

A Qualitative Study on Employees Carbon Footprint and Renewable Energy Awareness

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Abstract- Global warming, which has been one of the issues on the world's agenda in recent years due to climate change, threatens the lives of all living things. In order to combat the climate crisis, the European Union led the way against the climate crisis within the scope of the Green Deal in 2019. At this point, zero carbon emissions are targeted until 2050. An approach has been planned in order to calculate the carbon footprint of the products imported to EU countries. Transformation of organizations using renewable energy sources is seen as an alternative. In this study, it is aimed to create awareness of the employees about the use of carbon footprint and renewable energy sources. In the study, 13 open and closed-ended questions are asked to 49 employees using interview-based and semi-structured forms, which are qualitative research methods. Some research findings indicated that 77.6 % of the employees have knowledge about the carbon footprint. If 59% of employees are to buy a new vehicle, they would prefer an electric vehicle. Regarding whether to use renewable energy, 51% of employees stated that high installation costs are a problem. The purpose of this study, it is aimed to contribute to future studies by raising awareness about carbon footprint calculations and the use of renewable energy resources.

Keywords carbon footprint, renewable energy awareness, green deal, zero carbon emission, qualitative research

1. Introduction

Carbon dioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O), Hydrofluoride carbons (HFCs), Perfluorocarbons (PFCs), Sulfurhexafluoride (SF₆), and compounds that have the property of retaining heat in the atmosphere are called greenhouse gases. The gases that cause the main greenhouse effect in the world are 36-70% water vapor, 9-26% carbon dioxide, 4-9% methane and 3-7% ozone. While some of the greenhouse gases occur naturally, some are produced by humans [1]. Carbon dioxide (CO₂) emissions account for about 75% of the world's pollution due to more burning of conventional energy use [2]. Therefore, in recent years, various meetings have been held around the world because of global warming. Meetings held for this crisis caused by climate change aim to reduce the carbon emissions emitted into the atmosphere. Greenhouse gas emissions resulting from the burning of fossil fuels are one of the biggest causes of global warming. In order to deal with the global warming

problem at the international level, the Kyoto Protocol was signed in 1997 and started to be implemented in 2005. In addition, the World Standards Organization (ISO) has also published the ISO: 14064 standards on greenhouse gas emissions. It is an internationally valid standard used by the International Standards Institute for certification of balancing projects and carbon credits [3].

The European Union led the way with the Green Deal against the climate crisis in 2019. In this direction, it is foreseen that exports to EU countries will be based on carbon footprint calculation and if they are above the specified rates, they will be subject to granting. In December 2020, the European Council, representing the EU, approved the new binding EU target of at least 55% net local reduction in greenhouse gas emissions by 2030 [4]. In this way, in the sustainability assessment of countries, the links and effects between many components of the system

such as environment, policy, economy, planning and society should be analyzed in a more holistic way [5].

Environmental problems such as global warming and climate change bring along efforts to reduce carbon emissions. There is bidirectional causality between technological innovations, renewable and non-renewable resources, and natural resources with a carbon footprint. Therefore, countries need to develop energy strategy coherence in order to integrate their energy policy activities [6]. In line with this purpose, the concept of carbon footprint has come to the fore and many studies have been carried out around the world. Some of these studies focus on raising the awareness of individuals to reduce their carbon footprints. Industries such as industry, transportation, commerce and agriculture cause carbon emissions globally. Some useful renewable energy sources can be adopted to reduce carbon emissions and drive economic development [7].

The aim of this study is to evaluate carbon footprint and renewable energy awareness by interviewing 49 employees in Ankara.

2. Carbon Footprint and Renewable Energy

The most important factors affecting the ecological footprint are as follows: Industrialization, urbanization, population growth, waste, environmental pollution, fossil fuel consumption, scarcity of renewable energy use, uncontrolled consumption of natural resources, insufficient use of the recycling system, inability to protect natural life and technological developments. The elaboration and increase of ecological footprint studies also led to its privatization. The factors affecting the ecological footprint affect each other. However, the damage caused by fossil fuel consumption outweighs the others. This is actually the main factor that causes the carbon footprint [8]. Table 1 below contains the factors related to the calculation of the emission factor that occurs when people produce in daily life.

