



Review Article

Survey and analysis of the quantitative methods used in electricity research on GCC countries: 1983–2018

Mohammed A. AlKhars^{*}

KFUPM Business School, Department of Information Systems and Operations Management, KFUPM, Box 5076, Dhahran 31261, Saudi Arabia

Energy; Energy economics; Renewable energy resources; Energy sustainability; Energy conservation; Urban energy consumption; Electricity; Demand and supply; Literature review; GCC; Analysis tools; Renewable energy

ARTICLE INFO

Keywords:

Energy
Energy economics
Renewable energy resources
Energy sustainability
Energy conservation
Urban energy consumption
Electricity
Demand and supply
Literature review
GCC
Analysis tools
Renewable energy

ABSTRACT

This study provides a systematic analysis of research on the electricity sector in Gulf Cooperation Council (GCC) countries in the period 1983–2018. GCC countries have experienced tremendous economic growth in the past few decades. This was accompanied by a corresponding increase in electricity consumption. Therefore, a thorough review is needed to understand the research conducted on the electricity sector in GCC countries. This study reviewed articles published in five well-known energy journals: *Applied Energy*, *Energy*, *Energy Economics*, *Energy Policy*, and *Renewable and Sustainable Energy Reviews*. The articles were classified into seven categories based on the analysis tools implemented in the papers: 1. Simulation tools, 2. Scenarios tools, 3. Equilibrium tools, 4. Top-down tools, 5. Bottom-up tools, 6. Operations optimization tools, and 7. Investment optimization tools. This study also provides an overview of the research, including the increase in publications over time, an authorship analysis, a keywords analysis, and an analysis of the length of the publications.

1. Introduction

Gulf Cooperation Council (GCC) countries have experienced tremendous economic growth during the last four decades. This economic growth was accompanied by corresponding growth in electricity demand and supply. The average growth rate of electricity consumption per capita for GCC countries in the period 1971–2012 is 6.2% (Osman et al., 2016). Because of this marked increase in electricity demand and the expensive nature of investment in the electricity sector, several academic research papers have been published that address various aspects of demand and supply in GCC countries. This study aims to provide a synthesis of the research published in five well-known energy journals. These journals are *Applied Energy*, *Energy*, *Energy Economics*, *Energy Policy*, and *Renewable and Sustainable Energy Reviews (RSEr)*. To the best of the author's knowledge, this is the first study to provide a bibliographic analysis of current electricity supply and demand research in GCC countries. The author hopes that this literature review will provide researchers with a comprehensive understanding of electricity supply and demand issues in GCC countries. This review may also help these

researchers to investigate important areas not yet explored. The author has attempted to include all publications pertaining to the supply and demand of electricity in GCC countries. However, there is no guarantee that all papers are included or identified. If any paper was published in the five aforementioned journals and not included in this research, please feel free to contact the author.

2. Main text

2.1. Methodology

Literature reviews on published research in a specific scientific domain is critical for gaining a deeper understanding of the relevant issues and problems of the research area. For example, Emrouznejad and Yang (2018) provided a comprehensive list of published articles that used Data Envelopment Analysis (DEA) as an analysis tool. In the energy domain, Pfenninger et al. (2014) reviewed energy systems modeling for twenty-first century energy challenges. They grouped the models into four categories: energy systems optimization models, energy systems

^{*} Corresponding author.

E-mail address: malkhars@kfupm.edu.sa.

Table 1

List of journals used for the literature review.

Journal Name	Impact Indicators		
	Quartile	5-year Impact Factor	SJR
Applied Energy	Q1	7.888	3.162
Energy	Q1	5.582	1.990
Energy Economics	Q1	4.963	1.916
Energy Policy	Q1	5.038	1.994
RSER	Q1	10.093	3.036

simulation models, power systems and electricity market models, and qualitative and mixed-methods scenarios. [Jebaraj and Iniyan \(2006\)](#) also provided a review of energy models. They discussed various energy models such as energy planning models, energy supply–demand models, forecasting models, renewable energy models, emission reduction models, optimization models, and models based on neural network and fuzzy theory. Additionally, [Payne \(2010\)](#) reviewed literature specifically related to the causal relationship between electricity consumption and economic growth. Finally, [Connolly et al. \(2010\)](#) reviewed the computer tools used to analyze the integration of renewable energy. They classified these tools into seven categories: 1. Simulation tools, 2. Scenarios tools, 3. Equilibrium tools, 4. Top-down tools, 5. Bottom-up tools, 6. Operations optimization tools, and 7. Investment optimization tools. This review followed the work of Connolly et al. and used this method to classify the research on GCC electricity systems. The review will assist both researchers and decision makers by increasing their awareness of existing research in the electricity sector in GCC countries and to focus future research on important areas that have received less attention in the past years.

The literature review implemented in this paper focuses on studies published in top tier journals on energy research. The five journals selected for this purpose are *Applied Energy*, *Energy*, *Energy Economics*, *Energy Policy*, and *RSER*. These journals were selected to ensure that high quality papers are considered in this analysis of the electricity sector in GCC countries. All of these journals are published by Elsevier and are considered to be Q1 (a journal ranking based on quartile scores and impact factor) journals. [Table 1](#) provides the impact indicators of the five journals using the H-index and the Scimago Journal Rank (SJR).

The author used the following seven keywords to search for relevant articles: Saudi Arabia, United Arab Emirates, Oman, Bahrain, Qatar, Kuwait, and GCC. Only articles related to the supply or demand of electricity were used in the analysis. Other articles related to other fields—such as analysis of weather data, materials, or the production of oil and gas—were excluded from the analysis. This process was conducted for each of the five journals, and a total of 206 articles were found. The detailed distribution of this number among the five journals and among the different GCC countries is shown in [Table 2](#).

RSER published 76 articles, the highest number of articles, representing 37% of the total number of articles included in this review. This is followed by *Applied Energy* with a percentage of 25%. Moreover, 74 articles were published about the electricity system in Saudi Arabia, representing 36%, followed by the UAE with 18%.

The next section presents the descriptive statistics, including the analytical tools used, yearly publication, number of authors, keywords

used, and page numbers of articles.

2.2. An overview of GCC electricity literature

2.2.1. Overview of analytical tools used

As mentioned earlier, [Connolly et al. \(2010\)](#) classified the computer tools used to analyze the integration of renewable energy into seven categories. These seven categories are:

1. Simulation tools: These tools simulate the operation of the energy system in question to supply a set of energy demands.
2. Scenario tools: These usually combine a series of years or period into a long-term scenario.
3. Equilibrium tools: These aim to explain the behavior of supply, demand, and prices in an economy or in part of an economy (general or partial) with several markets.
4. Top-down tools: These are macroeconomic tools using general macroeconomic data to determine growth in energy prices and demands.
5. Bottom-up tools: These tools identify and analyze specific energy technologies and thereby identify investment options and alternatives.
6. Operation optimization tools: These tools optimize the operation of the energy system being studied.
7. Investment optimization tools: Lastly, these tools aim to optimize investments in an energy system.

The 206 articles considered in this literature review were classified using this categorization. [Table 3](#) shows the categorization of the articles according to the analysis tools.

2.2.2. Temporal analysis of published research

[Fig. 1](#) shows the increase in the number of articles on GCC electricity systems published from 1983 to 2018. There has clearly been an increase in the number of publications on the topic in recent years. There are three periods in the study period. The first period includes the years from 1983 to 2008. During this period, the minimum number of articles per year is zero and the maximum is four, with an average of approximately two articles per year. The second period goes from 2009 to 2015. The average number of articles is about 12, with a minimum of nine articles and a maximum of 15 articles per year. The third period is from 2016 to 2018. This period has a large number of publications, averaging 24 articles per year. The minimum is 11 articles, and the maximum is 31 articles published in 2017.

The increasing trend in the number of published articles concerning electricity in GCC countries matches the increasing trend of scientific publications in other fields. [Bornmann and Mutz \(2015\)](#) reviewed scientific publications from 1980 to 2012 using Web of Science (WoS) databases. They found that the global number of scientific publications experienced exponential growth, with an average annual increase of approximately 3%. Similarly, [Sa'ed et al. \(2015\)](#) analyzed the research output of 22 Arab countries published in 22 international Integrative and Complementary Medicine (ICM) journals indexed in the WoS databases. They identified 591 publications in 19 of these journals. Their analysis also showed an increase in the number of annual publications. In the period 1980–1989 (10 years), there were 29 publications. The number

Table 2

Numbers of articles published by journals and the countries studied.

