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Correspondence Addres
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E-mail: euras@euras-edu.org

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From The Editor

Euras Journal of Engineering and Applied Sciences (EJEAS), is a peer-reviewed academic journal, establishing a solid platform for all academicians, consultants, researchers, and those who have a strong interest in global current issues and trends in engineering and applied sciences. Euras Journal of Engineering and Applied Sciences is based on engineering and applied sciences; artificial intelligence, cybersecurity, environmental sciences, food and food safety, biotechnology, material science and composites, nanotechnology, energy technologies, electronics, robotics, thermal sciences, earthquakes – structures – foundation and earth sciences studies. Subject areas could be as narrow as a specific phenomenon or device or as broad as a system.

EJEAS was established with the intention of promoting scholarly communication all over the world in a more effective manner. Our aim is to establish a publication that will be abstracted and indexed in the Engineering Index (EI) and Science Citation Index (SCI) in the near future. The journal has a short processing period to encourage young scientists.

Prof. Dr. Hasan HEPERKAN
Editor

Research Article

A STUDY OF AN ONSHORE WIND FARM DESIGN IN BÜYÜKADA REGION[1*]

Emre LEBLEBİCİOĞLU[1], Tanay Sıdkı UYAR[2]

[1]*Marmara University, Department of Mechanical Engineering, Istanbul, Turkey, leblebicioglu.emre@gmail.com; ORCID: 0000-0001-9974-3645*

[2]*Beykent University, Department of Mechanical Engineering, Istanbul, Turkey, tanayuyar@beykent.edu.tr; ORCID: 0000-0002-0960-1203*

ABSTRACT

All world is in a clean energy transition from fossil fuels to renewables. Every year the renewable power capacity grows, while the growth of fossil fuel-based power capacity decreases. Wind farms (WFs) have an important role to accelerate the clean energy transition. That is why the WFs should be designed and planned well before the installation of them. The well-designed WFs give a higher capacity factor than the WFs that are not planned well. There are many WF design parameters that must be considered such as wind measurement, site analysis, environmental limitations etc. Hence there are wind farm design tools, which are used in the wind power sector and WindSim is one of these tools. In this study, an onshore wind farm was designed in the Büyükada region via WindSim. According to the results of this study, the feasibility of this WF and other energy system options were discussed and the necessary suggestions were emphasized.

Keywords: *Wind Farm, Wind Power Plant, Wind Energy, WindSim, Büyükada*

1. INTRODUCTION

Global warming or climate change threats humanity in many aspects. The growth of greenhouse gases in the atmosphere is the main reason for this inevitable fact. Growing population, energy production, industry and transportation sector are the main carbon sources that contribute to global warming. Among these sectors, the power sector leads the CO2 emissions by 40% [1]. This significant amount of emissions can reduce the energy transition from fossil fuels to renewable. Thus, the decreasing carbon foot-step is significant to deal with climate change. The main goal of the Paris Agreement is to keep the growth of global average temperature to under 2 °C [2].

Renewables showed a significant growth in the power sector in 2019 despite the COVID-19 pandemic. According to the REN 21 Global Status Report, the renewable power capacity grew more than 200 GW in 2019 and this is the highest renewable capacity growth ever. Moreover total renewable power capacity reached 2588 GW in 2019 worldwide. Solar and wind power are responsible for this notable growth as the previous year. While the solar power capacity increased to 627 GW from 512 GW, the wind power capacity increased to 651 GW from 591 GW [3].

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Even though there is a huge jump in the renewable power sector, the world is still dependent on fossil fuels in power generation. The share of electricity production by fossil fuels is around 80% worldwide [3]. However, the capacity expansions of renewable power plants are getting bigger than fossil fuel power plants. Wind and solar are two sources that showed the significant amount of growth last years.

However, the share of these sources in electricity production is not where expected yet. Because solar and wind are variable energy sources. When the wind blows and the sun shines, then the electricity is produced. Due to this reason, the capacity factor of wind and solar is relatively low compared with nuclear and natural gas. Wind power plants have a higher capacity factor than solar power plants due to the potential of electricity production at night time. By the developing technology, the capacity factor of wind farms is getting higher year by year. While the capacity factor of onshore wind farms is 34 % in 2018, this is expected to reach 58% in 2050 [4].

The wind power sector in Turkey is also growing. Turkey is a developing country, which aims to reach its own energy independence. That is why the long term energy policies of Turkey are based on domestic sources such as renewables and indigenous coal. Hence Turkey expands the renewable power capacity every year. The renewable power capacity of Turkey was 44588 MW in 2019, while it was 42215 MW in 2018. The installed wind power capacity makes up 7591 MW and 17% of the total renewable capacity in 2019 [5].

According to the development plan of Turkey, wind farms have an important role to achieve the energy goals of Turkey and the deployment of renewable energy systems. Furthermore, Turkey has considerably high wind energy potential with an annual mean speed of 2,6 m/s and a wind power density of 25,8 W/m2 [6]. According to Melikoglu's study, the feasible and theoretical wind power potential of Turkey is 48000 MW and 88000 MW respectively [6].

Figure 1 shows the change in wind power capacity from 2008 to 2019. The installed power capacity has been cumulatively increasing throughout the years. Moreover, the share of wind in the electricity production was 8% of the total electricity production in 2018 [7].

Figure 1. The capacity of Cumulative Installed Wind Power Plants in Turkey by years [7]

The WFs requires considerably large areas to be constructed. Furthermore, the WFs cannot be installed everywhere, only in the areas, which have efficient wind power potential. There are many parameters to design a WF efficiently such as site analyzing, wind assessment, micrositing. Thanks to the technology, there are some specific software where WFs can be designed. WindSim, wind farm design software is one of this software. In this study, an onshore wind farm was designed and results were obtained for Büyükada via WindSim. This study aims to show the estimated electricity production and the capacity factor of the planned wind farm in the region of Büyükada.

2. MATERIAL AND METHODS

In this study, Büyükada is the selected region for performing a wind farm design. Büyükada is an island, which is located on the Marmara Sea, Istanbul. Electricity access and transmission are challenging for the islands due to the limited area and transportation drawbacks. Central power plants such as coal, nuclear and natural gas are not environmentally feasible for small islands like Büyükada. A wind power plant is one of the best solutions to contribute to the electricity supply of Büyükada.

There are more or less 7500 people who live in Büyükada and this population changes for a year. Because Büyükada is a touristic destination for foreign and Turkish people. Thus, the electricity demand shows the changes. The estimated annual electricity consumption of Büyükada is approximately 3,65 GWh. Furthermore, Büyükada is a relatively small island whose size is 5,4 km2. This means that there is no large area to build a wind farm [9].

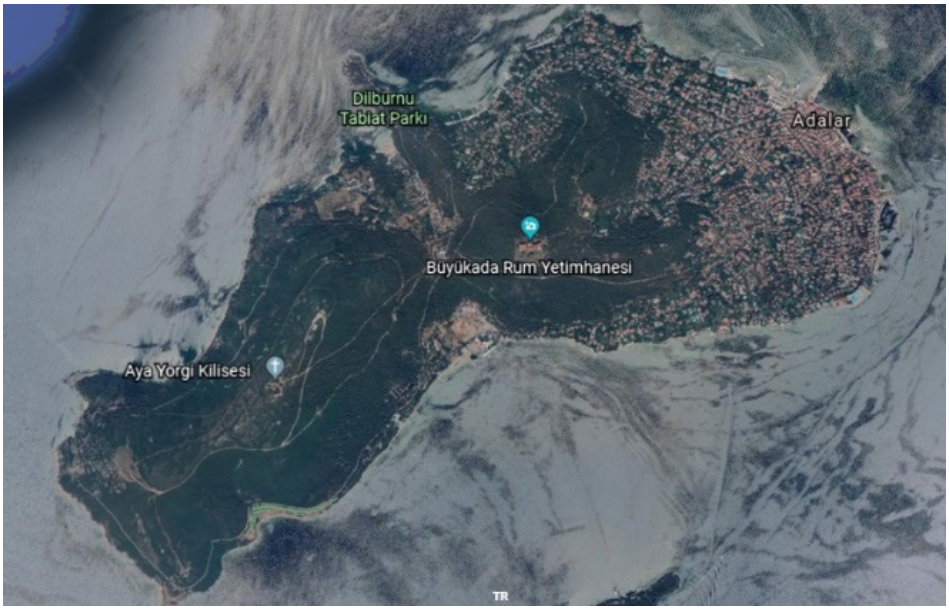

Figure 2. Top View of Büyükada

2.1. WIND POWER POTENTIAL OF TURKEY

Turkey has a notable wind power potential with an annual mean wind speed of 2,6 m/s and a power density of 25,8 W/m2 [10]. Nowadays, this potential is used to generate electricity by wind turbines. Wind turbines are located in an area where wind speed and power density are high and consist of wind farms. Theoretical and feasible wind energy potential in Turkey was estimated 88.000 MW and 45.000 MW respectively, according to Melikoglu's study [6].

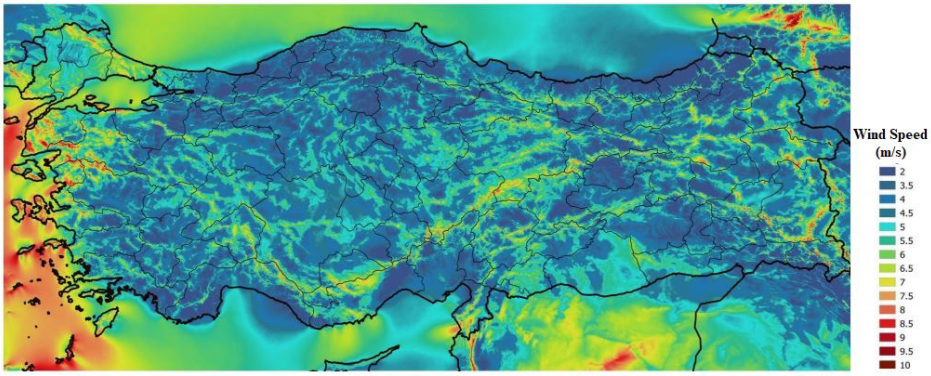

Figure 3: Wind energy potential atlas (WEPA) [10]

Figure 2 shows the wind speed distribution of Turkey at a 100 m elevation. Marmara region and the western side of Turkey have a relatively high wind power potential. Figure 3 also shows the wind power density distribution of Turkey

Sulukan study shows that wind-based electricity generation would reach 286,75 PJ in 2025 and the installed capacity was foreseen 29870 MW in the same year [11].

3. WIND FARM DESIGN IN BÜYÜKADA

WindSim is a modern Wind Farm Design Tool (WFDT) and it is used to optimize the annual power production and to design the wind farms. This is performed by computing numerical wind fields over the digitalized terrain and this is known as micrositing.

Windsim combines with wind speeds and wind directions for climate conditions to find an optimal position for each wind turbine of the WF. Climatology data is mostly obtained by on-site wind measurements. However, this data can be also found by meteorological models. WindSim can process both of these datasets.

WindSim has different modules to design a WF. These models can be also considered stages to get the estimated power generation data. These modules are Terrain, Wind Fields, Objects, Results, Wind Resources and Energy. In this section, the wind farm design for Büyükada is introduced by these 6 modules. [11]

3.1. TERRAIN

The first step of starting the feasibility analysis is to create the digital terrain model of Büyükada. Windsim gives the digital terrain model by using data of the geographical location. The elevation and roughness data, which are important for the wind farm design can be observed by this model. Figure 3 shows the elevation levels of Büyükada, while Figure 4 shows the roughness data.

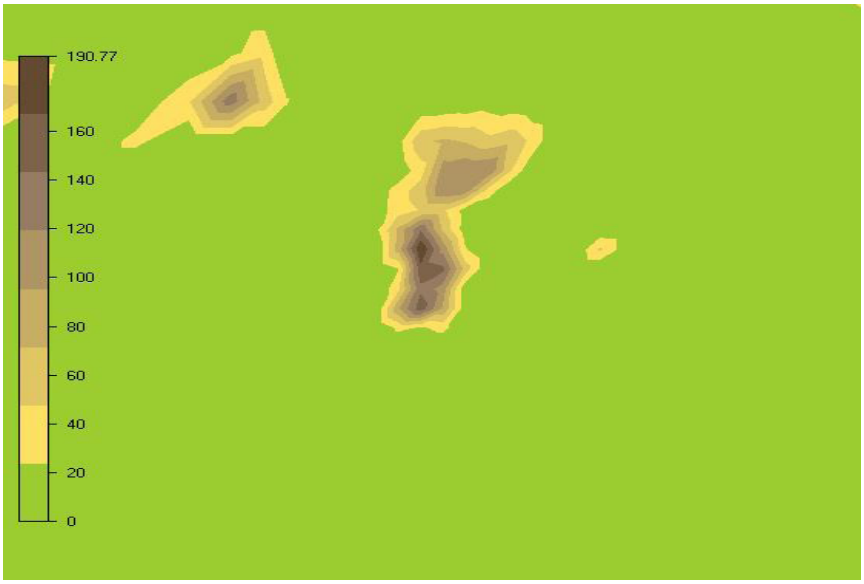

Figure 4. Digital terrain model - Elevation (m)

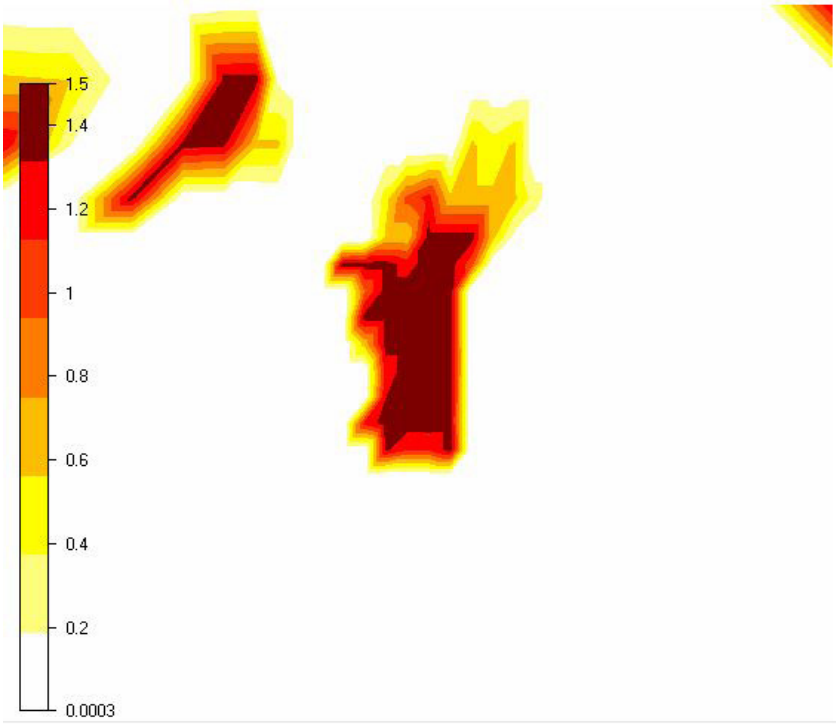

Figure 5. Digital terrain model - Roughness height (m).

3.2. WIND FIELDS

The module of wind fields is run on a basis of Reynolds Averaged Navier-Stokes equations (RANS) and the k-epsilon model is applied as a turbulence closure. In this module, the results of the digital terrain model are used. Due to the non-linear equations, the solution of the module is iterative. The solution is resolved until a converged result is obtained. 3D wind speed values on the terrain can be observed in Figure 5.

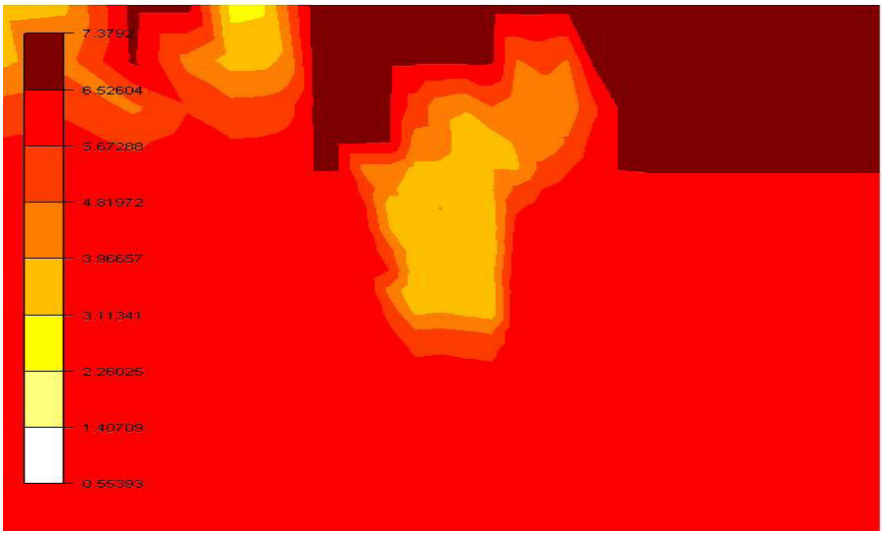

Figure 6. Convergence monitoring: Wind speed 3D (u,v,w)

3.3. OBJECTS

In the module of objects, the features of wind turbine and climatology data are used to locate the wind turbines in the best optimal area. Climatology data contains data of the hourly wind speed, wind direction during a year. These parameters are significant to simulate and calculate the estimated annual wind power generation. Gamesa G90 wind turbine was selected for this study. The power capacity of this turbine is 2 MW and two of these turbines were located on the terrain by considering the results of the terrain and wind field modules.

Table 1: The Datasheet of Gamesa 2 MW G90 Wind Turbine [12].

Gamesa 2 MW G90	
Manufacturer:	Gamesa
Rated Power:	2000 kW
Cut-in wind speed:	3,0 m/s
Rated wind speed:	11,0 m/s
Cut-out wind speed:	21,0 m/s
Diameter:	90 m
Hub height:	100 m
Swept area:	6362 m^2

The wind farm park layout can be seen in Figure 6. The wind turbines are located in a row with a specific distance from each other. This distance is generally 5 or 7 times the length of wind blades. Figure 6 also shows the wind measurement station behind the wind turbines. This location represents where the climatology data was obtained.

Figure 7. Park Layout of Wind Farm

3.4. RESULTS

The module of results is a kind of database where simulations of the wind field are saved. In this module, variables and 2D planes in the database can be extracted. Possible wind speed on the wind turbines can be observed in Figure 7. To sum up, this module shows the result of climatology data on the selected area and illustrates data that is imported to the software.

