 17, 2023.

In the first quarter of this year, KEPCO maintained coal generation at 39% and boosted nuclear generation to 45% from last year's 42%. This, however, implies that the usage rate of its nuclear plants exceeded 80%, compared to below 30% for Japan.

There are three strategies that might ease KEPCO's financial problems in fossil fuels; however, in reality the room for maneuver is limited:

1. **Increase power tariffs.** This is unworkable in the short term as the government in March delayed a proposed rise for the second quarter on inflationary concerns.<sup>4</sup>
2. **Use more renewables.** KEPCO needs both time and funds in order to increase renewable energy, but our October 2022 report has shown that its financial position is not strong.<sup>5</sup>
3. **Receive government liquidity support.** The supply of public money should be combined with a clear road map to switch from fossil fuels and to manage their price risk.

Of the three options above, government intervention is the only way out in practice.<sup>6</sup> KEPCO's earnings have deteriorated over the last decade due to the dominance of fossil fuels in its generation mix. In IEEFA's view, any upcoming government support or reform of the power market system for KEPCO should be accompanied by an immediate, material and enforceable pivot to renewable energy and a significant cost-cutting exercise that phases out substantial fossil fuels.

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<sup>4</sup> Reuters. [South Korea delays decision on energy price hikes for Q2](#). March 31, 2023.

<sup>5</sup> IEEFA. [KEPCO's clean energy transition hangs in the balance](#). Ng and Ilango. October 13, 2022.




<sup>6</sup> Korea JoongAng Daily. [Government raises electricity, gas prices to help save Kepeco](#). May 15, 2023.

## Financial Woes Deepening with Fossil Fuel Reliance

KEPCO is facing a financial challenge arising from its low capacity for renewable energy and over-reliance on fossil fuels. The challenge manifested itself last year in the form of operating losses of ₩32.7 trillion and, in the first quarter of this year, ₩6.2 trillion along with the exit of the chief executive. CEO Cheong Seung-il, who was due to serve until May next year, has had his resignation accepted by President Yoon Suk-yeol, Korean media reported on May 19.<sup>7</sup>

The significant operating losses last year stemmed from a mismatch between limited tariff increases and the spike in fossil fuel prices.

### KEPCO fuel cost by source, operating margin and overall share of fuel costs 2021-2022 (000 KRW/tonne and %)

Fuel source	Unit	2021	1Q22	1H22	9M22	2022
Coal	000 KRW/tonne	157.8	218.5	250.4	268.1	278.6
LNG 	000 KRW/tonne	724.7	1,417.0	1,315.4	1,393.6	1,543.7
Oil 	000 KRW/tonne	799.2	946.1	1,114.2	1,217.4	1,267.9
<b>Operating margin</b>	<b>%</b>	<b>-9.6</b>	<b>-50.6</b>	<b>-48.5</b>	<b>-45.5</b>	<b>-49.3</b>
Share of fuel costs						
Coal 		55.3	48.7	53.5	55.9	53.7
LNG 		32.0	42.2	37.2	35.1	37.6
Oil 		3.6	3.0	3.2	3.0	2.9
Nuclear and others 		9.1	6.1	6.1	6.0	5.8

The company's operating loss of ₩6.2 trillion was 21% lower than the ₩7.8 trillion lost during the same quarter last year. However, tariff increases have not kept up with the rising fossil fuel prices:

- Limited tariff increases.** KEPCO was charging ₩120.5/kWh as at the end of last year, and raised the rate by ₩11.4/kWh for the first quarter of this year. Any further increase was delayed by the government for two and a half months from March 1 due to the impact on

<sup>7</sup> The Korea Herald. [Yoon accepts resignation of KEPCO chief amid record losses](#). May 19, 2023.

living costs.<sup>8</sup> From ₩108.1/kWh at the end of 2021, the tariff had become 23% higher in Korean won terms by the 2023 first quarter. However, in US dollar terms, it had increased only 9.5%, to 10.3 cents/kWh. Since KEPCO buys coal and LNG in US dollars, the weakening of the won against the dollar effectively nullified the tariff increases. On May 16 this year, the power tariff went up by another ₩8/kWh.<sup>9</sup>

2. **Spike in fossil fuel prices.** The company paid ₩225 per kilogram for coal and ₩1,417/kg for LNG in the first quarter of last year, followed by ₩268/kg for coal and ₩1,859/kg for LNG in the same quarter this year. The price rises were 19% and 31%, respectively. Last year, KEPCO sustained a 77% loss margin on LNG and a 4% loss margin on coal, as detailed in our financial calculations in Appendix A.
3. **Loss margins of 31%-59% per quarter.** Due to the mismatch between tariff increases and fossil fuel prices, KEPCO has made operating losses every quarter since early last year. The 2022 operating loss margins ranged from a low of 41% in the 2022 third quarter to a high of 59% in the 2022 fourth quarter. For the first quarter of this year, the operating loss margin fell to 31%.

The following two tables outline KEPCO's financial challenge: limited room for tariff increases because of government concerns about living costs on the one hand, and vulnerability from the higher fossil fuel prices on the other.

