# Renewable Energy Impact on System Cost

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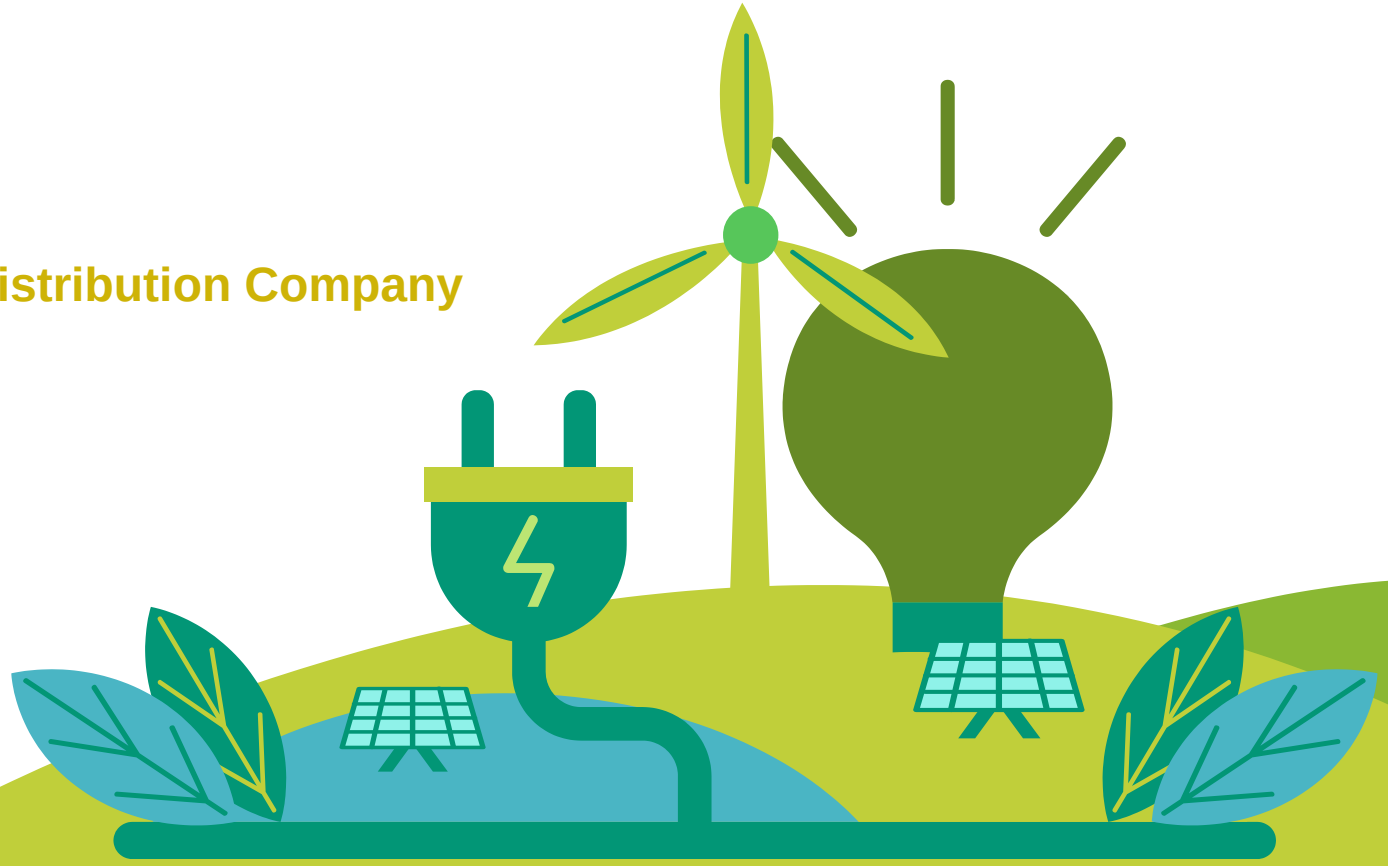