Journals/Country	Bahrain	GCC	Kuwait	Oman	Qatar	Saudi Arabia	UAE	Total	%
Applied Energy	7	2	8	6	0	16	13	52	25%
Energy	3	2	8	6	1	13	4	37	18%
Energy Economics	0	2	3	0	0	2	0	7	3%
Energy Policy	1	8	4	0	0	16	5	34	17%
RSER	2	12	5	13	2	27	15	76	37%
Total	13	26	28	25	3	74	37	206	100%
%	6%	13%	14%	12%	1%	36%	18%	100%	

Table 3

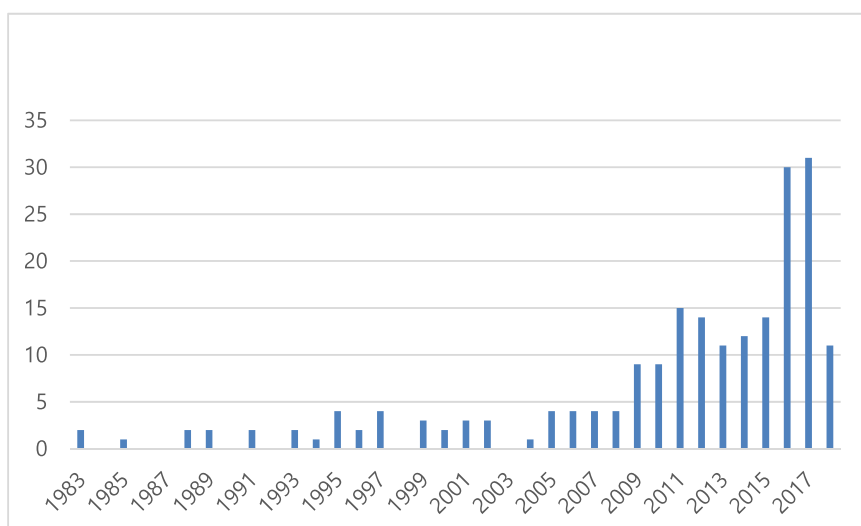
Breakdown of published articles by analytical tool used.

No	Analytical Tool	Articles
1	Bottom-Up	Al-Marafie (1988); Al Baharna and Al Mahdi (1991); Nasser and El-Kalay (1991); Alawaji et al., (1995); Alnaser (1999); Akbaba (1999); Alajlan (1999); Al Suleimani and Nair (2000); Al Suleimani and Rao (2000); Maheshwari et al., (2001); Alnatheer (2006); Rehman et al., (2007); Kazim (2007); Darwish et al., (2008); Jowder (2009); Al-Badi et al., (2009a,b); Malik and Al-Badi (2009); Albadi et al., (2009); Darwish et al., (2010); Charabi and Gastli (2010); Gastli et al., (2010); Gastli and Charabi (2010); Sultan et al., (2010); Reiche (2010); Siddiqi and Anadon (2011); Alnaser and Alnaser (2011); Alotaibi (2011); Kazem (2011); Al-Badi et al. (2011a); Redha et al., (2011); Al-Badi and Albadi (2012); Rehman and El-Amin (2012); Rehman and Sahin (2012); Rahman and Khondaker (2012); Rahman et al., (2012); Al-Alili et al. (2012b); Popli et al., (2012); Mezher et al., (2012); Malik and Bouzguenda (2013); Abdul-Majeed et al., (2013); Hussein et al., (2013); Al-Amir and Abu-Hijleh (2013); Mokri et al., (2013); Chandrasekharam and Aref (2014); Ghaffour et al., (2014); Lashin and Al Arifi (2014); Abdmouleh et al., (2015); Baseer et al., (2015); Mondal et al., (2016); Ouda et al., (2016); Paleologos et al., (2016); Khondaker et al., (2016); Kumar et al., (2016); Jamil et al., (2016); Juaidi et al. (2016a); Gherboudj and Ghedira (2016); Mohan et al., (2016); Al-Maamary et al., (2017a,b); Bou-Rabee et al., (2017); Nizami et al., (2017); Khan et al., (2017); Ramli et al., (2017); Mokheimer et al., (2017); Kouta et al., (2017); Alnaser (2018); Alnaser et al., (2018); Alsayegh et al., (2018); Almarshoud and Adam (2018)
2	Equilibrium	Ayyash et al., (1983); Ayyash (1983); Ayyash and Hammoudeh (1985); Al-Marafie et al., (1989); Kellow (1989); Al-Hinai et al., (1993); Burney and Al-Matrouk (1996); Dincer et al., (2004); Dincer et al., (2005); Eissa (2011); BuShehri and Wohlgenant (2012); Ahmad and Ramana (2014); Mondal et al., (2014); Matar et al., (2015); Juaidi et al. (2016b); Groissböck and Pickl (2016); Allasseri et al., (2017); Matar and Anwer (2017); Matar et al., (2017)
3	Investment	Alnatheer (2005); Al-Muhawesh and Qamber (2008); Farnoosh et al., (2014); Jayaraman et al., (2015); Almansoori and Betancourt-Torcat (2015); Jayaraman et al., (2017); Alshammari and Sarathy (2017); Baseer et al., (2017); Al Garni and Awasthi (2017); Parkinson et al., (2018)
4	Operational Optimization	Abdel-Aal and Al-Garni (1997); Badri et al., (1997); Ramanathan (2005); Al-Iriani (2005); Malik and Al-Zubeidi (2006); Malik (2007); Al-Sanea and Zedan (2008); AlRashidi and El-Naggar (2010); Al-Sanea and Zedan (2011); Shams et al., (2016); Atif and Al-Sulaiman (2017); Saghaififar and Gadalla (2017);
5	Scenario	Alnaser (1995); Al-Ismaïly and Probert (1996); Al-Ismaïly and Probert (1997); Al-Ajlan et al., (2006); Wood and Alsayegh (2014); Asif (2016); Treyer and Bauer (2016); Sgouridis et al., (2016); Matar (2018);
6	Simulation	Gari et al., (1988); Abdelrahman et al., (1993); Maheshwari and Al-Murad (2001); Alawaji (2001); Omar and Al-Ragom (2002); Radhi et al., (2009); Radhi (2009); Shaahid and El-Amin (2009); Rehman and Al-Hadhrani (2010); Radhi (2011); Krarti and Hajiah (2011); Gastli and Charabi (2011); Charabi et al., (2011); Taleb and Sharples (2011); Al-Sanea et al., (2012); Radhi (2012); Al-Masri and Abu-Hijleh (2012); Al-Alili et al. (2012a); AlFarra and Abu-Hijleh (2012); El Fadel et al., (2013); Shaahid et al., (2013); Shaahid et al., (2014); Aldossary et al., (2014); Rohani and Nour (2014); Krarti (2015); Al-Yahyai and Charabi (2015); Kharseh et al., (2015); Alrashed and Asif (2015); Mokheimer et al., (2015); Saghaififar and Gadalla (2015); AlAjmi et al., (2016); Al Busaidi et al., (2016); Mujeebu et al., (2016); Almarshoud (2016); Kaddoura et al., (2016); Al-Ugla et al., (2016); Abd-ur-Rehman and Al-Sulaiman (2016); Azar et al., (2016); De Wolf et al., (2017); Martín-Pomares et al., (2017); Rashwan et al., (2017); Rehman et al., (2017); Krarti et al., (2017); Kassem et al., (2017); Al-Sharafi et al., (2017); Rehman (2017); Gelan (2018a,b); Krarti and Dubey (2018);
7	Top-Down	Al-Garni et al., (1994); Al-Ismaïly and Probert (1995); Nizami and Al-Garni (1995); Abdel-Aal et al. (1997); Al-Faris (2002); Ben-Nakhi and Mahmoud (2002); Al-Iriani (2006); Squalli (2007); Rehman and Mohandes (2008); El-Sebaï et al., (2009); Mahmoud and Alajmi (2010); Ozturk and Acaravci (2011); Al-Badi et al. (2011b); Radhi and Sharples (2013); Al-Mulali and Tang (2013); Alkhathlan and Javid (2013); Mansouri et al., (2013); Al-Mulali and Ozturk (2014); Salahuddin and Gow (2014); Salahuddin et al. (2015); Jammazi and Aloui (2015); Alshehry and Belloumi (2015); Boräng et al., 2016; Sweidan and Alwakid (2016); Atalla and Hunt (2016); Osman et al., (2016); Hussain and Al-Alili (2016); Ghazal et al., (2016); Charfeddine and Khediri (2016); Bekhet et al., (2017); Hasanov et al., (2017); Mezghani and Haddad (2017); Mahalik et al., (2017); Hussain and AlAlili (2017); Azar and Al Ansari (2017); Salahuddin et al., (2018); Charfeddine et al., (2018)

increased to 82 publications in the period 1990–1999. From the year 2000, the number of publications was presented on a yearly basis. In 2000, there were 25 publications. This number increased annually and reached 66 publications in 2013. In another study, [Tadmouri and Tadmouri \(2002\)](#) analyzed biomedical research in the Kingdom of Saudi Arabia during the period 1982–2000. They used the Science Citation Index (SCI) and PubMed databases and found 5,962 articles. The first

article was published in 1982 and it was the only publication in that year. The number of publications increased annually, reaching 508 in the year 2000.