**Table 1: KEPCO 2021-1Q23 Sales, Tariffs, Fuel Costs and Losses (₩ bn, GWh, ₩/kWh, US\$/kWh, US\$/tonne)**

Key measures	Unit	2021	1Q22	1H22	9M22	2022	1Q23
Power sales	₩ bn	57,309	15,378	29,469	47,957	66,199	20,259
Power sales	GWh	533,431	143,180	272,179	416,171	547,933	NA
Power tariff	₩/kWh	108.1	110.4	110.4	116.4	120.5	131.9
Power tariff	US\$/kWh	0.094	0.092	0.090	0.092	0.093	0.103
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KEPCO coal cost	US\$/tonne	137.9	181.4	203.2	211.5	215.8	210.2
KEPCO LNG cost	US\$/tonne	633.3	1,176.2	1,067.3	1,099.3	1,195.8	1,457.5
Operating losses	₩ bn	-5,487	-7,787	-14,303	-21,834	-32,655	-6,178

Source: KEPCO Investor Presentations and IEEFA estimates.

The operating losses in Table 1 show that KEPCO's tariff increases have been unable to keep up with rising coal and LNG prices for more than two years.

IEEFA estimates that the KEPCO 2022 tariffs remained flat in US dollar terms at around US\$0.093/kWh, a major challenge as coal and LNG prices are denominated in US dollars. On a

<sup>8</sup> Reuters. [South Korea delays decision on energy price hikes for Q2](#). March 31, 2023.

<sup>9</sup> The Korea Herald. [Electricity bills to rise by 5.3% as Kepco battles mounting losses](#). May 15, 2023.



quarterly basis last year, KEPCO was loss-making.

**Table 2: KEPCO 2022 Quarterly Sales, Fuel costs, Losses and Loss Margins (₩ bn, GWh, ₩/kWh, US\$/tonne)**

Key measures	Unit	1Q22	2Q22	3Q22	4Q22	1Q23
Power sales	₩ bn	15,378	14,091	18,488	18,242	20,259
Power sales	GWh	143,180	128,999	143,992	131,762	NA
KEPCO coal costs	US\$/tonne	181.4	203.2	227.1	229.5	210.2
KEPCO LNG costs	US\$/tonne	1,176.2	946.4	1,159.8	1,500.6	1,457.5
Operating losses	₩ bn	-7,787	-6,516	-7,531	-10,821	-6,178
Operating margin	%	-50.6	-46.2	-40.7	-59.3	-30.5

Source: KEPCO Investor Presentations and IEEFA estimates.

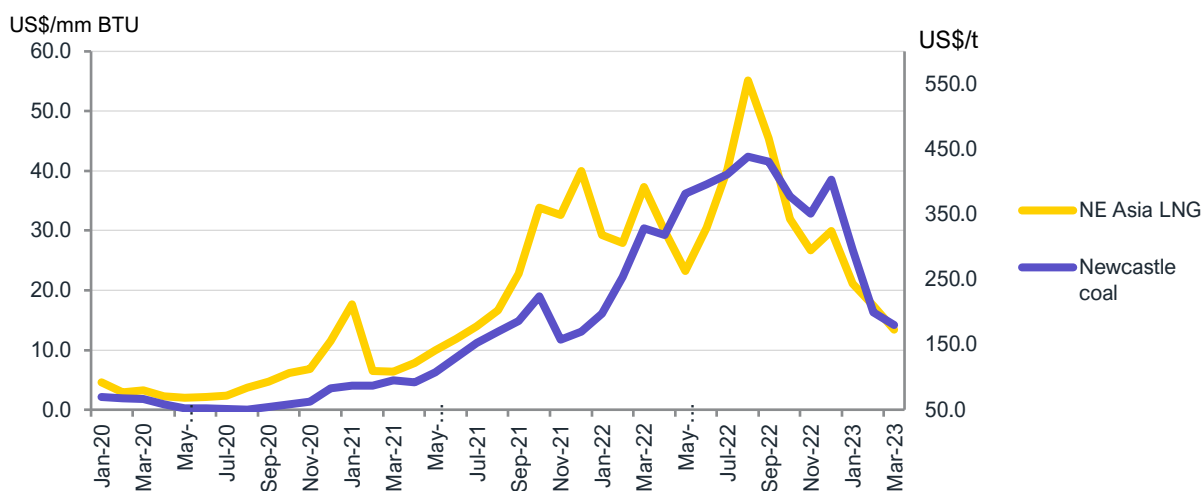
The financial impact of the mismatch between KEPCO's limited tariff increases and the higher fossil fuel prices is in the significant operating losses. Although the power tariff was allowed to rise for the first quarter of this year, the utility continued to lose money, recording an operating loss margin of 31%. This meant for every US\$1 of revenue, KEPCO lost 31 US cents.

## Rise of Fossil Fuel Prices

Last year, both coal and LNG prices surged to new highs due to sudden changes in supply. A reduction in Russian pipeline gas supplies to Europe set off a scramble for LNG shipments to the European Union, while a lack of new coal supply capacity worldwide and Russia's exit from supplying coal to global markets coincided with the post-COVID economic revival, causing a spike in coal prices, although the prices of both fossil fuels have softened starting in the fourth quarter of last year.

Figure 1 shows Newcastle coal prices (US\$/tonne) and Northeast Asia LNG prices (US\$ per million British thermal unit). These prices respectively peaked at US\$438/tonne and US\$55/MMBtu, both in August last year. This March, the Newcastle coal price was US\$178/tonne and the LNG price, US\$13.40/MMBtu.