6-7 November 2024, İstanbul

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- Cost of New Connections to the Distribution Network
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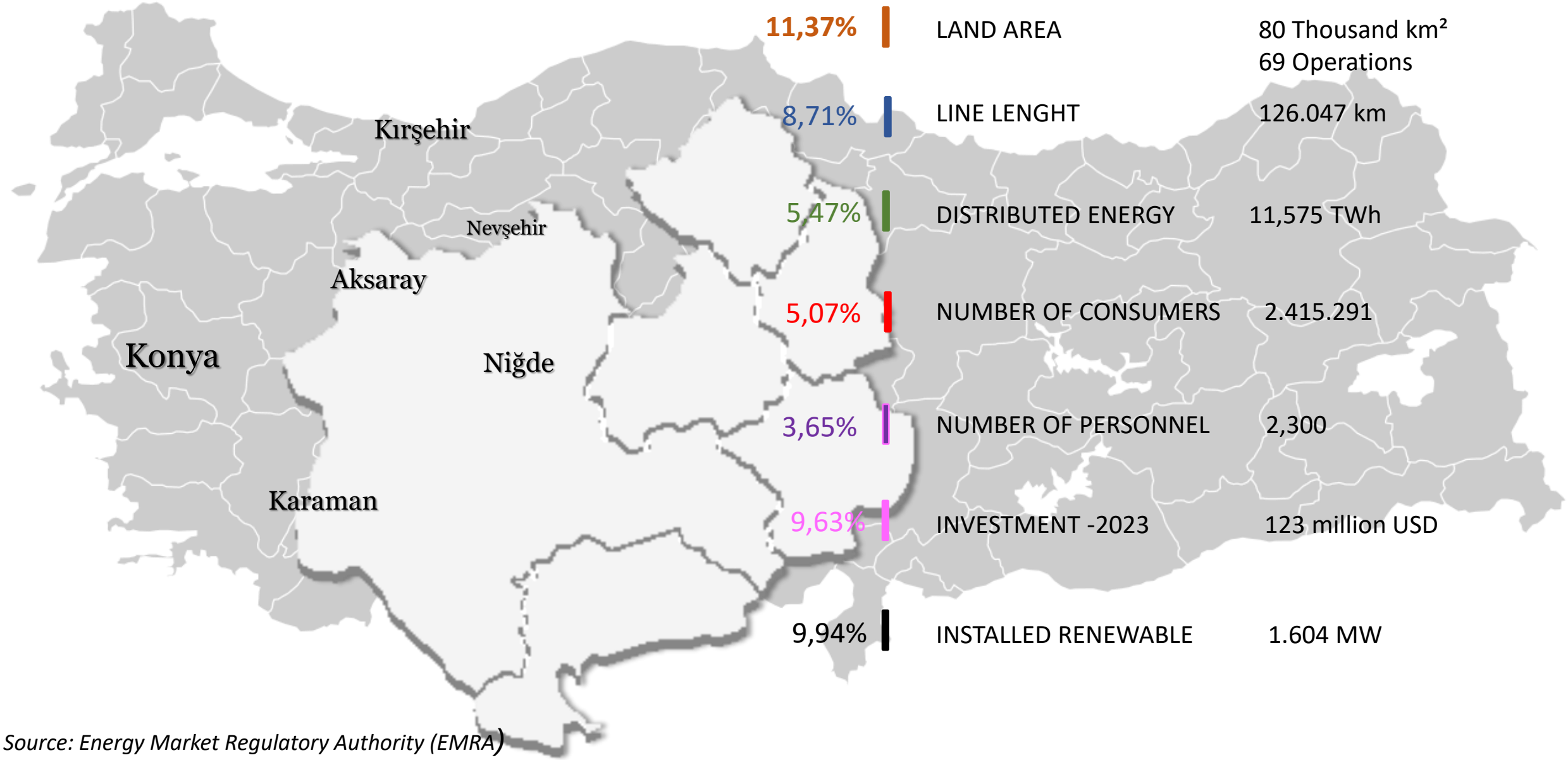
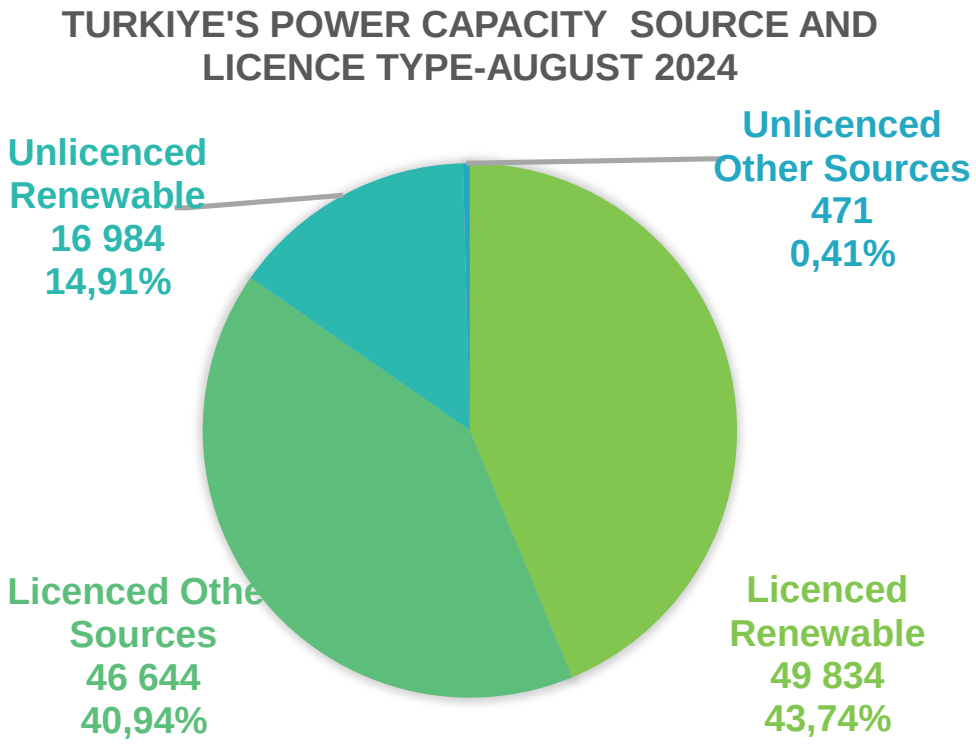
# A Quick Glance at MEDAŞ




| | | |
|---|---|---|
| 11,37% | LAND AREA | 80 Thousand km²<br>69 Operations |
| 8,71% | LINE LENGHT | 126.047 km |
| 5,47% | DISTRIBUTED ENERGY | 11,575 TWh |
| 5,07% | NUMBER OF CONSUMERS | 2.415.291 |
| 3,65% | NUMBER OF PERSONNEL | 2,300 |
| 9,63% | INVESTMENT -2023 | 123 million USD |
| 9,94% | INSTALLED RENEWABLE | 1.604 MW |

*Source: Energy Market Regulatory Authority (EMRA)*

# Renewable Generation in Distribution Level




2023

| TOTAL DISTRİBUTED ENERGY | TOTAL UNLICENCED ENERGY | RATE |
|---|---|---|
| 193.740 | 14.796 | 7,64% |

- All unlicensed connections are at distribution voltage level. 97,1% of unlicensed installed capacity is renewable

