IJEEP
INTERNATIONAL JOURNAL OF ENERGY ECONOMICS AND POLICY

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2019, 9(6), 38-44.

Comparing the Impact of Wind Power and Solar Power Investment on Industrial Development: Application of Dynamic Energy Industry-related Models

Cheng-Yih Hong[1], Hsiu-Ching Chang[2]*

[1]Department of Finance, Faculty of Finance, Chaoyang University of Technology, Taiwan, [2]Department of Business Administration, Chaoyang University of Technology, Taiwan. *Email: hcyih@cyut.edu.tw

Received: 20 May 2019 **Accepted:** 06 September 2019 **DOI:** https://doi.org/10.32479/ijeep.8152

ABSTRACT

Taiwan's energy transformation to change the power structure is a new energy policy for economic development, industrial upgrading and environmental preservation. This study investigates the possibility of evaluating the economic spillover effects and CO_2 emissions to evaluate new energy policy objectives by investing in solar and wind power generation systems. The research results show that the short-term solar investment in economic effects is superior to wind power generation, and the economic spillover increases the scale of CO_2 emissions. The main reason is that the high ratio of equipment for wind power generation comes from imports and reduces the spillover effect. Observing the economic spillover effects of individual industries, solar investment has the largest increase in "Sewage Treatment Sector and Resource Recovery" sectors, while wind investment has the largest increase in "Machinery-related industries." The scale of CO_2 emissions in individual industries, solar investment has increased the most emissions by "Chemical" sectors, and wind investment has increased by "Service industries." However, from a long-term perspective, the industrial upgrading through economic restructuring and the low emission coefficient of wind power will greatly improve the economic spillover effect of wind investment and improve the environment.

Keywords: Solar Power, Wind Power, Economic Spillover Effects, CO_2 Emissions
JEL Classifications: Q43, Q56, C54, C67

1. INTRODUCTION

For a long time, Taiwan's power sources have relied mainly on thermal power generation, which accounts for more than 80% of the total power supply, with coal-fired power accounting for the majority. Under such a power structure, Taiwan's economic development has also created a high degree of economic growth for 30 years. Entering the economic situation of Taiwan in the 1990s, the production bases of traditional industries moved to Southeast Asia, China and other regions, and the loss of large amounts of capital has greatly reduced domestic investment, and Taiwan faces industrial hollowing out.

In 2002, Taiwan joined the WTO's world trade system, which represents the challenge of facing a larger international market in a liberalized economy. The world's "financial tsunami" broke out in 2008, and the Taiwan economy suffered major damage (Hong and Li, 2015). The export recession in the fourth quarter of 2009 was nearly 40%. This series of international economic environment and world financial events have made Taiwan must rethink industrial restructuring and energy policy, because these are closely related to the competitiveness of Taiwan's industrial market and deeply affect future economic development. In 2017, Taiwan proposed a new energy policy to try to solve the long-term industrial restructuring and develop a new economic growth model. The goal of the new energy policy is to replace thermal power generation with renewable energy, and to promote economic investment by investing in high-tech industries in a way that energy transformation changes the power supply structure.

Taiwan is surrounded by the subtropical monsoon climate and has some renewable energy development conditions, among which the natural conditions of solar energy and wind power are the best. Due to the different investment industries of different renewable energy sources, the cost of construction costs is not the same, so the economic spillover effect will be different. In addition, the difference in solar power and wind power generation will have different environmental impacts, so the scale of CO_2 emissions will also vary.

Since 2017, renewable energy development has become Taiwan's new energy policy. The policy goal of Taiwan's energy transformation is to adjust the power source structure. It also hopes that investment in renewable energy will drive economic growth and industrial upgrading, and create employment opportunities. The research purpose of this study will be to compare the economic spillover effects of solar and wind system investments with the scale of CO_2 emissions, and conclude the assessment of renewable energy in Taiwan's energy policy. In order to evaluate the above research purposes, this paper uses the dynamic industry-associated spillover model for the estimation of economic spillovers, and the dynamic energy industry correlation model for the estimation of CO_2 emissions.

2. LITERATURE REVIEW

Investment can really drive economic development (Hong and Li, 2015), but economic development has also led to an increase in energy consumption (Wolde-Rufael, 2010, Paul and Uddin, 2011, Karhan, 2019). The question that follows is whether the environment can continue to be protected.