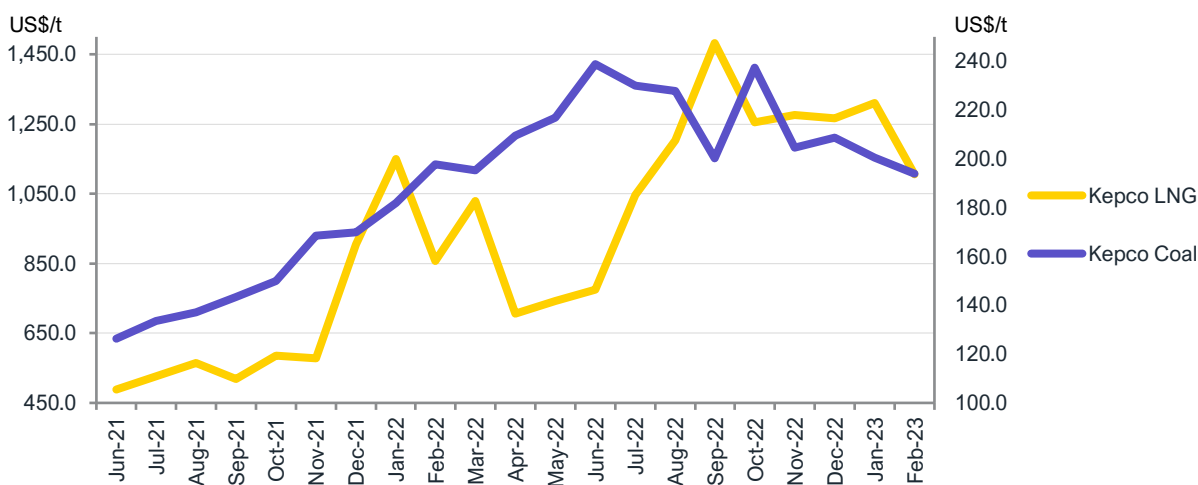
**Figure 1: NE Asia LNG Price and Newcastle Benchmark Coal Price (US\$/MMBtu, US\$/tonne)**



Source: Reuters and IEEFA estimates.

These high fossil fuel prices were also reflected in the realized coal cost and LNG cost for KEPCO throughout last year. Although LNG spot prices have declined since April, KEPCO's purchase price for the fossil fuel will lag for two to three months before the company starts to pay less to buy further supplies. It is likely to see fuel costs coming down only in the third quarter of this year.

**Figure 2: KEPCO Realized LNG and Coal Costs (US\$/tonne)**



Source: KEPCO Investor Presentations and IEEFA estimates.

KEPCO appears to be waiting for a decline in fossil fuel prices and a rise in tariffs to protect its finances. While this strategy might work, there are three points to consider:

1. IEEFA calculations show that at the level of the LNG price in the first quarter of this year, KEPCO sustained a 95% operating loss margin. LNG may be not financially viable until the third quarter, given a two-to-three-month lag for lower LNG prices to take effect in fuel purchases.

2. IEEFA calculations also show that coal generation was marginally profitable in the first quarter of 2023 under a roughly 9% operating margin. To KEPCO's credit, the profit kept the share of coal in total power generation at 39% in the 2023 first quarter, down from 40% in the 2022 first quarter.
3. KEPCO has generated more nuclear energy as an alternative since the first quarter of this year to reduce losses.

Based on the power tariff and the LNG cost of ₩1.86 million per tonne in the first quarter of this year, IEEFA estimates KEPCO lost US\$0.09/kWh of LNG-generated power, an operating loss margin of 95%.

Although LNG spot prices fell in May, these lower levels will take two to three months to flow through to KEPCO, making LNG a financially unviable resource until the third quarter of 2023 at least.

In the interim, KEPCO will continue to see significant losses on each kWh of LNG-generated power. It is possible for the company's financial viability to come under pressure in the absence of a fast decline in fossil fuel prices.

As highlighted in IEEFA's commentary on LNG price volatility,<sup>10</sup> more renewable power capacity must be built to mitigate the impact of high fossil fuel prices.

**Table 3: KEPCO 2021-1Q23 LNG Costs, Tariffs, Losses and Loss Margins (₩/tonne, US\$/tonne, US\$/MMBtu, ₩/ kWh, US\$/tonne)**

Capacity	Unit	2021	2022	1Q 23
KEPCO LNG cost	000 ₩/tonne	724.7	1,543.7	1,858.6
KEPCO LNG cost	US\$/tonne	633.3	1,195.8	1,457.5
<b>Conversion factor tonne to MMBtu</b>		53.6	53.6	53.6
KEPCO LNG cost	US\$/mm BTU	11.8	22.3	27.2
<b>Power tariff</b>	000 ₩/ kWh	108.1	120.5	131.9
Power tariff	US\$/ kWh	0.094	0.093	0.103
<b>Conversion factor of kWh to MMBtu</b>		135.1	135.1	135.1
<b>Tariff per MMBtu of LNG</b>	US\$/MMBtu	12.8	12.6	14.0
KEPCO LNG cost	US\$/MMBtu	11.8	22.3	27.2
<b>Difference with LNG cost</b>	US\$/MMBtu	0.9	-9.7	-13.2
<b>Profit margin</b>	%	7.4	-77.0	-94.6
<b>Profit/loss per kWh</b>	US\$/ kWh	0.007	-0.072	-0.098

Source: KEPCO Investor Presentations and IEEFA estimates.

