Adv. Math. Fin. App., 2025, **10**(2), P. 165-180

**Advances in Mathematical Finance & Applications**
**www.amfa.iau-arak.ac.ir**
**Print ISSN**: 2538-5569
**Online ISSN**: 2645-4610
**Doi**: 10.71716/amfa.2025.31121556

Case Study

# Effect of Carbon Tax Policies in Logistics Systems (Study: Pulp and Paper Industries)

Hadi Najafian[a], Habibollah Javanmard[a,*], Ahmad Sarlak[b]

[a] *Department of Industrial Management, Arak Branch, Islamic Azad University, Arak, Iran*
[b] *Department of Economic, Arak Branch, Islamic Azad University, Arak, Iran*

ARTICLE INFO

*Article history:*
Received 2024-06-03
Accepted 2024-08-12

Keywords:
Carbon Tax
Tax Policy
Logistics
Simulation

ABSTRACT

Two policies of carbon tax are considered by many countries for reduce carbon emissions. First policy emphasized on tax and second policy notice subsidy for carbon emission control. The results show that according to conditions, two policies can effective on reducing carbon emissions and technology development. A carbon tax Policy is needed to reduce carbon emissions in logistics systems. The purpose of this paper is to present effect of carbon tax policies for logistics in Iran pulp and paper industry. The research method is descriptive and data collection is survey, Samples consists two groups. The first group are experts for proposing possible Policy and determining evaluation indices and selecting the appropriate Policy. The second group are managers in pulp and paper company for choose an appropriate Policy. Effect of factors on carbon tax was determined by experts' interviews and fuzzy mean. Two suitable policies that covers the fossil fuels, were selected for simulation by VENSIM software. We considered 10 years for test and 10 years for simulation. Results showed both policies affect pollution reduction, reducing the fossil fuels consumption, reduction of emissions and increase innovation in the logistics system. The second policy that is carrying out carbon tax is more effective than the first policy which paying subsidies to reduce emissions.

## 1 Introduction

One of the policy tools in reducing greenhouse gas emissions and preventing climate change is carbon tax which has been applied in the united nation organization since 1990 [1]. Some countries have put this tax on the agenda. The first countries in the use of this tax are Finland 1990, Norway and Sweden, 1991 and Denmark 1992. Carbon tax is implemented in accordance with the needs of time and place, and also the type of carbon tax advantages and disadvantages and policy making in each country [2]. For this reason, each country has introduced reforms in policy making and methods by analyzing the advantages and disadvantages of carbon tax [3]. European union offered the world integrated carbon tax from 1990 to 2000, the European countries have adopted for trade liberalization but not all countries

* Corresponding author. Tel.: +989362696930
E-mail address: *javanmardha@yahoo.com*

welcomed it [4]. Other industrialized countries since late 2000 have considered carbon tax more than ever [2] and several European countries with other developed countries, such as Australia and Japan, began the carbon tax in 2008. in emerging economies, such as south Africa, Mexico, Chile, and India, carbon tax was implemented to implement climate policy objectives in early 2010 [5]. The positive results of using carbon tax to counter climate change prompted the adoption of the Paris agreement in December 2015 and was implemented in November 2016. More than 150 countries participated in the Paris agreement [6]. The experience of carbon tax in recent years has shown benefits and disadvantages of development and carbon tax. these experiments have shown that carbon tax is a tool capable of adapting to a wide range of goals, policies and national context [7]. How far the use of income forms acceptance, it is likely to depend on prior knowledge and public information on carbon tax. in particular, the researches in tax revenue show that people do not understand the regulatory impact of carbon tax but they understand reduction of greenhouse gas emissions, regardless of the use of tax revenue. environmental taxes (similar) indicate that people have revised their beliefs about the effectiveness and understanding of these policies [8]. however, before implementing the actual policy and experiences, providing information and recommendations for improving public understanding and gaining sufficient public support for carbon tax is very important [9]. The CO2 emission in Iran has a growing trend and from about 532 million tons in 2008 to more than 912 million tons in 2016 (Iran's energy balance sheet, 2017). Results of the researches indicate that the volume of greenhouse gases emission will reach to 1732 m tons of carbon dioxide in 2030 but it can be reduced by 12 percent by proper policy making [10]. Iran automotive industry has a wide supply chain and has a great role in carbon emissions. Providing a proper policy in carbon tax based on effective scenario analysis will help to reduce carbon emissions in this industry. Each carbon tax policy has different effects that depend on views, attitude and conditions, so each country has been implemented one type based on their conditions [11]. Research in this context has proposed various effects and also specific implications that are contradictory to each other [12]. Researches on carbon tax are mainly related to the positive and negative aspects of taxes in the economy and society. Due to many cases such as revenues and resources, the system of management, government system, macro goals and different policies of the government, it is necessary to present a suitable Policy regarding the conditions of Iran. Carbon emissions in the logistics system for Iran's industries are very high. there are two basic reasons for this. The first is a long distance between suppliers and manufacturers. The second is the existence of high - consumption vehicles in logistics systems. The paper industry has a large supply chain, as well as the volume of material in the logistics system. In the inbound logistics too many forklifts and heavy machinery needed for loading and unloading the voluminous row and residue materials and also many trucks are required to carry them from whole of the Iran country and neighbor countries with a very long distance. In the outbound logistics there are same situation for distribution the heavy and voluminous papers products as roll and pallet in whole of the Iran country and export to neighbor countries. So, carbon emissions in this logistics system are very high and need to reduce carbon emissions. One of the factors that force the owners and managers to improve the logistics system and transportation is the government pressure in implementing carbon tax. The government and paper manufacturers have to find a suitable policy after implementing the carbon tax. Suitable Policy for paper logistics system needs to scenarios analysis and it's depended on determining the goals, advantages and disadvantages of carbon tax. This paper improves on the existing literature in two ways. Firstly, many studies focused on effect of carbon taxes in economy, resource taxes and energy demand and there are few studies comparing the different policies of a carbon tax in industries. This is a knowledge gap that we will fill. Secondly, there are limited studies in the

field of provide or developing scenarios for carbon tax that they have been done for specific countries and are not to adapt in conditions of Iran. This research identifies effect of carbon tax policies for the logistics system in Iran paper industry. This paper is arranged as follows: the second section involves a literature review of carbon taxes and carbon tax policies. The third section constructs the methodology. The fourth section introduces the data and scenarios analysis for carbon tax policies in pulp and paper industries and also show the results of each policy and compares the two policies, and the last section presents the conclusion of the article.