The general increase of scientific publications can be attributed to three reasons. The first reason is the global increase in the number of scientists. The second is the increasing number of scientific discoveries worth communicating to peers and the public. The third is the

**Fig. 1.** Distribution of electricity articles from 1983 to 2018.

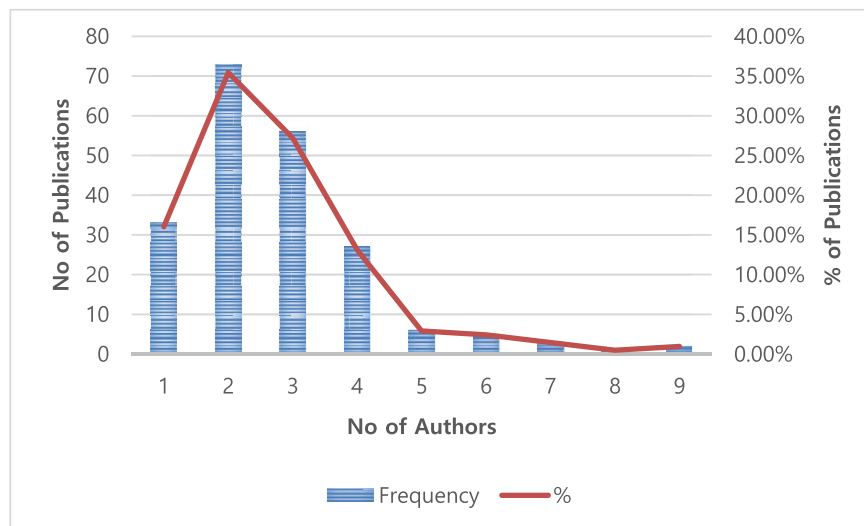


Fig. 2. Distribution of electricity-related articles by number of authors (1983–2018).

Table 4

The 50 most-used keywords in GCC electricity articles.

No	Keywords	Number of Articles
1	Renewable energy	32
2	Saudi Arabia, Saudi Arabia (KSA), Kingdom of Saudi Arabia	22
3	United Arab Emirates (UAE), United Arab Emirates, UAE	19
4	GCC, GCC countries, Gulf Cooperation Council, Gulf Corporation Countries	17
5	Energy consumption	16
6	Carbon dioxide emission, Carbon emission, Carbon emissions, CO2 emission, CO2 emissions	14
7	Solar electricity generation, Solar electricity, Solar energy, Solar Power	14
8	Oman	13
9	Economic growth, Economics growth	11
10	Energy conservation	10
11	Solar radiation	10
12	Wind energy, Wind power	9
13	Solar	9
14	Photovoltaic, PV	8
15	Demand management, Demand side management, DSM	7
16	Wind	7
17	Kuwait	6
18	Electric energy consumption, Electricity consumption	6
19	Buildings, Existing buildings	5
20	Geographic information system, GIS	5
21	Energy efficiency	5
22	Electricity generation	5
23	Electricity, Electric power	5
24	Wind speeds, Wind speed	5
25	Waste-to-energy (WTE), Waste-to-energy	4
26	Solar irradiance	4
27	CSP	4
28	Capacity factor	4
29	Energy	4
30	Environment	4
31	Financial development	4
32	GHG emissions, Greenhouse gas emissions	4
33	Multi-criteria analysis, Multi-criteria decision, Multi-criteria decision analysis	4
34	Subsidy, Subsidies	4
35	Greenhouse gases, Greenhouse gases, Greenhouse gas	4
36	Duqm	3
37	Diesel generators, Diesel-engine	3
38	Demand response	3
39	BiPV	3
40	Battery	3

Table 4 (continued)

No	Keywords	Number of Articles
41	Artificial neural networks, Artificial neural network	3
42	Abu Dhabi	3
43	Energy policies, Energy policy	3
44	Energy savings, Energy saving	3
45	Neural networks	3
46	Nuclear energy, Nuclear power	3
47	Optimization	3
48	Solar photovoltaic	3
49	TRNSYS	3
50	Wind turbine	3

administrative pressure of academic institutions on their members to publish (Pautasso, 2012). These three reasons can also be applied to the increase in studies in GCC countries, which have experienced marked economic and academic growth in the last four decades. One more plausible reason for the increase in scientific publication on electricity in GCC countries could be the improvement in means of communication, such as the use of the Internet to share scientific publications with peers all over the world.

2.2.3. Author statistics

Fig. 2 shows the frequency and percentage of authors of the articles considered in this study. A total of 33 articles (16.02%) were published by a single author, while two articles (0.97%) were published by nine authors, the maximum number of authors identified in this study. The average number of authors per article is 2.73. The highest number of articles (73) were published by two authors, which is the mode.

2.2.4. Keywords statistics

Most of the articles surveyed included keywords. Table 4 shows the top 50 keywords used in these articles. “Renewable energy” is the most-used keyword in the articles. This reflects the importance of considering renewable energy to supply electricity in GCC countries. The second most-used keyword is “Saudi Arabia,” which appeared in 22 articles, and the third is “United Arab Emirates,” followed by “GCC” and “Energy consumption.”

2.2.5. Statistics based on length of publications

Altogether, more than 2,300 pages have been published on GCC electricity issues in the five selected scientific journals. The number of pages per article ranges from five to 46 pages, with an average length of

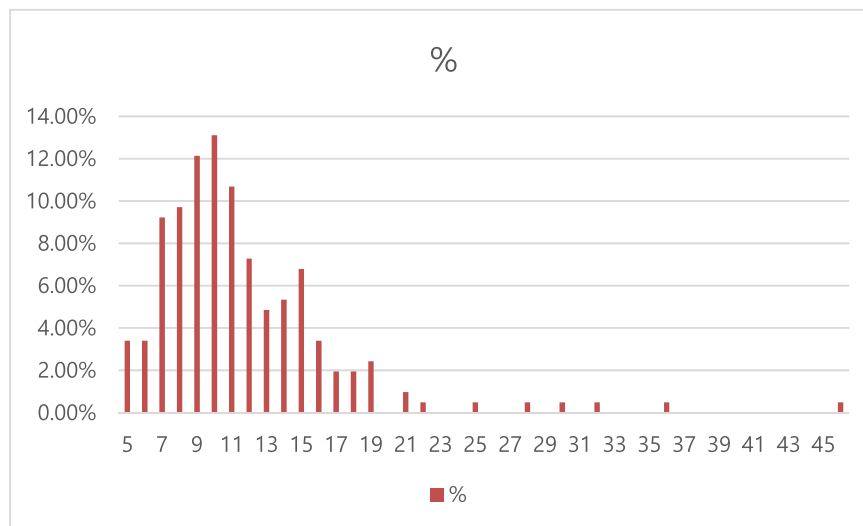


Fig. 3. Distribution of electricity-related articles by number of pages (1983–2018).

Table 5

The five most-used keywords in GCC electricity articles in the period 2016–2018.

No	Keywords	Number of Articles
1	Renewable energy	13
2	Saudi Arabia, Kingdom of Saudi Arabia	10
3	GCC countries, Gulf Cooperation Council, Gulf Corporation Countries	10
4	United Arab Emirates (UAE), United Arab Emirates, UAE	9
5	Energy consumption	9

approximately 11.6 pages per article. Approximately 36% of the articles are between nine and 11 pages in length and about 79% of the articles are between 7 and 15 pages. Fig. 3 shows the distribution of the GCC electricity articles according to the number of pages.

2.3. Current and future research

To evaluate researchers' current topics of interest concerning electricity in GCC countries, the keywords for the articles in the last three years (2016–2018) were analyzed. Table 5 shows the top five most used keywords in the surveyed articles. "Renewable energy" is the keyword that appears most often in the articles. This indicates that renewable energy is an emerging technology that GCC countries are seriously thinking of utilizing to provide electricity to their people. Moreover, "energy consumption" also appeared frequently, suggesting that high energy consumption puts pressure on GCC countries to meet the energy needs of the people.

3. Conclusion

This study conducted a systematic analysis of current published research on electricity supply and demand in GCC countries during the period 1983–2018. The scope of the review was limited to the following five well-known energy journals: Applied Energy, Energy, Energy Economics, Energy Policy, and Renewable and Sustainable Energy Reviews. First, the study showed that the number of publications were very small at the beginning of the period. However, the number increased from 2009 and in the last three years (2016–2018), there was an average number of publications of approximately 24 per year. Second, more than 63% of the articles were published by two or three researchers, indicating a trend toward collaborated research. Third, "renewable energy" and "energy consumption" were among the highest number of most-used

keywords in these studies, indicating the importance of renewable energy resources and controlling energy consumption in GCC countries.

This paper contributes to electricity literature in two distinctive ways. First, it shows how different electricity demand and supply issues in GCC countries are analyzed using the seven quantitative analytical tools classified by Connolly et al. (2010). The study found that the two most-used analytical tools are the bottom-up and simulation tools. The use of quantitative tools to analyze demand and supply is crucial because of the expensive nature of the electricity infrastructure and the need to analyze different scenarios by changing parameters. The second scientific contribution of this study is that it provides a comprehensive list of articles that addressed several issues in the electricity sector in GCC countries. This list can assist scientists and researchers in conducting further research. For example, a researcher may investigate the link between electricity consumption and economic growth in a specific country or in the GCC countries as a group. According to the literature, there are four hypotheses that can be tested concerning the nexus between electricity and economic growth: conservation, growth, feedback, and neutrality (Payne, 2010). Another possible area of research is the provision of demand forecasts for electricity consumption in GCC countries by considering the latest actions of energy conservation policies. Additionally, GCC countries are seriously thinking of using renewable resources such as solar electricity to provide energy to meet its growing demand. This study provides a list of the articles that researchers need to conduct their research in the above-mentioned areas as well as other possible research areas.