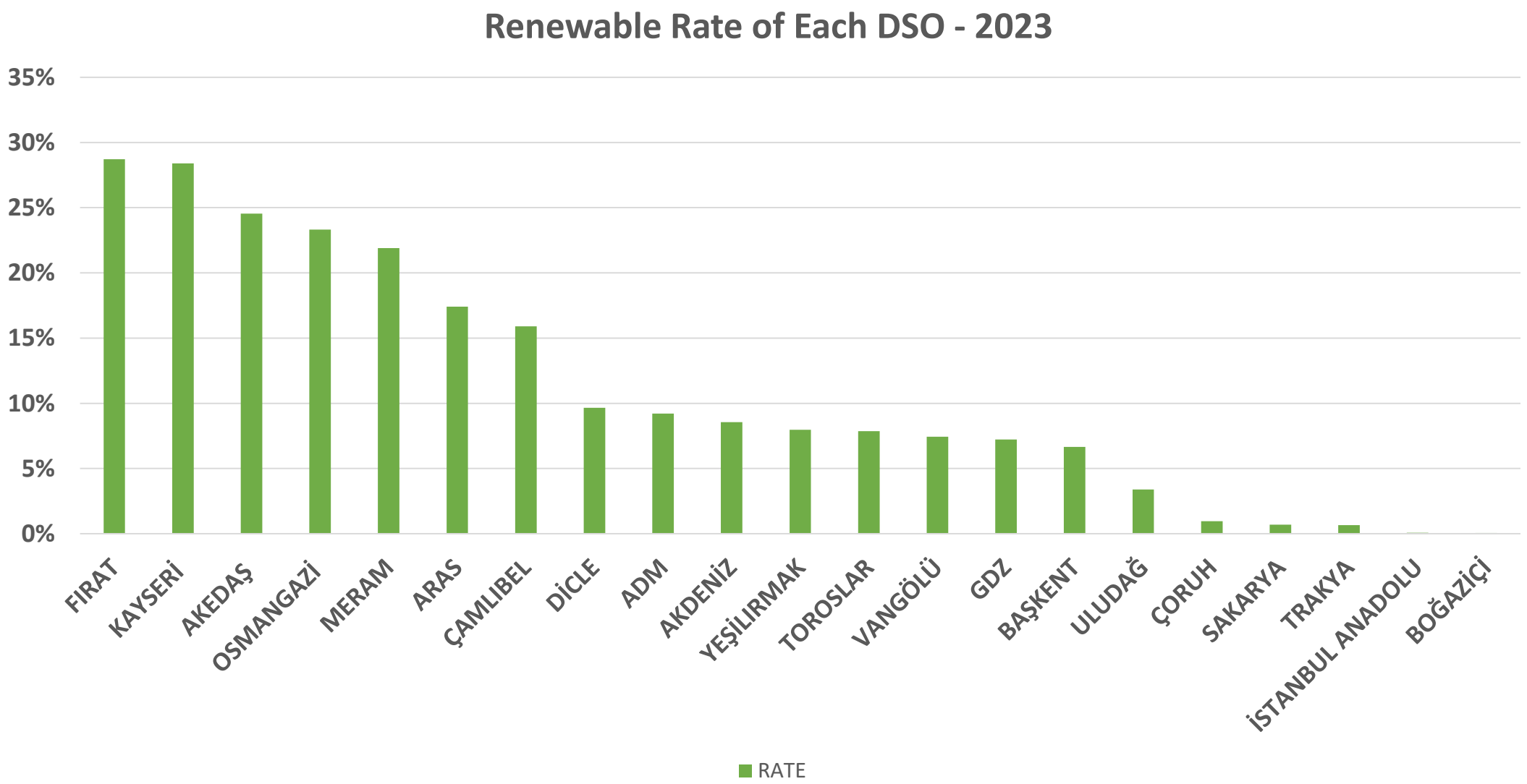
- 7,64% of the total distributed energy in Turkiye is provited/purchased from distributed renewable generation. The share of renewable energy in distributed energy is expected to continue to increase.

Why we think so;

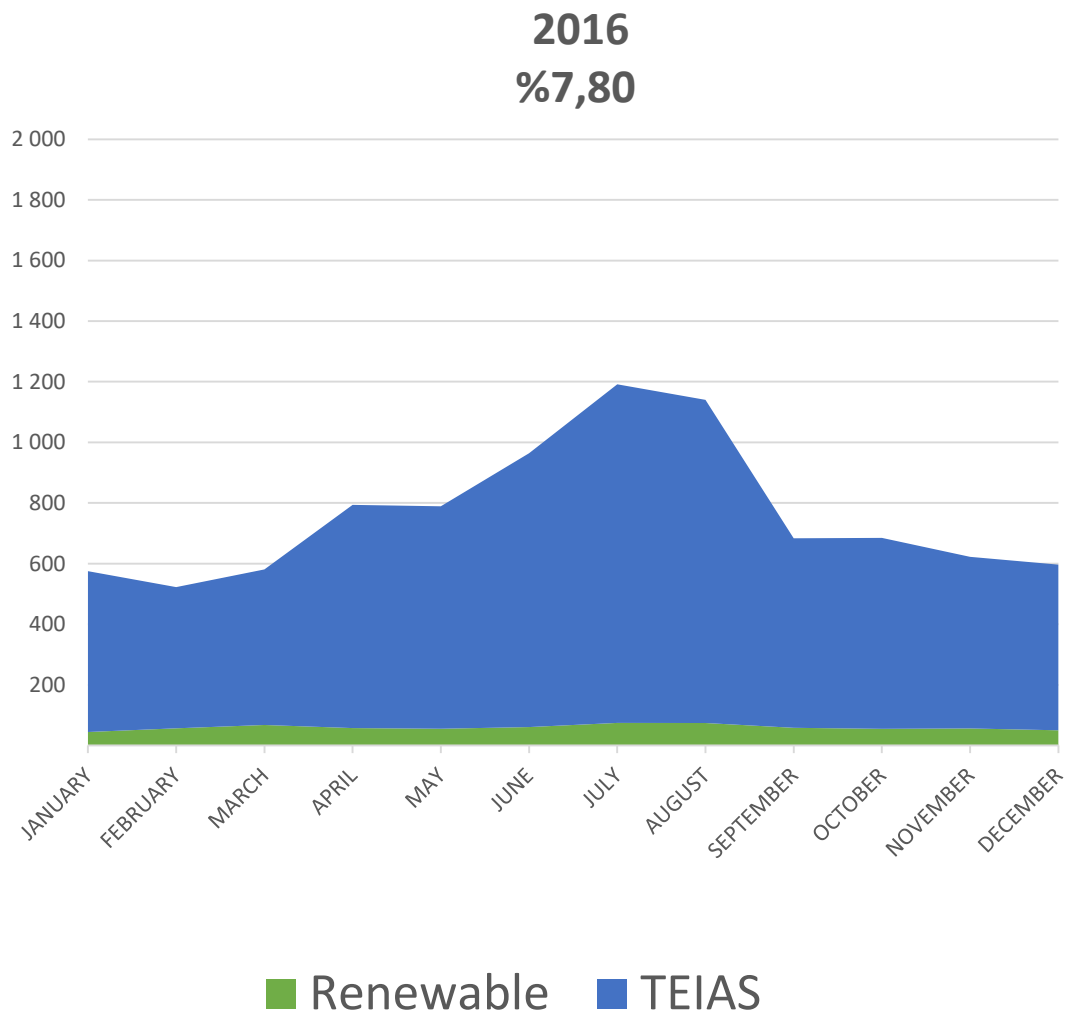
- Increase in energy prices.
- Increase in «end user» prices,
- Dramatic reduction in renewable investment costs,
- The growing of micro-scale battery storage solutions
- Government subsidies and incentives
- Other regulations of the regulator regarding renewable energy