## 2 Theoretical Backgrounds

### 2.1 Carbon Tax

Carbon tax is one of the most important ways that international institutions to reduce greenhouse gas emissions are concerned. Carbon tax is a direct government tax which is tailored to the amount of carbon oxide production in industry and some services and by carbon taxes can reduce other taxes [13]. The principle of carbon tax is simple: more greenhouse gas or carbon emission, more pay tax. One of the main examples of carbon tax is carbon tax on various types of fuel or carbon compounds that have been implemented in France since 2014 [14]. According to the conditions to collect carbon tax, it can be paid before or after consumption of fossil fuel. carbon tax purpose integrating in social costs and negative environmental impacts resulting from economic activities with the price of products and services costs. the carbon tax on fossil fuels, which is also called carbon tax, is equivalent to carbon dioxide tax arising from combustion of fossil fuels [15]. In carbon tax, emissions of pollutants, which are caused by fossil fuels consumption, are included in fuel prices [16]. The objective of carbon tax is to reduce energy consumption and emissions and on the other hand reduce labour taxes and thereby reduce labour costs and stimulate new jobs [17]. The tax on pollutants is an instrument imposed by the government per unit (usually per ton) of pollutants released. Since fossil fuels are eventually considered as carbon dioxide emissions, European countries such as Denmark, Norway, Iceland, Ireland, Sweden and the Netherlands have high and effective carbon tax rates [18].

Most studies over the past 20 years have shown that many EU countries, focused on carbon tax and received acceptable results [19]. For determining the effectiveness and consequences of carbon tax some researches have done in Norway, Sweden and Denmark. They analysed the environmental impacts of carbon tax in the 1990 s, Results show that carbon tax reduces co2 emissions the industry sector of Sweden and for Denmark, who distributed income tax revenues in the industry to finance improvements in energy productivity and reduce the reduced tax rates for energetic processes, agreed with the companies in the field of energy saving, it will show the effects of reducing carbon emissions in the industry, and also carbon tax decrease greenhouse gas emissions in the home sector of Norway [20]. Germany and Japan have the same domestic product performance, the same territory has limited resources and are heavily dependent on energy imports. The two countries are investing heavily in technology innovation and development. They have similar energy consumption and greenhouse gas emissions [21]. But in the pricing approach carbon are different. Energy consumption in Japan is based on carbon tax by regional trade systems. Germany, as a member of the European union 's used EU emissions trading system, and approved carbon price of the European union (US $ 30.14 by 2020) to enforce market transparency [3]. The German government expects to have about 40 billion (US $ 47 billion) carbon tax revenue, which Policies to use it in renewable resources for electricity consumers, pay com-

pensation to citizens and industries, and fund other climate programs [22]. There is widespread scientific agreement that pollution taxation is effective for lowering atmospheric CO2 levels, optimal emission pricing posing a key challenge [23]. Relatively few research papers have addressed the impact and eco-efficiency of the already established carbon taxes. They are mostly studies and ex-post comparative analyses of carbon tax effects upon CO2 emissions conducted in Norway, Denmark, Sweden, Finland and Great Britain – see [24], [25], [26]. Focusing on changes in the behaviour of Danish households and corporations.

Lin and Li [27] argue that the carbon tax may reduce the power consumption, increase energy efficiency and support the use of renewable resources, while not hiding the shortcomings of the tax that may lead to slow growth of the economy and social welfare, the impaired competitiveness of related industries and carbon leakage effects. A science-based rational system of carbon taxation is thus of the utmost importance for respective governments. Recent research on pollution taxation provides mostly case studies analysing the impact of the carbon tax introduction in particular countries. In Spain, for example, Gemechu et al. [28] examined direct and indirect effects of environmental taxation on local products, focusing on CO2 emission intensities. For this purpose, environmental input-output (EIO) and price models were applied. Pereira and Pereira [29] discussed the dual role of the carbon tax as a climate and fiscal policy instrument in Portugal, developing marginal abatement cost curves for carbon dioxide emissions using a dynamic general equilibrium model of the Portuguese economy. Solaymani [30] studied carbon and energy taxation in Malaysia, which is one of the top greenhouse gas emitting countries in the ASEAN region. Pursuing a dynamic CGE model approach Van Heerden et al. [31] explored economic and environmental effects of the CO2 tax in South Africa. Regarding environmental tax implementation, Larsen et al. [32] tackled the issue of the social acceptability of sustainable climate policy, using Swiss sample survey data to test alternative carbon tax designs. Most recently, the literature has considered the impact and influence of carbon taxes on the environment [15]. A growing number of qualitative and quantitative studies have clearly demonstrated the public's preference for low-carbon grants in excess of taxes [33]. A USA survey found that the majority of Americans (i.e.,71%) support tax repayments and discounts for eco-friendly cars or solar panels, less than 50% support the introduction of carbon taxes [34].

## 2.2 Carbon Tax Policies

Corporate managers are influenced by different tax policies. corporate governance mechanisms play an important role in shaping and monitoring management field in corporate tax realm [35]. Therefore, each country should have its tax policy based on the type of ownership and management in corporations. According to the tax policy which the government decides to do, the managers can carry out tax programs and they can create opportunities for improvement in financial performance, one research for Indonesian stock exchange companies between 2014 and 2018 showed that the opportunity for tax planning affects the value and financial performance [36]. The North European countries implemented carbon tax as part of their overall tax reform effort [22].

The idea of carbon tax policy was first considered in 1990 by Finland. After that tax reforms and carbon taxes implemented by selected policy in Finland and Netherlands. Norway in 1991 and Sweden 1992 considered policies for carbon tax. In referencing carbon tax designs applied by Scandinavian countries, the research panel at Japan's Environmental Agency got together to discuss economic instruments available under Japan's Basic Environment Law and Basic Environment Plan (Table 1).

**Table 1**: Carbo Tax Policies in Typical Countries [37]

| Country | Year Uploaded | Tax Covered | Energy/ Fuels Covered |
|---|---|---|---|
| Finland | 1990 | Carbon Emission | Coal, Natural gas, Diesel and Gasoline, |
| Netherlands | 1990 | Carbon Emission | Coal, Natural gas, Coke oven, Diesel and Gasoline, Electricity |
| Norway | 1991 | Carbon Emission | Coal, Oil and Natural gas, Diesel and Gasoline |
| Sweden | 1992 | Carbon Emission | fossil Fuels |
| Japan | 2012 | Carbon Emission | Coal, Oil and Natural gas, Diesel and Gasoline |

In Japan four environmental tax plans were considered with the expectation that either option would help Japan to reduce carbon emissions and stabilize them [37]. Two plans considered tax being levied only on carbon fuels (fossil fuels), the latter two included renewables such as nuclear power and hydro-power. Similar to carbon tax designs applied by North European economies, all four carbon tax options considered by the research panel placed a higher focus on tax revenue generation rather than price effect [38]. In analysing the four carbon tax scenarios, the research panel concluded that carbon tax effect to Japanese economy would not be significant, and that negative effects could be averted by rerouting collected revenue to subsidize green energy technologies and to reduce other taxes (a double dividend6). In the fourth carbon tax option, Border tax adjustment was also considered in the context of a potential international carbon tax [39].

