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The electrical transmission and distribution network in the sectors of Baqubah city

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Abstract: Baqubah city is supplied by an integrated electrical grid system, starting with a high voltage of 400 kV, then distributed to a low voltage of 132 kV, and then to 33 kV in Baqubah city and the eastern and western zones, each of which consists of two sectors. These zones are distributed among the city's various land uses (residential, industrial, commercial, and governmental). The city also has a population of 128,064 in the eastern zone and 148,449 in the western zone. This network provides a centralized, scheduled power supply service to these uses, where the Electricity Directorate determines the hours of power outages and supply throughout the day, taking into account some urban uses within the city via an emergency line, such as hospitals and central service departments in the governorate administration. The city's need reached (465.51) MW and the supply reached (232.76) MW, which means that there is an energy deficit of (59)%.Baqubah city is supplied by an integrated electrical grid system, starting with a high voltage of 400 kV, then distributed to a low voltage of 132 kV, and then to 33 kV in Baqubah city and the eastern and western zones, each of which consists of two sectors. These zones are distributed among the city's various land uses (residential, industrial, commercial, and governmental). The city also has a population of 128,064 in the eastern zone and 148,449 in the western zone. This network provides a centralized, scheduled power supply service to these uses, where the Electricity Directorate determines the hours of power outages and supply throughout the day, taking into account some urban uses within the city via an emergency line, such as hospitals and central service departments in the governorate administration. The city's need reached (465.51) MW and the supply reached (232.76) MW, which means that there is an energy deficit of (59) %.

Keywords: *Baqubah city, Distribution network, Electrical transmission, Energy deficit in Iraq, High voltage, Power supply.*

1. Introduction

Electricity is the lifeblood of civilization and life, playing a pivotal role in achieving economic and social development for communities [1]. It is not only an essential means of improving quality of life, but also a key factor in driving economic growth and infrastructure development. Modern societies rely heavily on electricity to operate various economic sectors, making it an indispensable necessity [2].

Electricity is produced from a variety of sources, including natural resources such as oil, natural gas, and coal, as well as renewable resources such as water and geothermal energy. These diverse options are essential to ensuring sustainable energy production and meeting society's growing needs. However, a shortage of electricity can have negative impacts on the economy and social life, requiring careful planning to ensure its sustainable provision [3].

The volume of loads varies in the eastern and western parts of the city, which comprise four sectors. This depends on several factors, most notably area, land use, and population size. This impacts the increased pressure on electrical systems and the electrical transmission grid [4].

There is a direct relationship between consumption, connection equipment, transmission wires, transformers, and poles in the two areas and four sectors.

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The study was spatially defined in the city of Baqubah, the center of Baqubah district and the center of Diyala Governorate. Data from 2022 was used as the basis for collection and analysis. The sectoral boundaries were defined by the electricity sector and its transmission systems as the focus of the study See Figure No.

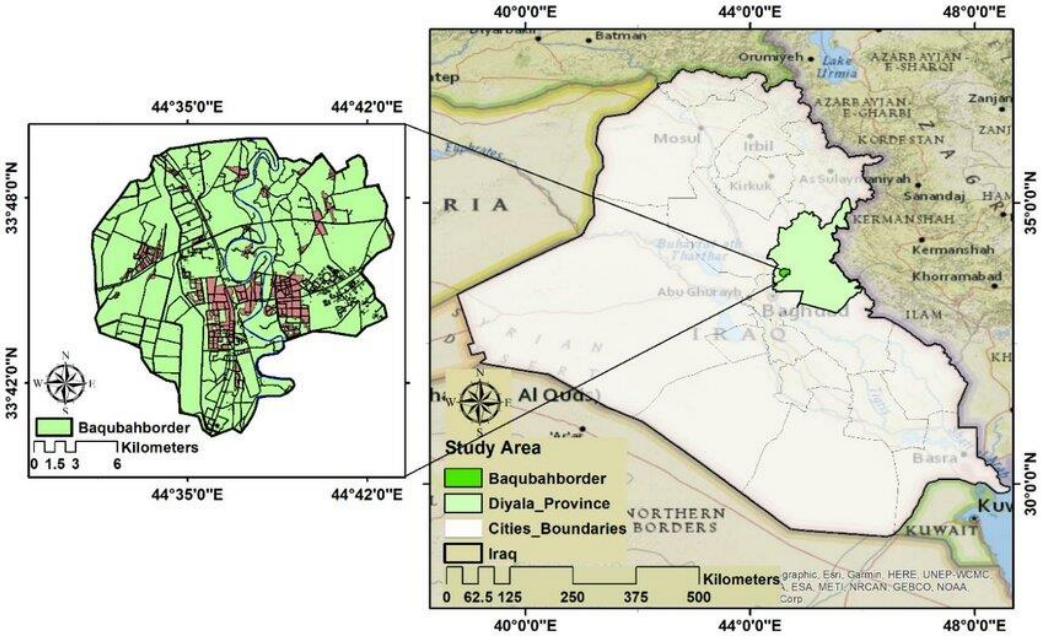

Figure 1.
Location of the study area in Baqubah city.

2. Research Objectives

The study aimed to identify and distribute the electrical power transmission networks within the city, and to identify the technical and geographical reasons behind this disparity. This reflects the function of the transmission network and the variation in loads and their causes within the city's two zones and its four sectors. This reinforces the contribution of this research in providing appropriate solutions to the Diyala Governorate Electricity Directorate to address the challenges and obstacles facing the transmission network system within the city.

3. Research Methodology

The study relied on descriptive methods, quantitative analysis, and cartography to solve the problem and prove the hypotheses.

3.1. The Electrical Power Transmission Stage

This is the second stage of the electrical power system, as electrical power is transmitted via overhead wires and underground cables. The transmission process takes place via these wires from the production stations to the transmission stations Figure 2. These wires have different voltages depending on the distance between the production stations and the transmission stations, as these wires operate at high voltages over long distances and at different voltages (400, 132, 33) [5]. Electrical power is transmitted at high voltage and low current to reduce and avoid power losses and minimize energy waste. Overhead lines include metal towers, insulators, conductors, and their accessories. They are characterized by their low economic cost, as well as voltage-stepping stations and transformers and voltage-stepping transformers [6].

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Figure 2.
Electrical power transmission station (South Baqubah station) near Diyala University.

The date of the photograph for Figure 2 is 24/10/2024. The main electrical power transmission lines are [7, 8]:
400 kV lines,see figure (3).

- Mirsad – Diyala line: Its total length is (225 km) with (623) towers, and it is divided into two lines:

1- The line that transmits electrical power from the production station in Kermanshah to the border, with a length of (90 km) and (250 towers).