<sup>10</sup> IEEFA. [Asia's lower LNG demand in 2022 highlights challenges for industry growth](#). Reynolds. January 11, 2023.

As for coal, IEEFA estimates that, based on the power tariff and the coal cost of ₩268,000/tonne in the first quarter of this year, the KEPCO profit per kWh of coal-generated power was US\$0.01 under an operating margin of 9%. To KEPCO's credit, it had limited the share of coal in total generation to 39% in the 2023 first quarter, versus 40% in the 2022 first quarter, a move consistent with South Korea's 10th Basic Plan for Long-term Electricity Supply and Demand 2023-2036, which aims to lower coal-powered generation.<sup>11</sup> In the first quarter of this year, KEPCO did not significantly boost coal power to reduce financial losses caused by LNG generation.

**Table 4: KEPCO 2021-1Q23 Coal Costs, Tariffs, Losses and Loss Margins (₩/tonne, US\$/tonne, US\$/MMBtu, ₩/ kWh, US\$/tonne)**

Capacity	Unit	2021	2022	1Q23
KEPCO coal cost	000 ₩/tonne	157.8	278.6	268.0
KEPCO coal cost	US\$/tonne	137.9	215.8	210.2
Power tariff	000 ₩/ kWh	108.1	120.5	131.9
Power tariff	US\$/ kWh	0.094	0.093	0.103
Coal required per kWh	kg	0.5	0.5	0.5
Conversion factor into tonne		2,222.2	2,222.2	2,222.2
Tariff per tonne of coal	US\$/tonne	209.9	207.4	229.9
KEPCO coal cost	US\$/tonne	137.9	215.8	210.2
Difference with coal cost	US\$/tonne	72.0	-8.4	19.7
Profit margin	%	34.3	-4.0	8.6
Profit/loss per kWh	US\$/ kWh	0.032	-0.004	0.009

Source: KEPCO Investor Presentations and IEEFA estimates.

## Using Nuclear Energy to Cut Losses

In the first quarter of this year, KEPCO used nuclear power to reduce financial losses while lowering the share of coal power in total energy generation to 39%. It did not turn to coal as a financial solution to stem the losses. The company also maintained LNG power generation at a 14% share to limit financial losses. This is consistent with the government's engagement with the G7 and also with the G7 target to reduce both gas and coal-fired generation.<sup>12</sup>

<sup>11</sup> International Energy Agency (IEA). [Korea Electricity Security Review](#). March 7, 2023.

<sup>12</sup> Reuters. [G7 ministers agree to cut gas consumption and speed-up renewable energy](#). April 15, 2023.

**Table 5: KEPCO 2021-1Q23 Power Generation by Type (%)**

Key measures	Unit	2021	1Q22	1H22	3Q22	2022	1Q23
Coal	%	43.0	40.0	39.0	41.0	40.0	39.0
Nuclear	%	39.0	42.0	44.0	43.0	43.0	45.0
LNG	%	14.0	14.0	13.0	13.0	13.0	14.0
Others	%	4.0	4.0	4.0	3.0	4.0	2.0

Source: KEPCO Investor Presentations and IEEFA estimates.

On a financial basis, IEEFA has calculated that nuclear costs are 9% of coal and 5% of LNG. The South Korean utility boosted the share of nuclear power in total energy generation to 45% in the 2023 first quarter from 42% in the 2022 first quarter. This strategy, plus a tariff increase of ₩11.4/kWh in the first quarter of 2023, helped lower operating losses by 21% year on year to ₩6.6 trillion.

**Table 6: KEPCO 2021-2022 Power Generation by Cost (₩/kWh, US\$/kWh)**

Key measures	Unit	2021	1H22	2022
Nuclear	₩/kWh	11.3	10.4	11.4
Coal	₩/kWh	71.0	112.7	125.4
LNG	₩/kWh	100.1	181.7	213.2
Tariff	₩/kWh	108.1	110.4	120.5
Nuclear	US\$/kWh	0.010	0.008	0.009
Coal	US\$/kWh	0.062	0.091	0.097
LNG	US\$/kWh	0.087	0.147	0.165
Tariff	US\$/kWh	0.094	0.090	0.093

Source: KEPCO Investor Presentations and IEEFA estimates.

The downside of the nuclear strategy is that, according to IEEFA calculations, KEPCO's usage rate of its nuclear capacity was already at 82% in 2022, approaching China's 86% for the same year. In Japan, the usage rate was 24% in 2021. The country was operating 54 nuclear reactors before the 2011 earthquake, and by June 2022, only 10 reactors had been restarted while 21 had been decommissioned.<sup>13</sup>

Last December, Japan launched a new policy to extend the life of old nuclear reactors and build new ones.<sup>14</sup> Waste management and safety measures are community issues that have been raised.<sup>15</sup>

<sup>13</sup> Nippon.com. [Japan's Nuclear Power Plants in 2022. June 29, 2022.](#)

<sup>14</sup> National Public Radio. [After the Fukushima disaster, Japan swore to phase out nuclear power. But not anymore.](#) December 22, 2022.

<sup>15</sup> Ibid.

Table 7: Nuclear Capacity Usage by Country 2020-22 (%)

Country	Unit	2020	2021	2022
South Korea	%	78.6	77.6	81.5
China	%	88.0	87.3	85.9
Japan	%	13.4	24.4	NA

Source: China Statistics Bureau, Statista and IEEFA estimates.