Table 1. Factors related to the calculation of the emission factor during production [9]

Electricity consumption	381.2 g/KWh
Service vehicle-Diesel Consumption	2,900 g/lt
Natural gas	1,814.971 g/m ³
Waste water	1,520.897 g/m ³
Industrial waste	16,645 kg/kg

It is very important to understand how economic growth models affect environmental degradation. In this regard, it is critical for the implementation of efficient and effective environmental management policies [10]. Technological innovations have contributed to progress in renewable energy and have helped countries optimize their use of renewable resources [11]. Renewable energy sources are recognized as a pollution-free and potential solution to climate change and energy security problems [12]. Human

demand for natural resources creates pressure on the ecosystem, causing many environmental problems that are not limited to loss of biodiversity, climate change, soil degradation and environmental pollution [13]. For example, there are studies that [14] solar energy consumption makes it easier to reduce the ecological footprint. Therefore, it is possible for RE sources to be an alternative for low CO₂. Since the decrease in CO₂ reduces the carbon footprint, the studies to be carried out should be directed against the CO₂ emission.

On the other hand, according to the International Energy Agency (IEA) electricity market report 2023 shows that renewables, combined with resurgent nuclear power, will more than cover growth in electricity demand between 2022 and 2025.

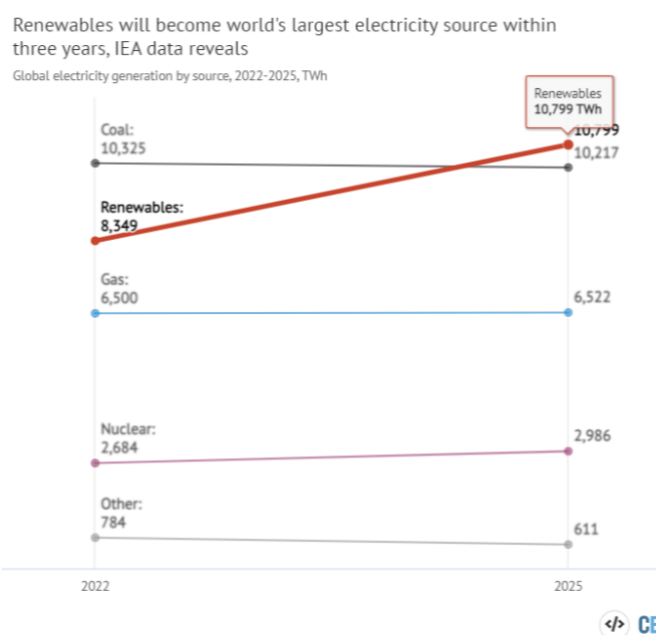


Fig 1. Renewables IEA data [15]

According to the last update and show in Fig 1:

The IEA expects exceptional but partially cyclical growth for renewables and nuclear in 2023, as they bounce back from drought (hydro) and outages (nuclear). The aggregate change from 2022 to 2025 obscures a mixture of structural and cyclical shifts. Specifically, the structural growth of renewables and nuclear may not yet be sufficient to outweigh rising demand [15]. According to the figure, This means that renewable energy sources will surpass coal in three years and become the world's largest source of electricity.

3. Method

The population of the research consists of the employees in Ankara. The sample of the study consisted of 49 randomly selected administrative and academic employees at universities in the province of Ankara. As data collection tools; semi-structured interview forms are used.

In the analyses of the interviews, descriptive and content analysis is carried out. Within the scope of the study, the analyzes are made with graphics and grouping.

Semi-structured interview questions are prepared. These interviews are frequently preferred, thanks to a certain level of standardization and flexibility, eliminating the limitations of tests and questionnaires based on writing and filling, and helping to gain in-depth information on a particular subject. Expert opinions are used to ensure the validity of the interview questions. The interview questions are prepared in accordance with the purpose of the study and evaluated in terms of content validity.

4. Findings

Demographic characteristics of employees for research

The demographic characteristics of the employees in the research group are evaluated in terms of the answers given by the participants.

1. What is your education level? and 2. In which branch have you studied/are you studying?

It is stated that the education level of the employees participating in the research is 9 associate degree, 22 undergraduate and 18 graduate levels.

It has been observed that the majority of the employees are in the field of social sciences, with 42.9 % of the studying field.