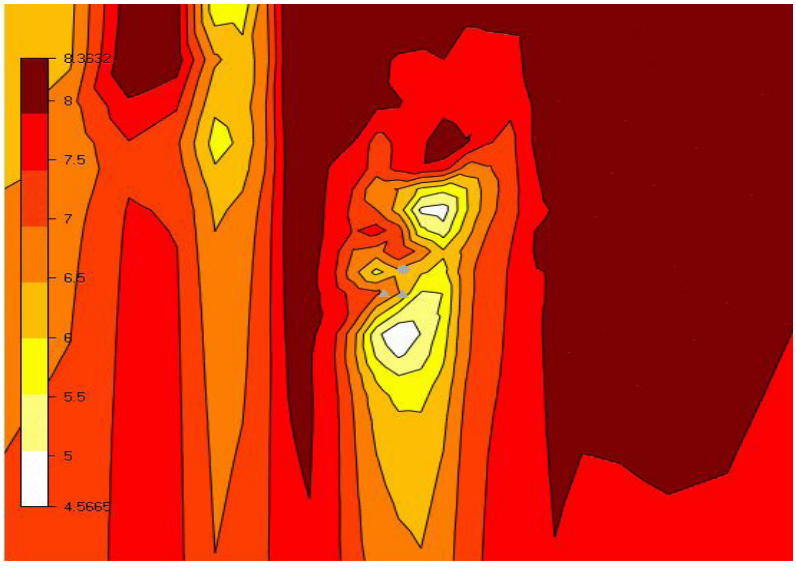

Figure 8. Wind speed 3D (u,v,w)

Wind speed values in the three dimensions can change in the software while adding different parameters into the software. Climatology data, turbulence and wind blockages can change the speed of the wind that blows on the wind turbines. This speed also changes in the module of wind resources.

3.5. WIND RESOURCES

The module of the wind resources shows the final wind speed and power density values after analyzing the parameters that can change the wind, such as turbulence regions, wind blockages, roughness, elevation etc. In this module, the potential of power generation can be observed and the power density and the wind speed regions on the digital terrain can be seen in Figure 8 and Figure 9 respectively.

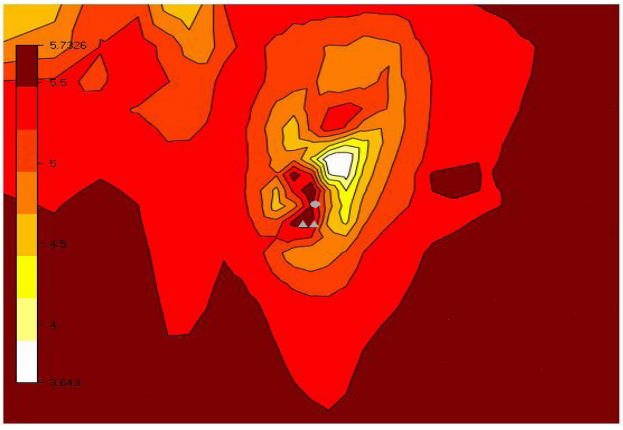

Figure 9. Wind speed 3D (u,v,w), Not Normalized

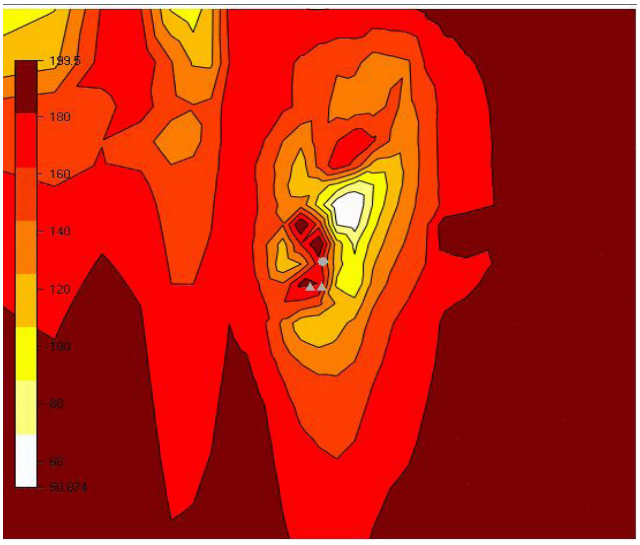

Figure 10. Power Density (W/m^2)

3.6. ENERGY

The final module of the WindSim is the energy module. This module gives the estimated power generation by the wind turbines. This is called annual energy production (AEP). AEP is calculated by using the data from previous modules. In this module, the annual electricity production by the wind farm can be observed and the capacity factor can be calculated. AEP can be seen in Figure 10 along with other parameters such as wind speed, power density etc.

name	power (kW)	hub height (m)	density (kg/m**3)	wind speed (m/s)	wind speed including wake losses (m/s)	power density (W/m**2)	gross AEP (MWh/y)	AEP with wake losses (MWh/y)	wake loss (%)	full load hours (h)
wecs1	2000	100.0	1.225	6.20	6.20	250.3	4146.5	-	-	2073.2
wecs2	2000	100.0	1.225	6.27	6.27	262.7	4261.2	-	-	2130.6
All	4000	-	-	-	-	-	8407.7	-	-	2101.9
Mean	-	-	1.225	6.23	6.23	256.5	-	-	-	-
Reference production at climatology position: vortex_time_series_80m										
ref..	2000	100.0	1.225	6.21	-	251.8	4152.3	-	-	2076.1
ref..	2000	80.0	1.225	6.02	-	226.8	3846.5	-	-	1923.2

Figure 11. Energy production based on the frequency table.

The estimated annual electricity production of the wind farm is more or less 8407,7 MWh/y as is seen in Figure 10. Recall that the average annual electricity consumption of Büyükada is 3650 MWh. The wind farm can able to supply this demand. However, the wind is a variable source, which means the wind cannot be enough to spin turbines all the time. When the electricity demand is high in the daytime, wind turbines may not be enough to supply this due to the low wind speed. That is why the wind farm should support the energy storage systems and solar PV systems can be also considered.

The capacity factor of this system is calculated by using the annual electricity production and the installed power capacity. The estimated capacity factor of this WF is calculated by the following formula.

The capacity factor of this WF is calculated as shown below.

$$\text{Capacity Factor} = \frac{8{,}4\ MWh/y}{(24\frac{hours}{day})*(365\ days)*4\ MW} * 100 = 24\% \quad (1)$$

The planned WF in Büyükada region is an onshore WF. The average capacity factor of onshore WFs is 34% in 2018. The capacity factor, which was calculated for this study is much lower than the average capacity factor. The reason for this situation is about geographical and environmental limitations. Because the WF cannot be placed in the residential zone and the size of Büyükada is limited. Moreover, the chosen area in Büyükada has high area roughness. For these reasons, the onshore wind power plants may be unfeasible for Büyükada. However, they should be still considered or the offshore WFs can be evaluated. In this study, the design of onshore WF in Büyükada was considered and analyzed.

4. CONCLUSION

This study shows that the wind farm can supply the electricity demand of Büyükada. However the electricity consumption changes during the day. The electricity demand reaches the maximum level day time and goes to the minimum level at the night time. That is why the wind power plant may not supply the electricity demand every hour since wind is the variable source. Therefore the designed wind farm should be supported by the energy storage systems. When the wind does not blow enough at the peak time. The storage system can supply the electricity need. The electricity production of the wind farms is high at night. Thereby the excess electricity is stored at night, when the electricity demand is low.

There are many types of electricity storage systems, which can be integrated into the WFs, such as the pumped hydro, compressed air storage, and utility-scale batteries. To sum up, the energy storage system is a necessity for 100% renewable energy systems. Hence Büyükada also needs a well-planned storage system.

Electric vehicles can be another efficient storage option for islands. There are electric vehicles in Büyükada, which can be used for vehicle to grid (V2G) technology. Vehicle to grid means that the electric vehicle act like a storage unit. When electric vehicles do not run, they can give the electricity to the power grid by the batteries within.

In this study, a wind farm design for Büyükada was showed via WindSim and results were obtained to analyze the feasibility of this wind farm. This designed WF is onshore. Offshore wind farms are another option for islands and should be also considered. However, the main focus of this study is the onshore WF design. Furthermore, some design parameters should be taken into account. For instance, the electrical distribution between WF and transformers. Moreover, the noise calculations of wind turbines can be also evaluated by WindSim. Although the environmental conditions were considered in this study, the detail of noise calculation was ignored. The wind turbine placement was performed with a specific distance between the residential zone and the WF (Approximately 1 km distance).

To sum up, the WFs should be planned well and they should be supported by other energy systems. Moreover, the roughness, the elevation, on-site wind measurement and other geographical details should be analyzed to obtain a more efficient WF.

As a result, Windsim and similar wind analysis software are significant for the pre-installation of a wind farm. These types of software tools must be used for designing wind power plants. This study is now a unique example for designing onshore WF on an island using WindSim.

REFERENCES

[1] IEA, Global energy-related CO2 emissions by sector, IEA, Paris https://www.iea.org/data-and-statistics/charts/global-energy-related-co2-emissions-by-sector.

[2] Bluebook citation: Paris Agreement to the United Nations Framework Convention on Climate Change, Dec. 12, 2015, T.I.A.S. No. 16-1104.

[3] REN21. 2020. Renewables 2020 Global Status Report (Paris: REN21 Secretariat). ISBN 978-3-948393-00

[4] IRENA (2019). Future of wind: Deployment, investment, technology, grid integration and socio-economic aspects

[5] IRENA (2020).Renewable capacity statistics 2020 International Renewable Energy Agency (IRENA), Abu Dhabi

[6] Melikoğlu, M. (2016). "The Role of Renewables and Nuclear Energy in Turkey's Vision 2023 Energy Targets: Economic and Technical Scrutiny". *Renewable and Sustainable Energy Reviews,* 62, pp. 1-12.

[7] TWEA (2019). "*Turkish Wind Energy Statistic Report 2019*". Turkish Wind Energy Association

[8] Adalar Belediyesi. "*İlçemiz* Sayfası-Büyükada". Retrieved from http://www.adalar.bel.tr/ilcemiz-sayfasi/buyukada.html

[9] Republic of Turkey Ministry of Energy and Natural Resources (2018). "Info Bank-Renewable Energy-Resources-Wind-Wind Energy Potential Map (REPA)". Retrieved from https://enerji.gov.tr/eigm-resources

[10] Sulukan E. (2018). "*An analysis of centennial wind power targets of Turkey*". Turkish Journal of Electrical Engineering & Computer Science (2018) 26: 2726 – 2736

[11] Meissner C. (2017). WindSim Getting Started 11th Edition. WindSim AS.

[12] GAMESA, Turbines-Gamesa G90-Datasheet. Retrieved from https://en.wind-turbine-models.com/turbines/763-gamesa-g90

Research Article

EVALUATION OF STRUCTURAL ELEMENTS AND MODELING OF ÇARDAK KHAN[1*]

Esra ŞAHİN[1]

[1] *Öğr. Gör., Department of Construction Technology, Istanbul Aydın University, Istanbul, Turkey, esrasahin3@aydin.edu.tr, ORCID: 0000-0001-5842-9115*

ABSTRACT

Historical masonry structures are of great importance in terms of transmitting our cultural heritage to future generations. In order to protect these masonry structures, it is necessary to evaluate the structural elements and model the building. In this study, it is aimed to model a historical building and present the structural elements depending on the current situation. The Çardak caravanserai in Denizli, which was built in the Seljuk Period, was chosen as a case study because it preserves its originality and integrity. In this context, the software used for modeling is SAP2000 v20.2 commercial finite element analysis and design software. For modeling, frame elements were used in columns, and shell elements were used in other structural elements. As a result, the structural elements were interpreted and the model was applied.

Keywords: *Historical Structure*, *Caravanserai, Modeling, Structural Element*

1. INTRODUCTION

Çardak caravanserai in Denizli, known as Han-abad, was built by Esedüddin Ayaz bin Abdullah Eş-Şihabi in 1230 during Alaeddin Keykubad period. The caravanserai is 55 km to the east of Denizli and 300 m to the north of Denizli-Afyon highway, connected to Çardak province. It continued to be used during the Beylik and Ottoman periods. Han-abad was used for cereal storage during World War 1 (1914-1918) and the Turkish War of Independence (1920-1922) [1]. Shortly after that, the local people used it as a sheepfold [2]. The 800-year-old monument has suffered many earthquakes and it has been subjected to excavations and restoration works throughout history. It was restored in the 1920s. Excavations were carried out at the caravanserai in 2006. The restoration works have continued, which started in 2017 [3,4].

Many artistic and architectural works have been done in Çardak caravanserai. The building elements and modeling of the historical building were made as a thesis study in 2019 and were edited as an article. In addition, the structural analyzes of the Çardak Khan were presented at ISPEC 9th International Science and Engineering Congress and published in the book.

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2. STRUCTURAL SYSTEM

The monument located in the east-west direction is formed a rectangular courtyard (32.27 m in length, 31.16 m in width) with building ruins and a prismatic shelter (29.23 m in length, 26 m in height) entered from the courtyard as shown in figure 1. The northern part of the courtyard is in ruins. These parts consist of various functions such as the bath, kitchen, storage, workshop, staff room and iwan. The shelter to the west of the courtyard is a vaulted building consisting of a single space. The length and weight of the shelter are 29.23 m. and 26 m., respectively. There are five barrel-vaulted galleries in the east-west direction. In addition, there are pierced walls separating the central walls. The height of the central gallery is 5.40 m. The vaults, which are 4.60 m high, descend from the center to the sides. Remains of low walls made of non-bearing walls also belong to the original platforms to accommodate people and belongings. The small ventilation holes in the vaults allow light to enter the shelter. The only opening at ground level is the portal. There are circular buttresses on both sides of the portal. Other buttresses have triangular and polygonal shapes. These buttresses ensure that the caravanserai is equally supported from both sides. Also, the caravanserai has a terrace. There is a staircase made of cut stone on the southeast side that enables access to this terrace [3,4].

Figure 1: Çardak Khan

3. STRUCTURAL ELEMENTS

Structural elements occur the superstructural elements, walls and buttresses, floor and staircase, and foundations.

Superstructural elements consist of vaults, arches, the squinch remain and a concrete slab as shown in figure 2. The barrel vaults of the shelter are located in east-west direction as shown in figure 3. The spanning distance at the center is 4.50 m, while it diminishes to 3.58 m and 1.97 m in the vaults at its north, and 3.06 m and 1.50 m in the vaults its south, respectively. Their heights are 3.10 m, 3.11 m, 3.37 m, 3.14 m and 2.98 m respectively from the north to the south. Their profiles are double centered and pointed as shown in figure 4. They are out of rubble stone put together with lime mortar. At their exterior, earthen finishing is observed. There are ventilation holes along the keystones of the vaults. Just under the springing line of the vaults, the construction holes are still observable [3].

Figure 2: Superstructure Elements as Viewed from The West

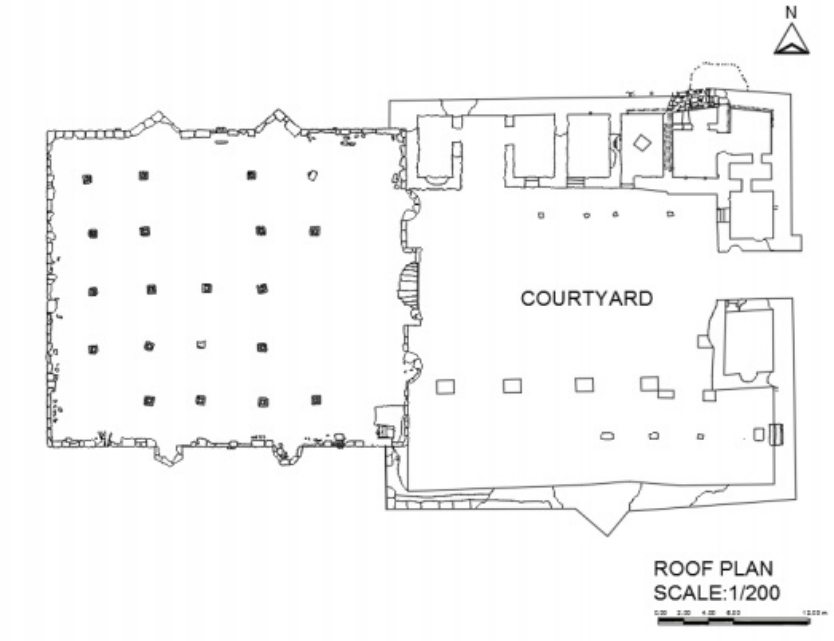

Figure 3: Roof Plan [5]

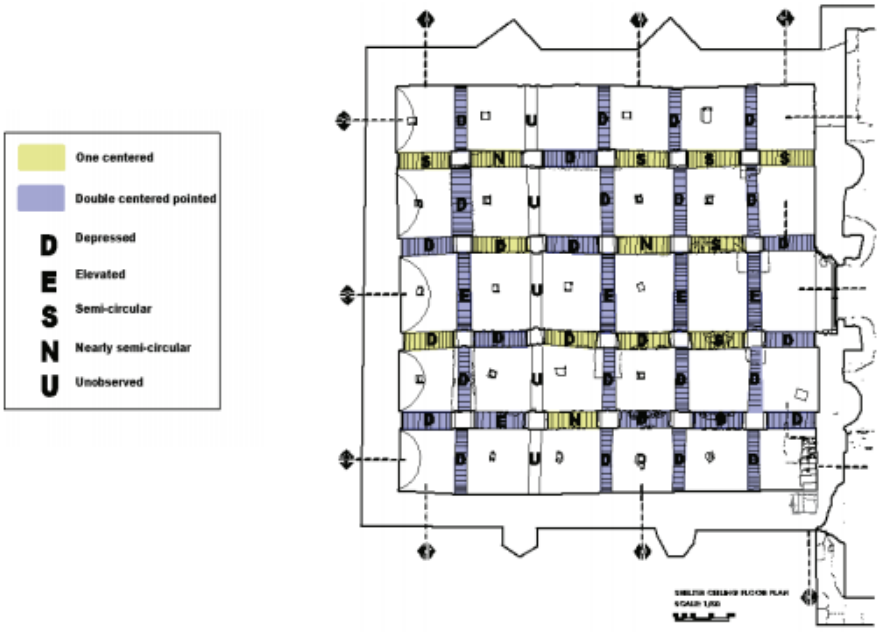

Figure 4: Vault and Arch [5]

The load-bearing exterior walls of the shelter are continuous walls. The eastern and southern ones that used to be observed from the old caravan route are out of well-cut stone at their outer surface, rough cut stone at inner surface and rubble stone and lime mortar in between as seen in figure 5. The western and northern walls that were designed as rear facades are out of relatively low-quality cut stone at their outer surfaces, rough cut stone at inner surface and rubble stone in between. The widths of northern and southern walls carrying the loads of the vaults are 1.80 m and 2.20 m, respectively. The widths of 29 the western and eastern walls carrying their own loads are 1.40 m and 1.70 m, respectively [3].