The challenge for KEPCO is that, having operated at a usage rate of above 82% in the first quarter of this year, it has only a limited amount of further nuclear-powered energy generation to continue reducing losses. Several risks are associated with having so little space to maneuver:

1. **Safety risk.** Increasing nuclear usage beyond 80% would strain the plants to a greater extent, posing a risk to safety.
2. **Execution risk.** KEPCO has plans for three new nuclear reactors<sup>16</sup> that will provide an aggregate capacity of 4.2GW and are set to begin operations between 2023 and 2025. According to a Reuters analysis in 2022,<sup>17</sup> having more operational nuclear reactors would alleviate the company's financial distress but would not be adequate to offset the losses as 15 new nuclear reactors are needed for effective mitigation.

Experience shows that if KEPCO or its subsidiary Korea Hydro & Nuclear Power, which operates the reactors in the country, encounters any delay in obtaining approval for commissioning new reactors due to safety concerns, it could impede KEPCO's road to recovery.<sup>18</sup>

3. **Policy risk.** President Yoon has rejected the notion of phasing out nuclear energy, diverging from the stance of the previous president, Moon Jae-in, who aimed to phase out nuclear energy.

Yoon's stance marked the second significant reversal for the industry in less than a decade that resulted in business losses. Business risk in the nuclear industry, which requires long-term investments and commitment, could increase due to policy uncertainty<sup>19</sup> caused by the constitutional limit of a single five-year presidential term. Therefore, the possibility exists of another reversal occurring.

4. **Financial risk.** KEPCO plans to restore financial soundness<sup>20</sup> through a ₩25 trillion restructuring plan. It wants to lower costs by delaying facility construction projects and investments and by reducing operating expenses while working with the government to reform the market system to cut consumer spending on the purchase of electricity.

<sup>16</sup> Moody's. [Korea Electric Power Corporation Update following rating affirmation with a stable Credit Opinion](#).

<sup>17</sup> Reuters. [KEPCO reports record quarterly loss as nuclear power plays catch up](#). May 13, 2022.

<sup>18</sup> Power Engineering. [S. Korea regulators delay nuclear operating license decision](#). April 9, 2015.

<sup>19</sup> Reuters. [South Korea's nuclear power at inflection point as advocate wins presidency](#). March 11, 2022.

<sup>20</sup> KEPCO. [Q1 Earnings Results](#). May 16, 2023.

Overall, chances are that KEPCO is refraining from ambitious expansion of its nuclear operation in the near term, beyond the three new nuclear reactors mentioned earlier. The company will likely resort to keeping within 80% usage of its plants due to safety risks.

## Lagging in Renewable Energy Switch

In absolute terms, KEPCO's allocation of 2.4% to renewable sources in its total energy capacity at the end of last year was low. We compare KEPCO with two other national grids — the developed EU grid in Germany and the developing Asian grid in China. Two key conclusions can be drawn:

1. South Korea's renewable energy capacity of 2.4% was low compared with Germany's 64.6% and China's 28.8% (wind and solar power only). China's hydropower capacity was at 16.4%.
2. KEPCO increased renewable energy capacity from 1.6% in 2019 to 2.4% by end-2022. The corresponding figures for China (wind and solar power) were 20.6% and 28.8%.











Taking into account differences in the grid infrastructure and development, KEPCO is targeting renewable energy capacity of 18.7GW by 2026 from the current 2.5GW, an increase of 7.5 times. The issue is that allotting such a low capacity for renewable resources makes KEPCO financially vulnerable to high fossil fuel prices, a risk which unfortunately materialized in 2022. As highlighted in IEEFA's October 2022 report, it is questionable if KEPCO can increase its renewable capacity, given its cash-flow situation and the current fossil fuel problem.<sup>21</sup>

KEPCO has projected that 6%, or ₩1,043 billion, of its capital expenditure would be allocated to renewable energy in fiscal year 2023 (January-December), with a decrease to 3%, or ₩556 billion, expected in FY2024. Future capacity for renewable energy remains unknown, indicating that infrastructural expansion will be sluggish and that the decarbonization strategy is unclear.

For many years, coal has been considered as a reliable earnings generator at KEPCO. The company's highly leveraged business, tightening liquidity and operating losses notwithstanding, coal and other fossil fuels have dominated operations, leading it to take on more debt. The issue was compounded by a failure to set up effective hedging against surging fossil fuel purchase prices despite the likely impact on KEPCO's earnings and overall market trends. KEPCO is taking its time to implement a renewable energy buildout although renewable power generation costs have dropped significantly over the last decade.

<sup>21</sup> IEEFA. [KEPCO's clean energy transition hangs in the balance](#). Ng and Ilango. October 13, 2022.

**Table 8: KEPCO, China and Germany Power Generation Capacity Mix 2019-22**

Capacity	Unit	KEPCO		China		Germany	
		2019	2022	2019	2022	2019	2022
Coal/Thermal 	GW	34.3	32.6	1192.9	1319.8	43.5	37.9
Nuclear 	GW	23.3	24.7	45.5	55.5	8.1	4.1
LNG 	GW	16.5	18.1			29.9	32.1
Renewable 	GW	1.3	2.0	772.3	1133.3	123.1	144.1
Others 	GW	8.3	5.5			4.4	4.7
<b>Total</b>	<b>GW</b>	<b>83.7</b>	<b>82.7</b>	<b>2010.7</b>	<b>2508.6</b>	<b>209.0</b>	<b>222.9</b>
<b>% breakdown</b>							
Coal 	%	41.0	39.4	59.3	52.6	20.8	17.0
Nuclear 	%	27.8	29.8	2.3	2.2	3.9	1.8
LNG 	%	19.7	21.8	0.0	0.0	14.3	14.4
Renewable 	%	1.6	2.4	38.4	45.2	58.9	64.6
Others 	%	9.9	6.6	0.0	0.0	2.1	2.1
<b>Total</b>	<b>%</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Source: China Statistics Bureau, enerdata, destatts, ise, cleanenergy.org., Statista and IEEFA estimates.