Declarations

Author contribution statement

Mohammed A. AlKhars: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Acknowledgements

I thank Dr. Stefano Cordiner, Associate Editor –Energy Heliyon Journal, for handling the peer review process and providing constructive comments. I thank also the two anonymous reviewers for their comments which have improved the manuscript.

References

- Abdel-Aal, R.E., Al-Garni, A.Z., Al-Nassar, Y.N., 1997. Modelling and forecasting monthly electric energy consumption in eastern Saudi Arabia using abductive networks. *Energy* 22 (9), 911–921.
- Abdel-Aal, R.E., Al-Garni, A.Z., 1997. Forecasting monthly electric energy consumption in eastern Saudi Arabia using univariate time-series analysis. *Energy* 22 (11), 1059–1069.
- Abdelrahman, M.A., Said, S.A.M., Ahmad, A., 1993. A comparison of energy consumption and cost-effectiveness of four masonry materials in Saudi Arabia. *Energy* 18 (11), 1181–1186.
- Abdmouleh, Z., Alammari, R.A., Gastli, A., 2015. Recommendations on renewable energy policies for the GCC countries. *Renew. Sustain. Energy Rev.* 50, 1181–1191.
- Abdul-Majeed, M.A., Al-Hadhrani, L.M., Al-Soufi, K.Y., Ahmad, F., Rehman, S., 2013. Captive power generation in Saudi Arabia—overview and recommendations on policies. *Energy Policy* 62, 379–385.
- Abd-ur-Rehman, H.M., Al-Sulaiman, F.A., 2016. Optimum selection of solar water heating (SWH) systems based on their comparative techno-economic feasibility study for the domestic sector of Saudi Arabia. *Renew. Sustain. Energy Rev.* 62, 336–349.
- Ahmad, A., Ramana, M.V., 2014. Too costly to matter: economics of nuclear power for Saudi Arabia. *Energy* 69, 682–694.
- Akbaba, M., 1999. Energy conservation by using energy efficient electric motors. *Appl. Energy* 64 (1–4), 149–158.
- Alajlan, S.A., 1999. Photovoltaic grid-connection system as load-shaving tool in Riyadh, Saudi Arabia. *Appl. Energy* 63 (2), 91–99.
- Al-Ajlan, S.A., Al-Ibrahim, A.M., Abdulkhaleq, M., Alghamdi, F., 2006. Developing sustainable energy policies for electrical energy conservation in Saudi Arabia. *Energy Policy* 34 (13), 1556–1565.
- AlAjmi, A., Abou-Ziyan, H., Ghoneim, A., 2016. Achieving annual and monthly net-zero energy of existing building in hot climate. *Appl. Energy* 165, 511–521.
- Al-Alili, A., Hwang, Y., Rademacher, R., Kubo, I., 2012a. A high efficiency solar air conditioner using concentrating photovoltaic/thermal collectors. *Appl. Energy* 93, 138–147.
- Al-Alili, A., Islam, M.D., Kubo, I., Hwang, Y., Rademacher, R., 2012b. Modeling of a solar powered absorption cycle for Abu Dhabi. *Appl. Energy* 93, 160–167.
- Al-Amir, J., Abu-Hijleh, B., 2013. Strategies and policies from promoting the use of renewable energy resource in the UAE. *Renew. Sustain. Energy Rev.* 26, 660–667.
- Alasserri, R., Tripathi, A., Rao, T.J., Sreekanth, K.J., 2017. A review on implementation strategies for demand side management (DSM) in Kuwait through incentive-based demand response programs. *Renew. Sustain. Energy Rev.* 77, 617–635.
- Alawaji, S., Smiai, M.S., Rafique, S., Stafford, B., 1995. PV-powered water pumping and desalination plant for remote areas in Saudi Arabia. *Appl. Energy* 52 (2–3), 283–289.
- Alawaji, S.H., 2001. Evaluation of solar energy research and its applications in Saudi Arabia—20 years of experience. *Renew. Sustain. Energy Rev.* 5 (1), 59–77.
- Al-Badi, A.H., Albadi, M.H., 2012. Domestic solar water heating system in Oman: current status and future prospects. *Renew. Sustain. Energy Rev.* 16 (8), 5727–5731.
- Albadi, M.H., El-Saadany, E.F., Albadi, H.A., 2009. Wind to power a new city in Oman. *Energy* 34 (10), 1579–1586.
- Al-Badi, A., Malik, A., Al-Areimi, K., Al-Mamari, A., 2009a. Power sector of Oman—today and tomorrow. *Renew. Sustain. Energy Rev.* 13 (8), 2192–2196.
- Al-Badi, A.H., Malik, A., Gastli, A., 2009b. Assessment of renewable energy resources potential in Oman and identification of barrier to their significant utilization. *Renew. Sustain. Energy Rev.* 13 (9), 2734–2739.
- Al-Badi, A.H., Albadi, M.H., Al-Lawati, A.M., Malik, A.S., 2011a. Economic perspective of PV electricity in Oman. *Energy* 36 (1), 226–232.
- Al-Badi, A.H., Malik, A., Gastli, A., 2011b. Sustainable energy usage in Oman—opportunities and barriers. *Renew. Sustain. Energy Rev.* 15 (8), 3780–3788.
- Al Baharna, N.S., Al Mahdi, N.A., 1991. Energy savings at the Rifa'a power station with a combined-cycle system for water production. *Energy* 16 (4), 713–720.
- Al Busaidi, A.S., Kazem, H.A., Al-Badi, A.H., Khan, M.F., 2016. A review of optimum sizing of hybrid PV–Wind renewable energy systems in Oman. *Renew. Sustain. Energy Rev.* 53, 185–193.
- Aldossary, N.A., Rezgui, Y., Kwan, A., 2014. Domestic energy consumption patterns in a hot and humid climate: a multiple-case study analysis. *Appl. Energy* 114, 353–365.
- Al-Faris, A.R.F., 2002. The demand for electricity in the GCC countries. *Energy Policy* 30 (2), 117–124.
- AlFarra, H.J., Abu-Hijleh, B., 2012. The potential role of nuclear energy in mitigating CO₂ emissions in the United Arab Emirates. *Energy Policy* 42, 272–285.
- Al Garni, H.Z., Awasthi, A., 2017. Solar PV power plant site selection using a GIS-AHP based approach with application in Saudi Arabia. *Appl. Energy* 206, 1225–1240.
- Al-Garni, A.Z., Zubair, S.M., Nizami, J.S., 1994. A regression model for electric-energy-consumption forecasting in Eastern Saudi Arabia. *Energy* 19 (10), 1043–1049.
- Al-Hinai, H., Batty, W.J., Probert, S.D., 1993. Vernacular architecture of Oman: features that enhance thermal comfort achieved within buildings. *Appl. Energy* 44 (3), 233–258.
- Al-Irani, M.A., 2005. Climate-related electricity demand-side management in oil-exporting countries—the case of the United Arab Emirates. *Energy Policy* 33 (18), 2350–2360.
- Al-Irani, M.A., 2006. Energy–GDP relationship revisited: an example from GCC countries using panel causality. *Energy Policy* 34 (17), 3342–3350.
- Al-Ismaïly, H.A., Probert, S.D., 1996. Prospects for harnessing wind-power economically in the Sultanate of Oman. *Appl. Energy* 55 (2), 85–130.
- Al-Ismaïly, H.A., Probert, S.D., 1995. Solar-desalination prospects for the sultanate of Oman. *Appl. Energy* 52 (4), 341–368.
- Al-Ismaïly, H.A., Probert, D., 1997. Prospects for Omani coal. *Appl. Energy* 58 (2–3), 131–160.
- Alkhathlan, K., Javid, M., 2013. Energy consumption, carbon emissions and economic growth in Saudi Arabia: an aggregate and disaggregate analysis. *Energy Policy* 62, 1525–1532.
- Al-Maamary, H.M., Kazem, H.A., Chaichan, M.T., 2017a. Climate change: the game changer in the Gulf Cooperation Council region. *Renew. Sustain. Energy Rev.* 76, 555–576.
- Al-Maamary, H.M., Kazem, H.A., Chaichan, M.T., 2017b. The impact of oil price fluctuations on common renewable energies in GCC countries. *Renew. Sustain. Energy Rev.* 75, 989–1007.
- Almansoori, A., Betancourt-Torcat, A., 2015. Design optimization model for the integration of renewable and nuclear energy in the United Arab Emirates' power system. *Appl. Energy* 148, 234–251.
- Al-Marafie, A.M.R., 1988. Assessment and prospects for energy resources in Kuwait. *Energy* 13 (8), 647–656.
- Al-Marafie, A.M.R., Suri, R.K., Maheshwari, G.P., 1989. Energy and power management in air-conditioned buildings in Kuwait. *Energy* 14 (9), 557–562.
- Almarshoud, A.F., Adam, E., 2018. Towards VLS-PV deployment in Saudi Arabia: challenges, opportunities and recommendations. *Energy Policy* 114, 422–430.
- Almarshoud, A.F., 2016. Performance of solar resources in Saudi Arabia. *Renew. Sustain. Energy Rev.* 66, 694–701.
- Al-Masri, N., Abu-Hijleh, B., 2012. Courtyard housing in midrise buildings: an environmental assessment in hot-arid climate. *Renew. Sustain. Energy Rev.* 16 (4), 1892–1898.
- Al-Muhawesh, T.A., Qamber, I.S., 2008. The established mega watt linear programming-based optimal power flow model applied to the real power 56-bus system in eastern province of Saudi Arabia. *Energy* 33 (1), 12–21.
- Al-Mulali, U., Ozturk, I., 2014. Are energy conservation policies effective without harming economic growth in the Gulf Cooperation Council countries? *Renew. Sustain. Energy Rev.* 38, 639–650.
- Al-Mulali, U., Tang, C.F., 2013. Investigating the validity of pollution haven hypothesis in the gulf cooperation council (GCC) countries. *Energy Policy* 60, 813–819.
- Alnaser, N.W., 2018. First smart 8.64 kW BIPV in a building in Awali Town at Kingdom of Bahrain. *Renew. Sustain. Energy Rev.* 82, 205–214.
- Alnaser, N.W., Al Othman, M.J., Dakhel, A.A., Batarese, I., Lee, J.K., Najmali, S., et al., 2018. Comparison between performance of man-made and naturally cleaned PV panels in a middle of a desert. *Renew. Sustain. Energy Rev.* 82, 1048–1055.
- Alnaser, W.E., 1995. Renewable energy resources in the state of Bahrain. *Appl. Energy* 50 (1), 23–30.
- Alnaser, W.E., 1999. Mobile solar and wind-powered generator (MSWPG). *Appl. Energy* 64 (1–4), 97–105.
- Alnaser, W.E., Alnaser, N.W., 2011. The status of renewable energy in the GCC countries. *Renew. Sustain. Energy Rev.* 15 (6), 3074–3098.
- Alnatheer, O., 2005. The potential contribution of renewable energy to electricity supply in Saudi Arabia. *Energy Policy* 33 (18), 2298–2312.
- Alnatheer, O., 2006. Environmental benefits of energy efficiency and renewable energy in Saudi Arabia's electric sector. *Energy Policy* 34 (1), 2–10.
- Alotaibi, S., 2011. Energy consumption in Kuwait: prospects and future approaches. *Energy Policy* 39 (2), 637–643.
- Alrashed, F., Asif, M., 2015. Analysis of critical climate related factors for the application of zero-energy homes in Saudi Arabia. *Renew. Sustain. Energy Rev.* 41, 1395–1403.
- AlRashidi, M.R., El-Naggar, K.M., 2010. Long term electric load forecasting based on particle swarm optimization. *Appl. Energy* 87 (1), 320–326.
- Al-Sanea, S.A., Zedan, M.F., Al-Hussain, S.N., 2012. Effect of thermal mass on performance of insulated building walls and the concept of energy savings potential. *Appl. Energy* 89 (1), 430–442.
- Al-Sanea, S.A., Zedan, M.F., 2011. Improving thermal performance of building walls by optimizing insulation layer distribution and thickness for same thermal mass. *Appl. Energy* 88 (9), 3113–3124.
- Al-Sanea, S.A., Zedan, M.F., 2008. Optimized monthly-fixed thermostat-setting scheme for maximum energy-savings and thermal comfort in air-conditioned spaces. *Appl. Energy* 85 (5), 326–346.
- Alsayegh, O., Saker, N., Alqattan, A., 2018. Integrating sustainable energy strategy with the second development plan of Kuwait. *Renew. Sustain. Energy Rev.* 82, 3430–3440.
- Alshammari, Y.M., Sarathy, S.M., 2017. Achieving 80% greenhouse gas reduction target in Saudi Arabia under low and medium oil prices. *Energy Policy* 101, 502–511.
- Al-Sharafi, A., Sahin, A.Z., Ayar, T., Yilbas, B.S., 2017. Techno-economic analysis and optimization of solar and wind energy systems for power generation and hydrogen production in Saudi Arabia. *Renew. Sustain. Energy Rev.* 69, 33–49.