These walls are supported with buttresses from their exteriors, excluding the western one. There are two buttresses distributed evenly at each facade. Their forms are triangular (width: 375 cm, projection: 24 cm, height: 3.68 m), circular (width: 193 cm, projection: 110 cm, height: 5.27 m) and polygonal (width: 213 cm, projection: 121 cm, height: 4.80 m) starting from the north in clockwise order [3].

The interior load bearing wall of the shelter in figure 6, which are pierced with arches, are cut stone at their both surfaces. Their sections are unobserved. Their widths are 85 cm and 87.5 cm from the north to the south. The surfaces facing the central gallery are decorated with pilasters and animal figures. The non-load bearing walls at the interior belong to the original platforms for resting of people. At present, they define two u forms at the second and fourth galleries from the north to the south. They are single layered and out of rubble stone and lime mortar. Their widths are the same as the related load bearing wall. As the construction joints reveal, the service spaces around the courtyard were constructed after the completion of the shelter walls. Nevertheless, their techniques are very similar. Thus, there is not a period difference. The load-bearing exterior walls of the

service spaces around the courtyard are also continuous and three layered. The difference in the elaboration of front and rear facades 31 is visible here as well. They are well cut stone and relatively low-quality cut stone at the outer surfaces of the front and rear facades, respectively. The interior surfaces are rough cut stone and the cores are rubble stone and lime mortar. Only at the middle portion of the northern wall, which corresponds to the bath ruins, a different technique is observed: rough cut stone at both surfaces, and rubble stone and lime mortar in between. There is a triangular buttress (width: 229 cm, projection: 30 cm, height: 170 cm) supporting the southern wall. The widths are 104, 106, 110 and 105 cm, starting from the north in clockwise order. They are all partially collapsed and the maximum height observed is 1.85 m at the courtyard wall [3].

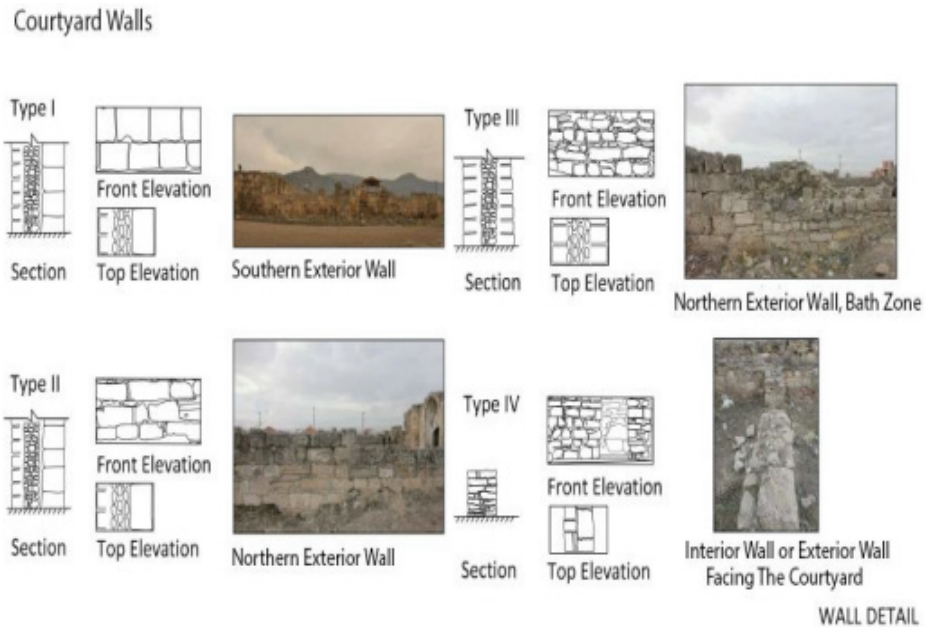

Figure 5: Wall Detail [5]

Figure 6: Interior Load Bearing Wall from Its Southeast

The ground of the shelter is screed at present. As the sampling excavations reveal, original rubble stone and compacted earth are present underneath the intervention layer as seen in figure 7. The courtyard is covered with debris in general. The staircase in figure 7 at the southeast corner of the shelter links the interior to the terrace roof. It is L formed; the lower portion is parallel to the eastern wall (width 35 cm, length 1.05 m), the upper portion is parallel to the southern wall (width 32 cm, length 1.25 m). The stairs are out of cut stone block, each approximately 30 cm in height [3].

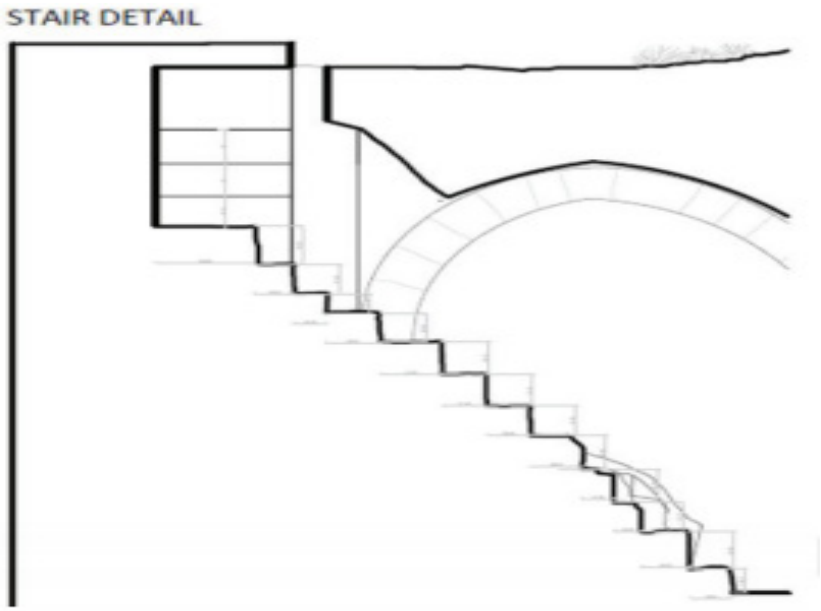

Figure 7: Stair Detail [5]

Figure 8: The Staircase

As the sampling excavations reveal, the foundations continue underneath the interior walls (non-load bearing walls) of the shelter and the interior walls of the service spaces as shown in figure 8. They are out of rubble stone [3].

Figure 9: The Foundations at The North

4. FINITE ELEMENT MODELING

Due to the complexity of load-bearing systems such as domes, vaults, and arches in historical masonry structures and the materials of these structures, some difficulties arise in the generation of finite elements in these structures. In order to minimize these difficulties, some simplifications in the varying cross-sections of the load-bearing elements and some idealization in material and geometry require [6].

In recent years, with the development of computer technology, geometric and material idealization has emerged in the finite element modeling of masonry structures. In geometric idealization, structural elements such as dome, vault and arch consist of linear parts for modeling. In material idealization, all elements are accepted as linear elastic since the building elements consist of brick and mortar. Thus, all structural elements are homogenized to a single elastic material [7].

The architectural plans and sections of the caravanserai were drawn in AutoCAD format [5]. Three-dimensional model was developed according to this format and SAP2000 version 20.2 was used for modeling the masonry structure as seen in figure 9-13.

Frame and shell elements are used for the finite element model. While the frame element is suitable for the use of columns, shell elements are used in other elements such as dome, wall, vault, arch. The shell elements are divided into finite elements (mesh) to match boundary conditions. It was applied with the maximum unit side length of each partition

of 30 cm. The pin support is defined at the base of the three dimensional model. The mass source is specified as dead load [4].

According to the literature, the modeling techniques of masonry structures for finite elements consist of two parts, macro and micro modeling [8]. The modeling technique used in this study was preferred as macro modeling since the units forming the masonry structure are considered as a single homogenized material [4].

In addition, the total weight of the structure is 60560 kN. The outer wall, inner wall and roof thicknesses of the building were taken as 200 cm, 65 cm and 40 cm respectively [4].

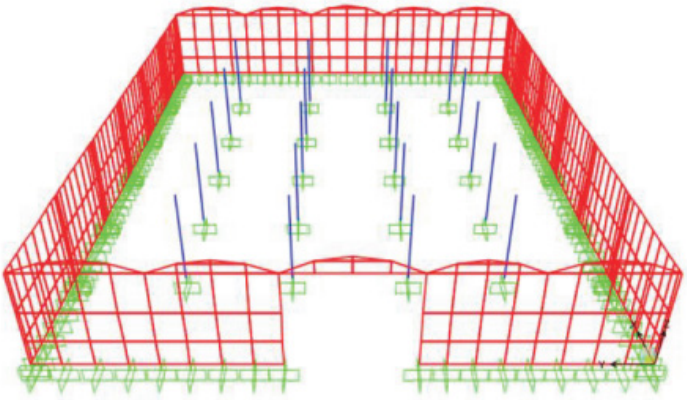

Figure 10: View of Columns and External Walls of The Khan

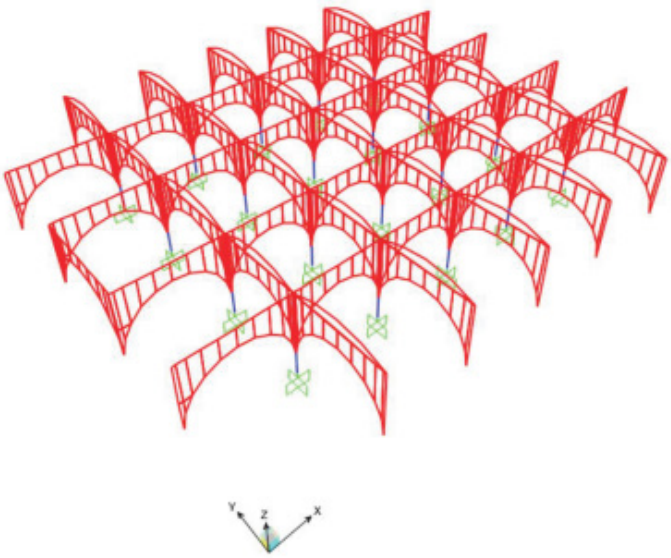

Figure 11: The Model without External Walls and Roof

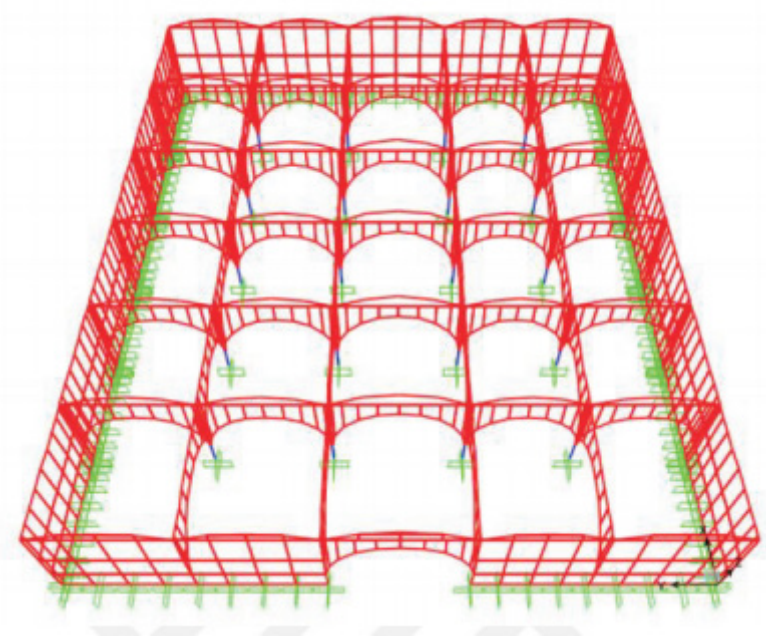

Figure 12: The Model without Roof

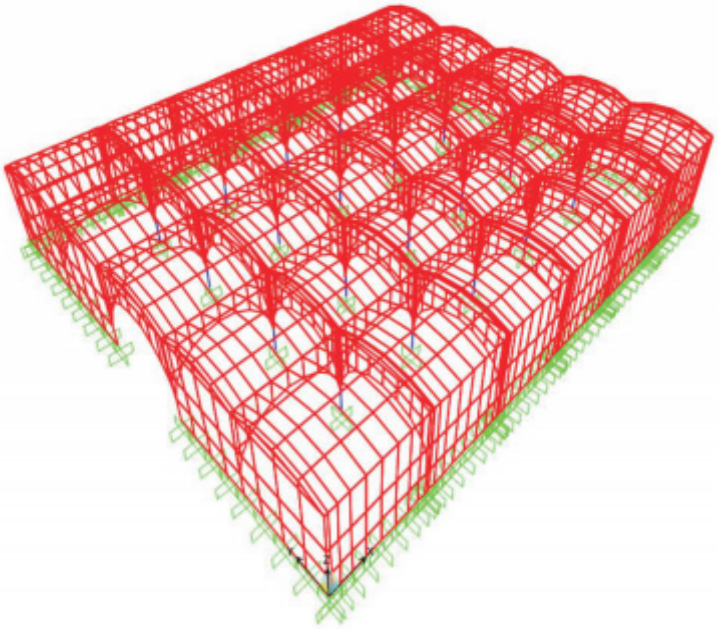

Figure 13: Shell and Frame Model

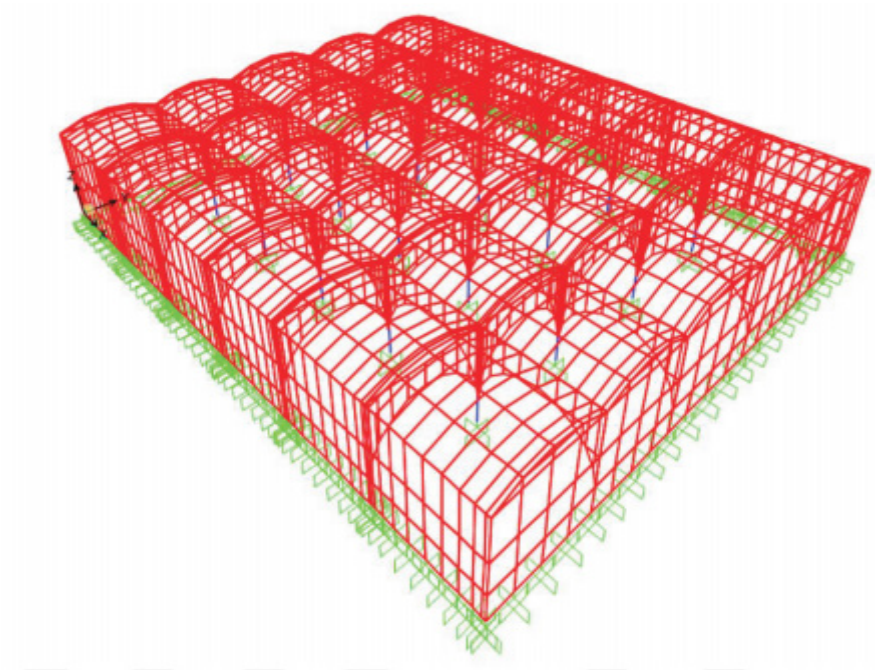

Figure 14: Back View of Shell and Frame Model

5. CONCLUSION AND RECOMMENDATION

Çardak caravanserai is a document reflecting the structural characteristics of the Seljuk period. It repeats the majority of the widespread characteristics, but there are a few peculiarities such as the two rectangular platforms, variation in the form of the buttresses, and masonry stairs providing access to the terrace roof.

In order to check for the validity of the finite element model operational modal analysis might be run and a calibration to the FEM model can be processed. The soil conditions need to be investigated as well to better assess the current situation. Material characterization and property estimation should be carried out in order to better represent them in the FEM model. In-situ and laboratory testing would be quite instrumental. Consolidation would be the first choice for preventive conservation. This would aim to restate the capacity with techniques such as injection of repair grout, and restating any loose units and completion of minor material losses.

Detailed structural analyzes and results are given in the master thesis "Structural Analyses and Assessment of Historical Çardak Caravanserai" published in 2019.

REFERENCES

[1] Kutlu M. (2009), Seljuk Caravanserais in The Vicinity of Denizli; Han-Abad (ÇardakHan) and Akhan, MSc. Thesis, Bilkent University, Ankara.

[2] Uzunçarşılı İsmail Hakkı. (1929), *Kitabeler 2*, İstanbul.

[3] Şahin E. (2019), Structural Analyses and Assessment of Historical Çardak Caravanserai in Denizli, Master Thesis, Izmir Institude of Technology, Izmir.

[4] Şahin E. (2020), Structural Performance Evaluation of Historical Çardak Caravanserai in Denizli by Performing Linear Analyses, 9th INTERNATIONAL CONFERENCE ON ENGINEERING AND NATURAL SCIENCES, ISBN: 978-625-7720-06-9, (Tam Metin/ Sözlü Bildiri), 160-172, Issued: 01.12.2020.

[5] Bayram A., Nalça C., Keke B., Özel E., Özdemir E., Yönetken E., Eken E., Durmuşlar F., Şener İ., Ergin M., Birgin Ö., Yönder M. (2017), Restoration Project of Çardak Khan Denizli, Design in Architectural Restoration II, 2016-2017 Spring Semester, Supervisors: M. Hamamcıoğlu Turan and K. Çelik, Izmir Institute of Technology (IZTECH), Department of Architectural Restoration, Izmir.

[6] Vakıflar Genel Müdürlüğü, 2016, "Tarihi Yapılar İçin Deprem Risklerinin Yönetimi Kılavuzu" https://www.vgm.gov.tr/organizasyonlar/Documents/Sablon+pdf 25/04/2019.

[7] Dabanlı Ö. (2008), Tarihi Yığma Yapılarının Deprem Performansının Belirlenmesi, Yüksek Lisans Tezi, İstanbul Teknik Üniversitesi, İstanbul.

[8] Kömürcü S. (2017), Analysis and Modelling of The In-Plane Behavior of Masonry Walls, MSc. Thesis, Istanbul Technical University, İstanbul.

Research Article

PROJECT OF THE STRENGTHENING OF A WATER TANK CARRIER SYSTEM WITH CARBON FIBER MATERIAL[1*]

Mehmet Fatih ALTAN[1], Muhammed AYDOĞAN[2]

[1] Prof., Department of Civil Engineering, Istanbul Aydin University, Istanbul, Turkey, mehmetaltan@aydin.edu.tr, ORCID: 0000-0003-0961-0115

[2] Department of Civil Engineering, Istanbul Aydin University, Istanbul, Turkey, mhmmdaydogan@gmail.com, ORCID: 0000-0002-8804-6577

ABSTRACT

Elevated water tanks with reinforced concrete carrier systems are extremely important structures for public service or industrial use, and therefore they should be kept in a usable condition after an earthquake. The design and construction methods of these structures are affected by current construction practices, physical properties of the material and climatic conditions. Structural system damages are inevitable due to reasons such as improper designs, wrong analysis, lack of seismic wave resistant design, faulty geological preferences. In this study, the reinforced concrete carrier system of a sample water tank was examined in both cases, both in its current form and reinforced with FRP, using the SAP2000 program. By discussing the advantages of using FRP in these structures, it was suggested that it could be preferred primarily for reinforcement.