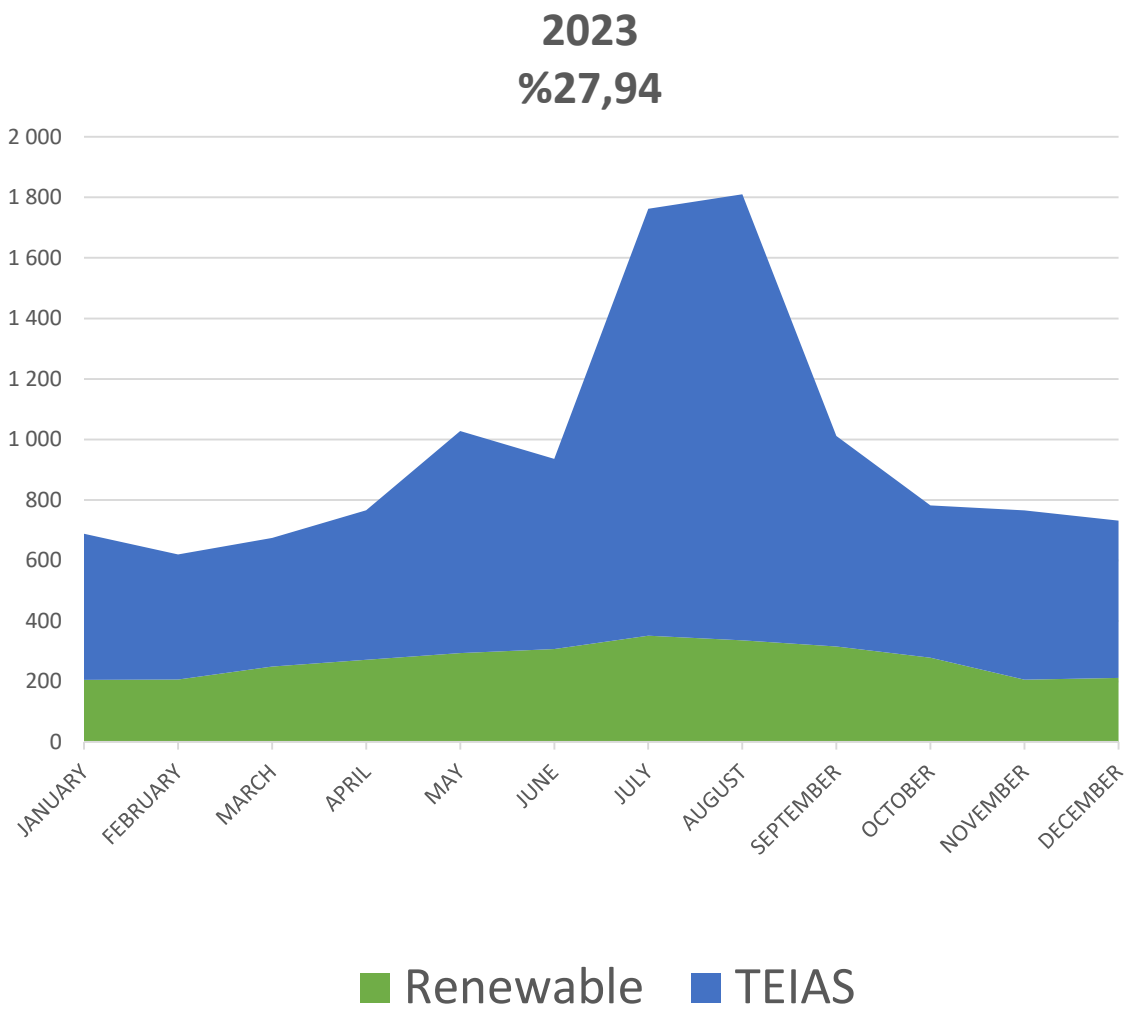
*Source: Energy Market Regulatory Authority (EMRA)*

# Share Of Renewable Energy in Distributed Energy By DSO



# Renewable Effect on Distributed Energy-MERAM Case



# Renewable Effect on Distribution Costs

| Renewable Costs | | OPEX-CAPEX | DSO | Investor /Prosumer Cost |
|---|---|---|---|---|
| Before Connection | Application and Technical Evaluation | OPEX | ✓ | ✓ (Fixed Application Charge) |
| | Project Approval and Temporary Acceptance | OPEX | ✓ | ✓ (Fixed and Variable Charge) |
| | Cost of New Connections to the Distribution Network | CAPEX | | ✓ (Grid Construction Costs) |
| After Connection | Balance and Settlement Operation Costs | OPEX | ✓ | ✓System Operation Fee-Distribution<br>✓ System Operation Fee – Incumbent Supply Company |
| | Difficulties in Operation and Maintenance | OPEX | ✓ | |
| | AMR and SCADA Operation Costs | OPEX / CAPEX | ✓ | ✓ |
| | Network Stability Costs (Battery Energy Storage Systems) | CAPEX / OPEX | ✓ | ✓ |
| | Reactive Energy Compansation (Reactor and capacitor inv.) | CAPEX / OPEX | ✓ | |
| | Effects on Technical Lost | T&L Performance | ✓ | |

# Application and Technical Evaluation

- Application Fee
- Project approval, temporary acceptance procedure, etc)

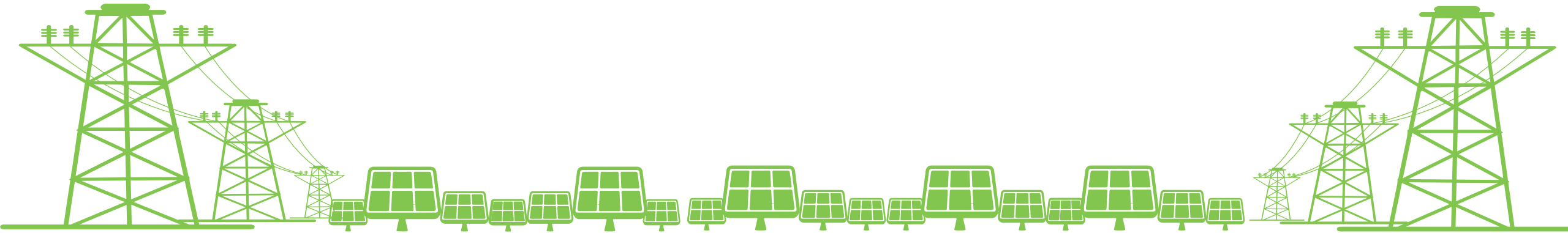
  - 50% of the income generated is taken into account in the revenue requirement.

  - According to generally accepted tariff rules, special costs which are collected from the user who caused the cost.

# Cost of New Connections to the Distribution Network

- The connection line for connecting the power plant to distribution network is constructed/founded by the investor. (Overhead lines or cables, Expenses for obtaining the necessary official permits for the project… )

- After the provisional acceptance, the DSO is responsible for their operation and maintenance.