- Alshehry, A.S., Belloumi, M., 2015. Energy consumption, carbon dioxide emissions and economic growth: the case of Saudi Arabia. *Renew. Sustain. Energy Rev.* 41, 237–247.
- Al Suleimani, Z., Nair, V.R., 2000. Desalination by solar-powered reverse osmosis in a remote area of the Sultanate of Oman. *Appl. Energy* 65 (1–4), 367–380.
- Al Suleimani, Z., Rao, N.R., 2000. Wind-powered electric water-pumping system installed in a remote location. *Appl. Energy* 65 (1–4), 339–347.
- Al-Ugla, A.A., El-Shaarawi, M.A.I., Said, S.A.M., Al-Qutub, A.M., 2016. Techno-economic analysis of solar-assisted air-conditioning systems for commercial buildings in Saudi Arabia. *Renew. Sustain. Energy Rev.* 54, 1301–1310.
- Al-Yahyai, S., Charabi, Y., 2015. Assessment of large-scale wind energy potential in the emerging city of Duqm (Oman). *Renew. Sustain. Energy Rev.* 47, 438–447.
- Asif, M., 2016. Growth and sustainability trends in the buildings sector in the GCC region with particular reference to the KSA and UAE. *Renew. Sustain. Energy Rev.* 55, 1267–1273.
- Attalla, T.N., Hunt, L.C., 2016. Modelling residential electricity demand in the GCC countries. *Energy Econ.* 59, 149–158.
- Atif, M., Al-Sulaiman, F.A., 2017. Energy and exergy analyses of solar tower power plant driven supercritical carbon dioxide recompression cycles for six different locations. *Renew. Sustain. Energy Rev.* 68, 153–167.
- Ayyash, S., Hammoudeh, S., 1985. Economic analysis of energy management for cooling systems in Kuwait. *Energy* 10 (6), 721–725.
- Ayyash, S., Salman, M., Suri, R.K., 1983. Cool storage for energy saving and management in Kuwait. *Energy* 8 (12), 973–979.
- Ayyash, S., 1983. Power needs of cooling systems in Kuwait and their effects on the utility. *Appl. Energy* 13 (2), 109–120.
- Azar, E., Al Ansari, H., 2017. Framework to investigate energy conservation motivation and actions of building occupants: the case of a green campus in Abu Dhabi, UAE. *Appl. Energy* 190, 563–573.
- Azar, E., Nikolopoulou, C., Papadopoulos, S., 2016. Integrating and optimizing metrics of sustainable building performance using human-focused agent-based modeling. *Appl. Energy* 183, 926–937.
- Badri, M.A., Al-Mutawa, A., Davis, D., Davis, D., 1997. EDSF: a decision support system (DSS) for electricity peak-load forecasting. *Energy* 22 (6), 579–589.
- Baseer, M.A., Meyer, J.P., Alam, M.M., Rehman, S., 2015. Wind speed and power characteristics for Jubail industrial city, Saudi Arabia. *Renew. Sustain. Energy Rev.* 52, 1193–1204.
- Baseer, M.A., Rehman, S., Meyer, J.P., Alam, M.M., 2017. GIS-based site suitability analysis for wind farm development in Saudi Arabia. *Energy* 141, 1166–1176.
- Bekhet, H.A., Matar, A., Yasmin, T., 2017. CO₂ emissions, energy consumption, economic growth, and financial development in GCC countries: dynamic simultaneous equation models. *Renew. Sustain. Energy Rev.* 70, 117–132.
- Ben-Nakhi, A.E., Mahmoud, M.A., 2002. Energy conservation in buildings through efficient A/C control using neural networks. *Appl. Energy* 73 (1), 5–23.
- Böräng, F., Jagers, S.C., Povitkina, M., 2016. Political determinants of electricity provision in small island developing states. *Energy Policy* 98, 725–734.
- Bormmann, L., Mutz, R., 2015. Growth rates of modern science: a bibliometric analysis based on the number of publications and cited references. *J. Assoc. Inform. Sci. Technol.* 66 (11), 2215–2222.
- Bou-Rabee, M., Sulaiman, S.A., Saleh, M.S., Marafi, S., 2017. Using artificial neural networks to estimate solar radiation in Kuwait. *Renew. Sustain. Energy Rev.* 72, 434–438.
- Burney, N.A., Al-Matrouk, F.T., 1996. Energy conservation in electricity generation: a case study of the electricity and water industry in Kuwait. *Energy Econ.* 18 (1–2), 69–79.
- BuShehri, M.A., Wohlgenant, M.K., 2012. Measuring the welfare effects of reducing a subsidy on a commodity using micro-models: an application to Kuwait's residential demand for electricity. *Energy Econ.* 34 (2), 419–425.
- Chandarasekharam, D., Aref, L., 2014. CO₂ mitigation strategy through geothermal energy, Saudi Arabia. *Renew. Sustain. Energy Rev.* 38, 154–163.
- Charabi, Y., Al-Yahyai, S., Gastli, A., 2011. Evaluation of NWP performance for wind energy resource assessment in Oman. *Renew. Sustain. Energy Rev.* 15 (3), 1545–1555.
- Charabi, Y., Gastli, A., 2010. GIS assessment of large CSP plant in Duqm, Oman. *Renew. Sustain. Energy Rev.* 14 (2), 835–841.
- Charfeddine, L., Al-Malk, A.Y., Al Korbi, K., 2018. Is it possible to improve environmental quality without reducing economic growth: evidence from the Qatar economy. *Renew. Sustain. Energy Rev.* 82, 25–39.
- Charfeddine, L., Khediri, K.B., 2016. Financial development and environmental quality in UAE: cointegration with structural breaks. *Renew. Sustain. Energy Rev.* 55, 1322–1335.
- Connolly, D., Lund, H., Mathiesen, B.V., Leahy, M., 2010. A review of computer tools for analysing the integration of renewable energy into various energy systems. *Appl. Energy* 87 (4), 1059–1082.
- Darwish, M.A., Abdulrahim, H.K., Amer, A.B., 2008. On better utilization of gas turbines in Kuwait. *Energy* 33 (4), 571–588.
- Darwish, M.A., Al Awadhi, F.M., Amer, A.O.B., 2010. Combining the nuclear power plant steam cycle with gas turbines. *Energy* 35 (12), 4562–4571.
- De Wolf, C., Cerezo, C., Murtadhawi, Z., Hajiah, A., Al Mumin, A., Ochsendorf, J., Reinhart, C., 2017. Life cycle building impact of a Middle Eastern residential neighborhood. *Energy* 134, 336–348.
- Dincer, I., Hussain, M.M., Al-Zaharnah, I., 2004. Energy and exergy use in public and private sector of Saudi Arabia. *Energy Policy* 32 (14), 1615–1624.
- Dincer, I., Hussain, M.M., Al-Zaharnah, I., 2005. Energy and exergy utilization in agricultural sector of Saudi Arabia. *Energy Policy* 33 (11), 1461–1467.
- Eissa, M.M., 2011. Demand side management program evaluation based on industrial and commercial field data. *Energy Policy* 39 (10), 5961–5969.