3. Do you use a vehicle? What type of fuel do you use if you are driving?

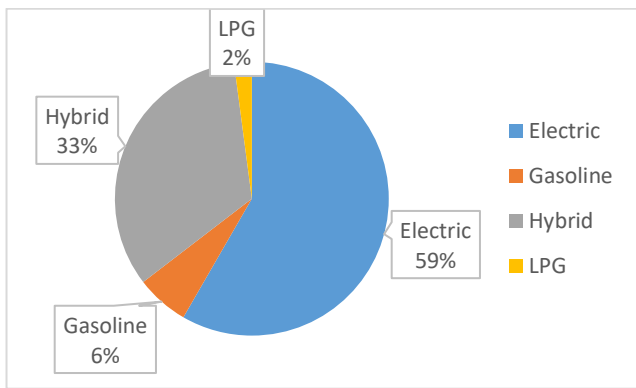


Fig 2. Type of fuel

The nature of the question asked about whether the employees' drive or not is asked to identify the fuels that cause carbon footprints. It has been seen that gasoline is used the most with 61,2 %. In addition to being against the formation of carbon footprints, it has been observed that there is no use of electric vehicles that provide orientation to renewable energy sources. This situation shows that the

society did not have carbon footprint and RE awareness, especially in the past years.

4. If you were to buy a new vehicle, what type of vehicle would you buy?

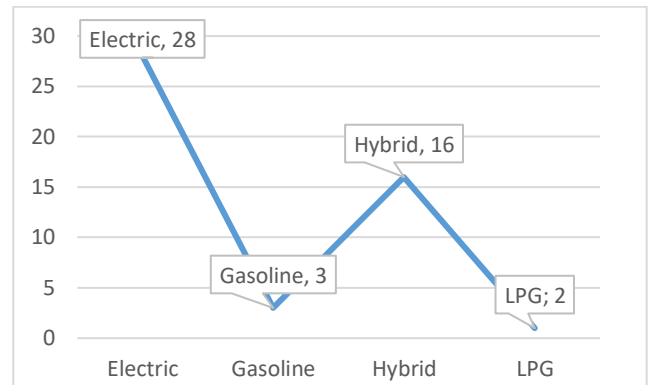


Fig 3. Buying new vehicle

Approximately 60% of the employees stated that they can buy an electric vehicle if a new vehicle is purchased. This shows that there is an increasing trend towards electric vehicles. It can be thought that investments in electric vehicles and advertisements have an important role in recent years. Electric vehicles (EVs) are becoming increasingly popular due to their low emissions and the growing availability of charging infrastructure. Hybrid electric vehicles (HEVs) also offer reduced emissions and improved fuel efficiency compared to conventional gasoline-powered vehicles. If you're looking for a more sustainable option, consider purchasing a used electric or hybrid vehicle, as this can help extend the lifespan of existing vehicles and reduce the need for new vehicle production.

5. Do you have any information about the carbon footprint?

Table 2. Employee information about the carbon footprint

Feature	Categories	f	%
Employee information about the carbon footprint	Yes	38	77,7
	No	11	22,3

6. Which sector do you think harms the nature more in carbon footprint calculations?

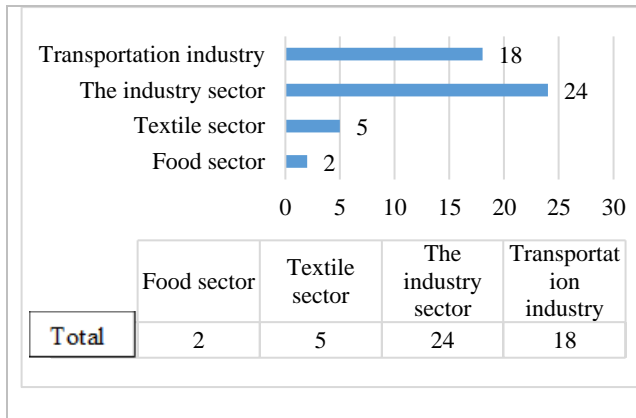


Fig 4. Sector that Causes Carbon Footprint

The majority of the employees stated that the transportation and industry sectors are more effective in the formation of carbon footprint. It's difficult to identify a single sector as being responsible for the most harm to the environment in terms of carbon footprint. The energy sector, including power generation and transportation, is often considered one of the largest contributors to greenhouse gas emissions and therefore has a significant impact on the environment. However, other sectors such as agriculture, deforestation, and industrial processes also play a significant role in contributing to global carbon emissions.