Keywords: *Pushover Analysis, Reinforcement, Seismic Performance, Vibration Forces, Elevated Water Tanks.*

1. INTRODUCTION

Elevated water tanks with reinforced concrete carrier systems are extremely important structures for public service or industrial use, and therefore they should be kept in a usable condition after an earthquake. The design and construction methods of these structures are affected by current construction practices, physical properties of the material and climatic conditions. Structural system damages are inevitable due to reasons such as improper designs, wrong analysis, lack of seismic wave resistant design, faulty geological preferences. Water tank design parameters include selecting the overall design of the tank, building materials and coatings. The design depends on the location of the tanks, different approaches are used for aboveground or underground water tanks [1]. Tanks can be made of RC or steel. Raised tanks are usually raised above ground level

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using columns and beams. Retrofitting is a method applied to increase the strength of the existing structure and also increases the strength of the newly constructed structures due to the error in the design and construction errors. If we list the methods of retrofitting. Over slabbing, sprayed concrete with additional reinforcement, steel plate bonding, external prestressing, concrete jacketing, steel jacketing and FRP wrapping [2,3].

2. MATERIALS AND METHODS

Housner conducted the first research to address the seismic response behavior of both underground and high water reservoirs exposed to earthquake lateral loads. Housner proposed a formulation to model the dynamic response of water inside tanks that are still widely used in engineering practice. According to Housner's proposed formulation, the hydrodynamic response is divided into two components of impulsive and convective vibration [4,5]. It is assumed that the impulsive vibration mode is attached to the tank wall (rigid connection). Convective motion, on the other hand, is the oscillation of the water surface, which has a longer vibration period, modeled as a collective mass attached to the wall using springs [6].

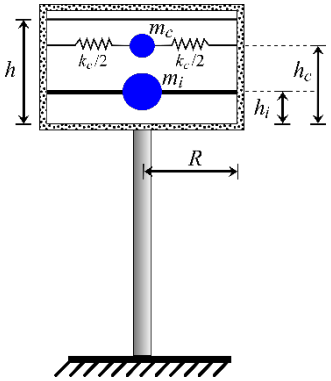


Figure 1: Mechanical model equivalent to the raised water tank

The equations for the Housner (Epstein, 1976) approximations for hydrodynamic pressure are set below [7].

$$\omega^2 = \frac{g}{R} 1.84 \tanh\left(1.84 \frac{h}{R}\right) \tag{1}$$

$$h_i = \frac{3}{8} h \tag{2}$$

$$k_c = m_c \frac{g}{R} 1.84 \tanh\left(1.84 \frac{h}{R}\right) \tag{3}$$

$$m_c = m_w \cdot 0.318 \frac{R}{h} \tanh\left(1.84 \frac{h}{R}\right) \tag{4}$$

$$m_i = m_w \frac{\tanh\left(1.74 \frac{R}{h}\right)}{1.74 \frac{R}{h}} \tag{5}$$

$$h_c = \left(1 - \frac{\cosh\left(1.84 \frac{h}{R}\right) - 1}{1.84 \frac{h}{R} \sinh\left(1.84 \frac{h}{R}\right)}\right) h \tag{6}$$

Where, w structural frequency, k_c stiffness of convective mass springs, m_c convective masses, m_i impulsive mass, h_c height of convective masses, h_i height of the impulsive mass, m_w total mass and g ground acceleration [8].

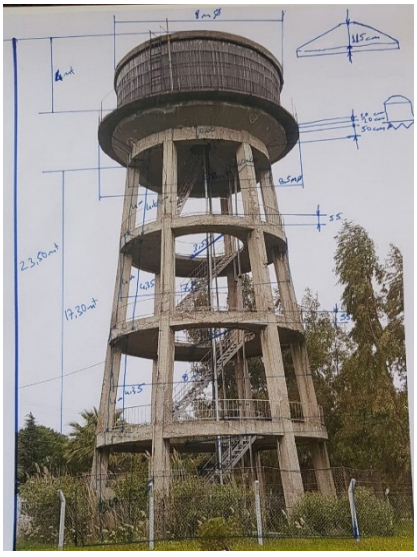


Figure 2: Sample water tank with RC carrier system

The SI international measurement unit system (kN, m) was used both in design, calculations and drawings.

Table 1: SI international units of measure

Physical size	Unit of
Length	m
Loads	kN
Weight	kN
Mass	Kn.sn^2/m
Momentum	kN.m
Stress	kN/m^2

For the structural design of the structure, SAP2000 Ver 14.2.4 computer aided design and analysis program, capable of performing finite element analysis, was used. The dead load will include the weights of all fixed parts of the structures and their additions. The following assumptions have been made for all weight calculations.

- Roof cover volume unit weight, $\gamma = 0.25$ kN/m^2
- Volume unit weight of reinforced concrete, $\gamma = 25.0$ kN/m^3
- Volume unit weight of concrete without reinforcement, $\gamma = 25.0$ kN/m^3
- G dead = dead load
- WG = water weight
- Q live = 3 kN/m^2

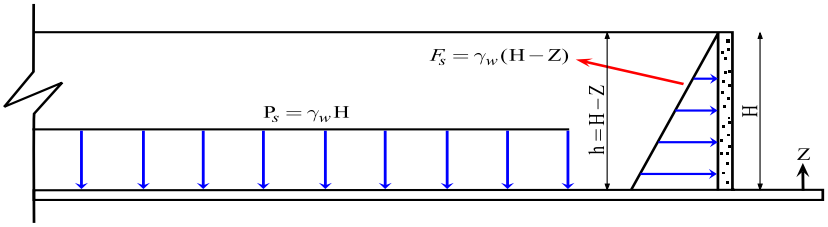


Figure 3: Hydrostatic pressure (a)

If we take $F_s = \gamma_w (H - Z) = 1000(4 - Z)$ and $Z = 0$

$F_s = 4000$ kg/m^2 = 40 kN/m^2 is found.

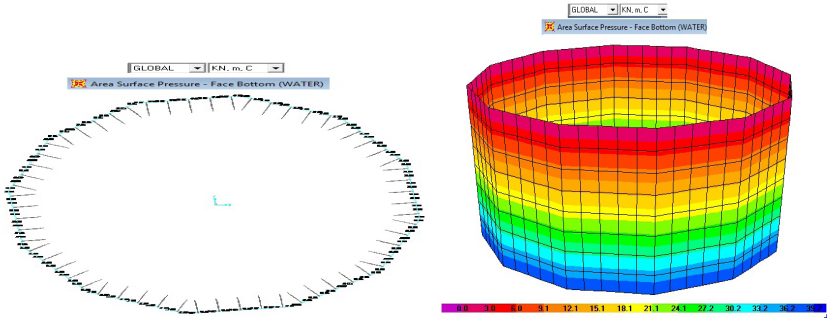


Figure 4: Hydrostatic pressure (b)

Table 2: Effective ground acceleration coefficient (A_0)

Earthquake Zone	A_0
1	0.40
2	0.30
3	0.20
4	0.10

The effective ground acceleration coefficient for the earthquake load is taken as A_o = 0.4, building importance factor, I = 1 and soil group = C (Soil Investigation Report). The Spectrum coefficient is calculated from the following equations.

$$S(T)=\begin{cases}1+1.5\dfrac{T}{T_A} & ,\ 0\le T\le T_A\\ 2.5 & ,\ T_A<T\le T_B\\ 2.5\left(\dfrac{T_B}{T}\right)^{0.8} & ,\ T_B<T\end{cases} \tag{7}$$

The following defined reduced acceleration spectrum is used in Sap2000.

$$S_R(T_n)=\frac{S(T_n)}{R_a(T_n)} \tag{8}$$

Calculation of the storey masses was made by taking n = 0.3 according to the following equations.

$$W=\sum_{i=1}^{N} w_i \tag{9}$$

$$w_i = g_i + nq_i \tag{10}$$

Table 3: Spectrum characteristic periods (T_A, T_B)

Local ground class	T_A (sec)	T_B (sec)
Z1	0.10	0.30
Z2	0.15	0.40
Z3	0.15	0.60
Z4	0.20	0.90

For the internal forces found, the section will be increased by taking β = 0.9, and if V_{tB} < β.V_t for the predicted earthquake, all internal force and displacement magnitudes found according to the mode combination method will be increased according to equation 11.

$$B_D=\frac{\hat{a}\,V_t}{V_{tB}}B_B \tag{11}$$

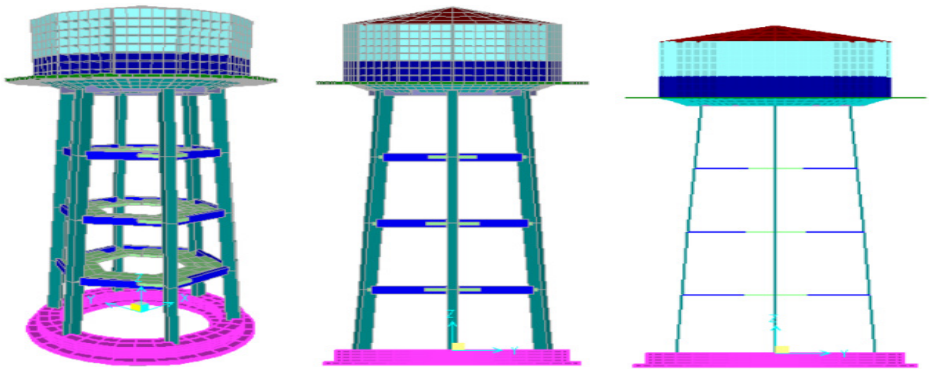


Figure 5: Computer model of the building

Where V_{tB} is the building total load and V_t is the building total earthquake load. The formulas used for the equivalent earthquake load value to be used for the above calculation;

$$A(T) = A_0 \cdot I \cdot S(T) \tag{12}$$

$$S_{ae}(T) = A(T) \cdot g \tag{13}$$

$$V_t = \frac{W \cdot A(T_1)}{R_a(T_1)} \geq 0.10 \cdot A_0 \cdot I \cdot W \tag{14}$$

$$T_1 = 2\pi \left(\frac{\sum_{i=1}^{N} m_i \cdot d_{fi}^2}{\sum_{i=1}^{N} F_{fi} \cdot d_{fi}} \right)^{\frac{1}{2}} \tag{15}$$

Input Parameters		
Fluid Unit Weight, γ =	1	ton/m^3
Tank Diameter, R =	4	m
Water Height, h=	4	m
Seismic Zone=	1	
Soil Type=	Z3	
Important factor, I=	1	
TA=	0.15	sec
TB=	0.6	sec
Reduction Factor, R=	4	
Effective Ground Acceleration, A0=	0.4	g
Natural Period of Vibration of the Fluid Tank, T =	3.033353	sec
Spectral Acceleration, SA	0.068379	g
Acceleration Gravity	9.81	m/s^2
General Computations		
Water Weight, W=	230	ton
Steel Tank Weight, Wt =	185	
Calculations of Impulsive Forces		
Equivalent weight of fluid, W0=	124.7299	ton
Gross Equivalent weight of fluid, W0"=	309.7299	ton
Application distance from the bottom of the tank, h0 (EBP) = h0"=	1.5	m
Application distance from the bottom of the tank, h0 (IBP) =h0"=	3.187969	m
Impulsive Force, P0=	49.89195	m
Modified Impulsive Force, P0" =	123.892	ton
Bending Moment, M0" (EBP)=	185.8379	ton.m
Bending Moment, M0" (IBP)=	394.9638	ton.m
Calculations of Convective Forces		
Equivalent Oscillating Weight, W1=	69.54116	ton
Application distance from the bottom of the tank, h1 (EBP)=	2.421962	m
Application distance from the bottom of the tank, h1 (IBP)=	3.137424	m
Circular frequency of free Vibration, ω =	2.071366	rad
Natural Period of Vibration, T =	3.033353	sec
Maximum Displacement of W1, A1=	0.323843	m
Angular amplitude of water free oscillation, θh =	0.118083	
Convective Force, P1=	9.853947	ton
Bending Moment, M1 (EBP)=	23.86589	ton.m
Bending Moment, M1 (IBP)=	30.91601	ton.m
Maximum Water surface Displacement, dmax=	0.446913	m
K rigidity of the mass of oscillation	298.0662	ton.m

Figure 6: Hydrodynamic forces in a cylindrical tank (h <1.5R)

3. REINFORCEMENT OF THE WATER TANK USING FRP

The displacement limit for the non-reinforced model is =: (disp/h) < 0.025, disp (max) = 0.025x18.35x100 / 4.5 = 10.1 cm and the displacement in the model is = 17.80 cm. If we take the time period = 1.26;

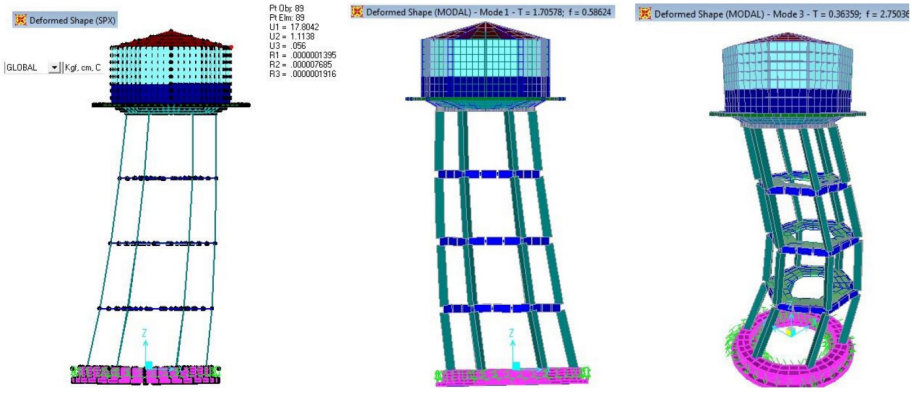
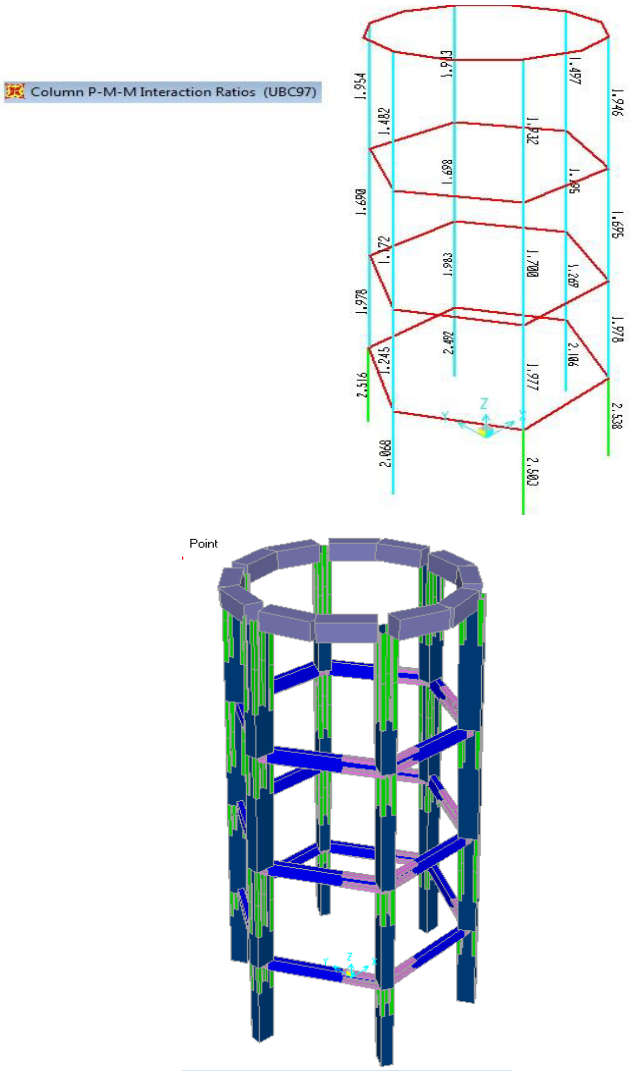


Figure 7: Deformed shape

All of the columns have 2Ø14 iron in 4Ø22 cores on short corners and stirrups are positioned Ø8/20 cm apart. For all the beams, there are 2Ø12 piles at the top and 4Ø12 reinforcement at the bottom. In this model, the concrete class has been entered as f_c = 10 Mpa.



(a) (b)

Figure 8: (a) Column and beam design (not reinforced) (b) Bracing made in beams and columns

For the model reinforced with FRP, the braces are 4 pieces (12x12x1) and the brace area is: 24x4 = 96 cm^2.

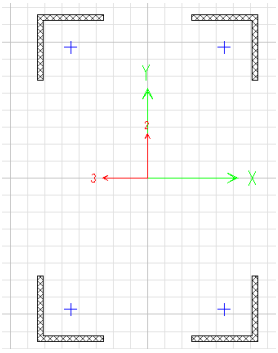
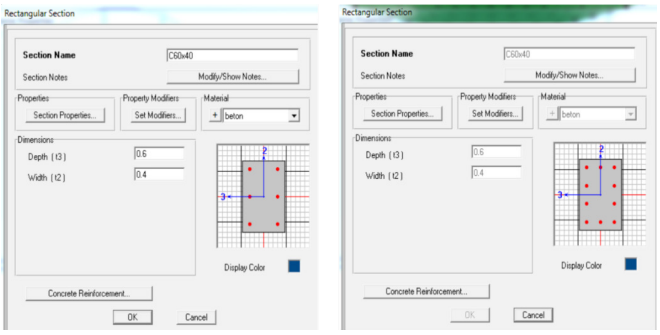


Figure 9: Column section with FRP bracing

After these brackets are made, we use the section in Figure 10 (b) instead of the column section.



(a) (b)

Figure 10: (a) Non-reinforced column section (b) Reinforced column section

Assuming that it increases the axial strength of the column by 100 %, the concrete class has been entered as f_c = 20 Mpa.