## Limited Strategic Options

As KEPCO continues to face operating issues from uncertain LNG prices, it generated more nuclear power in the first quarter of this year and has not boosted coal-powered generation to lower losses, as the current report has discussed.

The utility remains vulnerable in this quarter and the next as the lower LNG prices in May will come through only in the third quarter.

In the interim, there are three possible strategies for KEPCO to manage its financial losses:

- 1. Tariff increases.** On May 16, the KEPCO power rate went up by ₩8/kwh<sup>22</sup> after having been delayed since March as the government tried to manage the impact of higher costs of living.<sup>23</sup> The increase was eventually allowed to provide KEPCO with some financial relief.

Going forward, it may be difficult to put further tariff increases through government approval and, at the very best, delays can be expected.

- 2. Buildout of more renewable capacity.** This requires significant capex beyond the current 6% guided but would need time and financing. It would be a tough measure as highlighted in

<sup>22</sup>The Korea Herald. [Electricity bills to rise by 5.3% as Kepco battles mounting losses](#). May 15, 2023.

<sup>23</sup> Reuters. [South Korea delays decision on energy price hikes for Q2](#). March 31, 2023.



IEEFA's October 2022 report about KEPCO, that bad investment choices in fossil fuels have resulted in a weak balance sheet.

In addition, KEPCO is overleveraged and does not have sufficient internal cash sources to cover debt that will mature in the next 12 months.<sup>24</sup> KEPCO issued ₩22 trillion in corporate bonds in 2022 and a further ₩37 trillion in 2023. Media reports have said that this will lead to continued distortions in the South Korean bond market.<sup>25</sup>

- 3. South Korean government funds.** Last year, KEPCO accounted for 46% of the country's domestic bond market.<sup>26</sup> It would be difficult for the company to continue turning to the domestic bond market for funding.

As of May, KEPCO plans to restore financial soundness through a restructuring plan costing ₩25 trillion. It wants to cut costs by delaying facility construction projects and investments and reducing operating expenses while working with the government to reform the market system to cut consumer spending on electricity purchase.<sup>27</sup>

KEPCO also intends to sell its most valuable real estate assets, and cancel salary raises and bonuses for executive and senior employees. However, these measures may not be enough to offset KEPCO's grave deficit. Government intervention is likely the last resort.

While government funds may provide short-term financing support, some form of longer-term plan would be needed to manage financial losses and improve its financial position.

Any upcoming government intervention or reform in the market system should be accompanied by an immediate, material and enforceable pivot at KEPCO to renewable energy, and a significant cost-cutting exercise that phases out substantial fossil fuels.

Although the resignation of the CEO has meant some accountability, many unresolved issues remain and need to be discussed. These issues include KEPCO's commitment to managing coal-powered generation in line with the country's 10th Electricity Plan,<sup>28</sup> and to improving financial performance in ways other than waiting for fossil fuel prices to come down.

KEPCO's earnings have deteriorated over the last decade due to the dominance of fossil fuels in its generation mix. Accepting LNG as a bridging fuel in its future generation mix simply replaces one fossil fuel with another, without addressing the fundamental problem of high and volatile fuel prices. The absence of any planned diversification from fossil fuels will continue to undermine profits, and exacerbate stranded asset risks for KEPCO's new LNG projects.

<sup>24</sup> IEEFA. [KEPCO's clean energy transition hangs in the balance](#). Ng and Ilango. October 13, 2022.

<sup>25</sup> Nikkei Asia. [South Korean politics tie KEPCO's hands on electricity rate hikes](#). April 23, 2023.

<sup>26</sup> Ibid.

<sup>27</sup> KEPCO. [Earnings Results 2023 1st Quarter](#).

<sup>28</sup> IEA. [Korea Electricity Security Policy](#). March 7, 2023.

## Conclusion

South Korea's renewable energy capacity of 2.4% is far lower than China's 28.8% and Germany's 64.6%. Last year, renewable energy from KEPCO made up only 2.1% of its total generation, compared to 44.6% from the German grid and 12.3% from wind and solar power in China. However, this low renewable energy capacity and share of total generation hurt KEPCO's bottom line last year when coal and LNG prices surged. The mixed news is that at present, based on coal costs and tariffs in the first quarter of this year, KEPCO is making a profit.

The utility faces a financial challenge from its low renewable energy capacity and over-reliance on fossil fuels. The mismatch between limited tariff increases and the spike in fossil fuel prices translated into significant operating losses last year and in the first quarter of this year. The operating loss margin ranged from a high of 59% in the 2022 fourth quarter to a low of 31% in the 2023 first quarter.