2- The line that transmits electrical power from the border to the Diyala 400 kV station, with a length of (135 km) and (373 towers), refer to Figure (2-5).

- Diyala – Mansouriya line: It transmits electrical power from the Mansouriya gas station to the Diyala 400 kV station, with a length of (110 km).
- East Baghdad – Diyala 1 line: It transmits electrical power from the East Baghdad 400 kV station to the Diyala 400 kV station, with a length of (52 km).
- East Baghdad – Al-Ameen line: Its length is (89.5 km) with (247 towers).
- Diyala 400 kV – Baqubah West Double Line (Both Directions): It transmits electrical power from the Diyala station to the Baqubah West station, with a length of 8 km and is distributed across 22 towers.
- 132 kV lines, refer to Figure (2) and follow the routes listed in Table (2).
- East Baghdad – West Baqubah line: It transmits electrical power from the East Baghdad station to the West Baqubah station (secondary substation), with a length of (35 km) and is distributed across (97 towers).
- East Baghdad – East Baqubah line: It transmits electrical power from the East Baghdad 400 kV station to the East Baqubah station (132.33.11), with a length of (30 km) and is distributed across (83 towers).
- East Baqubah – West Baqubah line: It transmits electrical power from the East Baqubah station (132.33.11) to the West Baqubah station (132.33.11), with a length of (13.8 km) and is distributed across (83 towers).

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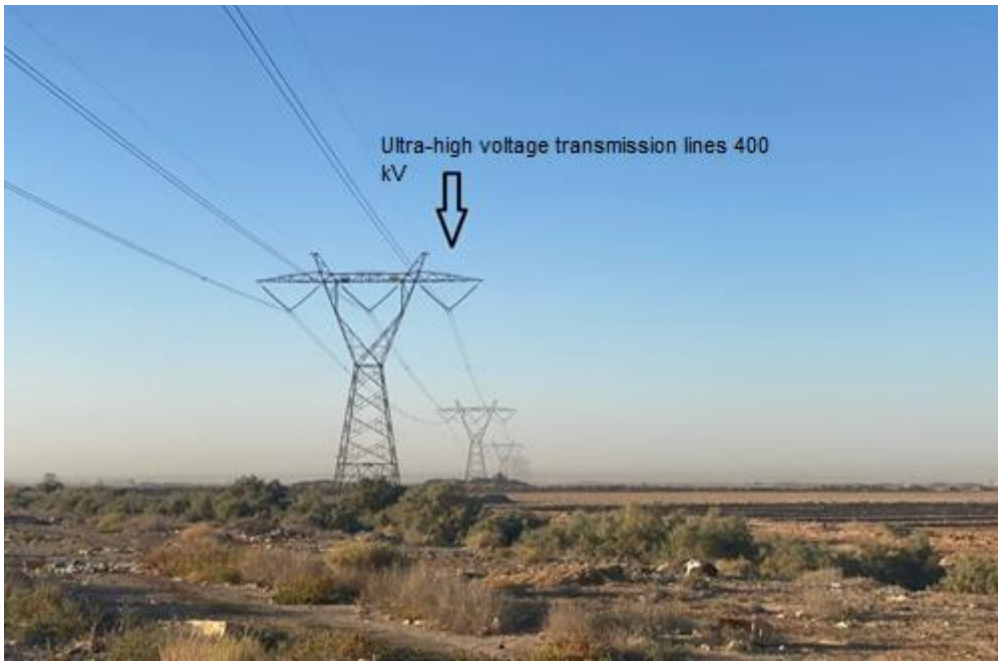

Figure 3.
Ultra-high voltage transmission lines 400 kV.

- 132 kV lines, as shown in Figure (4) and follow the routes listed in Table 1.
- East Baghdad – West Baqubah line: It transmits electrical power from the East Baghdad station to the West Baqubah station (secondary substation), with a length of (35 km) and is distributed across (97 towers).
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Figure 4.
132 kV high voltage transmission line.

Table 1.
Ultra-high voltage transmission lines of 400 kV in the Diyala Governorate electrical power transmission network.

Line Name	Wire Type	Length (km)	Number of Towers
Diyala / East Baghdad	T.AAA.C	52	144
Diyala / Al-Ameen	T.AAA.C	89.5	247
Diyala / Mansouriya	Acsr 490	110	278
Diyala / Mirsad	T.AC.S.R	225	607
Total		476.5	1276

Table 2.
High voltage transmission lines of 132 kV in the Diyala Governorate electrical power transmission network.

Line Name	Wire Type	Length (km)	Number of Towers
East Baghdad – West Baqubah	Lark	35	97
East Baghdad – East Baqubah	Partridge	30	83
East Baqubah – West Baqubah	Lark	13.8	38
Diyala – West Baqubah 1+2 (two lines)	Teal	8	22
Total		86.8	240

3.2. Stage of Electrical Power Distribution

The distribution stage represents the final step of the electrical power system, where it receives electrical energy from the transmission stations at 132 kV, reduces it to 33/11 kV, and then distributes it to the city's network via wires. The voltage is further reduced by the overhead transformers spread across the alleys and streets of the city, which step it down to 400 kV [7]. From these transformers, lines are connected to supply residential areas, transformers, and other activities within the city. These transformers vary in size and type [9]. Distribution stations are spread across the sectors of Baqubah city, where a connected electrical network covers the city. This network is divided into the central and peripheral sectors, as some areas of Baqubah city receive electrical power from stations outside the city [10]. There are also distribution stations within the city that cover areas outside the city, as shown in Figure 5 and 6. These stations are distributed throughout Baqubah city, as indicated in Table 3. Figure 5, and Figure 6.

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Figure 5.
Korean electrical power distribution station in the second sector near the Razzi overpass.

Table 3.
Geographic Distribution of Electrical Stations in Baqubah City.