When analyzing economic growth and environmental improvement, many documents solve the problems between the two through investment and technology improvement. Omer (2008) analyzes the contribution to climate change by reducing energy consumption. Stram (2016) believes that investing in renewable solar and wind power renewable penetrations can reduce direct pollution and CO_2 emissions. Tang et al. (2016) analyzed the relationship between energy consumption and economic growth in Vietnam during the period 1976-2010. The research results indicate that energy consumption is not a limiting factor for economic growth in Vietnam's economic development experience. The study pointed out that energy conservation policies that reduce energy use to promote environmentally friendly development will not have a serious impact on economic growth.

Hong et al. (2017) pointed out that investment R and D can also reduce CO_2 emissions in addition to economic spillover effects, and Hong and Yen (2019) analysis of renewable energy investment can drive urban industrial development and improve the environment. Ye et al. (2012) analyzed the feasibility of China's Hainan Island renewable energy investment. The study emphasizes that changes in power sources and the cost of renewable energy equipment will enable the economy to continue to develop and protect the natural environment. Apergis and Payne (2009) used the Central American data from 1980 to 2004 to analyze the relationship between energy consumption and economic growth. The study found that there is a causal relationship between energy consumption and economic growth in the short term.

On the other hand, Bode et al. (2003) analyze the relationship between economic growth and gas emissions from the development of the tourism industry. The study emphasizes that the use of wind and solar energy can reduce damage to the environment and develop tourism. Solarin (2014) studies tourism development in Malaysia and explores the determinants of carbon dioxide emissions, including GDP, energy consumption, financial development and urbanization. The paper found that tourists are an important factor in pollution, but it is not possible to confirm the causal relationship between tourism and economic growth over a long period of time. Ozturk (2016) Analyzes tourism development from energy consumption, air pollution, health spending and economic growth. This study found a long-term correlation between energy consumption, environmental sustainability, economic growth and tourism indicators.

Karhan (2019) stressed that the relationship between renewable energy consumption and economic growth has become an important issue. The study points out the different causal relationships between renewable energy consumption and economic growth in different periods. The study by Kougias et al. (2019) argues that the deployment of renewable energy can reduce dependence on energy imports, reduce fiscal costs, and improve environmental pollution.

3. EMPIRICAL MODELS

3.1. Data

Taiwan's new energy policy are plan "4-year wind power generation promotion plan" and the establishment of solar power system, the former set to complete 520 MW offshore wind power generation system in 2020, the latter plans to generate 25 billion kWh of annual power generation, solar energy It will be able to drive a total investment of NT$1, 200 billion (=US$40,000 million). This study compares the scale of investment in solar energy and wind power generation system with NT$100 billion (=US$3,333.33 million), and estimates the economic spillover effect and economic effect on CO_2 emissions from different renewable energy sources. The difference between the economic and environmental effects of a power generation system. Tables 1 and 2 represent the cost of building a solar and wind power system for US$3,333.33 million, respectively.

From the perspective of raw material supply for renewable energy, solar energy and wind power related industries have different supply chain relationships in Taiwan. The domestic self-sufficiency rate of solar energy systems is relatively high, and it is almost possible to supply related equipment by domestic enterprises. However, the development of motor systems for wind power generation in Taiwan is relatively slow and must rely on imports, which will affect the economic effects and the scale of CO_2 emissions.

Table 1: Rack-mounted rooftop solar system costs

Category	Category cost
Power plant cost	2275.33
Photovoltaic module	1060.33
Inverter	481.00
Array frame (aluminum)	339.00
Array mount (steel)	154.67
Step-up transformer	153.67
Wiring	86.67
Construction cost	636.33
Foundation civil engineering construction	144.67
Related engineering pay	491.67
Other cost	421.67
Commercial	27.00
Management	158.67
transport	32.67
Other	203.33
Total cost	3333.33

Unit: US$ million

3.2. Methodology

In order to estimate the effects of the energy-generating power sector, the study expands the power sector of the industry-related Table. The new industry-related Table will include various types of renewable energy sources, such as nuclear power, firepower, hydropower, solar energy, and wind power, as shown in Table 3.

The production quantity decision model of the industry-related production function is as follows:

$$x_j^1 = \min\left[\frac{X_{ij}^{11}}{a_{ij}^{11}}, \frac{X_{ij}^{21}}{a_j^{21}}\right](i, j = 1, ..., n) \quad (1)$$

In addition, the production function of the electric power sector can be expressed by (2).

$$Z_k = \min\left[\frac{X_{ik}^{12}}{a_{ik}^{12}}, \frac{X_k^{22}}{a_k^{22}}\right](i, j = 1, \cdots, n \;\; k = 1, \cdots, 5) \quad (2)$$

z_k: Power production sectors
X_{ik}^{12} : i sector investment in k sector
X_k^{22} : Power sectors input to k sector
a_{ik}^{12} : i sector input coefficient for k sector
a_k^{22} : Power sectors input coefficient to k sector.