Most governments in the developed countries classify environmental taxes based on the type of pollution source in three groups of energy tax, tax on waste disposal and taxes on the transportation [6]. The efficiency of environmental taxes depends on various factors such as economic, sustainability, market efficiency, etc [20]. Generally, the objectives of this type of taxes have been to reduce energy consumption with high carbon, development and increase in renewable energy consumption [40]. So far, eleven projects for carbon tax have been introduced in various researches. These designs are mainly different in the covered areas [41]. Table 2 presents the carbon tax policies have been used in the world

**Table 2**: Types of Carbo Tax Policies in the World [22]

| Policy Name | Energy/ Fuels Covered |
|---|---|
| CEPE (ETH) | five energy sectors (crude oil, refined oil, gas, coal, electricity) |
| DIEM | six energy sectors (crude oil, refined oil, ethanol, gas, coal, electricity), 5 non - energy, 3 demand, 6 non - energy production |
| EC-MSMR (Env. CC Canada) | five energy sectors (crude oil, refined oil, gas, coal, electricity), 15 non - energy production |
| NewERA (NERA) | twelve sectors: 6 energies (oil, gas, coal, foil, electricity, biofuel); four non - energy sectors (production, services, transport, disposal of waste) |
| IGEM-N (DJA) | six energy sectors (coal, oil extraction, gas mining, oil refining, electricity and gas), 30 non - energy |
| G-Cubed (ANU) | twenty sectors (14 energy, 6 non - energy) |
| GH-E3 (RFF) | thirty - five sectors, (9 energy sector, 26 non - energy) |
| USREP-ReEDS (NREL ،MIT) | five energy sectors (crude oil, refined oil, gas, coal, electricity) and six non - energy sectors |
| NEMS (EIA) | 4 supply sectors (coal, oil, gas, renewable energy); electricity, refinement. |
| USDA | 38 energy sectors (5 energy sectors, 33 non - energy sectors) |
| ADAGE-US (RTI) | ten sectors (5 non - energy and 5 energy sectors) |

All carbon policies depend on two factors: first, fuels and energy covered and second, tax rate and parameters. parameters in each policy are divided into some levels according to their influential degree, in which consumers, low carbon preference. Accordingly, it is suggested that governments implement appropriate carbon tax policies at different industrial developmental phase, supplemented by support policies paying most attention on vigorously promoting low - carbon consumption or subsidizing low -

carbon behaviour [42].

## 3 Methodology

The research method is descriptive and applied, as it aims to determine Effect of Carbon Tax Policies for logistics system in paper industries by developing studies on carbon tax Policy. The research is both quantitative and qualitative in terms of approach. The samples consist of two groups. The first group includes 10 experts in industrial and economic, and senior managers in the field of industry and tax in Iran who have experience in both of industry and economics, as well as scientific-research and executive backgrounds in paper industries or economic ministry. All of them had sufficient expertise in the expected criteria. Their opinions are used to identify and validate effective indices in carbon tax, and also to determine the effective rate of indices in tax Policies. Ten experts are sufficient for pairwise comparison studies, the number of experts as interviewees should be between 5 to 15 people are recommended. The number of experts was obtained using the snowball method, where the interview started with two experts known to the researcher, and another person was introduced by experts 1 and 2, and this process continued until the necessary reliability was obtained by the pairwise comparison method. In the pairwise comparison method, the percentage of agreement in the interview should be at least 80%. Equation 1 shows how to calculate the Scott coefficient.

$$P_i = (OA - EA)/(1 - EA) \tag{1}$$

In equation 1, OA is the expected percentage of agreement between two evaluators, and EA is the expected percentage of agreement. The agreement percentage of the seventh interviewee was 82%, but the interviews continued until the tenth interview, during which no new components or categories were identified, and the Scott coefficient reached 94%. The second group consists of decision-makers and top managers of paper industries in Iran, including six selected companies from the centre, north, south, east, and west of Iran. Their approximate number is 240, and their experiences were used to determine the effective indices in tax policies. 240 questionnaires were distributed among them, and with great effort, 164 questionnaires were returned. Their information is presented in Table 3. A semi-specialized questionnaire by executive studies on determining the effective indices in carbon tax provided to collect data from experts, and the Delphi method was used to determine effective indices in carbon tax. In the quantitative method, a questionnaire was used to obtain the opinions and experiences of managers and experts to determine the effective indices in carbon tax. After that we used the expert's opinion for determine the effective rate of indices in tax policies.

**Table 3:** Paper Manufacturers and the Number of Questionnaires

| Row | Company Name | Location in IRAN | Type of industry | Distributed | Collected |
|---|---|---|---|---|---|
| 1 | Iranian Caspian | Center | Paper & Cartoon | 40 | 34 |
| 2 | Pars paper | South | Paper | 40 | 25 |
| 3 | Rasha Caspian | West | Paper | 40 | 30 |
| 4 | Chooka | North | Paper & wood | 40 | 38 |
| 5 | Caspian Cartoon | Center | Cartoon & Packaging | 40 | 32 |
| 6 | Golriz | East | Paper | 40 | 28 |
| Total | | | | 240 | 164 |

# 4 Data Analysis and Finding

Three stages were conducted to analyse the data, which are explained below.

## 4.1 Carbon tax Policies for Paper Industries

Initial carbon tax Policies for Iranian paper Industries considered by Najafian et al in 2022 were introduced six Policies as shown in table 4. Six Policies are possible for Iran industries and two suitable Policies were selected for paper industries [43].

**Table 4**: Carbon Tax Policies for Iranian Industries [43]

| Row | Taxation Policy | Covered Commodities | Tax Rate |
|---|---|---|---|
| 1 | Tax rate for carbon emission | Oil fuel | Local Rate |
| 2 | Tax rate for carbon emission | Gas fuel | Local Rate |
| 3 | Tax rate for carbon emission | Fossil fuel | Local Rate |
| 4 | Subsidy for decrease emission | Oil fuel | Local Rate |
| 5 | Subsidy for decrease emission | Gas fuel | Local Rate |
| 6 | Subsidy for decrease emission | Fossil fuel | Local Rate |

Two selected Policies are No. 3 and 6 in table 4. These Policies, consists oil and gas fuel consumption but in Policy 3 tax rate for emission considered and in Policy 6 subsidy for emission decrease has noticed. We analyzed effect of these Policies as shown in table 5.

**Table 5:** Carbon Tax Policies for Paper Industries

| Policy | Taxation Policy | Covered Commodities | Tax Rate |
|---|---|---|---|
| 1 | Subsidy for decrease emission | Fossil fuel | Local Rate |
| 2 | Tax rate for carbon emission | Fossil fuel | Local Rate |

## 4.2. Determining the Indicators for Policies Analysis

To identify and validate effective indices in carbon tax, fuzzy screening process has used. The use of fuzzy sets is more compatible with linguistic and sometimes vague human explanations, and therefore it is better to use fuzzy sets (using fuzzy numbers) to make long-term predictions and make decisions in the real world [44]. A fuzzy screening process was used through the steps in fig. 1.