It's important to address emissions from multiple sectors in order to effectively mitigate the impact on the environment. According to the answers given in Fig 4 shows industry sector causes carbon footprint more.

7. Which carbon footprint do you think creates the most in your daily life?

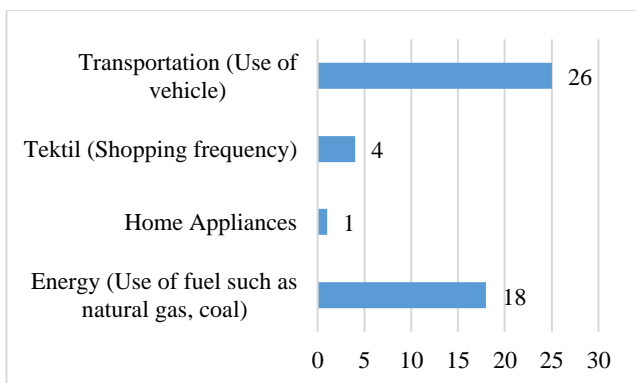


Fig 5. Carbon footprint in daily life

It is thought that it creates a carbon footprint of about 80% in daily life, originating from energy and transportation consumption. In the daily life of a human,

transportation is often one of the largest contributors to their personal carbon footprint. Activities such as driving a gasoline-powered car, taking flights, and using shipping services can contribute significantly to carbon emissions.

Additionally, energy use in the home, such as heating and cooling, lighting, and using electronic devices, can also contribute to a person's carbon footprint. Food choice and production also play a role, as the agriculture and livestock industries are significant sources of greenhouse gas emissions. Reducing energy use and increasing energy efficiency, using sustainable transportation options, eating a plant-based diet, and reducing waste can all help reduce one's personal carbon footprint.

8. Which technological developments do you think play a role in increasing energy efficiency?

55.1% of the employees think that artificial intelligence technologies contribute to energy efficiency.

- Smart grid technology, which enables the efficient distribution of electricity, can help reduce energy waste and increase the use of renewable energy sources.
- Energy-efficient building design and materials can help reduce the amount of energy needed for heating, cooling, and lighting.
- LED lighting and other efficient lighting technologies can significantly reduce energy use for lighting.
- Energy-efficient appliances, such as refrigerators, washing machines, and air conditioners, can significantly reduce energy use in the home.
- Building automation systems and smart home technologies can help reduce energy waste by automating energy-saving practices such as turning off lights and adjusting temperature settings.
- Electric and hybrid vehicles, as well as fuel-efficient gasoline-powered vehicles, can reduce transportation-related emissions.
- Renewable energy technologies, such as solar panels and wind turbines, can reduce the use of fossil fuels and lower greenhouse gas emissions.
- These and other energy-efficient technologies can play an important role in reducing energy waste and increasing sustainability, helping to mitigate the impacts of climate change.

9. Does your family have a tendency towards renewable energy sources to prevent carbon emissions?

For this question, 71.4 % of the employees stated that no precautions are taken, while the remaining personnel used electric vehicles and made more conscious consumption. This shows that the society has just reached a new consciousness about using renewable energy sources.

10. Which renewable energy source do you think can be an alternative for electricity usage and heating?

This question is an open-ended question. In the answers, 81.7 % of the employees think that wind, solar and geothermal energy can be an alternative, and 18.3 % of them think that other energy sources are an alternative. Considering that solar and wind energy are more common worldwide, this can be seen as the right approach.