Station Name	Latitude (N)	Longitude (E)
West Baqubah Secondary Transmission Station	33.771849	44.58139
Diyala Electricity Transmission Branch	33.747255	44.66161
South Baqubah Electricity Transmission Station	33.694439	44.6061
Diyala 400 kV Electricity Transmission Station	33.823233	44.57901
Baqubah Center Sector Electricity Distribution Station	33.746167	44.62435
Korean Electricity Distribution Station	33.716256	44.61788
Saif Saad Electricity Distribution Station	33.745519	44.50257
East Baqubah Electricity Distribution Station	33.759067	44.64085
7 Nisan Electricity Distribution Station	33.741933	44.62704
Tahrir Electricity Transmission Station	33.743469	44.66368

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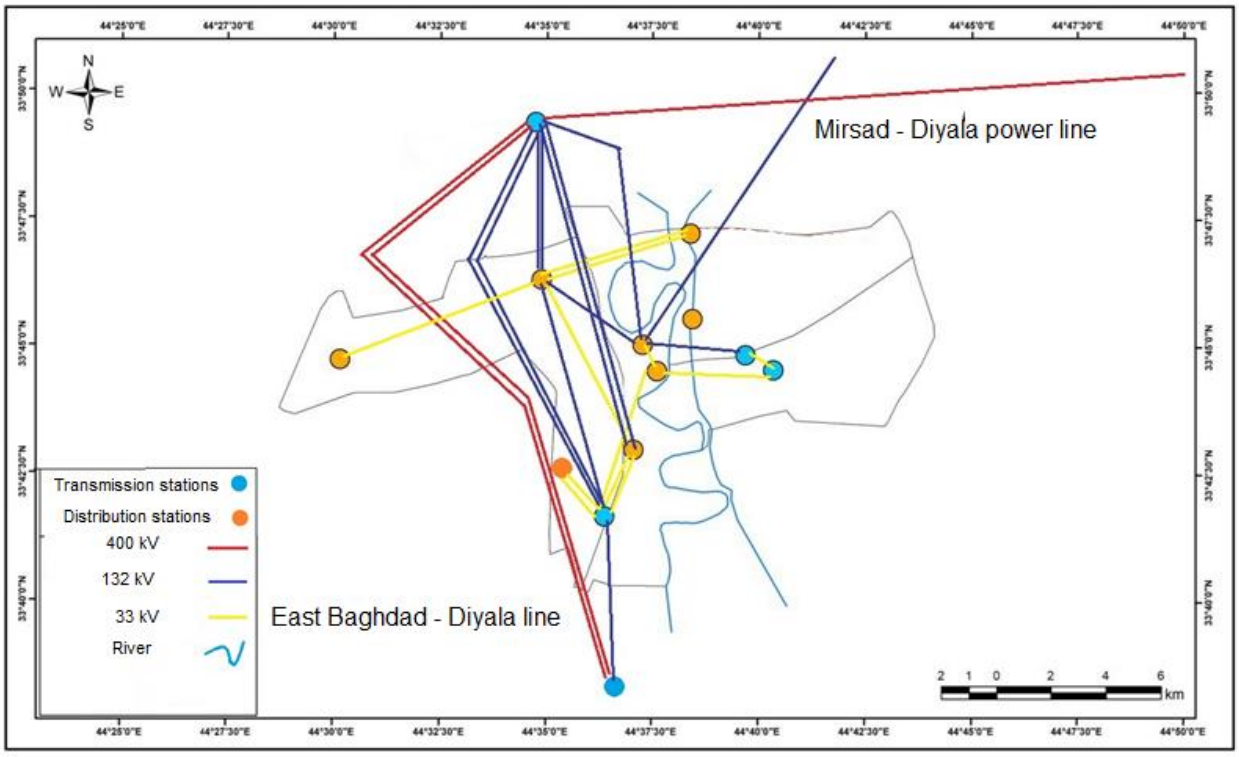

Figure 6.
Electrical Distribution Network in Baqubah City 2022.

The electrical grid in Baqubah is distributed through the presence of material requirements related to the electrical function in terms of energy transmission and distribution in the city's sectors. This grid is distributed over two areas, eastern and western.

3.3. Eastern Zone

The electrical network in this zone consists of the physical requirements that make up the electrical network in this zone. These requirements are (poles, wires, and transformers [11].

3.3.1. Poles in the Eastern Zone

The electrical pole is a basic structure in electrical distribution and transmission networks. It is mostly made of iron and is used to support high voltage and low voltage lines, contributing to the safe and efficient transfer of electrical energy between power stations and consumers. These poles are a vital part of the energy infrastructure, ensuring the continuity of electricity flow to homes, factories, and public facilities [12].

The poles are divided into high voltage poles and low voltage poles, and there are two types of poles: round and mesh. The number of round high voltage poles in this zone reached (2761 poles), including (1471 poles) of high voltage round poles in the first sector, which represents (53.3%) of the total number of high voltage round poles in the eastern zone, and (1290 poles) in the third sector, which represents (46.7%) of the total number of poles in this zone. The number of mesh high voltage poles in this zone reached (1812 poles), including (1078 poles) in the first sector, representing (59.5%) of the total number of mesh high voltage poles, as shown in Figure (2-11) in the eastern zone, and (734 poles) of mesh high voltage poles in the third sector, representing (40.5%) of the total number of mesh high voltage poles in this zone [13, 14].

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The high-voltage wires carry 33/11 KV and are longer than the low-voltage poles and are located on the outskirts of cities and along the main streets. The low-voltage poles are also divided into two types: round and mesh. They carry low-voltage wires of 4.0 KV and are shorter than the high-voltage poles and are located inside the residential neighborhoods and alleys. The number of round low-voltage poles in this area reached (5028 poles), including (2703 poles) in the first sector, representing (53.7%) of the total round low-voltage poles in the eastern area. The number of round low-voltage poles in the third sector reached (2335 poles), representing (46.3%) of the total round low-voltage poles in the eastern area [15]. The number of meshed low-voltage poles in this area reached (2337 poles), including (1165 poles) in the first sector, representing (49.9%) of the total meshed low-voltage poles in the eastern area. Their number in the third sector reached (1172 columns), representing (50.1%) of the total number of low-pressure columns interconnected in the eastern range. See Table (4) and Figure (7) [14].

Table 4.
Electricity poles in the eastern part of Baqubah city.

Sector Name	High Voltage Mesh Pole	% (High Voltage Mesh Pole)	High Voltage Round Pole	% (High Voltage Round Pole)	Low Voltage Mesh Pole	% (Low Voltage Mesh Pole)	Low Voltage Round Pole	% (Low Voltage Round Pole)
First	1078	59.5	1471	53.3	1165	49.9	2703	53.7
Third	734	40.5	1290	46.7	1172	50.1	2335	46.3
Total	1812	100	2761	100	2337		5038	100