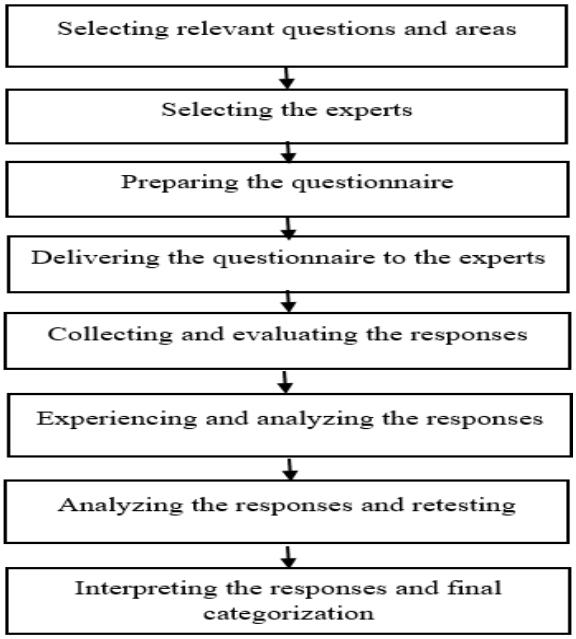


**Fig. 1:** Fuzzy Screening Process

Ten experts were asked to answer the questionnaire consisting of 15 effective carbon tax indices which were based on the literature and theoretical foundations of the research (Table 6.). The fuzzy value of each research question was calculated based on the experts' opinions and was considered as a triangular fuzzy number (U, M, L), where the lower limit value of this triangular fuzzy number for each question was equal to the minimum value assigned by the experts from the Likert scale (1 to 5), the middle limit of this fuzzy number was the geometric mean of all experts' opinions to the questionnaire item, and the upper limit of this fuzzy number was the maximum value assigned by the experts from the Likert scale. Based on the experts' opinions and the threshold table, if the score (fuzzy value) of an index is less than the average value (3), it is considered unimportant and should be ignored. The consensus or agreement percentage (A.P) was that 70% of the experts provided the same answer to one of the answer options for each question. The consensus value in some questionnaire items did not reach the 70% threshold, so they were removed from the questionnaire and a second round of questionnaire was initiated. Along with this round, the overall results of the first questionnaire were also provided to the experts to answer the second questionnaire items based on the results of the first round. Five items from 15 indices, had less than 70% agreement in the first round and removed in the second round. The results of the second round showed that all 8 remaining items were agreed upon by the experts (Table 7, 8.).

**Table 6:** Effective Carbon Tax Indices Which Were Based on the Literature and Theoretical Foundations

| ROW | Effects |
|---|---|
| 1 | Increasing the tax income |
| 2 | Carbon Emission reduction |
| 3 | Other greenhouse Emission reduction |
| 4 | Improvement in logistics technology |
| 5 | Increase in production cost |
| 6 | Increasing the innovation in logistics processes |
| 7 | Costumers’ satisfaction |
| 8 | Popular satisfaction |
| 9 | Social Justice |
| 10 | Reduce of petrol consumption |
| 11 | Reduce of gas consumption |
| 12 | Reduce of diesel consumption |
| 13 | Reduce of coal consumption |
| 14 | Improvement in logistics vehicles |
| 15 | Improvement in logistics equipment |

**Table 7:** The Results of Expert’s Agreement in First Round

| Row | Range | | | | | N | Fuzzy Value | | | Fuzzy Mean | A. P |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | V (1) | L (2) | M (3) | H (4) | VH (5) | | L | M | U | | |
| 1 | 2 | 5 | 2 | 1 | | 10 | 1 | 2.534 | 4 | 2.782 | 55 |
| 2 | | | 1 | 9 | | 10 | 3 | 3.942 | 4 | 3.721 | 95 |
| 3 | 8 | 1 | 2 | | | 10 | 1 | 1.153 | 3 | 2.065 | 45 |
| 4 | | | | 2 | 8 | 10 | 4 | 4.889 | 5 | 4.694 | 90 |
| 5 | 9 | 1 | | | | 10 | 1 | 1.546 | 2 | 2.023 | 45 |
| 6 | | | 4 | 3 | 3 | 10 | 3 | 3.381 | 5 | 3.690 | 70 |
| 7 | 7 | 2 | 1 | 1 | | 10 | 4 | 1.782 | 5 | 1.941 | 40 |
| 8 | 7 | 2 | 1 | | | 10 | 1 | 1.610 | 3 | 2.0883 | 45 |
| 9 | 2 | 3 | 5 | 1 | | 10 | 1 | 2.089 | 4 | 2.3636 | 49 |
| 10 | | | | 1 | 3 | 10 | 4 | 4.139 | 5 | 4.318 | 85 |
| 11 | | | | 1 | 9 | 10 | 4 | 4.945 | 5 | 4.722 | 95 |
| 12 | | | | 1 | 9 | 10 | 4 | 4.944 | 5 | 4.723 | 95 |
| 13 | 8 | 1 | 1 | | | 10 | 1 | 1.748 | 2 | 2.213 | 50 |
| 14 | | | 7 | 1 | 1 | 10 | 3 | 3.167 | 5 | 3.583 | 85 |
| 15 | | | 1 | 1 | 8 | 10 | 3 | 4.819 | 5 | 4.409 | 90 |

**Table 8:** The Results of Expert's Agreement in Second Round

| Row | Range | | | | | N | Fuzzy Value | | | Fuzzy Mean | A. P |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | V (1) | L (2) | M (3) | H (4) | VH (5) | | L | M | U | | |
| 1 | | | 1 | 9 | | 10 | 3 | 3.942 | 4 | 3.721 | 95 |
| 2 | | | | 2 | 8 | 10 | 4 | 4.889 | 5 | 4.694 | 90 |
| 3 | | | 4 | 3 | 3 | 10 | 3 | 3.381 | 5 | 3.691 | 70 |
| 4 | | | | 7 | 3 | 10 | 4 | 4.136 | 5 | 4.318 | 85 |
| 5 | | | | 1 | 9 | 10 | 4 | 4.945 | 5 | 4.722 | 95 |
| 6 | | | | 1 | 9 | 10 | 4 | 4.944 | 5 | 4.721 | 95 |
| 7 | | 1 | 2 | 7 | | 10 | 2 | 3.751 | 4 | 3.377 | 85 |
| 8 | | | 7 | 2 | 1 | 10 | 3 | 3.167 | 5 | 3.583 | 85 |

The results of the Kendall's W test (agreement coefficient) for the first round are presented in Table 9. Since the Sig. level is less than 1%, it can be concluded with 99% confidence that the difference in mean ranks was not significant and there was agreement among the panel members. In the second round, components with less than score were removed based on the modifications made by the Delphi panel members, and the remaining 10 indices, were fully approved. The Kendall's W coefficient for both rounds was higher than 0.5 and approached 1, indicating a relatively strong evaluation. Therefore, the second round of the survey was terminated.