# Balance and Settlement Operation Costs

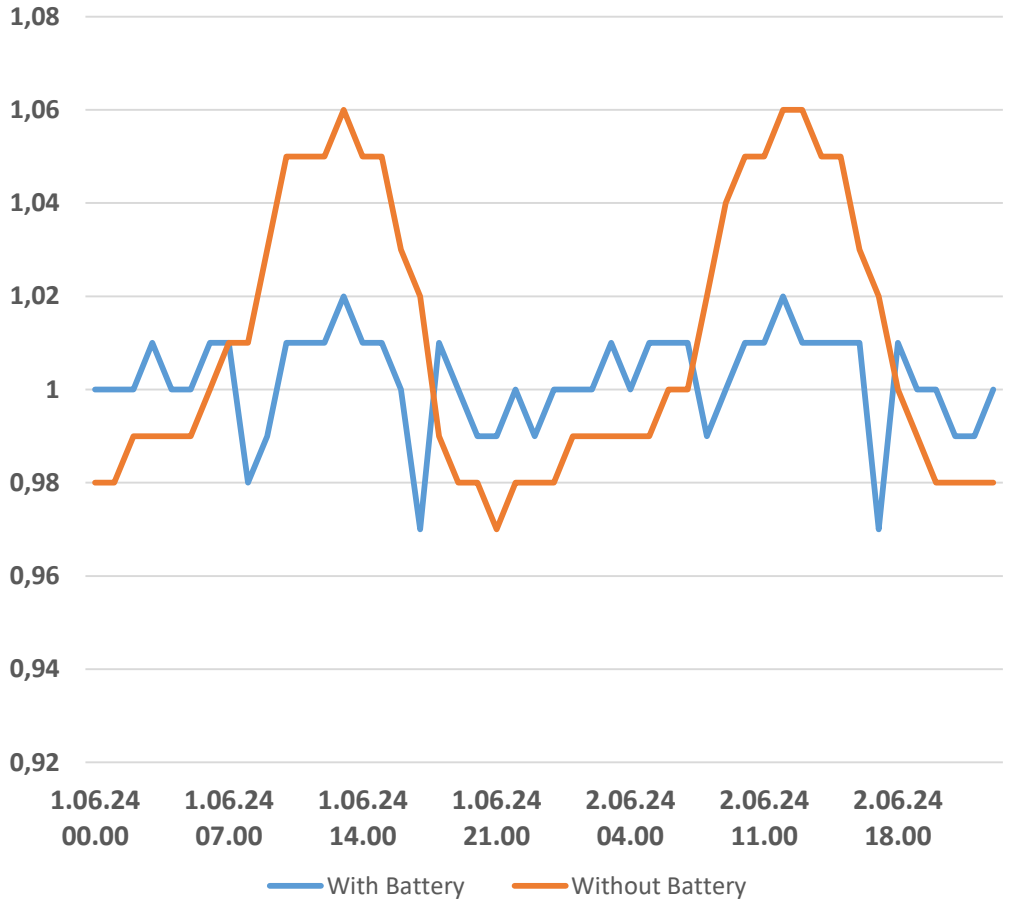
| | HOURLY | MONTHLY | ANNUAL |
|---|---|---|---|
| • Accounting and billing | - | X | - |
| • Data analising and demand control, | X | X | - |
| • Offset of production and consumption values for 720 hours | X | - | - |
| • Control of production quota, | - | X | X |

# Difficulties in Operation and Maintenance (Inc. AMR and SCADA Infrastructure)

- Increase at new energy plants connection, increases network operating costs. Moreover, these connections are not ordinary connections.
- Each new connection brings problems such as voltage fluctuation and reactive power limit problems.
- In order to detect and solve this problem, the network must be monitored in real time. Due to the increase in new renewable plants, SCADA and field teams need to be increased.
- More connection points increase opex, even with the same line length.
- As renewable resources directly increase operating costs, this must be one of the drivers of variable operating expenses.

# Network Stability Costs

- At the distribution voltage level, renewable energy connections cause voltage spikes.
- Energy Storage Systems(ESS) are critical in ensuring the voltage balance of the network.
- EMRA has approved 34.752 MW new Storage Associate Pre-License. 6.000 MW of this capacity is at the distribution voltage level.
- Although ESS is required in Renewable Production Pre-License Applications approved by EMRA, DSOs also have to invest in ESS to contribute to the balancing of the system.




# Reactive Energy Compansation

It's becoming harder to manage reactive energy…

| | Before Renewable | After Renewable |
|---|---|---|
| Active Energy Consumption(TSO) | 100 | 100 |
| Active Energy Generation (Renew.) | 0 | -60 |
| Net Active Energy Consumption | 100 | 40 |
| Cap. Reactive Energy Consumption | 10 | 10 |
| **Threshhold Ratio** | **15%** | **25%** |
| **Compansation Penalty(To TSO)** | **NO** | **YES** |

- DSO may face penalties despite no change in total reactive energy, due to reduced transmitted active energy from distributed generation

- To avoid these penalties, lower step-range compensation **investments are required.**