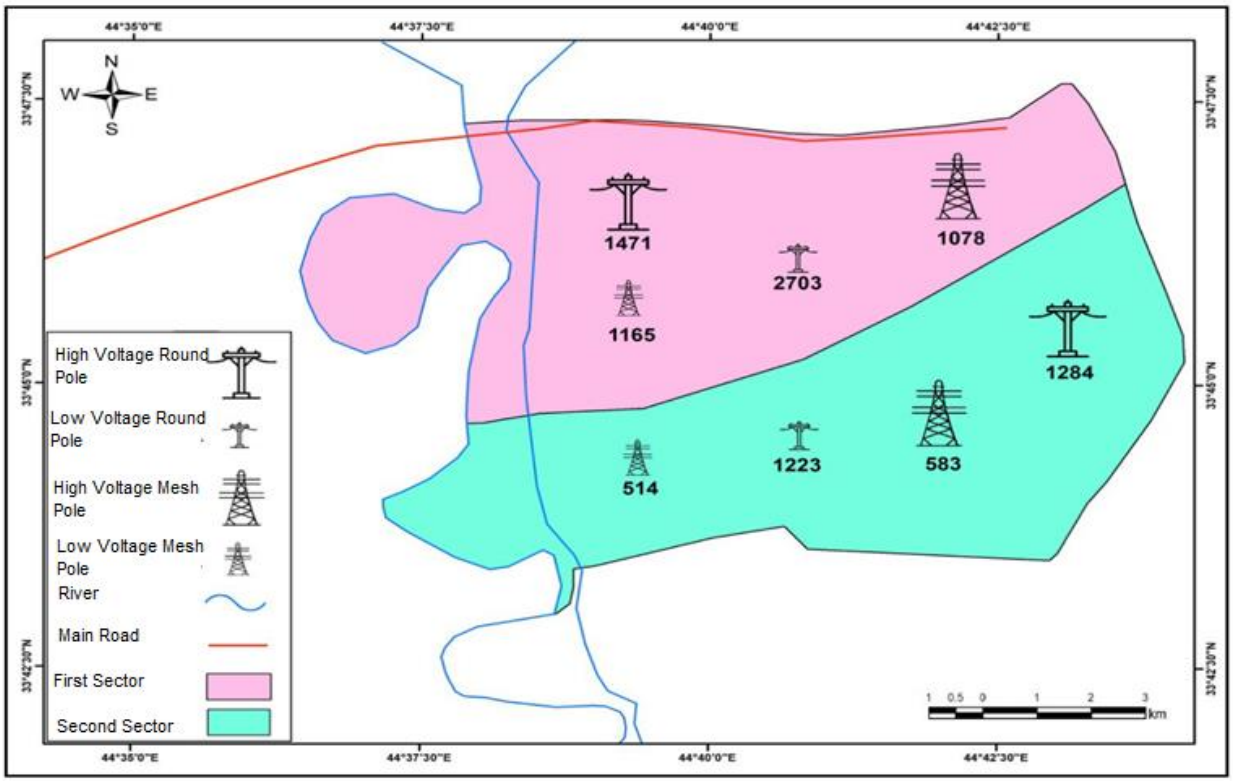

Figure 7.
Electricity poles in the eastern zone of Baqubah city.

3.3.1.1. Distribution and Spread of Wires in The Eastern Zone of Baqubah City

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Wire: A means of transmitting electrical energy from the producer to the consumer. Wire sizes, types, and methods of use vary. Some wires are high-voltage, capable of handling high voltages of up to 400,000 volts, while others are low-voltage, transmitting electrical energy within neighborhoods and cities ().

There are three types of wires and cables used in the transmission and distribution of electrical energy in the eastern region.

High-voltage feeders and wires: They transmit electrical energy at a voltage of 11/33 kV. Their total length is 501,870 meters in this region, including 232,740 meters in the first sector, representing 46.4% of the total length of high-voltage feeders in this region. Their total length is 269,130 meters in the third sector, representing 53.6% of the total length in this region [14].

Low-voltage wires: Electrical energy is transmitted within the city's neighborhoods and alleys with a voltage of 4.0 KV. Their total length in the eastern zone is (629,145 meters), including (269,970 meters) in the first sector, representing (42.9%) of their total length in the eastern zone. As for the third sector, their total length is (359,175 meters), representing (57.1%) of the total length of low-voltage wires in the eastern zone. 3- The pigtail antenna (low voltage): It transmits electrical energy in the city's neighborhoods and alleys with a voltage of 4.0 KV [16]. Its total length in the eastern zone reached (81,395 meters), of which (36,315 meters) in the first sector, representing (44.6%) of its total length in the eastern zone. Its total length in the third sector reached (45,080 meters), representing (55.4%) of its total length in the eastern zone. As shown in Table 5 and Figure 8.

Table 5.
The electrical wiring in the eastern sector of Baqubah.

Sector Number	High Voltage Wires (meters)	% (High Voltage Wires)	Low Voltage Wires (meters)	% (Low Voltage Wires)	Low Voltage Aerial Bundle Cable (meters)	% (Low Voltage Aerial Bundle Cable)
First Sector	232740	46.4	269970	42.9	36315	44.6
Third Sector	269130	53.6	359175	57.1	45080	55.4
Total	501870	100	629145	100	81395	100

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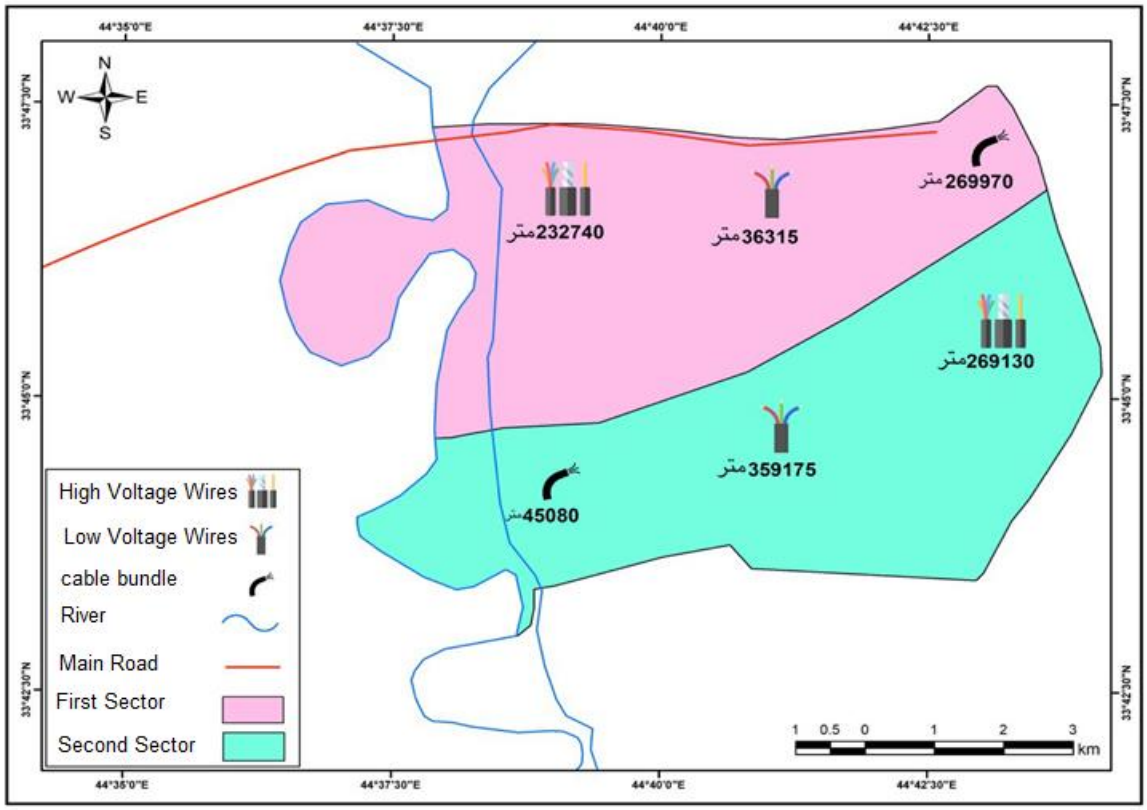