**Table 9:** The Results of the Kendall's W Test

| Number | 10 | 10 |
|---|---|---|
| Kendall's W | 0.723 | 0.885 |
| Chi-Square | 15.56 | 14.38 |
| Degrees of Freedom | 91 | 84 |
| Sig. Level | 0.098 | 0.121 |

the Effective carbon tax indices listed in Table 10.

**Table 10:** Effective Carbon Tax Indices Which Were Based on the Literature and Theoretical Foundations

| ROW | Effects |
|---|---|
| 1 | Carbon Emission reduction |
| 2 | Improvement in logistics technology |
| 3 | Increasing the innovation in logistics processes |
| 4 | Reduce of gasoline consumption |
| 5 | Reduce of gas consumption |
| 6 | Reduce of diesel consumption |
| 7 | Improvement in logistics vehicles |
| 8 | Improvement in logistics equipment |

After determining the aggregated effective carbon tax indices, a confirmatory factor analysis was conducted to determine the factors in selected industries. The collected questionnaires, which included measurement sample responses, were fed into the LISREL 8.5 software. Before conducting the factor analysis, the goodness-of-fit indices were evaluated, and the results showed that the fit indices were acceptable.

## 4.3 Determining the Amount / Weight of Indicators

For policies analysis we have determined the weight of indicators and amount of emission for each vehicle in logistics system (Table 11). Weight of indicators determined by ANP from expert opinion and amount of emission for each vehicle has issued by year book of Iran's statistics center.

**Table 11**: Weight of Indicators and Amount of Emission for Each Vehicle

| Indecies | Unit | Amount/Mean |
|---|---|---|
| Emission reduction from diesel truck | Emission for each truck in logistics | 28 Ton/year |
| Emission reduction from petrol consumption | Emission for each car in logistics | 3.5 Ton/year |
| Emission reduction from forklift | Emission for each forklift in logistics | 2 Ton/year |
| Emission reduction from gas consumption | Emission for each truck in logistics | 8.2 Ton/year |
| Emission reduction from oil consumption in stores | Emission for each store in logistics | 650 Ton/100m/year |
| Improvement in logistics processes and management | Weigh by ANP | 0.20 |
| Improvement in logistics technology and equipment | Weigh by ANP | 0.25 |
| Improvement in logistics vehicles | Weigh by ANP | 0.55 |

## 4.4 Scenarios and time bound for simulation

Scenario analysis by simulation in VENSIM software has used for determining the effect of tax policies. We considered two scenarios as policy in carbon tax (policy 1,2 in table 3) and current situation (Business as usual) for compromise (table 12).

**Table 12:** Scenarios for Test and Simulation

| **Scenarios** | **Taxation Policy** | **Time bound for test** | **Time bound for simulation** |
|---|---|---|---|
| Business as usual (Current situation) | Current situation | 10 years | 10 years |
| Government policy 1 | Subsidy for decrease emission | 10 years | 10 years |
| Government policy 2 | Tax rate for carbon emission | 10 years | 10 years |

## 4.5 Simulation results by VENSIM

For simulation we need real data from one of company in paper industry. Data for simulation has collected from logistics system in Rash Caspian Co. as sample. Rash Caspian is one of the big companies in paper industry that have extended logistics system in whole Iran country. Logistics vehicles in this company are shown in table 13.

**Table 13.** Logistics Vehicles in Rash Caspian

| Vehicles | Quantity |
|---|---|
| Diesel Truck | 300 |
| Pickup / cars | 350 |
| Forklift | 150 |
| Heavy machinery | 100 |
| Bus | 250 |
| Stores | 80,000 m2 |

Rasha Caspian have some alternatives for decreasing the fuel consumption in logistics vehicles and

equipment. These alternatives are depended on current situation and facilities in Iran country as below:

1. Diesel truck / Busses/ Pickup and cars can substitute by gas Vehicles.
2. Forklifts can substitute by Electrical Forklifts.
3. Stores consumption can substitute by gas and electrical utilities.

Depend on carbon tax implementing those alternatives will do in a growth rang that is 20% in every year for simulation. Result of simulation based on these assumptions by VENSIM have shown the effect of carbon tax on following items (fig. 1 to 4).