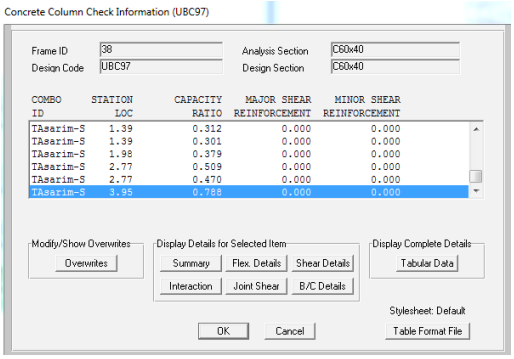


Figure 11: Column check information

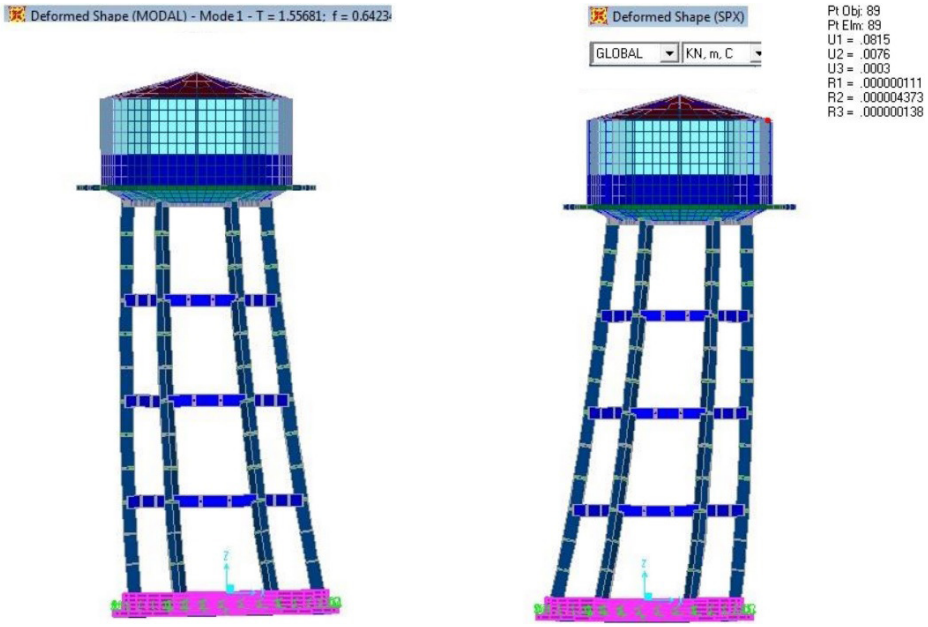


Figure 12: Time period = 1.56 seconds (period dropped 20%)

The displacement limit =: (disp/h) x cd < 0.025 and disp (max) = 0.025 x 18.35 x 100 / 4.5 = 10.2 cm > 8.2 cm.

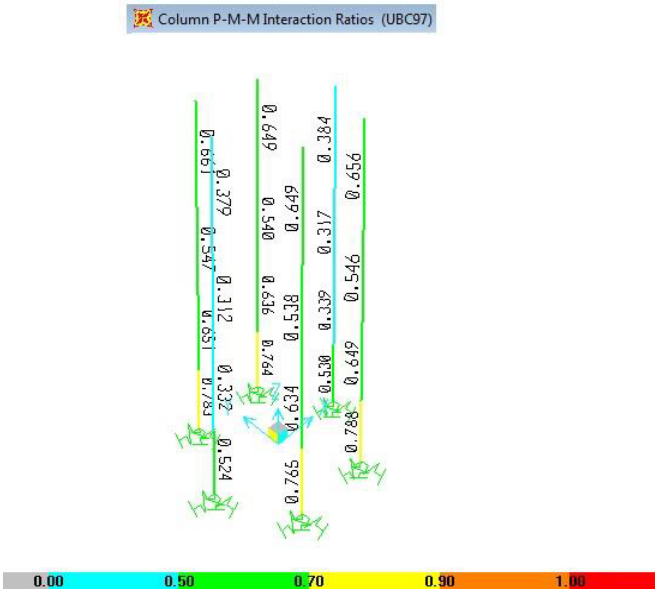


Figure 13: Column P-M-M interaction ratios

k_s = 10000 kN/m^3 and ground safety tension = 100 kN/m^2.

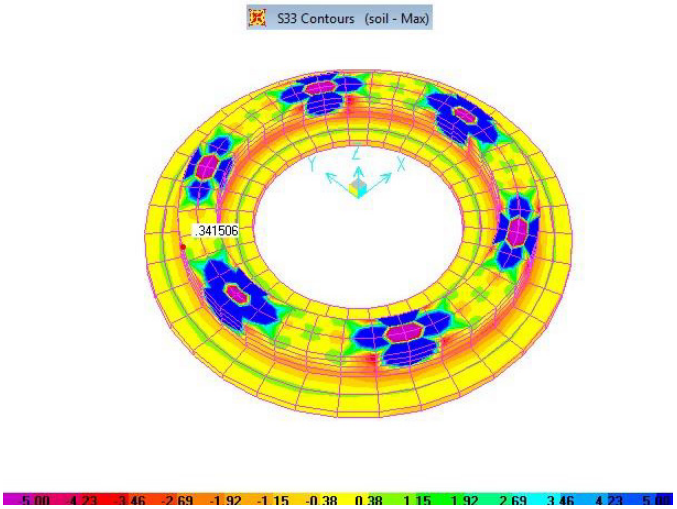


Figure 14: Foundation stresses (0.75 Dead + 0.75 Q Live + 0.75 SPX) were taken.

4. CONCLUSION AND SUGGESTIONS

FRP has an elastic behavior up to failure, unlike steel which exerts a constant wrapping pressure after application, and therefore applies the wrapping action differently than steel on concrete specimens under axial load. The advantages of using FRP to strengthen the carrier systems of water tanks can be listed as follows.

- It is resistant to corrosion,
- High strength / weight ratio,
- Shorter assembly time and cost,
- It is not conductive and metallic,
- Low maintenance requirements,

Fire resistance, which is an important disadvantage in the use of FRP, is not valid in water tanks. The possibility of fire in a building with risks from heating systems or full of flammable materials is not present in the water tank. In addition, we can talk about an extra advantage since no flammable material is stored in this type of tank. The possibility of leaks in the water tanks to cause corrosion in the conveyor system due to wear or insufficient maintenance is seriously reduced by the use of FRP. Advantages of using FRP over steel reinforcement include linear elastic behavior on failure, no yield, higher ultimate strength, and lower strain on failure. As a result, the use of FRP in water tanks is extremely important due to its increased load capacity and increased deformation capability.

REFERENCES

[1] Biradar G., Prakash C. H., Suresh D., Kumar S. K. S. (2016). Structural Strengthening of Reinforced Column.

[2] Kapadia I., Dholiya N., Patel P., Patel N. (2017). Parametric Study of Rcc Staging (Support Structure) For Overhead Water Tanks As Per 1S:811682–1985 and IS:3370.

[3] Soroushnia S., Tafreshi T., Omidinasab F., Beheshtian N., Soroushnia S. (2011). Seismic Performance of RC Elevated Water Tanks with Frame Staging and Exhibition Damage Pattern.

[4] Thalapathy M., Vijaisarathi R. P., Sudhakar P., Sridharan V., Satheesh V. S. (2016). Analysis and Economical Design of Water Tanks.

[5] Motavalli M. (2019). Column Confinement - Empa.

[6] ISIS Educational Module 4, An Introduction to FRP Strengthening of Concrete Structures, 2010.

[7] Livaoğlu R., Doğangün A. (2006). Simplified seismic analysis procedures for elevated tanks considering fluid–structure–soil interaction.

[8] Ghateh R. (2006). Nonlinear Seismic Response of Reinforced Concrete Pedestals In Elevated Water Tanks.

Research Article

FACTORS AFFECTING FOOD SELECTION AND NEW TRENDS IN CONSUMER FOOD BEHAVIOUR[1*]

Y. Birol SAYGI[1], Z. Dilistan SHIPMAN[2]

[1] Prof. Dr., Beykoz University, Head of Gastronomy and Culinary Arts Department, birolsaygi@beykoz.edu.tr, ORCID: 0000-0001-9829-960X

[2] Dr., İstanbul Bilgi University, Head of Gastronomy and Culinary Arts Department, dilistan.shipman@bilgi.edu.tr, ORCID: 0000-0001-9381-7295

ABSTRACT

Which products people purchase and consume, how they make their decision is known as the consumers' food choice process. The specs and the features of the products on the package may have an impact on personal food preferences. Other personal factors that affect food choices can be habits or taste preferences. Factors that are even more effective in choosing food are culture and tradition, the way individuals are brought up or the traditional role of food in the family. Our food choices are influenced by a complex group of factors that vary from person to person but can also depend on the culture. It may also depend on our mood or other factors such as our appetite and being in a hurry. The purpose of this article is to identify and discuss the most important trends in consumers' nutritional behaviors that contribute to the development of marketing strategies for food companies. The article shows the theoretical aspects of new trends in consumer food behavior, the marketing strategies of food companies and the interaction between these two aspects.

Keywords: *Food, Food Selection, Consumers, Consumer Behavior, Nutrition*

1. INTRODUCTION

Food selection is about what products people buy and eat and how they make decisions. Product characteristics that are visible on the package and affect personal preferences can also affect food selection. Other personal factors that influence food selection can be habits ("I always buy this") or taste preferences ("I like the taste of this"). Even more influential factors in food selection are culture and tradition, the way one is raised or the traditional role of the food in the family. Our food choices are influenced by a complex set of factors that vary from person to person but can also depend on culture. It may also depend on our mood or other factors such as our appetite and being in a hurry.

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Providing consumers with products that meet their needs and at the same time bring financial profit to their producer is a particularly difficult task for food producers because buyers' preferences arise from the subjective assessment of the sensory quality of foods. The manufacturer must also meet a number of systematic and legal requirements arising from the necessity to ensure the health safety of the manufactured products. Defining the market requirements for a manufacturer is a key marketing task in formulating the company's strategy [14].

The purpose of this article is to identify and discuss the most important trends in the nutritional behavior of consumers that have contributed to the development of marketing strategies for food companies. The article shows the theoretical aspects of new trends in consumers' food behavior, the marketing strategies of food companies and the interaction between these two aspects.

A person eats an average of 70 thousand times in his life, which means approximately 30 tons of food. A large part of this amount of food is consumed for nourishment, that is, to benefit from the nutrients contained in foods. Food is an integral part of people's daily lives. Apart from being a simple daily function, food is important for human health and happiness. Nutrition is the intake of each of the energy and nutrients required for human growth and development, tissue regeneration and functioning in adequate and balanced amounts, and their proper use in the body. Food processing has started in the prehistoric period in parallel with the increase in agriculture and livestock raising; it has become an inevitable phenomenon to protect our food in order to reduce the losses due to spoilage and to survive in times of famine. Food science is a multidisciplinary science. Food has a complex structural character and consumer preferences are at the forefront. Consumer preferences are an intersection formed by the combination of many factors. Examining the factors of this complex structure that affects consumers' choices is crucial for creating a successful product and for a sustainable success [1, 3, 5, 18, 24, 27, 28, 29].

Physiological Factors: Physiological factors affect the body's need and nutritional desire. It should contain sufficient nutrients for the body to stay healthy and function properly [2, 6, 12, 13, 25, 26, 31, 32, 34].

Hunger Level: Hunger can be defined as the feeling of emptiness, weakness or pain caused by lack of food. As time passes, it becomes more intense until you think less of food. Hunger is controlled by a small gland in the brain called the hypothalamus. The hypothalamus has important functions in the body and works in coordination with the pituitary gland. It is their duty to control body temperature, regulate appetite, thirst and body fluids, balance sleep and alertness, control growth and various glands and sex hormones in the body.

Appetite: Appetite is the desire for food even when the body is not hungry. Appetite can be triggered by the appearance of the food, the flavor of the prepared food, the word food during speech and thinking. The hypothalamus gland registers these cues through the senses and sends messages that encourage the person to think about food. The salivary glands are stimulated, producing extra fluid, and mouth watering begin. Unlike hunger, if the appetite is not satisfied, it will eventually disappear from the body.

Nutritional Requirements: Consumers make their food choices to stay healthy and feel healthy. Our foods must provide essential nutrients necessary for metabolism. There are five different categories of nutritional requirements: body size / type, age, activity level, gender, and health status.

Body size / type: Varies in accordance with the nutritional requirements of different human body sizes. Individuals with larger sizes need more nutrients to maintain the functions of their bodies. Likewise, there are people with smaller body sizes that require less protein for the maintenance and repair of their body tissues because their body mass is smaller.

Age: Buyer decisions are affected by extroverted characteristics such as age, stages of family life, lifestyle and personality. There are certain characteristics that can be distinguished from the needs and interests of every age group for example, wellness and diet products for the elderly. Life cycles are also among the factors that affect purchasing decisions. The human body goes through certain growth stages throughout its life. Dramatic changes are seen in body proportions from infancy to adolescence. Arms increase in length and muscle ratio allowing more movement and coordination; their legs are extended to complete half the body height. The growth and development period continue throughout adolescence until the body reaches a more mature form. Since foods carry out special functions within the body, the amount of nutrients an individual needs is regulated by growth processes.

Level of activity: The requirement for a physically active person to consume more energy-giving foods is higher than the person who lives a less active life. A sedentary person requires less nutrients than an active person. If a person consumes a large amount of energy but does not move much, the body stores the excess as adipose tissue.

Gender: The individual's gender also determines the nutritional requirements. Biological activities such as menstruation and childbirth mean that women should take a diet with a higher content of iron and calcium intake. Men have a higher percentage of muscle tissue in their bodies. For this reason, they need to take higher amounts of protein than women. Gender also affects the parts of the body where adipose tissue is stored. Women are more likely to have extra fatty tissue in their upper arms, breasts, waist, hips, and thighs.

Health status: A person's state of health can make the person consume certain types of food less than other foods. For example, if a person has high cholesterol (which can ultimately cause heart disease), he/she should reduce the amount of saturated fats in their diet. Some diseases that may be associated with malnutrition include beriberi, pellagra, rickets, scurvy, osteoporosis, and anemia.

Personal Eating-Drinking Reactions: Our personal perceptions have a huge impact on our food choice. Individuals choose or reject their food based on their reactions to the food's physical appearance, presentation, smell, and texture. We use our senses to measure the quality of food. Judgments based on these reactions are called sensory perceptions. Attractive colors and creative presentations stimulate our appetite. Food preparationers are aware that the aesthetic appearance of the meals can increase or delay the appetite of those to whom the meals are served. Food is placed on the plate in a way to increase the appetite. Some people have limited food choices because they have a physical reaction. Responses vary among individuals and may include abdominal swelling, vomiting, itching and skin rash, wheezing, headache, and disturbed sleep.

Psychological Factors: Psychological factors are related to the mind and emotions. They differ from person to person, depending on their lifestyle and the person's upbringing. These are difficult to define. While the choices made as a result of emotions, self-confidence and attitudes may change day by day, some psychological factors such as beliefs, habits, values and past experiences with food have a permanent effect on the

selected foods. Psychological factors may play a more dominant role in our food choices compared to other factors (2, 15, 17).

Values: Value is a deeply personal sense of what is important. Values are strong enough to influence behavior and motivate action. A person's values can reflect the values of the family and culture in which they were brought up, or they can be a personal response to experiences encountered through life. During food selection, the values likely to influence the choices are related to food sources and health protection. For example, vegetarianism is a reflection of food choice.

Beliefs and Attitudes: People become owners of beliefs and attitudes by experiencing and learning. Beliefs and attitudes affect people's purchasing behavior. A belief is a defining thought of a person about something. Beliefs can be built on knowledge, conviction and creed. Feelings may or may not play a role in beliefs. Manufacturers are very concerned with consumers' beliefs about their products and services. Beliefs create product and brand images, and people act on the images of products and brands. When consumers are asked whether they like a product, advertisement or brand, they are actually asked to express their attitude (33). Attitudes are the outer defense of inner feelings and reflect people's tendency towards objects. Although beliefs and attitudes are similar to each other as the final outcomes of the learning process with their cognitive and motivational processes, there are important differences between them. These contain different attributes and consequences in terms of behavior. Therefore, it is very important to state both concepts differently in order to gain a solid scientific meaning. Beliefs about what is acceptable for food vary around the world and often depend on religion and cultural heritage. A belief is an opinion that need not be based on positive scientific evidence. Unlike durable values, beliefs can be challenged and changed. Many religions have food traditions and impose restrictions on what their followers eat. Besides religious traditions, some social groups and cultures have specific beliefs about food. Most of these beliefs cannot be confirmed. Some cultural beliefs often prohibit eating certain foods and lead to food taboos. These taboos are more common in primitive cultures.

Habits: Food choices are usually routine. A habit is a phenomenon that is done regularly without thinking. Their eating habits are the same and like all habits, it is not easy to change. Our food habits are sometimes unhealthy. Changing personal diet is not easy.

Ego: Ego refers to how we feel about ourselves and how we define our personal appearance, including the size, shape and weight of our body (body image). How we look physically (our strengths and weaknesses), how well coordinated we are, how shy or sociable we are, how well we manage our money, how we dress, how skilled we are to art, music, dance, how important we are in the family as brother, son or daughter. Self-esteem develops in childhood. Dissatisfaction with body image increases from the age of eleven to middle ages, especially for women. Also, the ego is not static and can change over time, even several times a day.

Motivation: A person has many needs at any given time. Some needs are biological. These needs arise from physiological states of tension such as hunger, thirst and restlessness. Other needs are psychogenic. In other words, it arises from psychological states such as being known, respecting one's person or belonging to a place. A need becomes a motive when it is brought to a sufficient level of compulsion and craving. This motif is a need that challenges one enough to take action.

Intuition: Intuition is when one selects, organizes, and interprets information data to create a meaningful picture of the world. Intuition depends not only on physical impulses,

but also on the impulse's relationships with the surrounding field and on the conditions within the individual. The key word in the description of intuition is individual. People's intuition towards the same object is different.

Learning: Learning is a process in which individuals acquire knowledge and experiences regarding purchasing and consumption, guiding similar behaviors in the future. In other words, the consumption information and experiences obtained during the learning period guide the purchasing behavior. Experiences are used to meet the needs in determining attitudes and judgments about oneself or the environment, and this is the result of learning. Learning style is one of the most important factors affecting human behavior with its content and qualities. It benefits from learning and experiments in creating perceptions and concepts related to its own existence and environment in solving problems in meeting human needs. In general, people determine their needs and desires, especially their physical and instinctive needs through learning.

Perception: Perception is to learn about objects, events and relationships according to stimuli from the environment with the help of the sensory organs. However, perception is not only a physiological event, but also a subjective condition that is affected by the individual's beliefs, attitudes and personality traits. Individuals perceive them according to their opinions, beliefs and value judgments. The marketing components offered by the marketing manager and the component perceived by the target consumer may differ from each other. The target consumer's interpretation of new marketing components in a different way and in a way they want to see may cause some difficulties in the implementation of the marketing program. Perception is the physical and physiological aspects of the activity. Sensations are not independent events. A perception is made with almost every sensation. Thus, the simplest elements of psychological events are perceptions, not sensations. There is almost no sensation that does not end with perception. The effects from the environment stimulate the sensory organs, so as soon as the resulting nerve current reaches the brain, the sensory event occurs in a perception.

Attitude: Attitude refers to positive information and positive or negative emotions about a food. Attitudes can be learned through experiment and contact with other people. Attitudes often do not change often and remain unchanged. Attitudes sometimes have strong and sometimes weak effects. Consumers' attitudes towards a food or a firm affect the success or failure of the strategy. As a matter of fact, if the consumer has a negative effect on the marketing strategy of the business, he not only buys the food himself, but also affects the environment around him.