Figure 8.
Electrical wires in the eastern zone of Baqubah city.

3.3.1.2. Electrical Transformers in the Eastern Part of Baqubah:

The transformer is a device that works to lower or raise the electrical voltage with an opposite change in the voltage and current in the two circuits. It transfers electrical energy from one circuit to another without a change in frequency, which means a reduction in voltage is accompanied by an increase in current, and vice versa [10]. Voltage-reducing transformers are used in the distribution network to convert medium-voltage electrical energy into low-voltage energy suitable for use by consumers. Their number in the eastern part reached 970 transformers, and these transformers vary in size [14]. The number of 100-amp transformers in the first sector and 4 transformers in the third sector, while the number of 250-amp transformers is 134 in the first sector and 109 in the third sector, while the number of 400-amp transformers is 464 in the first sector and 225 in the third sector, and the number of 635-amp transformers is 7. (Transformer) in the first sector and (11 transformers) in the third sector. The number of transformers with a capacity of (1000 amperes) in the first sector is (4) and in the third sector is (3). See Table 6 and Figure 9.

Table 6.
Numbers and types of electrical transformers in the eastern part of the city of Baqubah.

Eastern Zone	Sector Number	Size/100	Size/250	Size/315	Size/400	Size/630	Size/1000
First	9	134		464	7	4	
Third	4	109		225	11	3	
Total	13	243		889	18	7	

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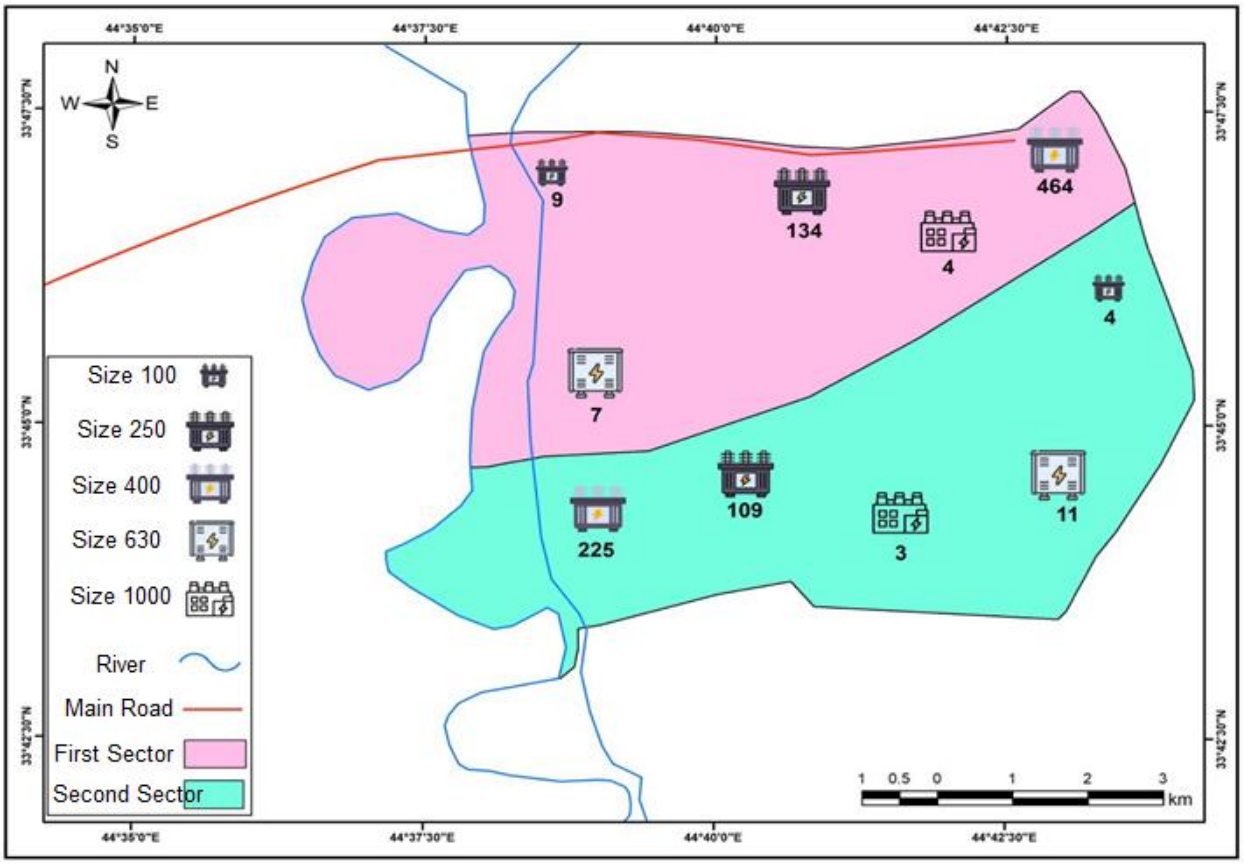

Figure 9.
Electrical Transformers in the Eastern Zone of Baqubah City.

3.3.2. The Western Zone of Baqubah

The electrical network in the western zone of Baqubah consists of similar physical requirements to the eastern zone of Baqubah, namely (poles, wires, and transformers) [15]. However, their size and number differ, reflecting the western zone's larger area than the eastern zone, its larger population, and the concentration of certain human activities in this zone, such as industries, government departments, hospitals, and higher education, represented by private universities and colleges. As previously mentioned, the electrical network in this zone is divided into (poles, wires, and transformers).