**Carbon Tax Effect on Carbon Emission in Logistics System**

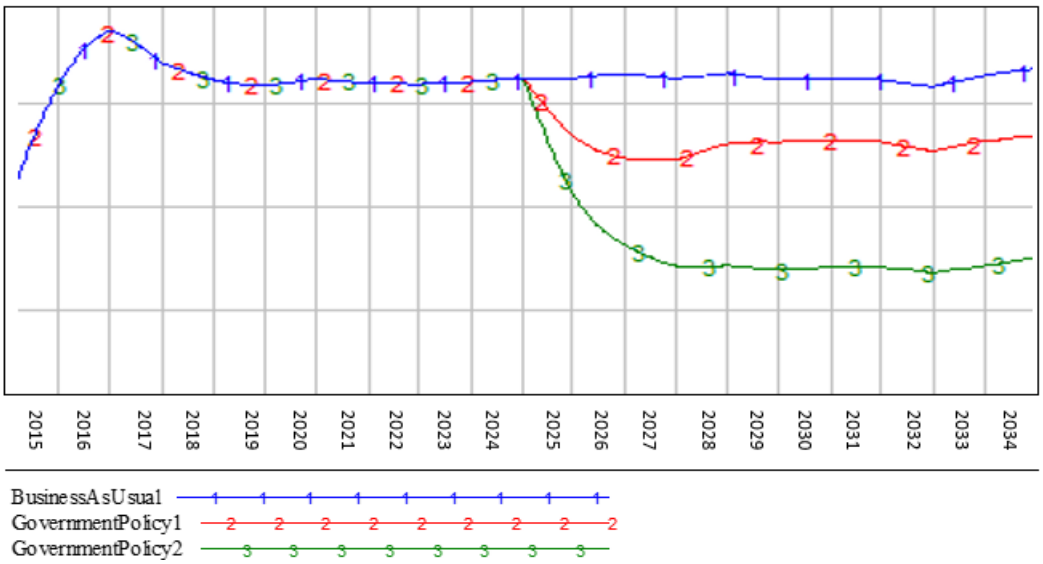


**Fig. 1:** Carbon Emission in Rsha Logistics System

**Carbon Tax Effect on Fossil Fuels Consumption in Logistics System**

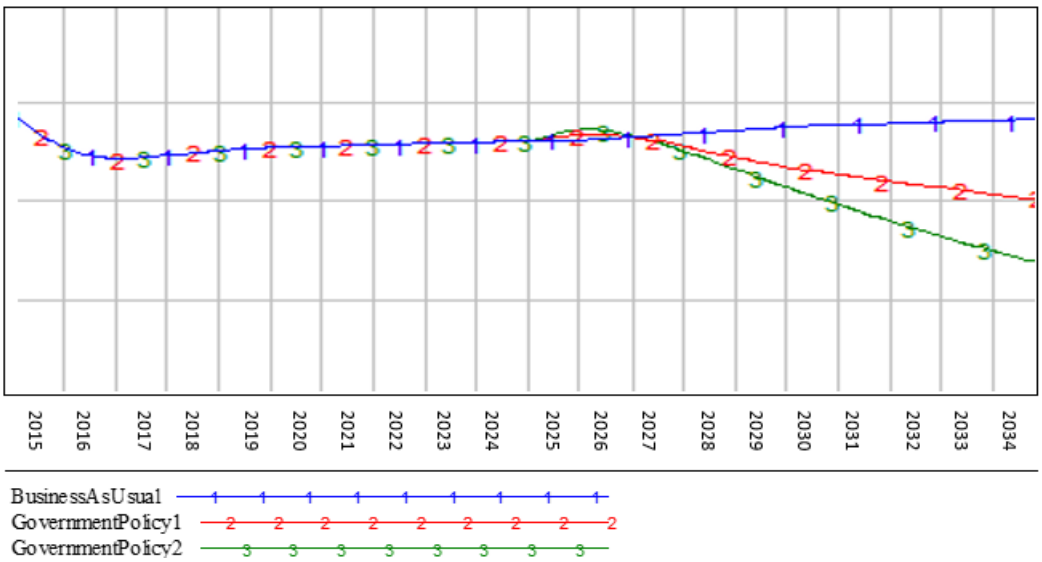


**Fig. 2:** Fossil Fuels Consumption in Rasha Logistics System

**Carbon Tax Effect on Number of Facilities and Vehicles with High Emission in Logistics System**

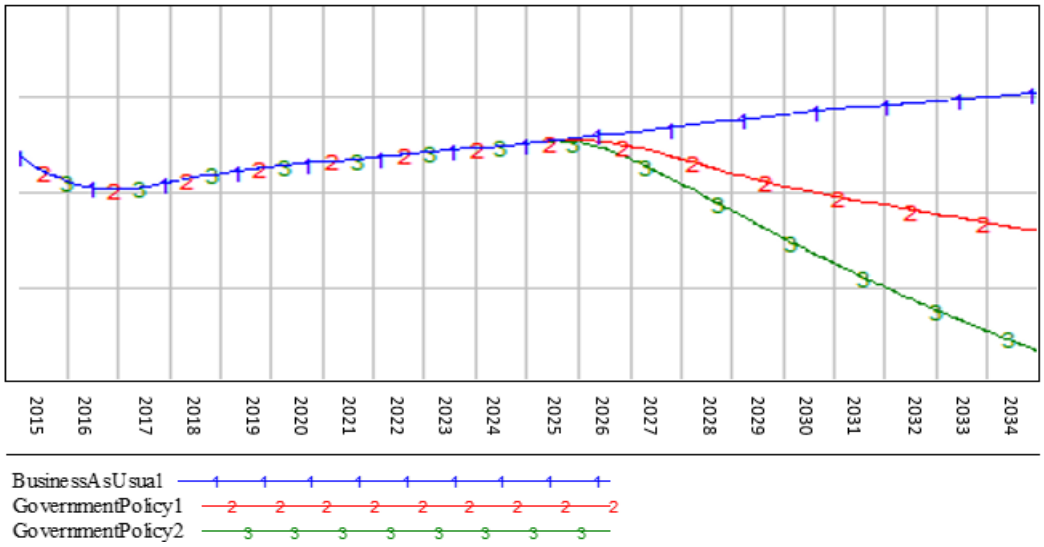


**Fig. 3:** Number of Facilities and Vehicles with High Emission in Logistics System

**Carbon Tax Effect on Technology and Processes Improvement in Logistics System**

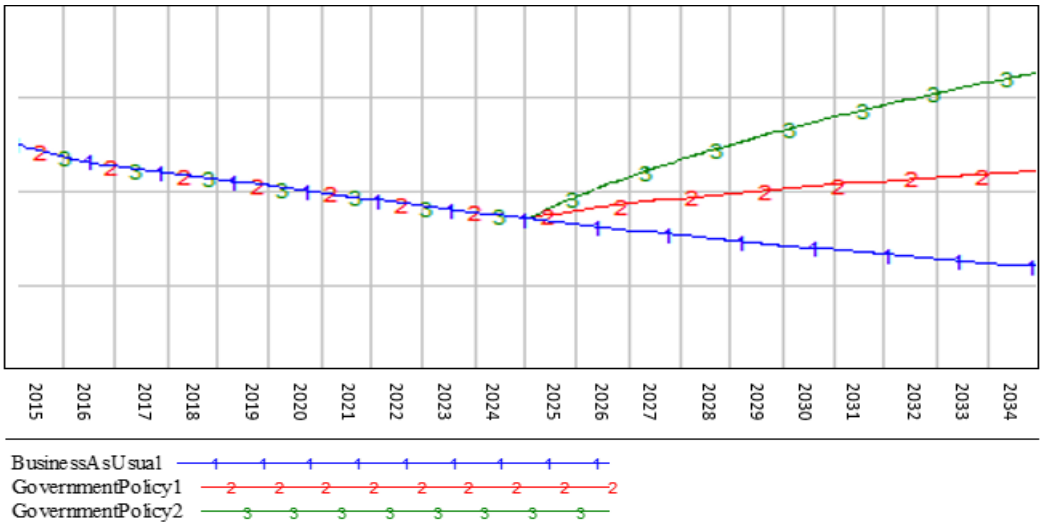


**Fig. 4:** Technology and Processes Improvement in Logistics System

After implementing the carbon tax in 2025, effect of each plan and current situation accurse that:

A) Carbon emission in logistics system will decrease in policies 1,2 from 2025 to 2018, but policy 2 has more effect than policy 1. Without carbon tax current emission of carbon will continue.

B) Fossil fuels consumption in logistics system will decrease in policies 1,2 from 2025 to 2034, but policy 2 has more effect than policy 1. Without carbon tax, fossil fuels consumption will increase.

C) Number of facilities and vehicles with high emission in logistics system will decrease in policies 1,2 from 2025 to 2034, but policy 2 has more effect than policy 1. Without carbon tax, number of facilities and vehicles with high emission will increase.

D) Technology and processes improvement in logistics system will growth in policies 1,2 from 2025 to 2034, but policy 2 has more effect than policy 1. Without carbon tax, Technology and processes improvement will decrease more than before.