When the formulas (1) and (2) are expressed in the horizontal direction, the original sectors and the power sectors can be written as (3) and (4) respectively.

$$\left[A^{11} \middle| a^{12}\right]\begin{bmatrix} X^1 \\ x^2 \end{bmatrix} + F^1 = X^1, A^{11}X^1 + A^{12}Z_k + F^1 = X^1 \quad (3)$$

$$\left[a^{21} \middle| a^{22}\right]\begin{bmatrix} X^1 \\ x^2 \end{bmatrix} + f^2 = x^2, A^{21}X^1 + A^{22}Z_k + f^2 = x^2 \quad (4)$$

Where,
A^{11}: Square matrix with a_{ij}^{11} as the element ($n \times n$)
A^{12}: Vector with a_{ik}^{12} as the element ($n \times 5$)

Table 2: Wind power system cost breakdown (8 MW offshore wind)

Category	Category cost
Wind-related infrastructure	813.33
Foundation pile and underwater infrastructure	522.97
Underwater infrastructure installation	147.21
Office buildings and ancillary buildings	143.15
Wind power equipment	2520.00
Wind turbine	1653.12
Tower and foundation	304.92
Crane costs	47.88
Construction equipment	25.20
Wind communication pipeline	5.04
PC monitor disk	2.52
800 KVA transformer	98.28
15 KV switchboard	78.12
High pressure pipeline in the plant	15.12
Low pressure pipeline in the plant	7.56
Cable trench	12.60
11.4 KV power line	219.24
Grounding facility	5.04
Lighting and aviation warning lights	5.04
Fire and alarm facilities	2.52
Other spare parts	37.80
Total cost	3333.33

Unit: US$ million

A^{21}: Vector with a_j^{21} as the element ($1 \times n$)
A^{22}: Vector with a_k^{22} as the element ($1 \times n$)
F^1: Final demand vector for the industrial sector ($n \times 1$)W
f^2: Final demand vector for the power sector (1×1)
X^1: Production vector of the industrial sector ($n \times 1$)
x^2: Production vector of the power sector ($n \times 1$)
Z_k: Vector with Z_1~Z_5 as the element (5×5).

The supply equation of the power sector is as in (5)

$$z_1+z_2+z_3+z_4+z_5 = x_2 \quad (5)$$

Then in z_1, z_2, z_3, z_4 and z_5 the equation (5) represent the power source, respectively, as follows,
z_1: Nuclear power
z_2: Firepower
z_3: Hydroelectric power
z_4: Solar power
z_5: Wind power.

The power supply ratios of the nuclear, thermal, hydraulic, solar, and wind powers of equation (5) are set to α_1, α_2, α_3, α_4 and α_5 respectively, as follows:
$z_1 = \alpha_1 x^2$
$z_2 = \alpha_2 x^2$
$z_3 = \alpha_3 x^2$
$z_4 = \alpha_4 x^2$

$$z_5 = \alpha_5 x^2 = (1-\alpha_1-\alpha_2-\alpha_3-\alpha_4)\, x^2 \quad (6)$$

(6) can be represented by a matrix, such as (7).

$$\begin{bmatrix}1&0&0&0&0\\0&1&0&0&0\\0&0&1&0&0\\0&0&0&1&0\\0&0&0&0&1\end{bmatrix}\begin{bmatrix}z_1\\z_2\\z_3\\z_4\\z_5\end{bmatrix}=\begin{bmatrix}\alpha_1\\\alpha_2\\\alpha_3\\\alpha_4\\1-\alpha_1-\alpha_2-\alpha_3-\alpha_4\end{bmatrix}x^2 \quad (7)$$

(7) can be expressed as equation (8), as follows,

$$B_z - cx_2 = 0 \quad (8)$$

Where,

$$B=\begin{bmatrix}1&0&0&0&0\\0&1&0&0&0\\0&0&1&0&0\\0&0&0&1&0\\0&0&0&0&1\end{bmatrix},\ Z=\begin{bmatrix}z_1\\z_2\\z_3\\z_4\\z_5\end{bmatrix},\ C=\begin{bmatrix}\alpha_1\\\alpha_2\\\alpha_3\\\alpha_4\\1-\alpha_1-\alpha_2-\alpha_3-\alpha_4\end{bmatrix}$$