11. Which renewable energy source do you think should be invested in more?

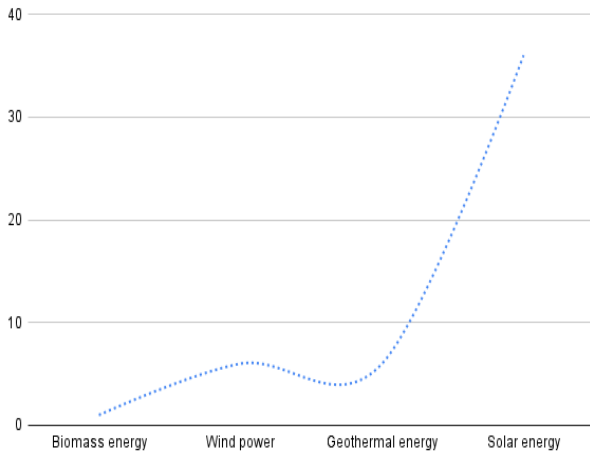


Fig 6. Renewable energy source investment

In fig 6, 76.7% of the answers are that more investment in solar energy should be made. The choice of which renewable energy source to invest in depends on several factors such as availability of resources, cost-effectiveness, scalability, and the energy needs of a particular region.

- Wind energy is a cost-competitive renewable energy source with great potential for large-scale energy production, particularly in regions with strong wind resources.
- Solar energy is becoming increasingly cost-effective and is well-suited for deployment in sunny regions with high levels of insolation.
- Hydropower, although a mature technology, can still provide significant amounts of renewable energy, especially in regions with abundant water resources.
- Biomass energy, which utilizes organic materials such as crops and waste products, can provide renewable energy while reducing waste and mitigating greenhouse gas emissions.
- Geothermal energy, which harnesses heat from the Earth, can provide stable and reliable base-load power.
- Ultimately, a diverse mix of renewable energy sources is likely to be the most effective and

sustainable approach to meeting energy needs while reducing greenhouse gas emissions.

12. What do you think is the society's biggest concern about whether or not to use renewable energy sources?

51 % of the employees are of the opinion that it is cost, 30.5 % of them due to the difficulty of installation, and 18.5 % of them that sudden power cuts may occur and other reasons.

- **Cost:** The initial investment costs for renewable energy technologies can be high, and there may be concerns about the affordability of transitioning to a renewable energy-based system.
- **Intermittency:** Renewable energy sources, such as wind and solar, can be intermittent and their availability may not always match energy demand. This can lead to concerns about energy reliability and security.
- **Infrastructure:** There may be concerns about the cost and feasibility of upgrading or building new infrastructure, such as transmission lines and storage facilities, to support a renewable energy-based system.
- **Public perception:** Some people may have concerns about the visual impact of renewable energy technologies, such as wind turbines, or may be resistant to change.
- **Job loss:** The transition to a renewable energy-based system may result in job losses in the fossil fuel industry, leading to concerns about the impact on local communities.
- **Technological limitations:** There may be concerns about the scalability and technical limitations of renewable energy technologies, such as their ability to meet energy demand during periods of low availability.
- Despite these concerns, many people believe that the transition to renewable energy is necessary to address the impacts of climate change and to ensure a sustainable energy future. Addressing these concerns through research, education, and policy initiatives can help overcome some of the barriers to the widespread adoption of renewable energy.

13. What do you think is the biggest advantage of renewable energy sources?

In this open-ended question, participants answered more than one answer. grouping is made in this direction. 90% of the answers given are to reduce environmental pollution, reduce energy costs and obtain more reliable energy.

The biggest advantage of renewable energy sources is that they offer a cleaner and more sustainable alternative to traditional fossil fuels, which are finite and emit harmful pollutants and greenhouse gases. Some specific advantages of renewable energy include:

- **Clean energy:** Renewable energy sources do not emit harmful pollutants or greenhouse gases,

reducing their impact on the environment and public health.

- Sustainability: Renewable energy sources, such as wind, solar, and hydropower, are abundant and renewable, meaning they can provide a sustainable source of energy for future generations.
- Energy independence: By using renewable energy sources, countries can reduce their dependence on imported fossil fuels and increase their energy security.
- Economic benefits: The use of renewable energy can create new jobs and economic opportunities in the energy sector, as well as in related industries such as manufacturing and construction.
- Cost competitiveness: The costs of renewable energy technologies have been decreasing in recent years, and in many cases, renewable energy is now cost-competitive with traditional fossil fuels.
- Energy access: Renewable energy technologies can provide access to electricity in remote and rural areas where access to traditional energy sources may be limited.
- Reduction of greenhouse gas emissions: The widespread use of renewable energy can help to reduce greenhouse gas emissions and mitigate the impacts of climate change.
- Overall, the use of renewable energy sources offers significant advantages in terms of clean energy production, sustainability, economic benefits, and energy independence.