## 5 Discussion and Conclusions

Tax policies affect firms' performance; these effects can be positive or negative. Managers by acceptance or avoidance the taxes can lead to positive or negatives performance. Researches have shown that tax acceptance have positive impact on innovation and fuel consumption in logistics but tax avoidance 's reverse and significant impact on investment efficiency [45]. For implementing the carbon tax, many policies have been introduced in the world and each country implemented a carbon tax policy according to its position and specific strategies. Six policies have been proposed for Iranian industries and two policies have been selected by experts' opinion. In both policies, fossil energy includes gasoline, diesel and gas for vehicles and facilities in the logistics system. but in the first policy subsidy is considered to reduce the pollution and in the second policy of carbon tax is considered for carbon emission. in order to determine the effect of each policy for the logistics system in pulp and paper industry, the index and their weights for the scenarios were provided by experts ' opinions and real data of equipment and vehicles in the logistics system and the amount of their pollution. then, using the VENSIM software the results showed that both policies affect pollution reduction, reducing the fossil fuels consumption, reduction of emissions and increase innovation in the logistics system. The second policy that is carrying out carbon tax is more effective than the first policy which paying subsidies to reduce emissions. In order to apply the one of selected policies, there are issues that need further research. If the goal of Iran's government is to accelerate the reduction of carbon emissions in the logistics system. the second policy should be selected. Results of research in Japan, USA, Finland and France have also shown imposing carbon tax in short term have positive effect in decreasing the carbon emission [39]. But if main goal is firstly, to support industry and production and also to develop technology and improve vehicles and secondly, reducing the carbon emissions will be priority, it is better to choose the first policy. In this policy the trend of reducing carbon emissions is lower than second policy, but it will give industries a chance to gradually improve technology by government supporting by using subsidy. the implementation of fossil fuel subsidies in Japan and Norway caused green technology investments to reduce greenhouse gas emissions and create green energy jobs and move the economy to clean energy [39]. However, the experiences show that the support of the Iran's government and subsidy for industry has not been successful for many years and there is a need to make changes in the implementation of this policy. In other hand in the second policy, pressure and speed of implementing carbon tax may reduce the industries empowerment for improvements in technology and innovations. Future researches can research in those subjects in different industries.

## References

[1] Cheng, Y., Sinha, A., Ghosh, V., Sengupta, T., Luo, H., Carbon tax and energy innovation at crossroads of carbon neutrality: Designing a sustainable decarbonization policy, *Journal of Environmental Management*, 2021; 294, doi: 10.1016/j.jenvman.2021.112957.

[2] Rausch. S., Reilly, J., Carbon taxes, Deficits, and Energy Policy Interactions, *National Tax Journal*, 2015; 68(1): 157-178. doi:10.17310/ntj.2015.1.07.

[3] World Bank., State and Trends of Carbon Pricing (Type). *World Bank, Washington DC*. 2020. doi: 10.1596/978-1-4648-1586-7.

[4] Konstantara, I., Skouri, K., Benkherouf, L., Optimizing inventory decisions for a closed–loop supply chain model under a carbon tax regulatory mechanism, *Int. J. Production Economics*, 2021; 239. doi:10.1016/j.ijpe.2021.108185.

[5] Rathore, M., Jakhar, S.K., Differential carbon tax policy in aviation: One stone that kills two birds? *Journal of Cleaner Production,* 2021; 296, 126479, doi: 10.1016/j.jclepro.2021.126479.

[6] Wang, M., Fang, X., Zhang, K., Exploring a pathway to optimize the carbon tax policy in terms of the economy, the environment and health: A scenario-based system dynamics approach, *journal of Heliyon*, 2024; 10, doi: 10.1016/j.heliyon. 2024.e31093.

[7] Sun, Y., Mao, X., Yin, X., Liu, G., Zhang, J., Zhao, Y., Optimizing carbon tax rates and revenue recycling schemes: Model development, and a case study for the Bohai Bay area, China, *Journal of Cleaner Production*, 2021; 296. doi: 10.1016/j.jclepro.2021.126519.

[8] Bragagni, M., Xhaferraj, L., Mazza, I., Concetti, G., Sustainable development and the need to reform the carbon tax. *Journal of Public Affairs*, 2022; (22) 1, doi: 10.1002/pa.2787.

[9] Zhang, J., Zhang, Y., Exploring the impacts of carbon tax on tourism-related energy consumption in China. *Sustainable development*, 2019; 27(3), 296-303. doi: 10.1002/sd.1900.

[10] Jahangard E, Banooei A A, Faridzad A, Barkhordari S, Amadeh H, Doudabi Nezhad A. The Double Dividend Hypothesis for Iran Economy: Modeling Carbon Taxes with a CGE Model. *Quarterly Journal of Energy Policy and Planning Research* 2019; 5 (3) :7-31, URL: http://epprjournal.ir/article-1-701-en.html., (In Persian).

[11] Atherton, J., Xie, W., Aditya, L.K., Zhou, X., Karmakar, G.K., Akroyd, J., Mosbach, S., Lim, M.Q., Kraft, M., How does a carbon tax affect Britain's power generation composition? *Applied Energy*, 2021; 298. doi: org/10.1016/j.apenergy.2021.117117.

[12] Adam, S., Delestre, I., Levell, P., Miller, H., Tax policies to reduce carbon emissions. *Fiscal Studies*, 2022; 43(3), 235-263. doi: 10.1111/1475-5890.12308.

[13] Ling, T., Jiaqian, W., Lean, Y., Qin. B., Carbon emissions trading scheme exploration in China: A multi-agent-based model." *Journal Energy Policy*, 2015; 81, 152–169. doi: 10.1016/j.enpol.2015.02.032.

[14]. Mideksa T.K., Pricing for a Cooler Planet: An Empirical Analysis of the Effect of Taxing Carbon, *CESifo Working Paper*, 2021; No. 9172. doi: 10.2139/ssrn.3885415.

[15] Wiskich A.A., Carbon tax versus clean subsidies: Optimal and suboptimal policies for the clean transition, *journal of Energy Economics*, 2024; 132. doi: 10.1016/j.eneco.2024.107410.

[16] Povitkina, M., Jagers, S., Matti, S., Martinsson, J., Why are carbon taxes unfair: Disentangling public perceptions of fairness, *Global Environmental Change*, 2021; 70, 529-554. doi: 10.2139/ssrn.3789927.

[17] Xu, X., Chen, Q., Che, Y., The impacts on CO2 emission reduction and haze by coal resource tax reform based on dynamic CGE model. *Journal of Resources policy*, 2018; 58, 268–276. doi: 10.1016/j.resourpol.2018.05.015.

[18] Tan, R., Lin, B., The influence of carbon tax on the ecological efficiency of China's energy intensive industries—a inter-fuel and inter-factor substitution perspective. *Journal of Environ. Management,* 2020; 261, 110252. doi: 10.1016/j.jenvman.2020.110252.

[19] Kong Chyong, C., Guo, B., Newbery, D, The impact of a carbon tax on the CO2 emissions reduction. *Journal of Wind Energy*. 2020; 41. doi: 10.5547/01956574.41.1.

[20] Andersson, J., Cars, carbon taxes and CO 2 emissions (Grantham Research Institute on Climate Change and the Environment Working Paper, London, England: *London School of Economics and Political Science*, 2015; 21, 234-254. doi: 10.1080/14693062.2018.1492897.