When F^1 and f^2 are known, equation (8) can be written as (9),

$$Z = B^{-1} cx^2 \quad (9)$$

Combining equations (9), (3) and (4), the equations for Industry-related and power sector can be represented by (10) and (11), respectively.

$$\left[A^{11} \middle| A^{12}\right]\left[\frac{X^1}{B^{-1}cx^2}\right]+F^1 = X^1 \quad (10)$$

$$\left[a^{21} \middle| a^{22}\right]\left[\frac{X^1}{B^{-1}cx^2}\right]+f^2 = x^2 \quad (11)$$

Therefore, (12) is obtained from equations (10) and (11).

$$\left[\frac{X^1}{x^2}\right]=\left[I-\begin{pmatrix}A^{11} & A^{12}c\\ a^{21} & a^{22}c\end{pmatrix}\right]^{-1}\left[\frac{F^1}{f^2}\right] \quad (12)$$

Refer to Hong et al. (2017) to establish a dynamic model of capital endogenous, as shown in (13).

$$\left[\frac{X^{1-dynamic}}{x^{2-dynamic}}\right]=\left(K^{-1}D+I\right)\left[I-\begin{pmatrix}A^{11} & A^{12}c\\ a^{21} & a^{22}c\end{pmatrix}\right]^{-1}\left[\frac{F^1}{f^2}\right] \quad (13)$$

Where K is a matrix of capital coefficients, I is a unit matrix, and $D = I-A-C$. A and C represent the input coefficient matrix and the consumption matrix, respectively. On the other hand, this paper only estimates the increase in CO_2 emissions from the economic spillover effect of the investment. When calculating the CO_2 emission amount of each power generation method in the power sector, the equation (14) can be used.

$$E=\left[e_x \middle| e_z\right]\left[\frac{X^{1-dynamic}}{z}\right] \quad (14)$$

Where E is the total emission of CO_2; e_x represents the emission coefficient of the unit output of the non-power sector; e_z represents the emission coefficient of the unit output of the power sector.

4. EMPIRICAL RESULTS

This section will estimate the economic spillover effects of solar and wind investments, as well as the scale of CO_2 emissions from the economic effects of both investments. The empirical results are as follows in Sections 4.1 and 4.2.

4.1. Compare the Economic Effects of Solar and Wind Power System Investments

First, from Table 4, the economic spillover effect of investing in solar power systems is US$5205.90 million, of which the company's gross induced added value is US$1634.14 million, and the related

Table 3: Industry-related table containing various power sources

Industry	Industry			
	Original industry sector 1 Industry 1… Industry n	Power sector 2 (nuclear-power, fire-power, hydro-power, solar-power, wind-power)	Final demand	Total production
Industry 1 : Industry n	X_{ij}^{11} : (i, j=1,..., n)	X_{ik}^{12} : (k=1,...,5)	F_i^1	X_i^1
Power sector	x_i^{21}	X_k^{22}	f^2	x^2
Additional value	v_j^1	v_k^2		
Production	X_j^1	Z_k		

Table 4: Economic effects generated by solar power investment

Economic effects	Production-induced value	Gross induced added value	Induced income of employment
Direct spillover effects	2354.41	726.98	411.12
First indirect spillover effects	2127.05	656.78	371.42
Second indirect spillover effects	724.44	250.38	154.98
Total spillover effects	5205.90	1634.14	937.52

Unit: US$ million

labor income is increased by US$937.52 million. Because Taiwan can provide most of the solar industry equipment, solar investment can help expand domestic demand and increase employment.

We can also observe from individual industries, as shown in Table 5. The increase in production-induced value of solar investment is mainly based on the economy of "Sewage Treatment Sector and Resource Recovery Sector" (US$752.14 million), "Service-related Sector" (US$584.97 million) and "Electric Machine Sector" (US$482.08 million). The most effective effect, and the biggest economic effect of the "Sewage Treatment Sector and Resource Recovery Sector" is that the solar-related materials need to be recycled.

In addition, the industry with the largest gross induced added value is "Service-related Sector," with a total revenue of US$361.32 million, followed by "Sewage Treatment Sector and Resource Recovery Sector" of US$268.74 million. In the induced income of employment, the total increase of "Service-related Sector" increased by US$258.15 million.