3.3.2.1. Columns in the Western Zone

Columns are divided into high-pressure columns, towers, and low-pressure columns. There are also two types of columns: round columns and lattice columns. The number of round high-pressure columns in this zone reached (6439) columns, including (1284) columns in the second sector, representing (19.9%) of the total number of columns in the western zone, and (5155) columns in the fourth sector, representing (80.1%) of the total number of columns in the western zone. The number of lattice high-pressure columns in this zone reached (2016) columns, including (1433) columns in the second sector, representing (28.9%) of the total number of lattice high-pressure columns in the western zone. As for the fourth sector, the number of columns reached (583) columns, representing (71.1%) of the total number of lattice high-pressure columns in the western zone, as these columns carry pressure wires. High voltage poles extend over long distances and are of high voltage (33/11 kV). These poles are characterized by being longer and stronger than low voltage poles and are found on the outskirts of cities and along main streets [13]. The low-pressure poles are also divided into two types: the poles are

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meshed and the others are round and carry wires with a low voltage of 4.0 kV and are shorter than the high-pressure poles and are distributed within the neighborhoods and alleys of the city. The number of round low-pressure poles in this area reached (12,782) poles, including (1,223) poles in the second sector, representing (9.6%) of the total number of round low-pressure poles for the western area. The number of round low-pressure poles in the fourth sector reached (11,009) poles, representing (90.4%) of the total number of round low-pressure poles in this area. The number of meshed low-pressure poles in this area reached (7,372) poles, including (514) poles in the second sector, representing (11.8%) of the total number of poles in this area. As for the fourth sector, the number of meshed low-pressure poles reached (3858) columns, representing (88.2%) of the total number of columns for low-pressure clamps in this range. See Table 7 and Figure 10.

Table 7.
Electricity Poles in the Western Zone of Baqubah City.

Western Zone	Sector Name	High Voltage Mesh Pole	% (High Voltage Mesh Pole)	High Voltage Round Pole	% (High Voltage Round Pole)	Low Voltage Mesh Pole	% (Low Voltage Mesh Pole)	Low Voltage Round Pole	% (Low Voltage Round Pole)
Second	583	28.9	1284	19.9	514	11.8	1223	9.6	
Fourth	1433	71.1	5155	80.1	3858	88.2	11559	90.4	
Total	2016	100	6439	100	4372	100	12782	100	

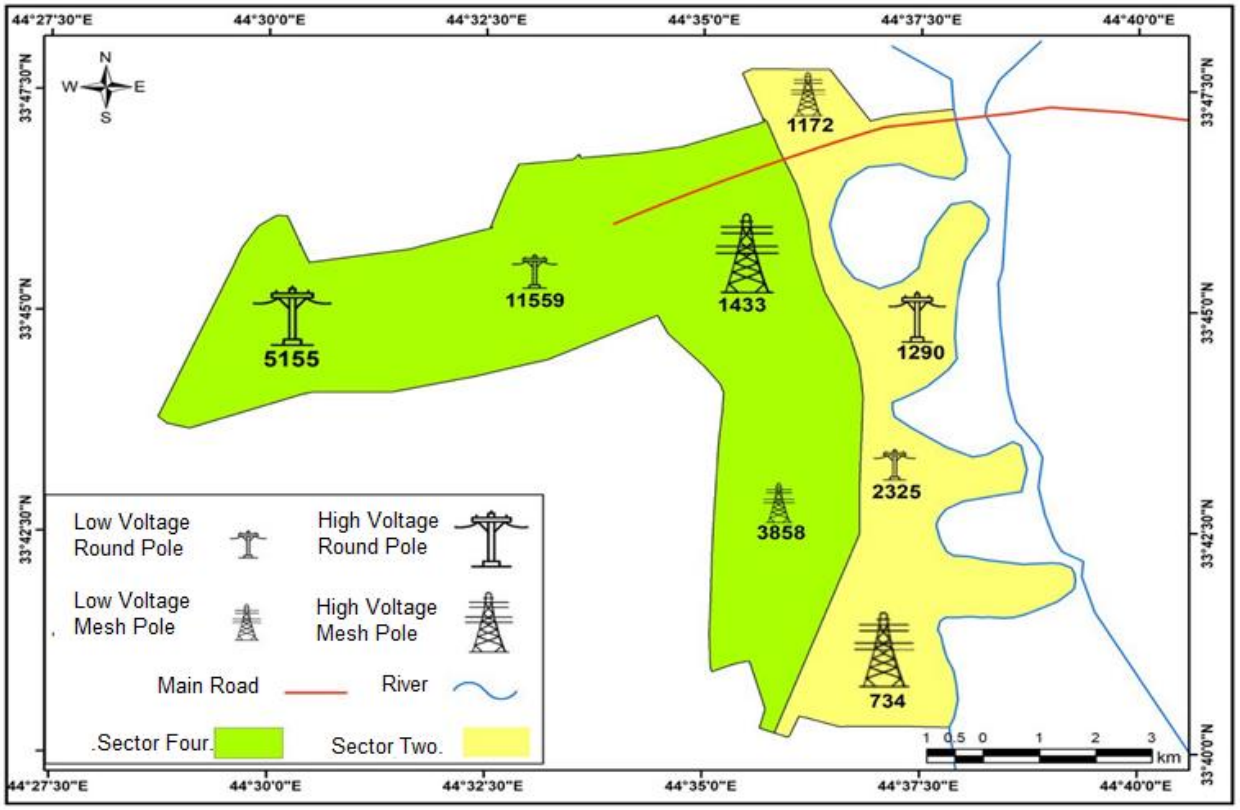

Figure 10.
Electricity Poles in the Western Zone of Baqubah City.

3.3.2.2. Distribution and Spread of Wires in the Western Zone of Baqubah City.

The wires used to transmit and distribute electrical energy in the western region are divided into three types. These types differ in size, type, and function. Some are high-voltage, transmitting electrical

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energy at 400,000 volts, while others are low-voltage, transmitting electrical energy within neighborhoods and cities. See Table 8 and figure 11. These types are:

1: High-voltage feeders and wires: These have a voltage of 33/11, and their total length in the western region is 768,379 meters, divided into two sectors: the second and fourth. The total length in the second sector is 150,661 meters, representing 19.6% of the total length of the high-voltage feeders in this region. In the fourth sector, their length is 617,718 meters, representing 80.4% of the total length in this region.

2: Pressure wires Low voltage cables: They transmit electrical energy at a voltage of 4.0 kV. Their total length in the western zone reached (1,825,765) meters. Their total length in the second sector reached (125,400) meters, representing (6.9%) of their total length in the western zone. As for the fourth sector, their total length reached (1,700,365) meters, representing (93.1%) of their total length in the western zone.