Personality: Each person has a different personality that affects their buying and selling. Personality is the distinct characteristics that cause a person to react consistently and constantly to his environment. Examination of strong correlations between certain personality types and food and brands, in which personality types can be classified, is an important variable in analyzing consumer behavior. Everyone has their own personality and inner structure. It is not always possible to decipher this personality. This can be possible with the determination of experiences and attitudes. Accordingly, the products to be consumed by each consumer and the brands to be preferred will be different. When marketers advertise consumer goods, they often emphasize features that everyone may find positive [33].

Social Factors: Together with the contact individuals have with each other (social factors), the cultures or societies people live in, affect their food choices. Your beliefs, traditions and taboos are influential factors. In addition, the effectiveness of the media, which is a part of daily life, in making certain food choices is not discussed. When

choosing food, lifestyle, job and education, the size of the family and the importance and place of hospitality in the social group are also important [2, 4, 7, 11, 18, 19, 20, 30].

Culture, Subculture and Traditions: Culture determines the lifestyle of human beings as a member of each society. The consumption patterns, needs, priority order of needs and satisfaction of needs are a function of culture. Cultural values affect consumer behavior and consequently consumption. Cultural values are learned in the family, school and workplace through social interaction and strongly influence individual behavior. Culture is the most fundamental determinant of a person's desires and behavior. Each culture consists of smaller subcultures that describe the more specific identification and sociolysis of its members. Nationalities, religions, racial groups and geographical regions make up the subculture. Religious, racial, national, local and similar groups with common characteristics form subcultures. Traditions are phenomena that are repeated at specific times by members of a group or community. Special occasions include many traditional and special foods. Family traditions often revolve around food, as are important social and cultural traditions in most societies.

Lifestyle: People of the same social class, subculture, and even the same profession can have very different lifestyles. The life system of a person is the lifestyle that is expressed in his activities, interests and ideas. Lifestyle can involve more than a person's social class and personality. If a person's social class is known, some speculation or interpretation can be made about his possible behavior, but this may not give him a full view. Lifestyles can also affect purchasing behavior [9]. In general, lifestyle factors that influence food choice are as follows.

Occupation: The occupation of the consumer primarily determines his income. In addition, working time, time spent commuting to work, leisure time, and evaluation style are important for an individual's food consumption. What you choose to eat may depend on the physical demands of your business. Active jobs require the worker to eat more carbohydrates to increase energy, while those who require less physical activity should be careful not to overeat.

Education: Smart options arise from knowing more about options. All kinds of communication help us know better about our food, which determines our choices. A person's better knowledge of the nutritional content, nutritional requirements, and food preparation of foods increases the likelihood of smart food choices.

Geographical location (Ecology): A country's basic foodstuffs depend on the ability to grow according to geography and climatic conditions. If the climate is tropical, foods such as sugar cane, pineapple, banana and coconut, if Mediterranean herbal and for the rural inland high-cold regions predominantly meat. Climate affects not only the types of food grown in a region, but also food choices. Summer brings the desire for fresh fruits and vegetables, ice cream and light meals, while winter is the season for soups, hot drinks and hot desserts.

Social Interaction: The result of globalization is that everyone goes everywhere, the internet allows us to shop from remote locations and trade deals between countries mean that an event in the far corner of the world can be felt in the rest of the world. While traveling, we meet a wide variety of dishes that we enjoy and will start looking for on the way back. Personal and close friends' interests affect their food preferences.

Family, Household Structures and Roles: The influence of family members on the recipients is very strong. The family is the most important consumer purchasing

organization. Marketing managers are closely concerned with the influence and roles of spouses and children in purchasing various products and services. These roles can be divided into five groups: opinion makers, influencers, decision makers, actual buyers, and users. Sometimes all or a few of these roles can be combined with one person. It serves family members, a subculture that transmits the cultural values of the society. The child acquires his social and cultural values and consumption habits from the family and carries their traces throughout his life. Therefore, it is possible to explain consumption habits with the life curve of the family. The structure of the family union determines the type, quality and amount of food consumed at a meal. For example, young children with very delicate taste buds may prefer less spicy foods, while seniors may show a slight sense of taste and prefer more flavored (especially salty and sweet) foods. Personal favorites within the household are often the most important factor in food selection. More attention needs to be paid to the preparation of food in an attractive and enjoyable way to meet the family's different dietary needs.

Roles and Status: The position of individuals in each of the groups such as family, club and association can be considered in terms of role and status. Each of the roles affects purchasing behavior. Each role has a specific status in society. Products can serve as status symbols for social classes, depending on geographical situation and even time. The personal characteristics of a person affect his purchasing decision. Among these features are his age, life period, profession, economic situation, lifestyle and personality and what he thinks of himself.

Social Class and Social Interaction: One of the sociocultural factors affecting the perceptions and purchasing behaviors of the consumer is the social class in which consumers are located. The concept of social class is a complex concept. Classifications of society are made from various angles, and different roles and rewards are prescribed to classes. Changes between roles and awards are determined. For example, society is divided into classes according to the criteria of managers, income and the type of work done. The classification in question is the vertical grouping of society in the form of lower, middle, and upper classes. In reality there is no clear boundary between these classes. In addition, the people who make up the classes cannot either change their place within the class or those in the lower class make an effort to move to the upper class. The food has long been a symbol of friendship and hospitality. When your guests come to your house, one of the first things you do is offer them something to eat and drink. Meals help even a shy person to create a comfortable environment where they can be a part of the group by keeping themselves busy by preparing or serving meals.

Reference Groups: Reference groups are people or groups that serve as the point of comparing values in the formation of attitudes and behaviors. The concept of reference is not limited to group size and membership and does not include a condition for identification with a group. In other words, the group can be symbolic, such as famous businesspeople, pop music stars or sports heroes. Reference groups used especially for attitudes and behaviors are called comparative reference groups. These groups may be neighbors whose lifestyle, home layout, furniture and automobile choices are admirable and valued in imitation. The same phenomenon applies to food.

Media: Media plays a big role in the food choices we make. Advertising of food is everywhere; every day we live in the noise from thousands of advertisements, magazines, billboards, radio, cinema, internet and television. Most of the foods advertised in the media are lower in nutritional value than their unprocessed or less refined alternatives. However, these products are presented as the foundation of a healthy and happy lifestyle.

Friendship and Peer Groups: One of the biggest factors in the purchasing behavior of the person and the purchasing process is the circle of friends. The circle of friends is an important factor in differentiating the attitudes in the selection of products and services in the search for information. An individual's peers are roughly the same age group of people of the same social status. Peer group influence is strongest in adolescence. In need of acceptance, teenagers eat what their friends eat, rather than those which their parents would think they should eat and what is nutritiously good. Trying new things in a peer group is safer and sharing food is a good way to get to know people and develop friendships.

Hospitality at home: The family having fun in the home environment is more informal. Cooking for others at home is an important social activity in daily life for ready consumption within the frame of the intensity of consumers' lives. Working parents don't have time to shop and cook for dinner parties. It is easier to use takeaway meals or to go to a restaurant where others prepare tables.

Economic Factors: Food selection is what products people buy and eat, and how they decide on this. Staying within certain budget limits affects our choices [2, 21].

Economic Conditions: As examined in the demographic dimensions of global consumer markets, the economic situation of the person is one of the main factors affecting the product and brand selection [33]. The economic situation depends on the level of disposable income, its stability, the time of taking over, savings and liquidity, asset values, credit and preferences between spending and saving. Producers and sellers of foods that are particularly sensitive to income follow these indicators closely. For example, if there is a recession, they redefine food and reduce locations, prices, production, and stocks. Economic factors affecting the consumer market are analyzed from two sides. First, to determine the purchasing power of the entire population, the national economy and trends in the economy and then the data on individuals and families are analyzed. The general economic situation and changes in the economy affect the purchasing and consumption tendency of the consumers. The imbalance of supply and demand, inflation and interest rates are economic factors that affect consumer decisions. Fluctuations in these factors should be recognized, the reasons should be determined, and the relevant economic and monetary policy of the state should be reviewed.

Cost of Food: Cost is one of the most important factors when choosing food. It is especially important for low-income families, students and the elderly. The proportion of these groups' spending on food is important in their total income. The costs of food vary with various factors; how much can be bought at a time (storage space is available, a more economical purchase can be made with large quantities), whether the food is seasonal or local, how much the food is processed (marinated meat products or instant salads, in many cases poorly processed foods, for example, freshly squeezed juices and fruit salads are sold more expensive than the regular product). If the place of purchase is carefully chosen, it can save money on a market or roadside purchase, however there are usually no guarantees of reimbursement, purchase of store specials and generic brands (which large supermarkets produce with their own labels) [33].

Available resources: Time is a limited resource for the purchase and preparation of ingredients required for food, which is wasted unless cooking skills are used. Resources can be used interchangeably. If you have money, you can choose to dine outside, but if you are economically not able to eat outside, you can use your skills, knowledge, and food ingredients to make a meal. Time and money can be used wisely by safely storing larger quantities of food than what is on sale or immediately available in season.

Market place: Market refers to the place where consumers buy food. Generally, the smaller the outlet, the more expensive the food items. Small stores buy food products from larger stores or wholesalers and increase the selling price to cover their expenses.

Profession and Financial Power: A person's choice of work affects the choice of food. The physical demands and social expectations of the job are reflected in food choices. Income from employment also determines the quality and quantity of selected foods. For everyone, economic factors are paramount when purchasing food.

2.NEW TRENDS IN CONSUMERS' FOOD BEHAVIOR

In recent years, significant changes have been observed in the food behavior of consumers. Economic, demographic, cultural, social, or environmental determinants affect the formation of new phenomena such as globalization, provisioning, virtualization, ecologization and rationalization (Figure 1) [10, 21].

Figure 1. New trends in consumers' food behavior

The globalization of consumption is manifested by the penetration of food consumption patterns across cultures. Among the various factors that contribute to the assimilation of food consumption patterns, the following points should be noted:

1. Increase of international and local retail chains (hyper and supermarkets and discount stores),

2. Development of internet and social media,

3. Development of fast-food chains,

4. Spread of prepared foods,

5. Facilitated mobility,

6. Nutritional recommendations for rational nutrition,

7. Mediterranean diet (higher intake of vegetables and fruits, lean meat, vegetable oils),

8. Loss of specific national features typical for each country.

It should be noted that, due to the dominance of the American consumption model, the globalization of the consumption process is often defined by Americanization or McDonaldization. This means combining the needs of specific goods and services globally. It should be noted that the unification, in response to the traditions and general culture of consumers, is seeking to express their national identity with an ethnocentric approach to more and more consumers. In this case, consumers do not buy a foreign product if they think that they may harm the economy and employment in the country of origin. Therefore, traditionally produced regional products are increasing in popularity, and companies that offer such goods are more and more respected.

The fact of putting consumption into service is associated with a decrease in consumption in the material sphere due to its growth in the intangible sphere. This leads to more purchases of intangible goods, like services. This trend also applies to food consumption. Eating out is increasingly practiced around the world, although it significantly affects the structure of household spending. There is a steady increase in the number of people eating out. Also, attention should be paid to a certain transformation of consumers' approach to products. At present, they want to opt for a variety of experiences rather than tangible assets. Therefore, the phenomenon known as the "Sensory Market", where products offer consumers a stronger and more intense opportunity to experience, experiment and take risks, is growing in popularity.

New trends in consumers' food behavior may be the virtualization of online shopping as well as the behavior associated with the growing popularity of grocery stores. E-commerce is becoming increasingly popular among companies, with consumers seeking alternative ways to purchase goods and access information about them, as well as those seeking access to new markets. According to many studies on the factors that cause satisfaction of consumers from online shopping, four main factors that affect the consumers' perception of Internet content can be distinguished:

1. *Security and privacy when shopping online,*
2. *Website design,*
3. *Website reliability,*
4. *Website customer services.*

Grocery online shopping is becoming more and more popular among consumers. There are currently a large number of online supermarkets where consumers can find almost all the food products they need and even deliver free of charge in the way they are most comfortable. It should be noted that many consumers still buy things (especially food) in traditional stores, but many of them link these two forms of shopping and there are a growing number of consumers buying only from online retailers.

While discussing the trends in consumption of food products and the nutritional behavior of consumers, very important facts in terms of environmentally friendly and rationalized food consumption should not be ignored. More and more consumers are opting for healthy, safe, traditionally produced products that reduce waste. In addition, they want to use renewed resources. Consumers believe that changing their diet and using supplements are two of the most important conditions for reducing treatment costs and improving overall health. In addition, numerous educational campaigns promoting healthy and rational lifestyles contribute to the critique of consumerism and try to persuade consumers to rationalize many areas of consumption, including nutrition. These conditions, which are

compatible with the concept of sustainable consumption, have influenced the development of the Voluntary Simplicity (VS) movement, which is an externally simple and self-rich lifestyle. This trend, related to food or diet, is purchasing sustainable products, extending the life cycle of products, avoiding waste, recycling, and transportation. Table 1 presents some examples of new trends in consumer activity as assessed by consumer food behavior and specific trends [10, 16, 17, 18].

3.MARKETING STRATEGIES OF FOOD MANUFACTURERS

Marketing strategies suggest that it should include ways to minimize pre-decision risk in order to reduce the concern on making a frequent or important purchase. The most common marketing tools defined as controllable parameters used to influence the consumer purchasing process are the "marketing mix", which includes product, price, place, and promotion (conventional framework). It differs from other classifications such as a good and service mix, distribution mix, or communication mix.

Table 1. Some examples of new trends in consumer activity are associated with consumer food behavior and particular trends.

New trend in consumers' food behaviour	Selected manifestations of activity
Globalization	• eating fast-food foods • acquisition of food in international retail chains • acquiring fashionable, advertised food products • introducing new products to the daily diet and searching for new cooking methods • eating meals in restaurants with international cuisine
Servicization	• Eating out • using catering • ordering dishes with home delivery • acquiring convenient products
Virtualization	• grocery shopping online • ordering take-out food online • searching for information about food products on the Internet
Rationalization	• paying attention to the composition of products • purchase of products from local suppliers • buying food products comes from a reliable source • consuming vegetables and fruits in the recommended amount of 5 servings daily • checking the expiration date of purchased food products • not wasting food • broadening knowledge about healthy nutrition
Ecologization	• procurement of organic products in stores or from a well-known farmer • paying attention to the packaging of environmentally friendly products

It has been found that the 4P mix is adapted for a variety of fields, including retail marketing. The store environment of the 4Ps mix is expanded with the inclusion of new elements such as store formats, personnel, and physical evidence. In the context of food retailing, it is stated that traditional marketing mix elements such as product quality and packaging, store location, price and promotional tools shape the purchasing behavior of consumers. Moreover, consumers tend to perceive environmental factors such as the atmosphere and personnel more when shopping in the supermarket. It should be noted that these factors affect the perceived value of consumers and their purchasing decisions for food products. If a company is to be profitable, it must create value for the product that meets the expectations of the consumer, while also generating profit for the producer. Researching current consumers' preferences, creating profiles, adapting actions to new trends and exchanging value with consumers is a prerequisite for an effective marketing strategy. The company's activities to create an effective marketing, include selecting the target market, determining the desired positioning of the products in the consciousness of the target consumers and determining a marketing action plan to achieve the desired positioning. In food companies, marketing decisions are usually the initiatives that bring the company's marketing efforts strategically to the highest return, based on some market and company analysis such as Porter's five forces Analysis of 5C, Marketing Mix Analysis, Pest Analysis, Breakeven Analysis.

The development of a marketing strategy starts with the consumer. However, determining target markets is a prerequisite. First, the company must segment its food market consumers and find the best way to characterize and differentiate them. Demographic (age, gender, income), geographic (country of origin, urban or rural) and lifestyle (hedonistic or value-based) criteria should be considered.

When formulating a marketing strategy, it is also necessary to take into account the appropriate selection of staff, training tailored to the specific nature of a commercial offer and the motivation, evaluation and control system to ensure the appropriate one. It should be noted that grocery stores are often a place of discovery and purchase. So, some consumers who buy a particular brand or product for a long time are tired and decide to change something. Therefore, a very important element of the company's strategy is to pay attention to the continuous product range development. The basis of an effective marketing strategy is to learn about and analyze customer needs and to consider the results of a new product during the design phase. As long as the company understands and shapes customer acquisition and retention, it is called "producer-consumer relationship management". A well-designed customer management system strengthens customer loyalty, which leads to higher profits [33].

4. EVALUATION AND CONCLUSION

The success of food companies today consists of two combined conditions; It is a combination of the efficiency of the functioning of the organization and the foreign and non-market conditions. Market orientation becomes a must in a competitive and sustainable buyer market and the company's success depends on the quality of meeting consumers' needs. Marketing has an important role in forming the strategies of companies, because in this way, the value of the consumers is created by meeting the needs of the consumers. A well-functioning marketing unit has an important role in the structure of every institution. The role of marketing is to be open to the needs and changing needs and preferences of the consumer.

The new trends in food behavior described above have a significant impact on the marketing strategy of companies in the food industry, in their suggestions and distribution in a way that meets the expectations of the buyers as much as possible. The technological advancement, globalization, provisioning and virtualization of consumption contribute to the situation where people seek products and services that can meet their needs. Consumers look for food alternatives that will allow them to shorten food preparation time, use their leisure time for work or rest, avoid wasting time for cleaning, maintain a balance between work and leisure life and maintain good health. In contrast, food companies offer new innovative products and services that will delight consumers, such as market-friendly and functional food products and specialized catering services. More and more restaurants attract customers with unique and attractive localization, arrangements or menu suggestions designed to stimulate their imagination and provide unusual impressions and emotions. Responding to new trends in consumer service and globalization, manufacturers should have the following characteristics [22, 23, 33];

1. Food production tailored to the individual nutritional needs of consumers or consumer groups,

2. Gastronomy development in modern shopping and entertainment centers,

3. Development of regional brands, confirmed by a certificate that guarantees the high quality of products, their origin in a particular region and the use of traditional production methods,

4. Setting up online platforms and supermarkets to purchase food products and meals online or by phone,

5. Using recyclable, biodegradable food packaging.

Changing consumer trends and manufacturers' reactions to food behavior play a key role in the success of product services (Table 2). Today's consumers are aware of foodborne illnesses or dangers and pay more attention to environmental protection. For this reason, they are watching products whose ingredients are preserved or must contain no or minimal content and amount of controversial ingredients. The ecological concept is very popular with consumers. Ecologization of consumption is one of the most characteristic contemporary trends in consumption processes. This phenomenon has a significant impact on the management processes in organizations. Consumers pay more attention to the producers' attitude towards the natural environment. Greening consumer behavior is an important reality, as companies are involved in proposals that will be competitive not only in terms of price but also in terms of benefit and quality based on safety for health and the natural environment [10, 16, 18].