**KEPCO faces a financial challenge from its low renewable energy capacity and over-reliance on fossil fuels.**

KEPCO's earnings have deteriorated over the last decade due to the dominance of fossil fuels in its generation mix. Accepting LNG as a bridging fuel in its future generation mix does not address the fundamental problem of high and volatile fuel prices. The absence of diversification from fossil fuels will continue to undermine profits and increase stranded asset risks for KEPCO's new LNG projects.

Increasing the power tariff is not workable in the short term as the South Korean government had delayed the second-quarter tariff increase until May. KEPCO has a 2025 target to boost renewable energy capacity by 300%, but this would require more financing.

As highlighted in IEEFA's October 2022 report, KEPCO already has weak financials; furthermore, it accounted for 46% of domestic bond issuances last year. The injection of more government funds can be a solution, but there are many outstanding issues, such as short and medium-term financing and how to manage fossil fuel losses.

KEPCO's fossil fuel problem has claimed one CEO, and has left the company with limited strategic options. Without a clear strategic direction out of its fossil-reliant energy generation, KEPCO's future increasingly becomes uncertain.

## Appendix A. Calculating Losses for KEPCO Per Unit of LNG/coal

In this section, IEEFA draws the conclusion that using LNG last year resulted in much higher losses than coal. We first calculate the losses for using coal to generate power in 2022 and the losses for using LNG to generate power. Under the tariff level and fossil fuel costs in the first quarter of this year, coal is not loss-making but LNG continues to be.

Here is how we calculate the loss due to coal:

1. Start with two variables: KEPCO coal cost per tonne and tariff per kWh
2. Convert coal into kWh: 0.5kg
3. Convert the tariff into tonne-of-coal basis
4. Compare KEPCO's coal cost per tonne with the realized tariff per tonne of coal

**Table 9: Calculation of KEPCO Realized Coal, Tariff and Operating Margin (000 ₩/tonne, US\$/tonne, ₩/ kWh, US\$/kWh, %)**

Key variables	Unit	2021	1Q22	1H22	9M22	2022
KEPCO coal cost	000 ₩/tonne	157.8	218.5	250.4	268.1	278.6
KEPCO coal cost	US\$/tonne	137.9	181.4	203.2	211.5	215.8
Power tariff	₩/kWh	108.1	110.4	110.4	116.4	120.5
Power tariff	US\$/kWh	0.094	0.092	0.090	0.092	0.093
Coal required per kWh*	kg	0.5	0.5	0.5	0.5	0.5
Conversion factor into tonne*		2,222.2	2,222.2	2,222.2	2,222.2	2,222.2
Tariff per tonne of coal	US\$/tonne	209.9	203.6	199.1	204.0	207.4
KEPCO coal cost	US\$/tonne	137.9	181.4	203.2	211.5	215.8
Difference with coal cost	US\$/tonne	72.0	22.3	-4.1	-7.4	-8.4
Profit margin	%	34.3	10.9	-2.1	-3.6	-4.0
Profit/loss per kWh	US\$/kWh	0.032	0.010	-0.002	-0.003	-0.004

Source: KEPCO Investor Presentations and\* IEEFA estimates.

We note that in 2021, KEPCO enjoyed a profit margin of about 34% on generating power using coal. It paid US\$138/tonne for coal and charged a power tariff of US\$0.094/kWh. Last year, KEPCO's coal operations reversed to a loss of 4% after coal costs rose to US\$216/tonne while tariffs remained flat at US\$0.094/kWh. For every kWh of power generated, KEPCO lost US\$0.004. It had made a profit of US\$0.032/kWh in 2021.

Here is how we calculate the loss due to LNG:

1. Start with two variables: KEPCO LNG cost per tonne and tariff per kWh
2. Convert tonne into MMBtu: one tonne of LNG is 53.57 MMBtu<sup>29</sup>
3. Convert tariff into MMBtu: 1kWh has 7.4 cubic feet, 1,000 cubic feet is 1.04 MMBtu, so 1 MMBtu is 135kWh<sup>30</sup>
4. Compare KEPCO LNG cost per mm BTU with realized tariff per mm BTU

In the LNG profit calculation, there is the additional step of converting KEPCO's LNG cost per tonne, and the tariff received per kWh, to an MMBtu basis. The conclusion is that from the first quarter of last year, KEPCO started losing money on LNG power generation due to the spike in LNG prices.

LNG prices were US\$11.8/MMBtu in 2021, but this rose to US\$22.0 in the first quarter of last year. KEPCO's LNG cost last year averaged US\$22.3/MMBtu, and with a tariff of US\$0.094/kWh, this would mean an operating loss margin of 77%, or a loss of US\$0.07 for every kWh generated using LNG as a fuel.

KEPCO's operating loss margin from using LNG to generate power was 64%-77% in 2022. This explains the overall KEPCO operating margin range of 41%-59% per quarter. Due to a lack of renewable power capacity, KEPCO has been reducing operating losses by burning more coal instead of LNG.