- El Fadel, M., Rachid, G., El-Samra, R., Boutros, G.B., Hashisho, J., 2013. Emissions reduction and economic implications of renewable energy market penetration of power generation for residential consumption in the MENA region. *Energy Policy* 52, 618–627.
- El-Sebaei, A.A., Al-Ghamdi, A.A., Al-Hazmi, F.S., Faidah, A.S., 2009. Estimation of global solar radiation on horizontal surfaces in Jeddah, Saudi Arabia. *Energy Policy* 37 (9), 3645–3649.
- Emrouznejad, A., Yang, G.L., 2018. A survey and analysis of the first 40 years of scholarly literature in DEA: 1978–2016. *Soc. Econ. Plan. Sci.* 61, 4–8.
- Farnoosh, A., Lantz, F., Percebois, J., 2014. Electricity generation analyses in an oil-exporting country: transition to non-fossil fuel based power units in Saudi Arabia. *Energy* 69, 299–308.
- Gari, H., Khalifa, A., Radhwan, A., 1988. Design and simulation of a solar-powered/fuel-assisted rankine engine for power generation. *Appl. Energy* 30 (4), 245–260.
- Gastli, A., Charabi, Y., 2010. Solar electricity prospects in Oman using GIS-based solar radiation maps. *Renew. Sustain. Energy Rev.* 14 (2), 790–797.
- Gastli, A., Charabi, Y., 2011. Solar water heating initiative in Oman energy saving and carbon credits. *Renew. Sustain. Energy Rev.* 15 (4), 1851–1856.
- Gastli, A., Charabi, Y., Zekri, S., 2010. GIS-based assessment of combined CSP electric power and seawater desalination plant for Duqm—Oman. *Renew. Sustain. Energy Rev.* 14 (2), 821–827.
- Gelan, A., 2018a. Economic and environmental impacts of electricity subsidy reform in Kuwait: a general equilibrium analysis. *Energy Policy* 112, 381–398.
- Gelan, A.U., 2018b. Kuwait's energy subsidy reduction: examining economic and CO₂ emission effects with or without compensation. *Energy Econ.* 71, 186–200.
- Ghaffour, N., Lattemann, S., Missimer, T., Ng, K.C., Sinha, S., Amy, G., 2014. Renewable energy-driven innovative energy-efficient desalination technologies. *Appl. Energy* 136, 1155–1165.
- Ghazal, M., Akmal, M., Iyanna, S., Ghoudi, K., 2016. Smart plugs: perceived usefulness and satisfaction: evidence from United Arab Emirates. *Renew. Sustain. Energy Rev.* 55, 1248–1259.
- Gherboudj, I., Ghedira, H., 2016. Assessment of solar energy potential over the United Arab Emirates using remote sensing and weather forecast data. *Renew. Sustain. Energy Rev.* 55, 1210–1224.
- Groissböck, M., Pickl, M.J., 2016. An analysis of the power market in Saudi Arabia: retrospective cost and environmental optimization. *Appl. Energy* 165, 548–558.
- Hasanov, F., Bulut, C., Suleymanov, E., 2017. Review of energy-growth nexus: a panel analysis for ten Eurasian oil exporting countries. *Renew. Sustain. Energy Rev.* 73, 369–386.
- Hussain, S., Al-Alili, A., 2016. A new approach for model validation in solar radiation using wavelet, phase and frequency coherence analysis. *Appl. Energy* 164, 639–649.
- Hussain, S., AlAlili, A., 2017. A hybrid solar radiation modeling approach using wavelet multiresolution analysis and artificial neural networks. *Appl. Energy* 208, 540–550.
- Hussein, M.T., Lashin, A., Al Bassam, A., Al Arifi, N., Al Zaharani, I., 2013. Geothermal power potential at the western coastal part of Saudi Arabia. *Renew. Sustain. Energy Rev.* 26, 668–684.
- Jamil, M., Ahmad, F., Jeon, Y.J., 2016. Renewable energy technologies adopted by the UAE: prospects and challenges—A comprehensive overview. *Renew. Sustain. Energy Rev.* 55, 1181–1194.
- Jammazi, R., Aloui, C., 2015. On the interplay between energy consumption, economic growth and CO₂ emission nexus in the GCC countries: a comparative analysis through wavelet approaches. *Renew. Sustain. Energy Rev.* 51, 1737–1751.
- Jayaraman, R., Colapinto, C., La Torre, D., Malik, T., 2015. Multi-criteria model for sustainable development using goal programming applied to the United Arab Emirates. *Energy Policy* 87, 447–454.
- Jayaraman, R., Colapinto, C., La Torre, D., Malik, T., 2017. A weighted goal programming model for planning sustainable development applied to gulf cooperation council countries. *Appl. Energy* 185, 1931–1939.
- Jebaraj, S., Iniyar, S., 2006. A review of energy models. *Renew. Sustain. Energy Rev.* 10 (4), 281–311.
- Jowder, F.A., 2009. Wind power analysis and site matching of wind turbine generators in Kingdom of Bahrain. *Appl. Energy* 86 (4), 538–545.
- Juaidi, A., AlFaris, F., Montoya, F.G., Manzano-Agugliaro, F., 2016a. Energy benchmarking for shopping centers in Gulf Coast region. *Energy Policy* 91, 247–255.
- Juaidi, A., Montoya, F.G., Gázquez, J.A., Manzano-Agugliaro, F., 2016b. An overview of energy balance compared to sustainable energy in United Arab Emirates. *Renew. Sustain. Energy Rev.* 55, 1195–1209.
- Kaddoura, T.O., Raml, M.A., Al-Turki, Y.A., 2016. On the estimation of the optimum tilt angle of PV panel in Saudi Arabia. *Renew. Sustain. Energy Rev.* 65, 626–634.
- Kassem, A., Al-Haddad, K., Komljenovic, D., 2017. Concentrated solar thermal power in Saudi Arabia: definition and simulation of alternative scenarios. *Renew. Sustain. Energy Rev.* 80, 75–91.
- Kazem, H.A., 2011. Renewable energy in Oman: status and future prospects. *Renew. Sustain. Energy Rev.* 15 (8), 3465–3469.
- Kazim, A.M., 2007. Assessments of primary energy consumption and its environmental consequences in the United Arab Emirates. *Renew. Sustain. Energy Rev.* 11 (3), 426–446.
- Kellow, M., 1989. Kuwait's approach to mandatory energy-conservation standards for buildings. *Energy* 14 (8), 491–502.
- Khan, M.Z., Nizami, A.S., Rehan, M., Ouda, O.K.M., Sultana, S., Ismail, I.M., Shahzad, K., 2017. Microbial electrolysis cells for hydrogen production and urban wastewater treatment: a case study of Saudi Arabia. *Appl. Energy* 185, 410–420.
- Kharseh, M., Al-Khawaja, M., Hassani, F., 2015. Utilization of oil wells for electricity generation: performance and economics. *Energy* 90, 910–916.