3: Low voltage overhead cables (pigtails): They are used to transmit electrical energy within the city's neighborhoods and alleys, at a voltage of 4.0 kV. They consist of several lines. Their total length in the western zone reached (95,903) meters, of which (70,920) meters are in the second sector, representing (73.9%) of their total length in the western zone. As for the fourth sector, their total length reached (24,983) meters, representing (26.1%) of their total length in the western zone .

Table 8.
Electrical Wires in the Western Zone of Baqubah City.

Sector Number	High Voltage Wires (meters)	% (High Voltage Wires)	Low Voltage Wires (meters)	% (Low Voltage Wires)	Low Voltage Aerial Bundle Cable (meters)	% (Low Voltage Aerial Bundle Cable)
Second	150661	19.6	125400	6.9	70920	73.9
Fourth	617718	80.4	1700365	93.1	24983	26.1
Total	768379	100	1825765	100	95973	100

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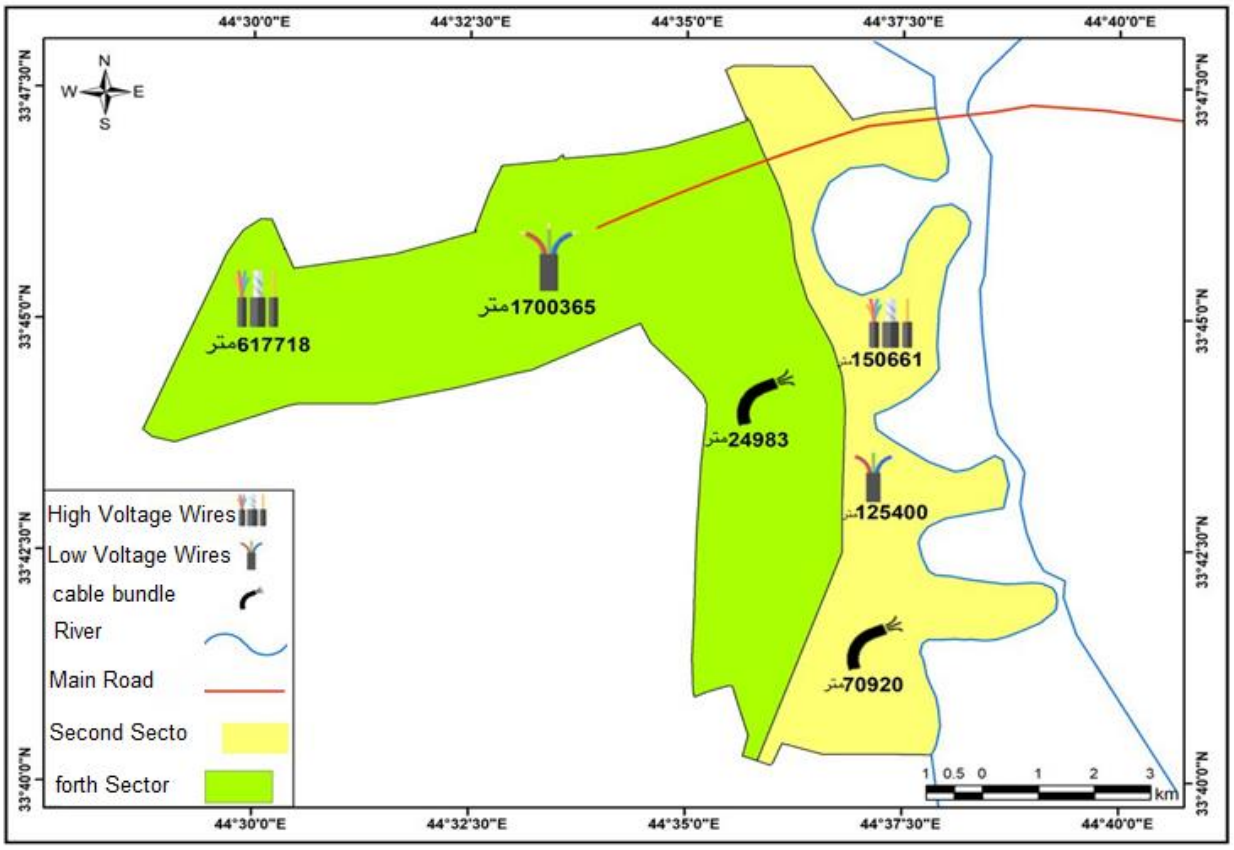

Figure 11.
Electrical Wires in the Western Zone of Baqubah City.

3.3.2.3. Transformers in the Western Area of Baqubah City

Their number in the western area reached (1465 transformers) and they are divided into different sizes. The number of transformers with a capacity of (100 amps) (Figure (12) reached (36 transformers) in this area, including (19 transformers) in the second sector, and (17 transformers) in the fourth sector. As for the transformers with a capacity of (250 amps) (Figure (2-13), their number in the western area reached (511 transformers) distributed over two sectors (1094 transformers) in the second sector, and (317 transformers) in the fourth sector. The transformers with a capacity of (315 amps) numbered (5) transformers in the western area and are only found in the second sector. The transformers with a capacity of (400 amps) (Figure (2-14) numbered (707 transformers) in the western area, including (205 transformers) in the second sector, and in the fourth sector their number reached (502 transformers). The number of transformers with a capacity of (630 transformers) (Figure (12) is (124 transformers) in the second sector, and (22 transformers) in the fourth sector. The number of transformers with a capacity of (1000 amps) (Figure (2-16) is (20 transformers) in the second sector and (52 transformers) in the fourth sector. The large transformers with a capacity of (2000 amps) are only present in the second sector and their number is (5 transformers). See Table 9 and Figure 12.

Table 9.
Numbers and types of electrical transformers in the western area of Baqubah city.