Table 2. Producers' reactions to new trends in consumers' food behavior

Globalization	Increasing the presence of fastfood restaurants, taking into account new consumer needs (for example food suitable for vegetarians or dieters), increasing the presence of global brands in the nutrition industry, opening new gastronomic establishments with international cuisines, establishing well-known international supermarkets
Servicing	opening new restaurants, offering home delivery meals, offering catering for any celebration, increasing the availability of ready-to-eat foods, providing unique taste, visual and emotional experiences in restaurants
Virtualization	Opening virtual markets, ordering food online, presenting all offers on the internet, collecting loyalty points in virtual customer accounts, informing about current promotions via e-mail or message
Modernization	sending information about product content, natural composition of products, food products, attention to reducing chemical components, sending information about the health properties of ingredients in products, offering products with low salt and fat content, making dishes in the form of vegetable and fruit salads, such dried fruit chips or serving naturally sweet snacks such as oatmeal bars
Ecologicalization	Presenting organic products in a wider range than ever before, controlling organic products for food packaging and certain components related to environmental management and greening the production process, reducing the negative environmental impacts of food production, creating special shop stands that deal with the effectiveness and impact aspects of the product.

The demand for raw materials and energy-efficient products that generate less waste, as well as products that are safe for human health (e.g. organic food) is still increasing. As many scientists point out, there is a growing need for safe and healthy foods with higher quality characteristics. In addition, traditional products with regional character have a positive relationship with consumers and are increasingly preferred. More important, consumers are willing to pay higher prices for such products [8, 14].

In addition, consumers are increasingly reacting to the eco-innovation proposed by businesses. This offers companies new growth opportunities. Among the initiatives that can be observed in the strategies of companies based on the trend of ecology and regionalization of food consumption are ISO (International Organization for Standardization) and EMAS standards (EU Eco-Management and Audit Scheme). Also, a new approach to the production of products taking into account all life cycles (controlling and greening the production process, using and disposing of the product), ecological product innovations (researching new technological solutions that reduce negative environmental impact) and development is the distribution of pro-ecological products. Attention should also be paid to the use of environmental issues in marketing and advertising. In addition to using the ecological trademarks system, it is important to use generally understood environmental protection issues in advertising messages.

Some studies show that the supplier green innovation path provides significant benefits to the company's environmental performance and competitive advantage [8, 33].

In the market economy, the consumer is the focus of attention. The success of a company that produces and sells products depends on the market decisions of consumers. Information about consumer behavior and the factors that shape the consumer is the basis of the company's marketing strategy. The aim of this study was to identify and discuss the most important trends in the nutritional behavior of consumers that contribute to the development of marketing strategies for food companies. In the studies covered in this article, it is observed that some examples of new trends in the food behavior of consumers are globalization, service, virtualization, ecology and rationalization of consumption. This phenomenon has a significant impact on the marketing strategy of companies trying to make suggestions and distributions from the food industry in a way that meets the expectations of consumers as much as possible. Some activities related to new trends in food consumers' behavior include the creation of new innovative food products (e.g. convenience or functional food products) and services (e.g. attractive restaurants, online platforms and supermarkets for purchasing), development of regional brands based on health and natural environmental safety. The development of the production of pro-ecological products suitable for quality can be distinguished. Future research may focus on issues related to marketing communication methods that are most effective for the food industry.

REFERENCES

[1] Anon., "Factors affecting food choice", www.meatandeducation.com, 12s., 2012.

[2] Anon., "Influencing Consumer Behaviour: Improving Regulatory Design", Australian Government, Department of Finance and Deregulation, Office of Best Practice Regulation, 73s., 2013.

[3] Anon., "Factors Affecting Food Selection",

http://factorsaffectingfoodselection.weebly.com/index.html, 2017a

[4] Anon., "Factors Affecting Food Choices Culture Social Emotions Agriculture, Technology, Economics, Politics", 24 s.

https://mrssgordon.wikispaces.com/file/view/Factors+Affecting+Food+Choices.pdf, 2017b.

[5] Anon., "Influences on Food Choices and Food Patterns", MHR Unit 1, 22s.,

https://www.mheducation.ca/web_resources/sch/mhr_ffl_sample_ch01.pdf, 2017c.

[6] A. Annunziata, R. Vecchio, "Factors affecting use and understanding of nutrition information on food labels: evidences from consumers", *Agriculture Economics Review*, 13(2), 103-116, 2012.

[7] S. Bleich, "Impact of environmental factors on individual food choices", World Health Summit October 21, 19 s., 2012.

[8] B. J. Bronnenberg, J. H. Dubé, "The Formation of Consumer Brand Preferences", Working Paper 22691, National Bureau of Economic Research, NBER Working Paper Series, 49 s., 2016.

[9] H. H. Chovanová, A. I. Korshunov, D. Babčanová, "Impact of Brand on Consumer Behavior", Procedia Economics and Finance 34 (2015), 615 – 621, 2015.

[10] G. Hanus, "The influence of the trends in consumers' food behavior contributing to the formulation of marketing strategies for food companies", World Scientific News, (112), s. 85-95, 2018.

[11] S. Higgs, J. Thomas, "Social influences on eating", Current Opinion in Behavioral Sciences, 9(June), s. 1-6, 2016.

[12] C. Hunter, "Nutrition Matters: Trends Affecting Food Choices", Nutrition File for Health Educators, 9s. 2010.

[13] Lau, D., Krondl, M., Coleman, P. "Psychological Factors Affecting Food Selection", J. R. Galler (ed.), Nutrition and Behavior © Plenum Press, New York, 1984.

[14] A. Kara, J. R. Méndez, O. Küçükemiroğlu, T. Harcar, "Consumer preferences of store brands: Role of prior experiences and value consciousness", Journal of Targeting, Measurement and Analysis for Marketing, (17), s. 127 – 137, 2009.

[15] I. H. Kaya, "Motivation Factors of Consumers' Food Choice", Food and Nutrition Sciences, (7), s. 149-154, 2016.

[16] V. Kumar, N. Umashankar, Y. Bhagwat, "Assessing the Influence of Economic and Customer Experience Factors on Service Purchase Behaviors", Marketing Science, 33(5), 673–692, 2016.

[17] T. Lautiainen, "Factors affecting consumers' buying decision in the selection of a coffee brand", Saimaa University of Applied Sciences Faculty of Business Administration, Lappeenranta Degree Programme in International Business, 40 s., 2015.

[18] B. Melovic, D. Cirovic, B. Dudic, T. B. Vulic, M. Gregus, "The Analysis of Marketing Factors Influencing Consumers' Preferences and Acceptance of Organic Food Products—Recommendations for the Optimization of the Offer in a Developing Market", MDPI, Foods (9), 25, 2020.

[19] M. Murimi, M. Chrisman, H. R. McCollum, O. Mcdonald, "A Qualitative Study on Factors that Influence Students' Food Choices", Journal Nutri Health, 2(1), 2016.

[20] M. Nestle, R. Wing, L. Birch, L. DiSogra, A. Drewnowski, A., S. Middleton, S. Sigman-Grant, W. Jeffery Sobal, M. Winston, "Behavioral and Social Influences on Food Choice", Nutrition Reviews, 56(5), s. 50-74, 1998.

[21] T. H. Nguyen, A. Gizaw, "Factors that influence consumer purchasing decisions of Private Label Food Products", A case study of ICA Basic, School of Business, Society and Engineering, Bachelor thesis in Business Administration FOA214, 92 s., 2014.

[22] P. Nowicki, T. Sikora, "Consumer Behavior at the Food Market", Research Gate, 9s., 2012.

[23] I. Popovic, B. A. K. Bossink, P. J. Sijde, "Factors Influencing Consumers' Decision to Purchase Food in Environmentally Friendly Packaging: What Do We Know and Where Do We Go from Here?", Sustainability, (11), 22, 2019.

[24] V. Ree1, N. Riediger, M. H. Moghadasian, "Factors affecting food selection in Canadian population", European Journal of Clinical Nutrition 62, 1255–1262; published online 1 August 2007, 2008.

[25] M. A. Razali, N. Zainol, K. H. Rezo, F. N. Tazijan, M. A. Ahmad, S. Rahim, N. Nordin, "Psychological Factors Affecting Universities' Students Food Choice", *ETAR-2014*, Volume 1, s. 384-390, 2014.

[26] K. Roininen, "Evaluation of Food Choice Behavior: Development and Validation of Health and Taste Attitude Scales, University of Helsinki Department of Food Technology, To be presented, with the permission of the Faculty of Agriculture and Forestry of the University of Helsinki, for public criticism in lecture hall B2, Viikki on May 11th, 55 s., 2001.

[27] Y. B. Saygı, "Gıda Seçimini Etkileyen Faktörler" I, Dünya Gıda Dergisi, 2017.11, s. 76-81, 2017a.

[28] Saygı, Y. B. (2017b). Gıda Seçimini Etkileyen Faktörler II, Dünya Gıda Dergisi, 2017.12, s. 78-83, 2017b.

[29] R. Shepherd, "Influences on Food Choice and Dietary Behavior", University of Surrey, UK, 68 s., 2017.

[30] S. Souter, C. S. Keller, "Food Choice in the Rural Dwelling Older Adult", www.snrs.org, 5(3), 19, 2002.

[31] D. Thiruselvakumar, K. Sinuvasan, R. S. Chakravarthy, E. Venkatesh, "Factors affecting food choice and attitude of choosing food items among adolescents in South India", International Journal of Scientific and Research Publications, 4(4):3, 2014.

[32] J. Vesela, S. Grebenova, "The Influence of Psychological and Social Aspects on the Eating Habits of Primary School Children", School and Health 21, Health Education: Contexts and Inspiration, s. 271-284, 2010.

[33] R. Vyas, J. K. Sharma, R. B. Sharma, "A Study on Consumer Behavior Towards Select Branded Food Items, *IOSR Journal of Business and Management (IOSR-JBM)*, 18(8), s. 01-08, 2016.

[34] E. B. Zielinska, "Role of Psychological Factors in Food Choice – A Review", *Polish Journal of Food and Nutrition Sciences*, 15/56(4), s. 379–384, 2006.

Research Article

ENERGY SYSTEM MODELING IN URBAN SCALE: CASE OF ÇANAKKALE[1*]

Seçkin BAKIRCI[1], Egemen SULUKAN[2], Tanay Sıdkı UYAR[3]

[1]İstanbul Yeni Yüzyıl University, Electrical and Electronics Engineering Department, 34010, İstanbul, Turkey, seckinbak@gmail.com, Corresponding author, ORCID: 0000-0002-1088-2065

[2]National Defence University, Turkish Naval Academy, Mechanical Engineering Department, 34942, İstanbul, Turkey, esulukan@dho.edu.tr, ORCID: 0000-0003-1138-2465

[3]Beykent University, Mechanical Engineering Department, 34398, İstanbul, Turkey, tanayuyar@beykent.edu.tr, ORCID: 0000-0002-0960-1203

ABSTRACT

As a result of the rapidly increasing urbanization in the last decades, 55% of the world population lived in cities in 2018. While this rate is approximately three-quarters of the total population in the European Union (EU), it is expected that by 2050, approximately 85% of the EU population will live in the cities. As a result of this rapid population increase in cities, the number of regions with relatively high energy needs is increasing. Being able to provide this intense energy need without interruption in cities also increases the importance of city-scale energy modeling studies. The case city of this study is Çanakkale, which is located in western Turkey, it has over 500 thousand of the population and a great potential for renewable energy production. In this study, a detailed Reference Energy System (RES) was created by determining the sources, process and conversion technologies, demands, energy carriers, and demand technologies of Çanakkale. Then, by collecting data, a base scenario and alternative scenarios were developed with Answer-TIMES. "20% More Efficient Technologies" and "Shutdown of Lignite Power Plants" are alternative scenarios of this study that are tailored from the base scenario.

Keywords *Energy Modeling, Answer-TIMES, Urban Scale Modeling*

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1. INTRODUCTION

It is becoming more difficult to manage the energy needs of regions, where there is a dense population in small areas. Being able to provide this intense energy need without interruption in cities also increases the importance of city-scale energy modeling studies.

Due to the rapid development of technology, electricity generation from renewable energy sources has become relatively more cost-effective than conventional power plants. The fact that renewable energy sources are inexhaustible, economic and most importantly not damaging ecological balance by following an environmental production method has led to the emergence of the concept "100% Renewable Energy ". When it comes to 100% renewable energy; a process that depends on renewable sources, does almost no damage to the environment and greenhouse gas emissions are close to zero and do not use any fossil fuels to produce energy.

In recent years, many countries have created renewable energy action plans, both because it is becoming feasible and because of its local and global environmental contributions. These countries have begun to set achievable targets with these local or national energy action plans and increase the share of renewable energy in energy production. Many projects, which are mostly prepared by local governments for the transition to 100% renewable energy on an urban scale, are progressing confidently within the framework of the plans created.

Energy modeling studies can show us the results of all scenarios that will be created by modeling regions where alternative sources are added to the system, where production with fossil resources is stopped, and even with the potential to produce energy with fully renewable resources. Various energy modeling tools can be used in such an action plan. These tools can be selected from dozens of programs according to the model to be installed and the desired results. In this study, the Answer-TIMES program was selected as the most appropriate modeling tool for the case city. Technologies, commodities and commodity flows are three types of assets that the TIMES energy model includes.

In this context, the chosen city was examined from a minimal cost and environmentally friendly perspective. The case city of this study is Çanakkale, which is located in western Turkey, it has over 500 thousand of the population and a great potential for renewable energy production. The city, which has a high potential for wind and solar energy in particular, already houses many renewable and fossil power plants. The city, which imports a large part of the electricity (Turkey's most industrialized cities, centers and metropolises are very close, and more than 26 million people live up to 400 kilometers away) generated from all these sources, has an important share in meeting Turkey's electric energy needs. In this study, a detailed Reference Energy System (RES) was created by determining the sources, process and conversion technologies, demands, energy carriers and demand technologies of Çanakkale. Then, by collecting data, a base scenario and alternative scenarios were developed with Answer-TIMES. The base scenario is based on 2016 data. A time horizon beginning in 2016 and ending in 2030 was deemed appropriate for the study. When the current situation (base scenario) is continued, alternative scenarios have been created by examining the changes in the balance of energy production and consumption of the city and the total cost of the system in 2030. In addition to the base scenario, 2 different alternative scenarios have been created that address different perspectives. These scenarios are: "closure of lignite power plants" and "20% more efficient technologies"

In the first section, general information about the importance of city-scale energy modeling, the chosen city and the method used for this study are given. Section 2 describes the methodology and development of the TIMES-Çanakkale model, also the assumptions of scenarios. Results of the base scenario and alternative scenarios are discussed in section 3. And the conclusion of the study is given in section 4.

2. MATERIAL AND METHODS

2.1. ANSWER-TIMES

Answer-Times is an energy system modeling program that enables the creation of economic models for energy systems of various sizes with a rich technology base to show the change in energy supply and demand over a specified time period. With Answer-TIMES, models can be created to analyze the entire energy system or single energy line on a large scale from local to global. In order to produce a reference scenario in the program, the current energy sources/stocks and technologies as well as potential resources and technologies, end-user energy demands and estimations must be provided by the user. [2]

Answer-TIMES is a mouse-controlled, visual-based and interactive windows operating system interface developed to increase the understandability and usability of any TIMES energy system model. [3]

Energy system modeling with Answer-TIMES has a complex structure. The collected data are entered into the TIMES model generator program by the researcher using the Answer-TIMES interface. Modeling is optimized and solved in TIMES by GAMS and other solvers to create suitable solutions for different scenarios predetermined by the researcher. Finally, suitable solutions for end-user evaluation and the feasibility of the scenario are displayed through the Answer-TIMES interface. [2] [3]

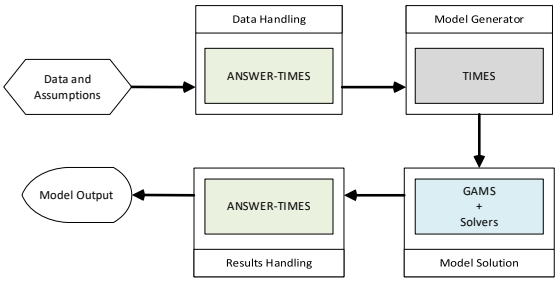

Figure 1. Mechanism of Answer-TIMES with TIMES Energy Model. [4]

Four different input types are required for any TIMES model: energy sources, energy demands, process&conversion technologies and current energy policies. [2]

2.2. DEVELOPMENT OF BASE SCENARIO FOR ÇANAKKALE

2.2.1. CASE CITY; ÇANAKKALE

Çanakkale, located in the northwest of Turkey, in the region of Marmara, located in between 25° 40′ - 27° 30′ east longitude and 39° 27′ - 40° 45′ north latitude. It has a total length of 671 km along the Marmara and Aegean Sea coasts. [5] Çanakkale Province has an area of 9,817 km² and a population of 519,793. Population density is 52 people per km² according to 2016 data. While the urbanization rate of the city is around 59.28%, its population is expected to reach 836,290 people in 2040. [6]

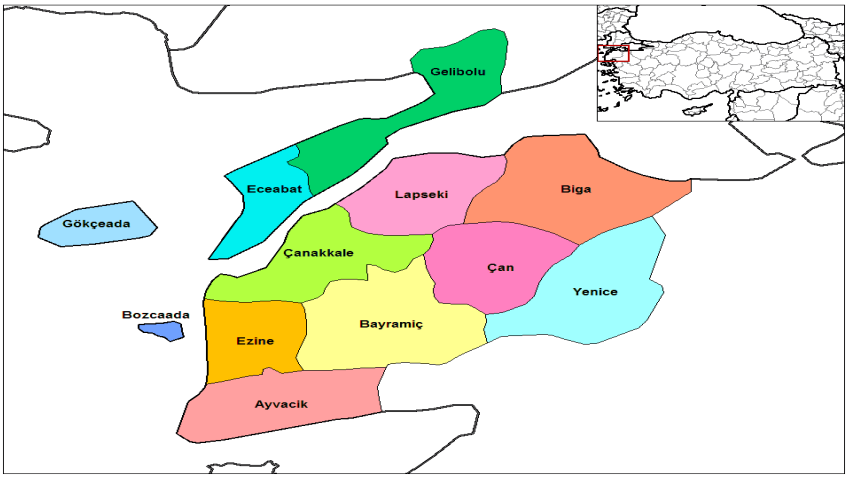

Figure *2*. Map of Çanakkale. [7]

Çanakkale, which has 2 airports and 5 ports, is close to many metropolises and industrial zones. The city also has a high potential for many renewable energy sources such as solar, biomass and wind. [5] [6]

2.2.2. DATA COLLECTION

The data needed for the Answer-TIMES energy model of Çanakkale was collected as a result of one-on-one interviews with the city's institutions and organizations (Provincial Directorate of Agriculture and Rural Affairs, Chamber of Industry, Special Provincial Administration, Çanakkale Municipality, electricity distribution company, non-governmental organizations, chamber of electrical engineers, etc.). Besides, data announced by institutions such as the Ministry of Energy and Natural Resources were used. The World Bank's forecast was used for the rate of economic growth and population growth projections are based on the statistical agency of Turkey. All data refer to 2016.