On the other hand, the economic effects of wind investment are shown in Table 6. The production-induced value has increased by US$4524.19 million in total. From the perspective of individual industries, "Machinery-related industries" is the most, accounting for US$2,031.09 million. Followed by US$1553.00 million for service sectors. The economic effect of gross induced added value and induced income of employment is still the largest in

Table 5: Indirect spillover effects generated by solar power investment

Sector	Production-induced value	Gross induced added value	Induced income of employment
Agriculture and mining sector	−33.73	−7.69	−7.45
Processing light industry sector	98.25	23.82	13.49
Chemical sector	423.32	59.77	34.38
Primary metal sector	84.01	22.00	16.37
Non-metallic minerals sector	299.60	37.24	17.97
Electric machine sector	482.08	152.30	53.79
Machinery sector	296.34	78.64	50.47
Electricity, gas burning sector	144.64	0.21	7.40
Sewage treatment sector and resource recovery sector	752.14	268.74	146.55
Infrastructure sector	−280.13	−89.19	−64.73
Service-related sector	584.97	361.32	258.15
Total	2851.49	907.16	526.40

Unit: US$ million

Table 6: Economic effects of the wind power system investment

Industry sectors	Economic spillover		
	Production-induced value	Gross induced added value	Induced income of employment
Agriculture-related industries	−10.43	5.62	3.67
Light industries	114.52	27.67	16.95
Chemical industries	426.05	58.71	30.05
Iron and non-ferrous industries	632.76	104.43	60.81
Machinery-related industries	2,031.09	565.81	265.62
Infrastructure industries	−222.81	−79.33	−63.90
Service industries	1553.00	984.15	588.76
Total	4524.19	1667.05	901.95

Unit: US$ million

Table 7: CO_2 emissions from the economic effect of solar power investment

Industry sectors	Economic spillover		
	Production-induced value	Gross induced added value	Induced income of employment
Agriculture and mining sector	−1,693.64	−386.13	−374.08
Processing light industry sector	10,470.89	2538.59	1437.68
Chemical sector	369,200.60	52,128.70	29,984.68
Primary metal sector	8953.28	2344.63	1744.62
Non-metallic minerals sector	31,929.56	3968.81	1915.13
Electric machine sector	51,377.18	16,231.22	5732.61
Machinery sector	31,582.13	8,380.98	5378.79
Electricity, gas burning sector	126,148.48	183.15	6453.95
Sewage treatment sector and resource recovery sector	6528.97	2332.80	1272.13
Infrastructure sector	−29,373.03	−9352.02	−6787.26
Service-related sector	5077.84	3136.45	2240.88
Total	610,202.26	81,507.18	48,999.13

Unit: Tons

Table 8: CO_2 emissions from the economic effect of wind power investment

Industry sectors	Economic spillover		
	Production-induced value	Gross induced added value	Induced income of employment
Agriculture-related industries	−523.71	282.19	184.28
Light industries	12,204.85	2948.90	1806.43
Chemical industries	371,581.58	51,204.21	26,208.25
Iron and non-ferrous industries	67,435.75	11,129.52	6480.76
Machinery-related industries	216,461.33	60,300.62	28,308.18
Infrastructure industries	−23,745.75	−8454.51	−6810.08
Service industries	403,065.81	250,866.71	142,179.07
Total	1,046,479.86	368,277.64	198,356.90

Unit: Tons

Table 9: Comparison of the economic spillover effects of solar and wind investments

Investment sectors	Economic spillover		
	Production-induced value	Gross induced added value	Induced income of employment
(1) 1 solar power investment	5205.90	1634.14	937.52
(2) Wind power investment	4524.19	1667.05	901.95
(1)/(2)	1.15	0.98	1.04

Unit: US$ million

Table 10: Comparison of CO_2 emissions from solar and wind investment

Spillover investment sectors	Economic		
	Production-induced value	Gross induced added value	Induced income of employment
(1) Solar power investment	610,202.26	81,507.18	48,999.13
(2) Wind power investment	1,046,479.86	368,277.64	198,356.90
(1)/(2)	0.58	0.22	0.25

Unit: Tons

“Service industries,” which is increased by US$984.15 million and US$588.76 million, respectively.

4.2. Comparing Co_2 Emissions from Investments in Solar and Wind Power Systems

Investment creates a variety of economic spillover effects, but it also increases CO_2 emissions. This section will analyze the economic creation process of investing in solar energy and wind power, and different industries will increase CO_2 emissions at different levels. Table 7 shows the increase in CO_2 emissions from various industries investing in solar energy. In the production-induced value creation process, the “Chemical Sector” increased the maximum CO_2 emissions (369,200.60 tons) more than half of the total. This situation also found an increase in CO_2 emissions in the gross induced added value and the induced income of employment.