Eastern Zone	Sector Number	Size/100	Size/250	Size/315	Size/400	Size/630	Size/1000	Size/2000
	Second	19	1094	5	205	124	20	5
	Fourth	17	317		502	22	52	
Total	13	13	243		889	18	7	

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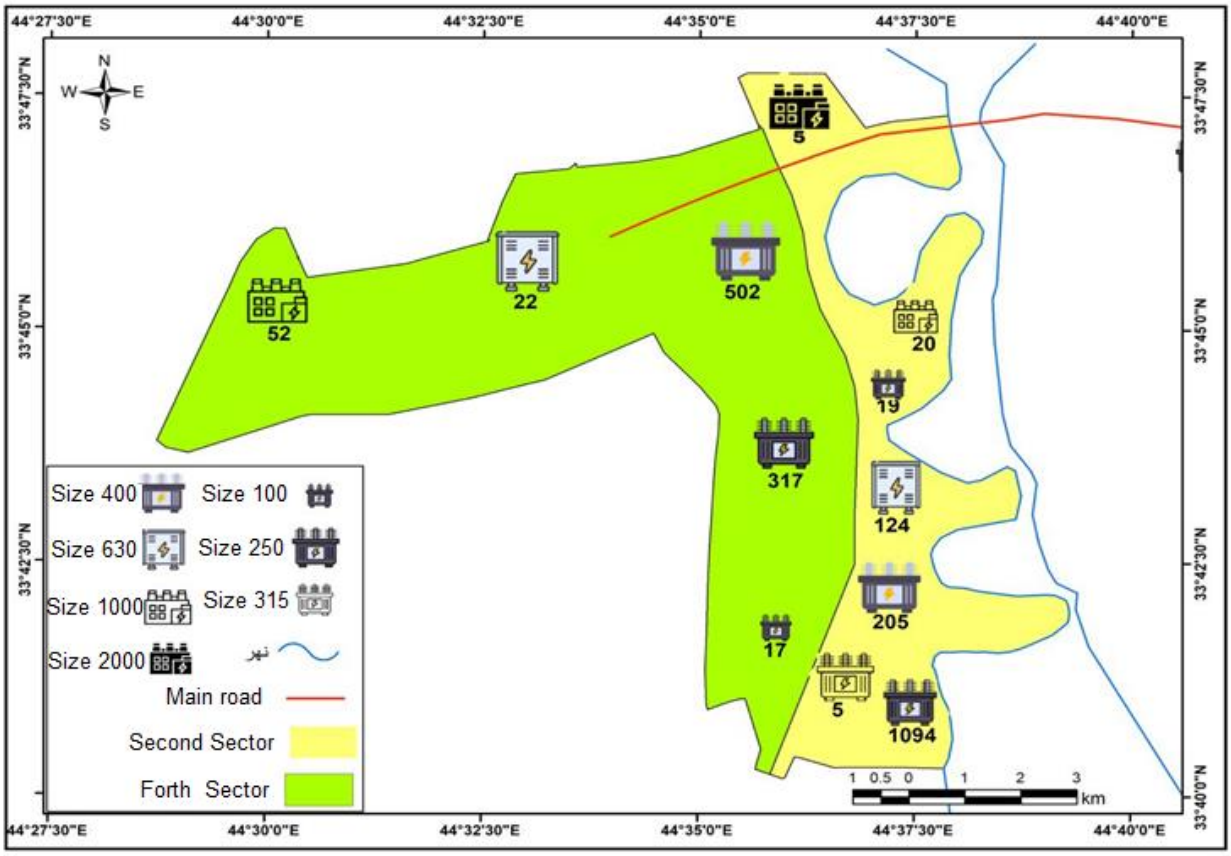

Figure 12.
Electrical Transformers in the Western Zone of Baqubah City.

This distribution of the electrical grid shows that the city is served by two systems: virtual and underground. The traditional virtual network covers the entire city of Baqubah, while the underground network is only in New Baqubah. These networks supply electricity from outside the city.

It has been shown that these networks contribute to supplying electricity to all sectors of the city, which are distributed across various land uses, with residential use accounting for more than 40%.

4. Conclusions

The study showed that the electrical power transmission network within Baqubah needs to be reorganized in some sectors, such as the primary sector, and to address the waste in supplied energy due to the outdated electrical grid system in most sectors of Baqubah, which contributes to the lack of control over consumption. Furthermore, the presence of informal settlements was one of the reasons for the shortage and inadequacy of the electrical power supplied to the city.

5. Recommendations

1. Reconsidering the traditional electricity system in the old neighborhoods and connecting it underground, similar to Baqubah-Aljadidah, to reduce waste.
2. Providing the electricity deficit by achieving justice in supplying the city with electricity at the hours stipulated by law.

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Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

References

[1] GE Power, *GER-3620P: Heavy-duty gas turbine operating and maintenance considerations*. Atlanta, GA: GE Power, 2021.

[2] I. Siemens Industry, *Basics of electricity: A quickSTEP online course – 150 years of the dynamo-electric principle*. Germany: Siemens AG, 2016.

[3] J. D. Glover, T. J. Overbye, and M. S. Sarma, *Power system analysis and design*, 6th ed. Boston, MA, USA: Cengage Learning, 2017.

[4] Louisiana Department of Transportation and Development Louisiana Transportation Research Center Technology Transfer and Training, *Understanding basic electricity and electronics*. Baton Rouge, LA, USA: LaDOTD, 2018.

[5] H. S. Ali Arzani, "Utilizing renewable energy for sustainable development in the Middle Euphrates governorates of Iraq: A study in energy geography," Master's Thesis, University of Baghdad, College of Arts, 2023.

[6] H. N. S. Al-Jabari, "Applications of renewable energy: Solar and wind energy in the Southern Governorates of Iraq: A study in energy geography," Master's Thesis, University of Basrah, College of Arts, 2012.

[7] A. R. F. Al-Zarkani, "Analysis of the spatial signature efficiency of the Al-Haidariya and New Najaf electric power stations," Master's Thesis, University of Karbala, College of Education for Humanities, 2022.

[8] Y. M. M. Darjal, "Spatial modeling of efficiency and localization of electric power stations in Baghdad Governorate," Doctoral Dissertation, Al-Nahrain University, College of Arts, 2024.

[9] Z. J. F. Al-Zarkani, "The reality of electric power production in Iraq and the potential for utilizing renewable energy," PhD Dissertation, University of Qadisiyah, College of Arts, 2022.

[10] R. A. R. Al-Sherefi, "Geographical distribution of electric power production and consumption in Iraq," PhD Dissertation, University of Basrah, College of Arts, 2013.

[11] F. A. Al-Taee, "Spatial analysis of electric power production, transmission, and consumption in the Middle Euphrates Governorates of Iraq," PhD Dissertation, University of Kufa, College of Arts, 2017.

[12] M. J. H. Al-Taee, "Electric power production and consumption in Diyala governorate," PhD Dissertation, University of Diyala, College of Education for Humanities, 2019.

[13] Z. A. A. Al-Attar, "Global climate change and the use of renewable energy to mitigate its impacts," Master's Thesis, University of Kufa, College of Education for Girls, 2011.

[14] H. K. D. Al-Quraishi, "Electric power industry in Baghdad Governorate: A study in industrial geography," Master's Thesis, University of Baghdad, College of Arts, 2009.

[15] M. S. Al-Kanani, "Electric power production and consumption in the southern region of Iraq," PhD Dissertation, University of Baghdad, College of Arts, 2010.

[16] T. Gonen, *Modern power system analysis*. London: Taylor & Francis Group, 2014.