# Reactive Power Support and Voltage Control

## Investment or Reactive Power Support?

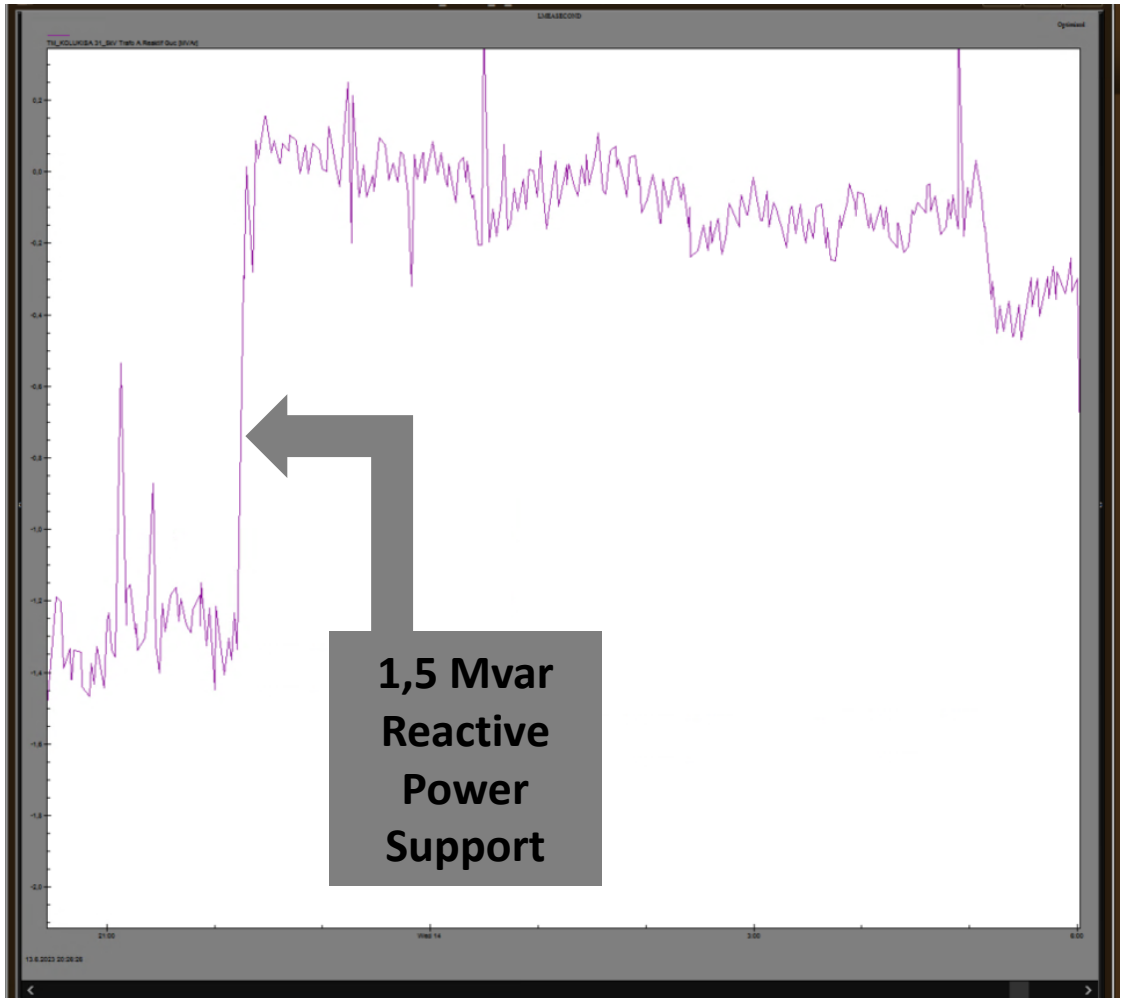
With the support of EMRA, the R&D study on "Providing reactive power support from Renewable Energy Power Plants" was completed. According to the results of this research;

| | Reactor Investment | Reactive Power Support |
|---|---|---|
| Reactor Investment (M$) | 60 | - |
| Technical Loss (MWh) | 3.427 | 1.298 |
| Maintenance Cost (M$) | 0,02 | 0,04 |
| Unit Cost of Tec. Loss($/Per MWh) | 33 | 100 |
| Total Reacitve Energy (MVARh) | 24.820 | 7.811 |
| Total Cost-Per Year(M$) | 0,20 | 0,13 |

*Reactor lifetime ise 30 years, Invertor life time is 10 years

* In both cases, reactive energy is kept within limits by necessary compensation.

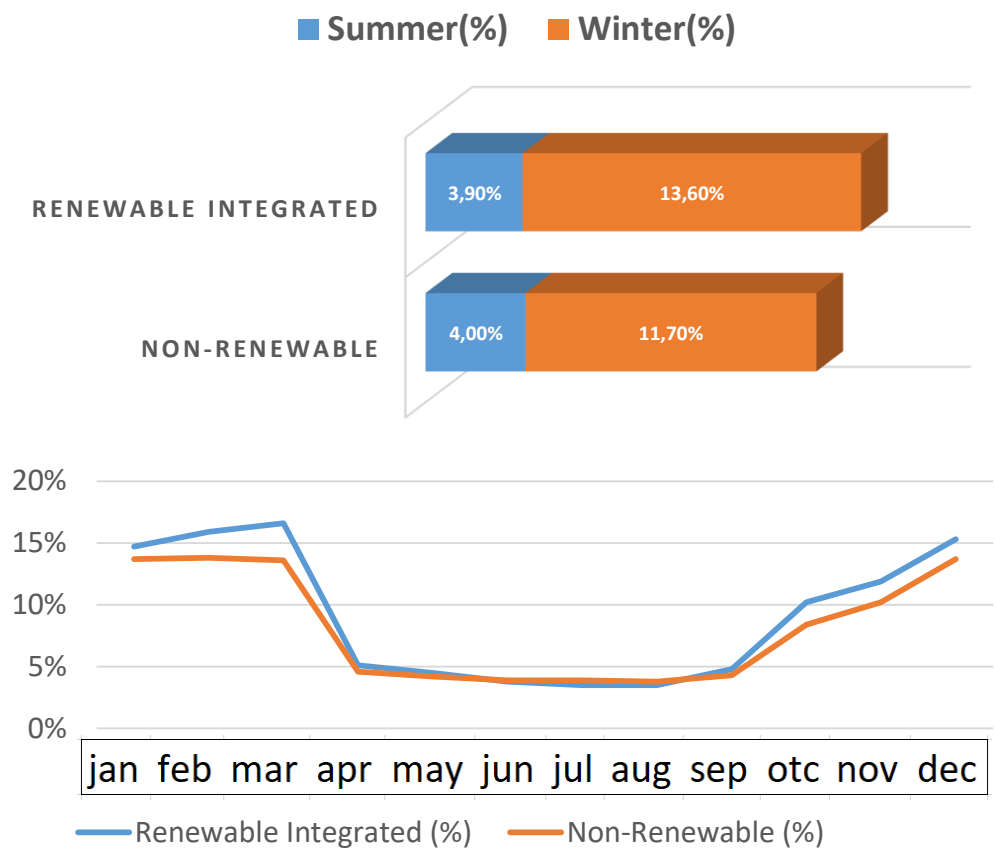
*Reactive power support helps keep the voltage within limits because the generation plants are distributed.




- In both cases, reactive energy is kept within limits by necessary compensation.
- Reactive power support helps keep the voltage within limits because the generation plants are distributed.