- Khondaker, A.N., Hasan, M.A., Rahman, S.M., Malik, K., Shafiqullah, M., Muhyedeen, M.A., 2016. Greenhouse gas emissions from energy sector in the United Arab Emirates—An overview. *Renew. Sustain. Energy Rev.* 59, 1317–1325.
- Kouta, A., Al-Sulaiman, F.A., Atif, M., 2017. Energy analysis of a solar driven cogeneration system using supercritical CO₂ power cycle and MEE-TVC desalination system. *Energy* 119, 996–1009.
- Krarti, M., Dubey, K., 2018. Review analysis of economic and environmental benefits of improving energy efficiency for UAE building stock. *Renew. Sustain. Energy Rev.* 82, 14–24.
- Krarti, M., Dubey, K., Howarth, N., 2017. Evaluation of building energy efficiency investment options for the Kingdom of Saudi Arabia. *Energy* 134, 595–610.
- Krarti, M., Hajiah, A., 2011. Analysis of impact of daylight time savings on energy use of buildings in Kuwait. *Energy Policy* 39 (5), 2319–2329.
- Krarti, M., 2015. Evaluation of large scale building energy efficiency retrofit program in Kuwait. *Renew. Sustain. Energy Rev.* 50, 1069–1080.
- Kumar, N.U., Mohan, G., Martin, A., 2016. Performance analysis of solar cogeneration system with different integration strategies for potable water and domestic hot water production. *Appl. Energy* 170, 466–475.
- Lashin, A., Al Arifi, N., 2014. Geothermal energy potential of southwestern of Saudi Arabia" exploration and possible power generation": a case study at Al Khouba area—Jizan. *Renew. Sustain. Energy Rev.* 30, 771–789.
- Mahalik, M.K., Babu, M.S., Loganathan, N., Shahbaz, M., 2017. Does financial development intensify energy consumption in Saudi Arabia? *Renew. Sustain. Energy Rev.* 75, 1022–1034.
- Maheshwari, G.P., Al-Murad, R., 2001. Impact of energy-conservation measures on cooling load and air-conditioning plant capacity. *Appl. Energy* 69 (1), 59–67.
- Maheshwari, G.P., Al-Ragom, F., Suri, R.K., 2001. Energy-saving potential of an indirect evaporative cooler. *Appl. Energy* 69 (1), 69–76.
- Mahmoud, M.A., Alajmi, A.F., 2010. Quantitative assessment of energy conservation due to public awareness campaigns using neural networks. *Appl. Energy* 87 (1), 220–228.
- Malik, A., Al-Badi, A.H., 2009. Economics of Wind turbine as an energy fuel saver—a case study for remote application in Oman. *Energy* 34 (10), 1573–1578.
- Malik, A.S., 2007. Impact on power planning due to demand-side management (DSM) in commercial and government sectors with rebound effect—a case study of central grid of Oman. *Energy* 32 (11), 2157–2166.
- Malik, A.S., Al-Zubeidi, S., 2006. Electricity tariffs based on long-run marginal costs for central grid system of Oman. *Energy* 31 (12), 1703–1714.
- Malik, A.S., Bouzguenda, M., 2013. Effects of smart grid technologies on capacity and energy savings—A case study of Oman. *Energy* 54, 365–371.
- Mansouri, N.Y., Crookes, R.J., Korakianitis, T., 2013. A projection of energy consumption and carbon dioxide emissions in the electricity sector for Saudi Arabia: the case for carbon capture and storage and solar photovoltaics. *Energy Policy* 63, 681–695.
- Martin-Pomares, L., Martínez, D., Polo, J., Perez-Astudillo, D., Bachour, D., Sanfilippo, A., 2017. Analysis of the long-term solar potential for electricity generation in Qatar. *Renew. Sustain. Energy Rev.* 73, 1231–1246.
- Matar, W., 2018. Households' response to changes in electricity pricing schemes: bridging microeconomic and engineering principles. *Energy Econ.* 75, 300–308.
- Matar, W., Anwer, M., 2017. Jointly reforming the prices of industrial fuels and residential electricity in Saudi Arabia. *Energy Policy* 109, 747–756.
- Matar, W., Murphy, F., Pierru, A., Rioux, B., 2015. Lowering Saudi Arabia's fuel consumption and energy system costs without increasing end consumer prices. *Energy Econ.* 49, 558–569.
- Matar, W., Murphy, F., Pierru, A., Rioux, B., Wogan, D., 2017. Efficient industrial energy use: the first step in transitioning Saudi Arabia's energy mix. *Energy Policy* 105, 80–92.
- Mezghani, I., Haddad, H.B., 2017. Energy consumption and economic growth: an empirical study of the electricity consumption in Saudi Arabia. *Renew. Sustain. Energy Rev.* 75, 145–156.
- Mezher, T., Dawelbait, G., Abbas, Z., 2012. Renewable energy policy options for Abu Dhabi: drivers and barriers. *Energy Policy* 42, 315–328.
- Mohan, G., Kumar, U., Pokhrel, M.K., Martin, A., 2016. A novel solar thermal polygeneration system for sustainable production of cooling, clean water and domestic hot water in United Arab Emirates: dynamic simulation and economic evaluation. *Appl. Energy* 167, 173–188.
- Mokheimer, E.M., Dabwan, Y.N., Habib, M.A., Said, S.A., Al-Sulaiman, F.A., 2015. Development and assessment of integrating parabolic trough collectors with steam generation side of gas turbine cogeneration systems in Saudi Arabia. *Appl. Energy* 141, 131–142.
- Mokheimer, E.M., Dabwan, Y.N., Habib, M.A., 2017. Optimal integration of solar energy with fossil fuel gas turbine cogeneration plants using three different CSP technologies in Saudi Arabia. *Appl. Energy* 185, 1268–1280.
- Mokri, A., Ali, M.A., Emziane, M., 2013. Solar energy in the United Arab Emirates: a review. *Renew. Sustain. Energy Rev.* 28, 340–375.
- Mondal, M.A.H., Hawila, D., Kennedy, S., Mezher, T., 2016. The GCC countries RE-readiness: strengths and gaps for development of renewable energy technologies. *Renew. Sustain. Energy Rev.* 54, 1114–1128.
- Mondal, M.A.H., Kennedy, S., Mezher, T., 2014. Long-term optimization of United Arab Emirates energy future: policy implications. *Energy* 114, 466–474.
- Mujeebu, M.A., Ashraf, N., Alsawayigh, A., 2016. Energy performance and economic viability of nano aerogel glazing and nano vacuum insulation panel in multi-story office building. *Energy* 113, 949–956.
- Nasser, A.E., El-Kalay, M.A., 1991. A heat-recovery cooling system to conserve energy in gas-turbine power stations in the Arabian Gulf. *Appl. Energy* 38 (2), 133–142.
- Nizami, S.J., Al-Garni, A.Z., 1995. Forecasting electric energy consumption using neural networks. *Energy Policy* 23 (12), 1097–1104.
- Nizami, A.S., Shahzad, K., Rehan, M., Ouda, O.K.M., Khan, M.Z., Ismail, I.M.I., et al., 2017. Developing waste biorefinery in Makkah: a way forward to convert urban waste into renewable energy. *Appl. Energy* 186, 189–196.
- Omar, E.A., Al-Ragom, F., 2002. On the effect of glazing and code compliance. *Appl. Energy* 71 (2), 75–86.
- Osman, M., Gachino, G., Hoque, A., 2016. Electricity consumption and economic growth in the GCC countries: panel data analysis. *Energy Policy* 98, 318–327.
- Ouda, O.K.M., Raza, S.A., Nizami, A.S., Rehan, M., Al-Waked, R., Korres, N.E., 2016. Waste to energy potential: a case study of Saudi Arabia. *Renew. Sustain. Energy Rev.* 61, 328–340.
- Ozturk, I., Acaravci, A., 2011. Electricity consumption and real GDP causality nexus: evidence from ARDL bounds testing approach for 11 MENA countries. *Appl. Energy* 88 (8), 2885–2892.
- Paleologos, E.K., Caratelli, P., El Amrousi, M., 2016. Waste-to-energy: an opportunity for a new industrial typology in Abu Dhabi. *Renew. Sustain. Energy Rev.* 55, 1260–1266.
- Parkinson, S.C., Makowski, M., Krey, V., Sedraoui, K., Almasoud, A.H., Djilali, N., 2018. A multi-criteria model analysis framework for assessing integrated water-energy system transformation pathways. *Appl. Energy* 210, 477–486.
- Pautasso, M., 2012. Publication growth in biological sub-fields: patterns, predictability and sustainability. *Sustainability* 4 (12), 3234–3247.
- Payne, J.E., 2010. A survey of the electricity consumption-growth literature. *Appl. Energy* 87 (3), 723–731.
- Pfenninger, S., Hawkes, A., Keirstead, J., 2014. Energy systems modeling for twenty-first century energy challenges. *Renew. Sustain. Energy Rev.* 33, 74–86.
- Popli, S., Rodgers, P., Evelyn, V., 2012. Trigenation scheme for energy efficiency enhancement in a natural gas processing plant through turbine exhaust gas waste heat utilization. *Appl. Energy* 93, 624–636.
- Radhi, H., Eltrapolsi, A., Sharples, S., 2009. Will energy regulations in the Gulf States make buildings more comfortable—a scoping study of residential buildings. *Appl. Energy* 86 (12), 2531–2539.
- Radhi, H., Sharples, S., 2013. Quantifying the domestic electricity consumption for air-conditioning due to urban heat islands in hot arid regions. *Appl. Energy* 112, 371–380.
- Radhi, H., 2009. Can envelope codes reduce electricity and CO₂ emissions in different types of buildings in the hot climate of Bahrain? *Energy* 34 (2), 205–215.
- Radhi, H., 2011. On the value of decentralised PV systems for the GCC residential sector. *Energy Policy* 39 (4), 2020–2027.
- Radhi, H., 2012. Trade-off between environmental and economic implications of PV systems integrated into the UAE residential sector. *Renew. Sustain. Energy Rev.* 16 (5), 2468–2474.
- Rahman, S.M., Khondaker, A.N., 2012. Mitigation measures to reduce greenhouse gas emissions and enhance carbon capture and storage in Saudi Arabia. *Renew. Sustain. Energy Rev.* 16 (5), 2446–2460.
- Rahman, F., Rehman, S., Abdul-Majeed, M.A., 2012. Overview of energy storage systems for storing electricity from renewable energy sources in Saudi Arabia. *Renew. Sustain. Energy Rev.* 16 (1), 274–283.
- Ramanathan, R., 2005. An analysis of energy consumption and carbon dioxide emissions in countries of the Middle East and North Africa. *Energy* 30 (15), 2831–2842.
- Ramli, M.A., Twaha, S., Al-Hamouz, Z., 2017. Analyzing the potential and progress of distributed generation applications in Saudi Arabia: the case of solar and wind resources. *Renew. Sustain. Energy Rev.* 70, 287–297.
- Rashwan, S.S., Shaaban, A.M., Al-Suliman, F., 2017. A comparative study of a small-scale solar PV power plant in Saudi Arabia. *Renew. Sustain. Energy Rev.* 80, 313–318.
- Redha, A.M., Dincer, I., Gadalla, M., 2011. Thermodynamic performance assessment of wind energy systems: an application. *Energy* 36 (7), 4002–4010.
- Rehman, H.U., 2017. Experimental performance evaluation of solid concrete and dry insulation materials for passive buildings in hot and humid climatic conditions. *Appl. Energy* 185, 1585–1594.
- Rehman, S., Ahmed, M.A., Mohamed, M.H., Al-Sulaiman, F.A., 2017. Feasibility study of the grid connected 10 MW installed capacity PV power plants in Saudi Arabia. *Renew. Sustain. Energy Rev.* 80, 319–329.
- Rehman, S., Al-Hadhrani, L.M., 2010. Study of a solar PV–diesel–battery hybrid power system for a remotely located population near Rafha, Saudi Arabia. *Energy* 35 (12), 4986–4995.
- Rehman, S., El-Amin, I., 2012. Performance evaluation of an off-grid photovoltaic system in Saudi Arabia. *Energy* 46 (1), 451–458.
- Rehman, S., El-Amin, I.M., Ahmad, F., Shaahid, S.M., Al-Shehri, A.M., Bakhashwain, J.M., 2007. Wind power resource assessment for Rafha, Saudi Arabia. *Renew. Sustain. Energy Rev.* 11 (5), 937–950.
- Rehman, S., Mohandes, M., 2008. Artificial neural network estimation of global solar radiation using air temperature and relative humidity. *Energy Policy* 36 (2), 571–576.
- Rehman, S., Sahin, A.Z., 2012. Wind power utilization for water pumping using small wind turbines in Saudi Arabia: a techno-economical review. *Renew. Sustain. Energy Rev.* 16 (7), 4470–4478.
- Reiche, D., 2010. Renewable energy policies in the Gulf countries: a case study of the carbon-neutral "Masdar City" in Abu Dhabi. *Energy Policy* 38 (1), 378–382.
- Rohani, G., Nur, M., 2014. Techno-economical analysis of stand-alone hybrid renewable power system for Ras Musherib in United Arab Emirates. *Energy* 64, 828–841.
- Sa'ed, H.Z., Al-Jabi, S.W., Sweileh, W.M., 2015. Scientific publications from Arab world in leading journals of Integrative and Complementary Medicine: a bibliometric analysis. *BMC Complement Altern. Med.* 15 (1), 308.
- Saghafifar, M., Gadalla, M., 2015. Innovative inlet air cooling technology for gas turbine power plants using integrated solid desiccant and Maisotsenko cooler. *Energy* 87, 663–677.