[21] Schafhausen, F., Climate policy of Japan and Germany in comparison. 21st reform group meeting. Prospects of climate change policy and green finance - low carbon strategies, energy plans and implementation of the Paris agreement. *Salzburg, Austria,* 2017; 34. doi: 10.1016/j.esg.2023.100187.

[22] Yunfei, I. Chenmu Du, Z., Xiang, J., Tian Wu, T., Tax policy or carbon emission quota: A theory on traditional ICEV transportation regulation, *Journal of Energy,* 2024; 2., doi: 10.1016/j.energy.2023.129848.

[23] Khastar M., Aslani A., Bekhrad, K., Naaranoja, M., Kowsari, H, Resiliency Analysis of Energy Demand System in Finland, *Present Environment and Sustainable Development*, 2018; 12(2). doi: 10.2478/pesd-2018-0046.

[24] Bosquet, B., Environmental tax reform: does it work? A survey of the empirical evidence. *J of Ecol. Econ*, 2000;34 (1), 19–32. doi: 10.1016/S0921-8009(00) 00173-7.

[25] Wier, M., Birr-Pedersen, K., Jacobsen, H.K., Klok, J., Are CO2 taxes regressive? Evidence from the Danish experiences. *J of Ecol. Econ*. 2005;52 (2), 239–251. doi: 10.1016/j.ecolecon.2004.08.005.

[26] Andersen, J.J., Greaker, M., Emission trading with fiscal externalities: the case for a common carbon tax for the non-ETS emissions in the EU. *Journal of Environ. Resour. Econ*. 2018; 7, (3), 803–823. doi: 10.1007/s10640-017-0184-x.

[27] Lin, B., Li, X., The effect of carbon tax on per capita CO2 emissions. Energy Policy, 2011; 39 (9), 5137–5146. doi: 10.1016/j.enpol.2011.05.050.

[28] Gemechu, E.D., Butnar, I., Llop, M, Castells, F., Economic and environmental effects of CO2 taxation: an input-output analysis for Spain. *Journal of Environ. Plan. Manag,* 2014; 57 (5), 751–768. doi: 10.1080/09640568.2013.767782.

[29] Pereira, A.M., Pereira, R.M., Environmental fiscal reform and fiscal consolidation: the quest for the third dividend in Portugal. *Public Financ. Rev*. 2014; 42 (2). doi: 10.1177/1091142113485803.

[30] Solaymani, S, Carbon and energy taxes in a small and open country. *Glob.J. Environ. Sci. Manag*, 2017; 3(1), 51–62. doi: 10.22034/gjesm.2017. 03.01.006.

[31] Van Heerden, J., Blignaut, J., Bohlmann, H., Cartwright, A., Diederichs, N., Mander, M., The economic and environmental effects of a carbon tax in South Africa: a dynamic CGE modelling approach. S. *Afr. J. Econ. Manag*. *Sci*, 2016; 19 (5), 714–732. doi: 10.4102/sajems. v19i5.1586.

[32] Larsen, J., Mohan, S., Herndon, W, Energy and Environmental Implications of a Carbon Tax in the United States. Rhodium Group for Columbia SIPA Center on Global Energy Policy, *United States*, 2018; doi: 10.1080/14693062.2022.2061405.

[33] Barragan-Beaud, C., Pizarro-Alonso, A., Xylia, M., Syri, S., Silveira, S., Carbon tax or emissions trading? An analysis of economic and political feasibility of policy mechanisms for greenhouse gas emissions reduction in the Mexican power sector. *Energy Policy*, 2018;122, 287–299. doi: 10.1016/j.enpol.2018.07.010.

[34] Ratanakuakangwan, S., Morita, H., Energy efficiency of power plants meeting multiple requirements and comparative study of different carbon tax scenarios in Thailand, *Cleaner Engineering and Technology*, 2021; 2 100073. doi: 10.1016/j.clet.2021.100073.

[35] Hamid, E., Amiri, H., Ahmadi, M.R., Salehi, A.K., Presenting a Model of Tax Non-Compliance in Iran Based on the Analytical Network Process, *Advances in Mathematical Finance and Applications*., 2023; 8(2), P. 385-418. doi: 10.22034/AMFA.2022.1956900.1738.

[36] Paidarmanesh, N., Mehrazeen, A., Abbaszadeh, MR.R., Massih Abadi, A., Firm Value, Tax Evasion, Tax Planning Opportunity and Financial Crisis of Firms, *Advances in Mathematical Finance and Applications*., 2024; 9(2), P.513-528. doi: 10.22034/amfa.2023.1967020.1795.

[37] Arimura, T.H., Abe, T., The impact of the Tokyo emissions trading scheme on office buildings: what factor contributed to the emission reduction? *Environmental Economics and Policy Studies,* 2020; 23(1). doi: 10.1007/s10018-020-00271-w.

[38] Kojima, S., Asakawa, K., Expectations for carbon pricing in Japan in the global climate policy context. In: Arimura, T.H., Matsumoto, S. (Eds.), Carbon Pricing in Japan. Economics, Law, and Institutions in Asia Pacific. Springer, *Singapore*, 2021. doi: 10.1007/978-981-15-6964-7_1. Retrieved from.

[39] Gokhale, H., Japan's carbon tax policy: Limitations and policy suggestions., Current Research in Environmental Sustainability, 2021; 3. doi: 10.1016/j.crsust.2021.100082.

[40] Lin, B., Jia, Z., The energy, environmental and economic impacts of Carbon tax rate and taxation industry: a CGE based study in China. *Journal of Energy*, 2018;159, 558–568. doi: 10.1016/j.energy.2018.06.167.

[41] McFarland, J., Fawcett, A.A., Morris, A.C., Reilly, J.M., Wilconxen P.J., Overview of the EMF 32 Study on U.S. Carbon Tax Scenarios, *Climate Change Economics,* 2018; 9 (1):1-37.
doi: 10.1142/ S201000781840002X.

[42] Liao, D., Tan, B., An evolutionary game analysis of new energy vehicles promotion considering carbon tax in post-subsidy era*, Journal of Energy*, 2023; 264. doi: 10.1016/j.energy.2022.126156.

[43] Najafian, H., Javanmard, H., Sarlak, A, Carbon Tax Plan for Iran's Automotive Industry, *Journal of business management,* 2023;1069064, (In Persian).

[44] Ghadirinejad, G., Rajab Beigi, M., Gholami, A.KH, Scenario Development of Talent Management System in Iran's National Oil Products Distribution Company, *Journal of System Management*, 2023; 9(4), 221-237. doi: 10.30495/JSM.2023.1984177.1812.

[45] Bashiri Manesh, N., Arefmanesh, Z., The Role of Effective Variables on The Relationship Between Tax Avoidance and Investment Efficiency, *Advances in Mathematical Finance and Applications*., 2023; 8(3), 829-847. doi: 10.22034/AMFA.2023.1968722.1806.