2.3. REFERENCE ENERGY SYSTEM

The TIMES energy model includes three types of assets: technologies, commodities and commodity flow. Technologies, which can also be called processes, include tools, devices or methods that transform goods into other types of goods. Commodities: It includes goods, energy providers and carriers, emissions and money flows. Commodity flow refers to the link between technologies and commodities. The diagram showing the relationships between technologies, commodities and commodity flow is called the Reference Energy System (RES). [2]

As shown in Figure 3, RES contains six columns. The first column contains the sources showing all the energy resources of the region. The second column shows the primary energy carriers, while the third column shows the process and conversion technologies. The fourth column indicates the final energy carriers and the fifth column indicates the demand technologies. Finally, the sixth column addresses the demand groups.

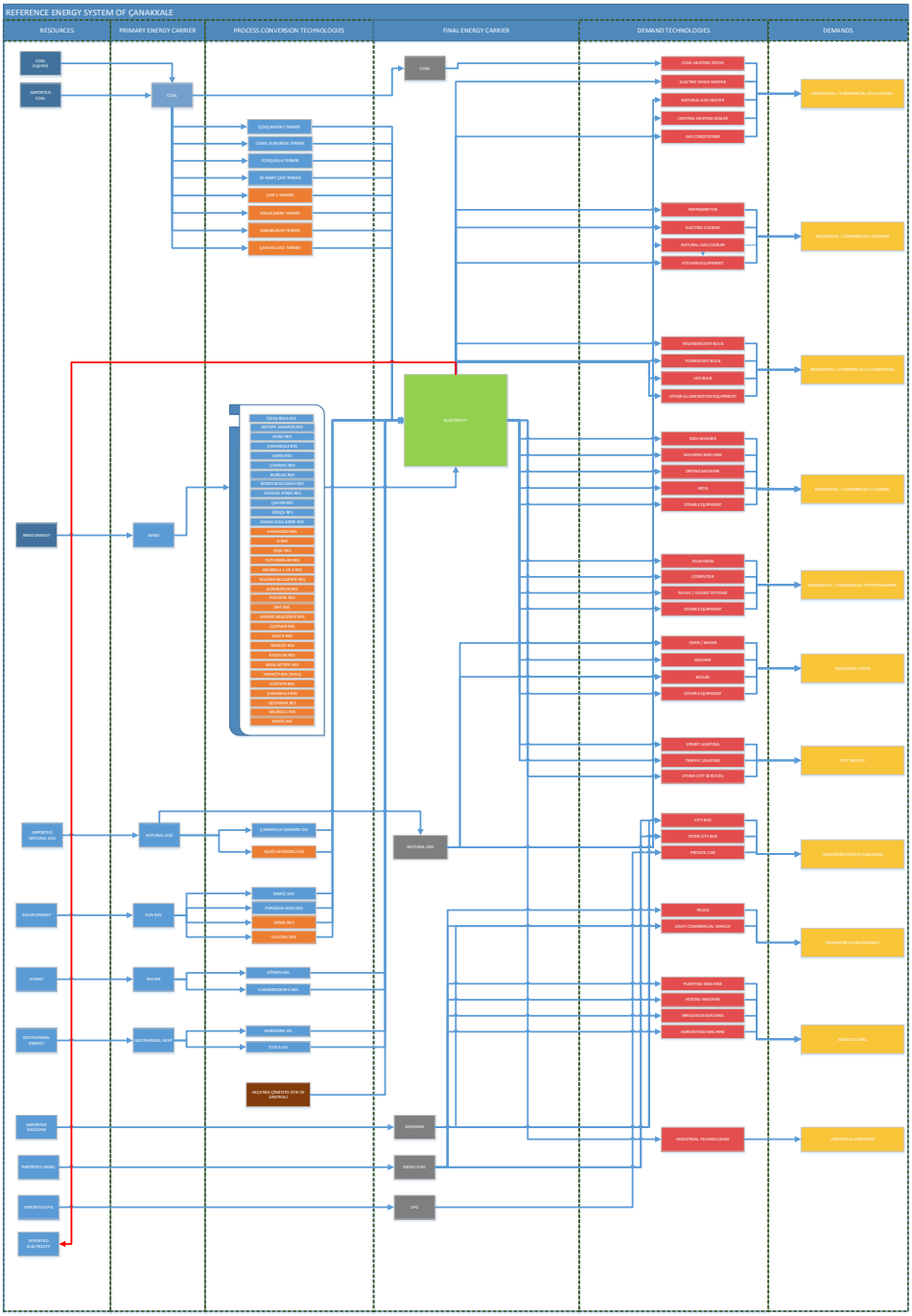

Figure 3. Reference Energy System of Çanakkale Province

2.4. DESCRIPTION OF BASE SCENARIO

To create a base scenario; the collected data, obtained by conducting interviews with various institutions in Çanakkale, information and documents, as well as by using online sources were classified and a data set was created. This data was entered into the database step by step and the base scenario was created. In short, the base scenario expresses the equivalent of the current situation of Çanakkale in 2030 as a result of the increase in energy demand due to the projected population growth and economic changes.

3. ANALYSIS OF THE SCENARIOS RESULTS

3.1. BASE SCENARIO

The base scenario is based on the reference energy system shown in Figure 3. In the figure, process-conversion technologies shown in column 3, the power plants are shown in blue represent the power plants currently in production. The orange ones are the plants that are planned to start production after 2016. The scenario was created in such a way that these plants will start production in the planned year. In the base scenario, our time horizon starts from 2016 and continues until 2030. The years 2020 and 2025 were determined as the years in which intermediate results were obtained and 2030 was the year in which the last results were obtained. Results are in millions of dollars (million $) and petajoules (PJ).

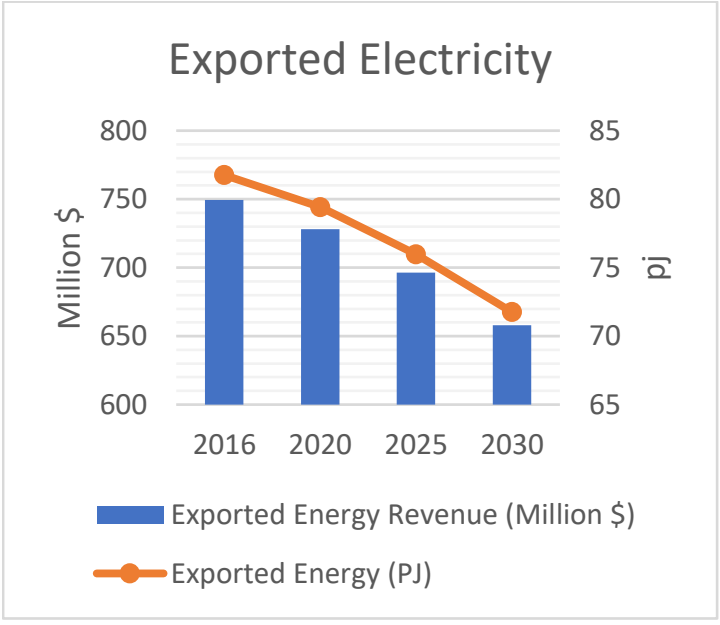

Figure 4. Base Scenario Exported Electricity Values.

As can be seen in figure 4, while the energy exported by the city decreased by approximately 10 petajoules by 2030 in the base scenario, the gain from the energy it exports decreased by approximately 90 million dollars accordingly. The reason for this is that despite the projected growth rate of 4%, the increase in energy production was not enough to meet this consumption. The energy needed by the city is higher in 2030 compared to 2016, and the share used by it has increased.

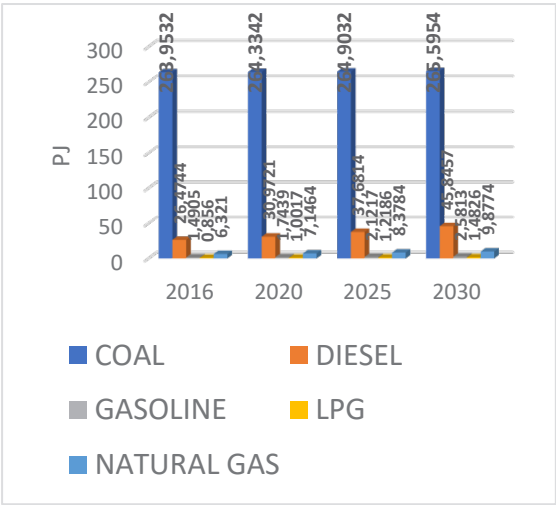

Figure 5. Base Scenario Imported Fossil Resources (PJ).

Figure 5 shows the imported fossil energy resources in terms of petajoules over the years. In the established model, while there is no significant increase in the production of coal plants over the years, there is a significant increase in the exports of other fossil resources due to the increase in demands.

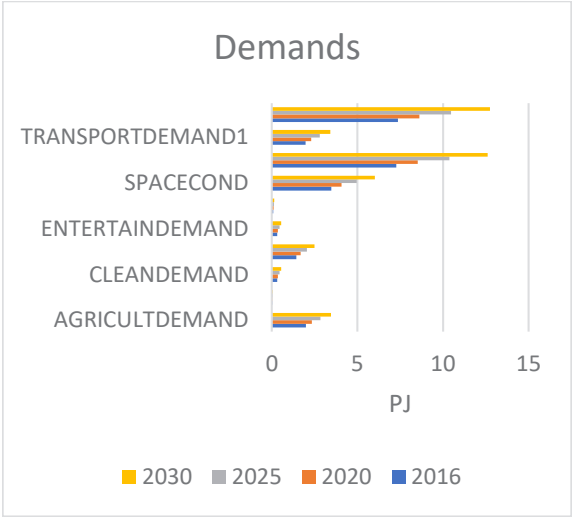

Figure *6.* Base Scenario Demands (PJ)

Figure 6 shows the change in demands. For example, the increase in transport and industrial demand has nearly doubled in 2030. These demand increases are also the main reason for the increases in fossil resource exports in the previous figure. For example, the increase in transportation demand is the main reason for the increase in diesel fuel requirements.

3.2. ALTERNATIVE SCENARIOS

3.2.1. SHUTDOWN OF LIGNITE POWER PLANTS SCENARIO

In this scenario, it is envisaged that 2 lignite-sourced fossil power plants in Çanakkale will be shut down until 2030. The total installed power of these closed power plants is 550MW.

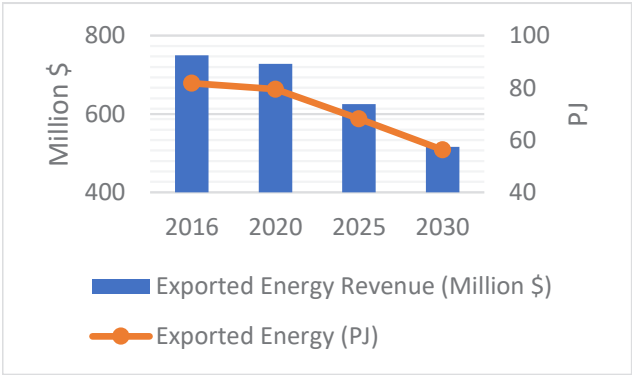

Figure 7. The shutdown of Lignite Power Plants Scenario-Exported Electricity Values.

As can be seen in figure 7, closing lignite power plants without any generation plants placed in their places significantly increases the cost of the system compared to the base scenario. Because the energy exported has decreased, and as a result, earnings have decreased by about 140 million dollars.

3.2.2. 20% MORE EFFICIENT TECHNOLOGIES SCENARIO

In this scenario, it is aimed to examine the effects of energy efficiency in houses on total consumption. For this reason, it is foreseen that all electrical devices in the residences will be replaced with 20% more efficient devices.

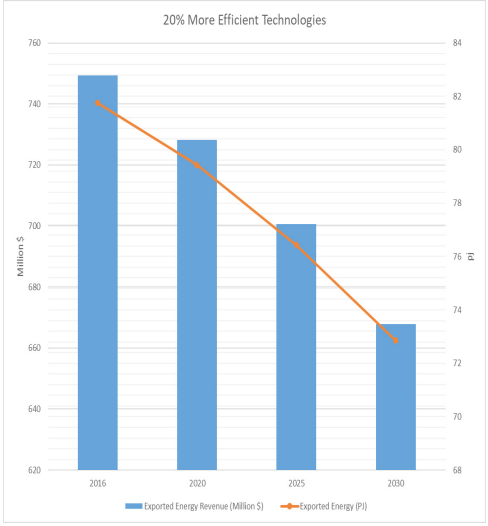

Figure 8. 20% More Efficient Technologies Scenario-Exported Electricity Values.

As can be seen in Figures 8 and 9, when devices that consume 20% less electricity are used in houses, an energy saving of approximately 1 petajoule is achieved compared to the base scenario. As a result of these savings, an increase of approximately 10 million dollars has been realized in electricity exports.

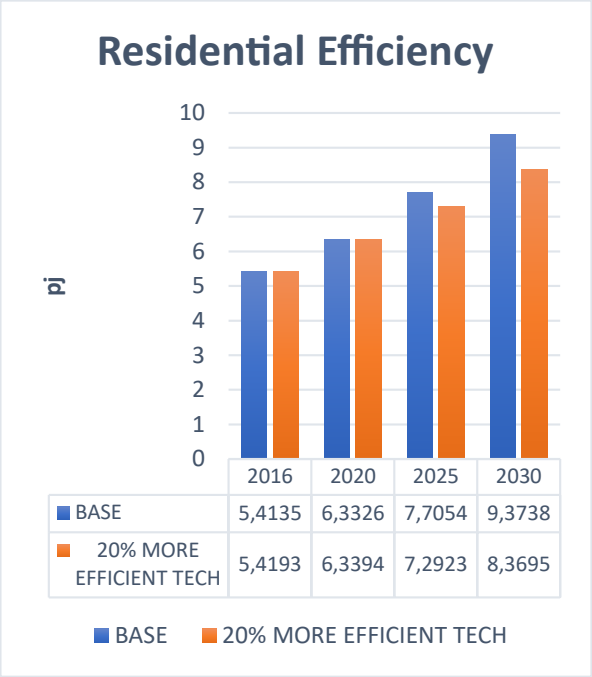

Figure 9. 20% More Efficient Technologies Scenario-Residential Energy Consumption. (PJ)

4. CONCLUSION

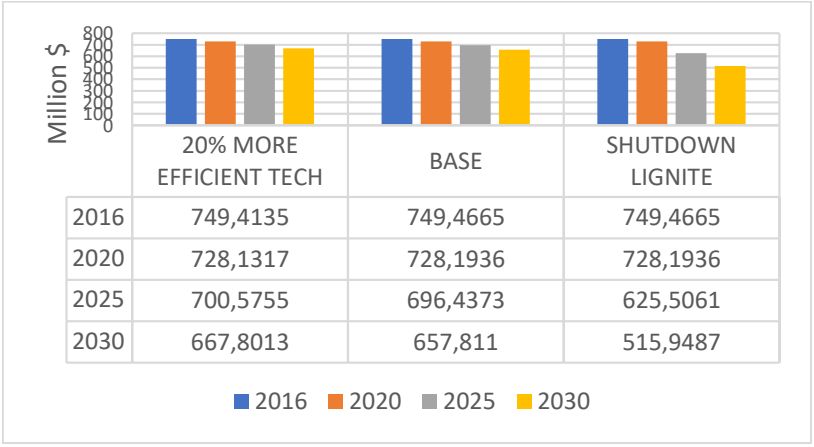

Figure 10. Exported Electricity

When all three scenarios are compared, as can be seen in figure 10, the model with the highest electricity export is the one in which 20% more efficient technologies are used. In this scenario, by 2030, the amount of surplus electricity has increased, as electricity consumption is less than in other scenarios. In the scenario of shutting down lignite power plants, there was a 550 MW decrease in the installed power, so the biggest decrease in the energy exported occurred in this scenario.

Table 1. Total Imported Fossil Resources Costs for All Scenarios.

	Million $			
	2016	2020	2025	2030
20% More Efficient Technology	864.3445	887.8619	922.9479	965.6411
Base Scenario	864.3445	887.8619	922.9479	965.6411
Shutdown Lignite Power Plants	864.3445	887.8619	862.6003	844.946

From the table showing the value of the total imported fossil resources, it is understood that the base scenario and the scenarios where 20% more efficient technologies are used are the same for fossil resource imports. Total imports for both scenarios increased by approximately 100 million dollars. In the lignite power plants decommissioning scenario, the import of fossil fuel resources decreased by approximately 20 million dollars. This decrease in the import of fossil fuel resources clearly shows that the CO_2 emission will decrease.

REFERENCES

[1] United Nations, "World Urbanisation Prospects 2018: Highlights", New York, 2019.

[2] R. Loulou, G. Goldstein, A. Kanudia, A. Lettila and U.Remme, "Documentation_for_theTIMES_Model-Part-I_July-2016," 10 May 2016. [Online]. Available: https://iea-etsap.org/docs/Documentation_for_the_TIMES_Model-Part-I_July-2016.pdf. [Accessed 21 June 2019].

[3] Noble-Soft Systems Pty Ltd, "ABARE's MARKAL MACRO/ANSWERTraining Program,"[Online].Available:http://www.noblesoft.com.au/answer/pdfs/ANSWERv6TIMES%20User%20Manual.pdf. [Accessed 21 June 2019].

[4][Online]Available:http://www.noblesoft.com.au/anstimmain.html#:~:text=ANSWER%2DTIMES%20is%20a%20userProgramme%20(IEA%2DETSAP).. [Accessed 14 February 2021].

[5] Tarım Gıda ve Hayvancılık Bakanlığı Çanakkale İl Müdürlüğü, "Çanakkale Brifingi," Tarım Gıda ve Hayvancılık Bakanlığı Çanakkale İl Müdürlüğü, Çanakkale, 2017.

[6] South Marmara Development Agency, "Çanakkale Energy Sector Investment Guide," South Marmara Development Agency, Balıkesir, 2017.

[7] Türkçebilgi, "List of populated places in Çanakkale Province," [Online]. Available: https://www.turkcebilgi.com/%C3%A7anakkale/harita. [Accessed 11 06 2019].

WRITING RULES

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Page Design: Text body area is (195mm x 275mm). 30 mm margin from top, 20 mm from down and 25 mm margin should be left on right/left sides.

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CONTACT

EURAS Journal of Engineering and Applied Sciences – EJEAS

Address: Besyol Mah. Inonu Cad. No: 38 Istanbul – Turkey

Phone: +90 (212) 411 61 68

Email: euras@euras-edu.org