- Saghafifar, M., Gadalla, M., 2017. Thermo-economic optimization of hybrid solar Maisotsenko bottoming cycles using heliostat field collector: comparative analysis. *Appl. Energy* 190, 686–702.
- Salahuddin, M., Alam, K., Ozturk, I., Sohag, K., 2018. The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO₂ emissions in Kuwait. *Renew. Sustain. Energy Rev.* 81, 2002–2010.
- Salahuddin, M., Gow, J., 2014. Economic growth, energy consumption and CO₂ emissions in Gulf Cooperation Council countries. *Energy* 73, 44–58.
- Salahuddin, M., Gow, J., Ozturk, I., 2015. Is the long-run relationship between economic growth, electricity consumption, carbon dioxide emissions and financial development in Gulf Cooperation Council Countries robust? *Renew. Sustain. Energy Rev.* 51, 317–326.
- Shaahid, S.M., Al-Hadhrami, L.M., Rahman, M.K., 2013. Economic feasibility of development of wind power plants in coastal locations of Saudi Arabia—A review. *Renew. Sustain. Energy Rev.* 19, 589–597.
- Shaahid, S.M., Al-Hadhrami, L.M., Rahman, M.K., 2014. Review of economic assessment of hybrid photovoltaic-diesel-battery power systems for residential loads for different provinces of Saudi Arabia. *Renew. Sustain. Energy Rev.* 31, 174–181.
- Shaahid, S.M., El-Amin, I., 2009. Techno-economic evaluation of off-grid hybrid photovoltaic-diesel-battery power systems for rural electrification in Saudi Arabia—a way forward for sustainable development. *Renew. Sustain. Energy Rev.* 13 (3), 625–633.
- Sgouridis, S., Abdullah, A., Griffiths, S., Saygin, D., Wagner, N., Gielen, D., et al., 2016. RE-mapping the UAE's energy transition: an economy-wide assessment of renewable energy options and their policy implications. *Renew. Sustain. Energy Rev.* 55, 1166–1180.
- Shams, M.B., Haji, S., Salman, A., Abdali, H., Alsaffar, A., 2016. Time series analysis of Bahrain's first hybrid renewable energy system. *Energy* 103, 1–15.
- Siddiqi, A., Anadon, L.D., 2011. The water–energy nexus in Middle East and North Africa. *Energy Policy* 39 (8), 4529–4540.
- Squalli, J., 2007. Electricity consumption and economic growth: bounds and causality analyses of OPEC members. *Energy Econ.* 29 (6), 1192–1205.
- Sultan, A.Y., Charabi, Y., Gastli, A., Al-Alawi, S., 2010. Assessment of wind energy potential locations in Oman using data from existing weather stations. *Renew. Sustain. Energy Rev.* 14 (5), 1428–1436.
- Sweidan, O.D., Alwaked, A.A., 2016. Economic development and the energy intensity of human well-being: evidence from the GCC countries. *Renew. Sustain. Energy Rev.* 55, 1363–1369.
- Tadmouri, G.O., Tadmouri, N.B., 2002. Biomedical research in the Kingdom of Saudi Arabia (1982–2000). *Saudi Med. J.* 23 (1), 20–24.
- Taleb, H.M., Sharples, S., 2011. Developing sustainable residential buildings in Saudi Arabia: a case study. *Appl. Energy* 88 (1), 383–391.
- Treyer, K., Bauer, C., 2016. The environmental footprint of UAE's electricity sector: combining life cycle assessment and scenario modeling. *Renew. Sustain. Energy Rev.* 55, 1234–1247.
- Wood, M., Alsayegh, O.A., 2014. Impact of oil prices, economic diversification policies and energy conservation programs on the electricity and water demands in Kuwait. *Energy Policy* 66, 144–156.