**Table 10: Calculation of KEPCO Realized LNG, Tariff and Operating Margin (000 ₩/tonne, US\$/tonne, ₩/ kWh, US\$/kWh, %)**

Key variables	Unit	2021	1Q22	1H22	9M22	2022
KEPCO LNG cost	000 ₩/tonne	724.7	1,417.0	1,315.1	1,393.6	1,543.7
KEPCO LNG cost	US\$/tonne	633.3	1,176.2	1,067.3	1,099.3	1,195.8
Conversion factor tonne to MMBtu		53.6	53.6	53.6	53.6	53.6
KEPCO LNG cost	US\$/MMBtu	11.8	22.0	19.9	20.5	22.3
Power tariff	000 ₩/ kWh	108.1	110.4	110.4	116.4	120.5
Power tariff	US\$/ kWh	0.094	0.092	0.090	0.092	0.093
Conversion factor kWh to MMBtu		135.1	135.1	135.1	135.1	135.1
Tariff per MMBtu of LNG	US\$/MMBtu	12.8	12.4	12.1	12.4	12.6
KEPCO LNG cost	US\$/MMBtu	11.8	22.0	19.9	20.5	22.3
Difference with LNG cost	US\$/MMBtu	0.9	-9.6	-7.8	-8.1	-9.7
Profit margin	%	7.4	-77.3	-64.6	-65.4	-77.0
Profit/loss per kWh	US\$/ kWh	0.007	-0.071	-0.058	-0.060	-0.072

<sup>29</sup> Enerdynamics. [Understanding Liquefied Natural Gas \(LNG\) Units. Shively. Accessed on June 15, 2023.](#)

<sup>30</sup> The United States Energy Information Administration. [How much coal, natural gas, or petroleum is used to generate a kilowatthour of electricity? November 8, 2022.](#)

Source: KEPCO Investor Presentations and IEEFA estimates.

The mixed news for KEPCO at present is that using February 2023 coal costs and tariffs, KEPCO is making a profit. However, using LNG even at lower February 2023 prices, KEPCO is still loss making for LNG generated power.

For the 1Q23 calculations, IEEFA has used the following underlying assumptions:

1. **1Q23 costs:** KEPCO coal cost of US\$210/tonne and LNG cost of US\$1,458/tonne or US\$20.7/mm BTU
2. **1Q23 tariffs:** Power tariff of KRW132/kWh which is about US\$0.103/kWh

**Table 11: Calculation of KEPCO Realized Coal, Tariff and Operating Margin in 2022 and 1Q23 (000 ₩/tonne, US\$/tonne, ₩/ kWh, US\$/ kWh, %)**

Key variables	Unit	2021	2022	1Q 23
KEPCO coal cost	000 ₩/tonne	157.8	278.6	268.0
KEPCO coal cost	US\$/tonne	137.9	215.8	210.2
Power tariff	000 ₩/ kWh	108.1	120.5	131.9
Power tariff	US\$/ kWh	0.094	0.093	0.103
Coal required per kWh	kg	0.5	0.5	0.5
Conversion factor into tonne		2,222.2	2,222.2	2,222.2
Tariff per tonne of coal	US\$/tonne	209.9	207.4	229.9
KEPCO coal cost	US\$/tonne	137.9	215.8	210.2
Difference with coal cost	US\$/tonne	72.0	-8.4	19.7
Profit margin	%	34.3	-4.0	8.6
Profit/loss per kWh	US\$/ kWh	0.032	-0.004	0.009

Source: KEPCO Investor Presentations and IEEFA estimates.

The positive side is that, with the current coal cost of US\$210/tonne, KEPCO is able to make a profit margin of 9% at US\$0.009/kWh on power generated by coal. This is less than half the profit level of US\$0.032/kWh recorded in 2021.

For LNG, at the current cost of US\$1,458/tonne, or US\$27.2/MMBtu, KEPCO is generating a loss margin of 95%, or US\$0.098/kWh.

This loss margin is worse than the 77% incurred last year, and it means KEPCO is again in a position, with no further tariff increases in sight, of having to resort to burning more coal or boosting nuclear power to lose less money. In the first quarter of this year, KEPCO reduced financial losses by 21% by boosting nuclear power generation to 45% from 43% in 2022. It also lowered the share of coal-powered generation to 39% from 40% in 2022, and raised LNG to 14% from 13% for 2022.

**Table 12: Calculation of KEPCO Realized LNG, Tariff and Operating Margin in 2022 and 1Q23**  
(000 ₩/tonne, US\$/tonne, ₩/kWh, US\$/kWh, %)

Key variables	Unit	2021	2022	1Q 23
KEPCO LNG cost	000 ₩/tonne	724.7	1,543.7	1,858.6
KEPCO LNG cost	US\$/tonne	633.3	1,195.8	1,457.5
<b>Conversion factor tonne to MMBtu</b>				
Conversion factor tonne to MMBtu		53.6	53.6	53.6
KEPCO LNG cost	US\$/mm BTU	11.8	22.3	27.2
<b>Power tariff</b>				
Power tariff	000 ₩/kWh	108.1	120.5	131.9
Power tariff	US\$/kWh	0.094	0.093	0.103
<b>Conversion factor kWh into MMBtu</b>				
Conversion factor kWh into MMBtu		135.1	135.1	135.1
<b>Tariff per MMBtu of LNG</b>				
Tariff per MMBtu of LNG	US\$/MMBtu	12.8	12.6	14.0
KEPCO LNG cost	US\$/MMBtu	11.8	22.3	20.7
Difference with LNG cost	US\$/MMBtu	0.9	-9.7	-13.2
<b>Profit margin</b>				
Profit margin	%	7.4	-77.0	-94.6
Profit/loss per kWh	US\$/kWh	0.007	-0.072	-0.098

Source: KEPCO Investor Presentations and IEEFA estimates.

## About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. [www.ieefa.org](http://www.ieefa.org)

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