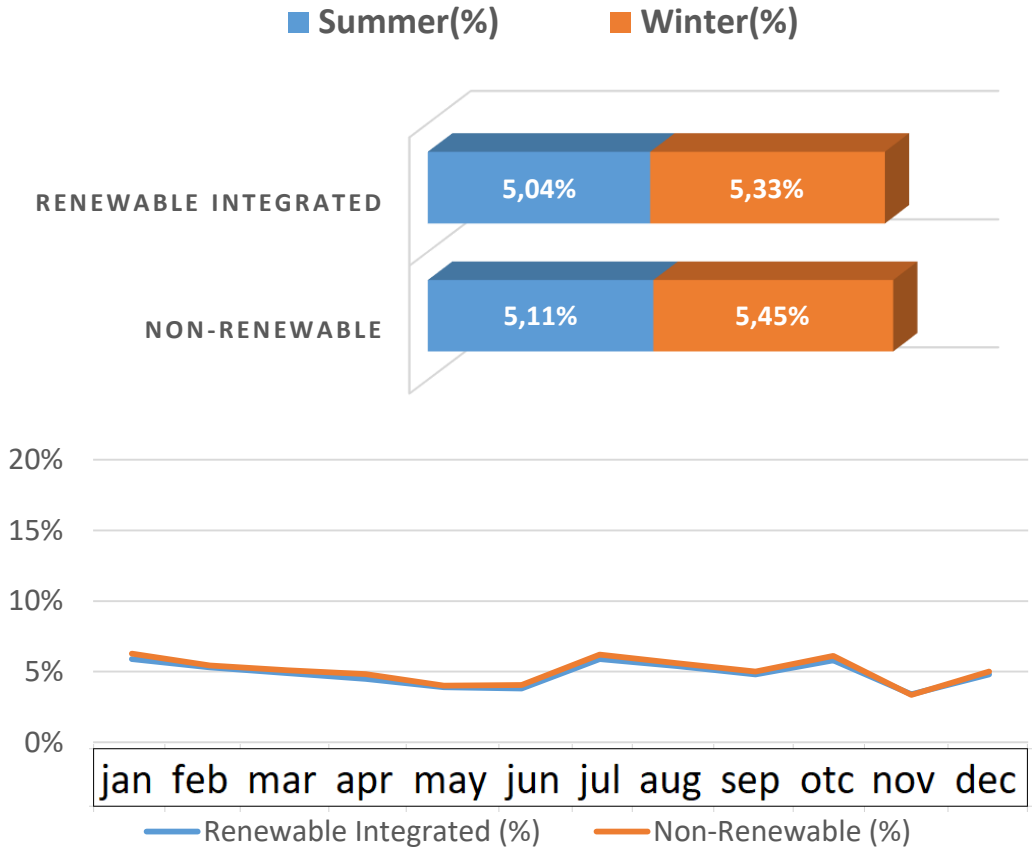
# Effects on Technical Losses

## A NEGATIVE SCENARIO - EFFECT OF RENEWABLE ENERGY ON MONTHLY LOSSES




| Date | Total Loss | Total Load | Rate |
|---|---|---|---|
| **Non-Renewable** | 1.040 | 20.214 | 5,15% |
| **Renewable Integrat** | 1.081 | 20.214 | 5,35% |

## A POSITIVE SCENARIO - EFFECT OF RENEWABLE ENERGY ON MONTHLY LOSSES




| Date | Total Loss | Total Load | Rate |
|---|---|---|---|
| **Non-Renewable** | 653 | 12.513 | 5,23% |
| **Renewable Integrat** | 623 | 12.513 | 4,99% |

# Tariff & Distribution Fee Structure (Distribution Level)

| EPDK tarafından onaylanan ve 1 Temmuz 2024 Tarihinden İtibaren Uygulanacak Vergi, Fon ve Pay Hariç Tarifeler | | | | | | | |
|---|---|---|---|---|---|---|---|
| Üreticiler İçin Veriş Yönünde Çift Terimli Dağıtım Tarifesi | | | | | Üreticiler İçin Veriş Yönünde Tek Terimli Dağıtım Tarifesi | | |
| Üretici | Kapasite | | Dağıtım Bedeli | Reaktif Enerji | Üretici | Dağıtım Bedeli | Reaktif Enerji |
| | Güç Bedeli | Güç Aşım Bedeli | | | | | |
| | kr/Ay/kW | kr/Ay/kW | kr/kWh | kr/kVARh | | kr/ kWh | kr/kVARh |
| | 2.528,63 | 5.057,27 | 17,0239 | 196,6895 | | 23,0911 | 196,6895 |
| Lisanssız Üreticilere İlişkin Tek Terimli Dağıtım Tarifesi | | | | | | | |
| Lisanssız Üretici-1 | | | | | 117,1606 | | 196,6895 |
| 5346 Sayılı Kanunun Eki I Sayılı Cetvelin (e) Bendi Kapsamındaki Lisanssız Üreticilere İlişkin Tek Terimli Tarife | | | | | | | |
| Lisanssız Üretici-2 | | | | | 36,9322 | | 196,6895 |

Licenced generation

Unlicenced generation - Dollar Based Feed-in Tariff

Unlicenced generation - Energy price-based Feed-in Tariff

| Prosumer Type | Export (kWh) | Import (kWh) | Distribution Fee-Export(DFE) (TL/kWh) | Distribution Fee Import (DFI) (TL/kWh) |
|---|---|---|---|---|
| Onsite | 100 | 100 | - | 100 * DFI * 0.5 |
| | 150 | 100 | 50 * DFE | 100 * DFI * 0.5 |
| | 100 | 150 | - | (100 * DFI * 0.5) + (50 * DFI) |
| Offsite | 100 | 100 | 100 * DFE | 100 * DFI |
| | 150 | 100 | 150 * DFE | 100 * DFI |
| | 100 | 150 | 100 * DFE | 150 * DFI |