5. Results

Within the framework of the Green Deal, efforts are underway to reduce the carbon footprint. In addition to the sectors where carbon footprint calculations are made, it is very important to be aware of the society at this stage. Therefore, this study on the employees of the institution is carried out in order to raise awareness.

A central element of every successful attempt to curb carbon emissions is to price carbon effectively, which, however, rests on the condition that unilateral climate action will not result in carbon leakage [16]. Carbon footprint and renewable energy are essential to promote sustainable development and combat climate change. Individuals, organizations, and governments can take several measures to reduce their carbon footprint and increase their use of renewable energy [17].

Today, environmental problems such as climate change and environmental pollution are among the priority issues around the world [18]. Many different strategies are applied to solve these problems. One of them is the application of renewable energy and carbon footprint concepts. Carbon footprint is a concept that measures the amount of carbon dioxide emissions of a person or a business into the atmosphere. The carbon footprint includes emissions from each person's or business' energy use, transportation, and

production of products. Worldwide, reducing the carbon footprint is considered important for reducing environmental problems such as climate change and environmental pollution. The use of renewable energy and reducing its carbon footprint increase its efficiency and the use of renewable energy sources can be made using more efficient ways. In addition, society can play an effective role in reducing carbon footprints by taking into account the energy and materials used in the production process of products. In the study, 13 open and closed-ended questions are asked to 49 employees' using interview-based and semi-structured forms, which are qualitative research methods. The research findings indicated that 77.6 % of the employees have knowledge about the carbon footprint. If 59 % of employees are to buy a new vehicle, they would prefer electric vehicle. Regarding whether or not to use renewable energy, 51% of employees stated that high installation costs are a problem.

More research should be done for future studies. First, large-scale surveys and statistical analysis may offer a more comprehensive recommendation. Secondly, by analyzing the results obtained from the carbon footprint calculations in the studies to be carried out, which sectors cause more carbon footprints in daily life and their importance may increase in this direction. By raising awareness of carbon footprint and renewable energy, individuals, employees and organizations can make informed decisions that contribute to a more sustainable future for all.

Some advice for employees and organizations:

- Raise Awareness: It is important to raise awareness about sustainability and energy efficiency within the organization. Organizing trainings or information campaigns explaining the concept of carbon footprint and the impact of energy resources to employees.
- Energy Efficiency: Since electricity consumption is high in public institutions, it is necessary to reduce the carbon footprint these areas [19]. Energy efficiency studies help both reduce the carbon footprint of employees and reduce energy costs for institutions. Encourage employees to use energy-efficient lighting, computers and office equipment. Simple measures can be taken, such as turning off unused devices, putting them into sleep mode, or switching them to power saving mode.
- Sustainable Transportation: Encourage employees to choose sustainable transportation options. You can encourage low-carbon modes of transport such as public transport, cycling or walking. If you can, you can make it easier for your employees to use these options by providing infrastructure such as bicycle parking areas, showers or electric vehicle charging stations to the workplace.
- Recycling and Waste Management: Establish recycling and waste management policies and encourage employees to practices such as recycling bins, saving

paper, reducing disposable products. In addition, appropriate facilities can be provided to ensure the correct recycling of electronic waste.

- Renewable Energy Sources: Aim to meet your organization's energy consumption from renewable energy sources. Consider the installation of renewable energy systems such as solar or wind power. If not possible, consider using your energy provider's programs based on renewable energy sources.
- Telecommunications and Virtual Meetings: Use telecommunications and virtual meeting tools to reduce travel and transportation costs.

6. Discussion

The findings emphasize the importance of trainings to increase the awareness of employees on carbon footprint and renewable energy. These trainings can help employees to raise awareness of these issues, both individually and corporately, and take appropriate measures to reduce their carbon footprints. In addition, increasing the use of renewable energy sources and raising awareness of this issue will be an important step.

In this study, we conducted a qualitative research based on interviews with 49 employees. However, it is obvious that a large-scale quantitative study will yield different results. Therefore, researching with more employees can provide both greater awareness and more in-depth research on the reduction of carbon footprint and the use of renewable energy sources.

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