Table 8 shows the increased CO_2 emissions from the wind power investment process. The increase in production-induced value of total CO_2 emissions is 1,046,479.86 tons, with the highest emissions from “Service industries” followed by “Chemical industries.” In addition, the company’s gross induced added value is still the most popular in terms of CO_2 emissions from “Service industries,” followed by “Machinery-related industries.” The CO_2 emissions in the induced income of employment are also the most in “Service industries” and “Machinery-related industries.”

5. CONCLUDING REMARKS

The empirical results in Section 4 can be organized as Table 9 and Table 10. Table 9 found that the production-induced value of solar investment is about 1.15 times that of wind power, but the effect of the company’s gross induced added value is only 0.98. The increase in labor income of related industries engaged in investment is greater than that of the solar industry, which is about 1.04 times that of wind power systems.

Table 10 shows the CO_2 emissions from solar power and wind power investment. In comparison, wind investment CO_2 emissions are larger. The CO_2 emissions produced by solar energy in production-induced value, gross induced added value and induced income of employment are only 0.58, 0.22 and 0.25 for wind power, respectively.

The above analysis shows that the short-term wind power generation has less economic benefits. The main reason is that in addition to the industrial differences, a large part of the equipment and materials need to be imported, and the technical level of solar energy production technology is relatively mature. If after long-term industrial adjustment, the wind power related industries will be able to increase the self-sufficiency rate of the domestic industry, and then the economic benefits will increase.

From the comparison of economic effects and environmental improvement, the current industrial structure estimation results show that the investment in solar power generation systems is superior to wind power generation. However, considering the adjustment and upgrading of the industry, the low emission coefficient of CO_2 for wind power generation will likely establish better economic effects and environmental conditions. Renewable energy politics shoulders the multiple tasks of economic development, industrial upgrading and environmental protection. This will be an important policy implication of energy transformation.

REFERENCES

Apergis, N., Payne, J.E. (2009), Energy consumption and economic growth in Central America: Evidence from a panel co integration and error-correction model. Energy Economics, 31, 211-216.

Bode, S., Hapke, J., Zisler, S. (2003), Need and options for a regenerative energy supply in holiday facilities. Tourism Management, 24(3), 257-266.

Hong, C.Y., Huang, C.H., Li, J.F. (2017), Investment, energy consumption and CO_2 emissions: An analysis on the strategy of industry development. International Journal of Energy Economics and Policy, 7(4), 138-143.

Hong, C.Y., Li, J.F. (2015), On measuring the effects of fiscal policy in global financial crisis: Evidences from an export-oriented Island economy. Economic Modelling, 46, 412-415.

Hong, C.Y., Yen, Y.S. (2019), A Way from renewable energy sources to urban sustainable development: Empirical evidences from Taichung city. International Journal of Energy Economics and Policy, 9(2), 83-88.

Karhan, G. (2019), Does renewable energy increase growth? Evidence from EU-19 countries. International Journal of Energy Economics and Policy, 9(2), 341-346.

Kougias, I., Szab, S., Nikitas, A., Theodossiou, N. (2019), Sustainable energy modelling of non-interconnected Mediterranean Islands. Renewable Energy, 133, 930-940.

Omer, A.M. (2008), Renewable building energy systems and passive human comfort solutions. Renewable and Sustainable Energy Reviews, 12(6), 1562-1587.

Ozturk, I. (2016), The relationships among tourism development, energy demand, and growth factors in developed and developing countries. International Journal of Sustainable Development and World Ecology, 23, 122-131.

Paul, B.P., Uddin, G.S. (2011), Energy and output dynamics in Bangladesh. Energy Economics, 33, 480-487.

Solarin, S.A. (2014), Tourist arrivals and macroeconomic determinants of CO_2 emissions in Malaysia. Anatolia, 25, 228-241.

Stram, B.N. (2016), Key challenges to expanding renewable energy. Energy Policy, 96, 728-734.

Tang, C.F., Tan, B.W., Ozturk, I. (2016), Energy consumption and economic growth in Vietnam. Renewable and Sustainable Energy Reviews, 54, 1506-1514.

Wolde-Rufael, Y. (2009), The defence spending-external debt nexus in Ethiopia. Defense and Peace Economics, 20, 423-436.

Ye, B., Tang, J., Lu, Q. (2012), Feasibility analysis of renewable energy powered tourism Island-Hainan, China. Journal of Renewable and Sustainable energy, 4(6), 063127.