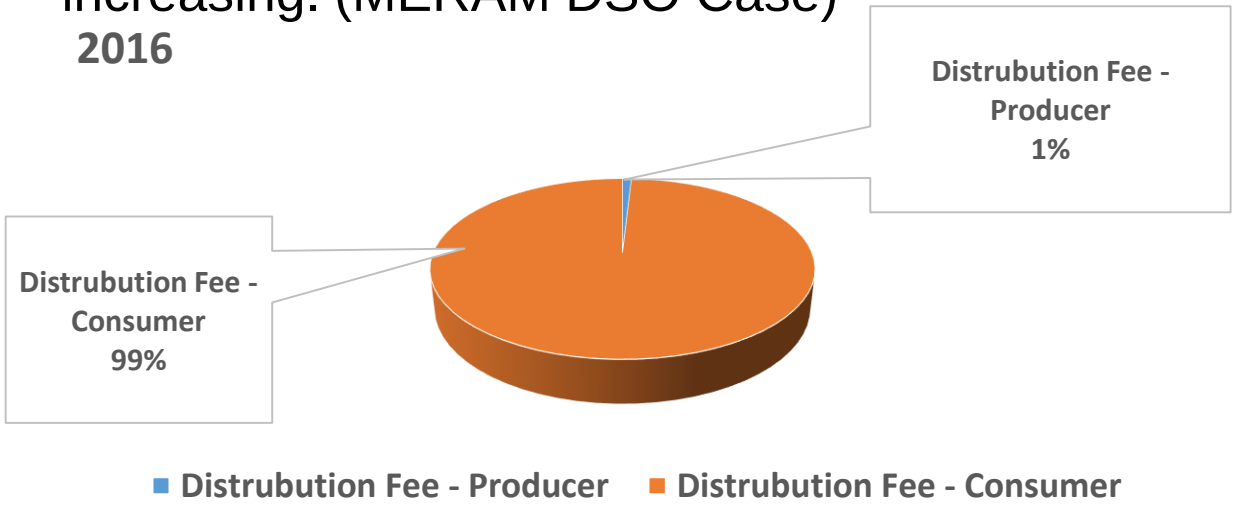
- **At offsite location, distribution usage fees are charged for both production and consumption.**

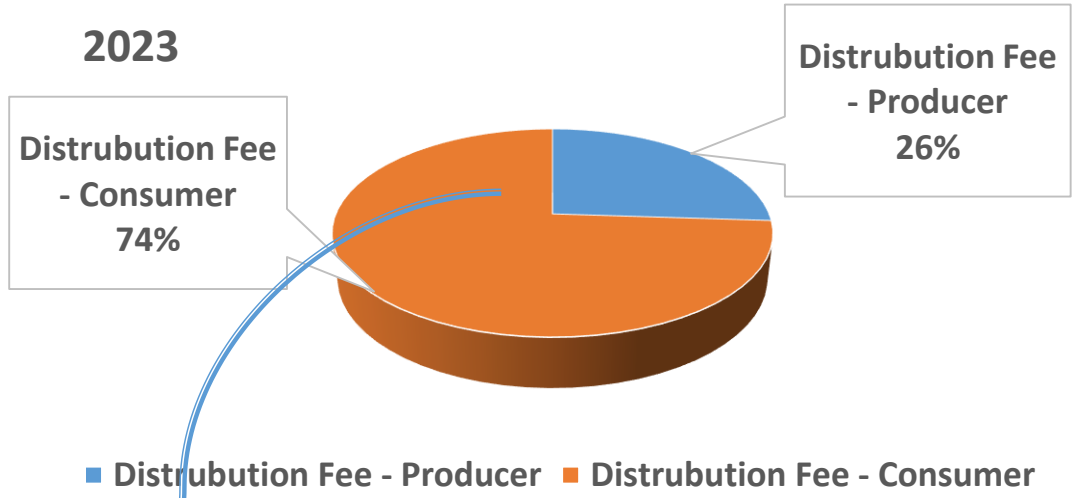
**-At onsite location, 50% discounted distribution usage fee is charged for net-metered consumption.**

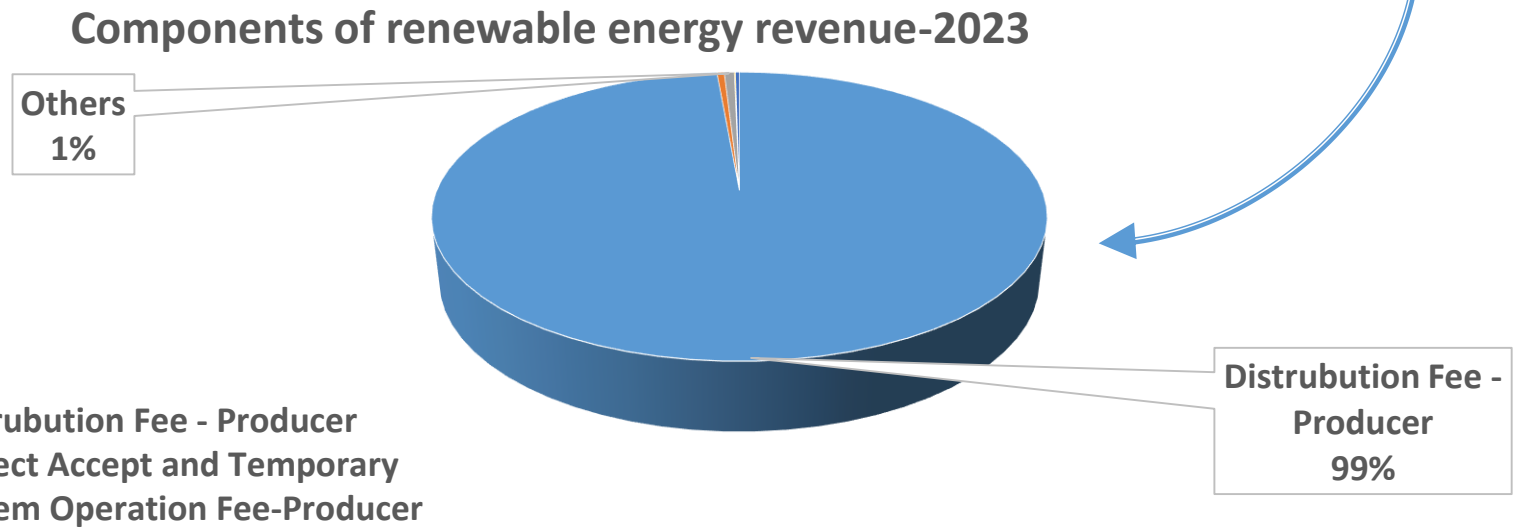
**- In DSOs with many onsite plants, distribution fee discounts reduce revenue**

# Renewable Effect on Distribution Revenue

The share of system usage fees collected from producers within the revenue cap is gradually increasing. (MERAM DSO Case)




# Final Thoughts

- The paradigm has shifted; 'prosumer' instead of 'consumer' is outdated. Perhaps we could say 'Prostormer' instead.
- System usage fees for prosumers are impacting revenue balance,
- Managing the grid has become much more challenging and costly following the integration of renewable energy.
- Collecting renewable energy management costs from all customers is not fair.
- Renewable energy grid investments are funded by the investor, but their impact on other opex/capex costs is essential for system balance.

# Thank You