Environmental Industry Letters
https://journals.tultech.eu/index.php/eil
ISSN: 2806-2965
Volume 2, Issue 1
DOI: https://doi.org/10.15157/eil.2024.2.1.16-29
Received: 21.01.2024; Revised: 26.02.2024; Accepted: 15.03.2024

Research Article

Green Branding of Czech-Poland Merchandise through Hydrogen Energy: A Study for Sustainable Production and Market Differentiation

Seyed Morteza Javadpour[1*]

[1] Mechanical Engineering Department, University of Gonabad, Gonabad, Iran

*** smjavadpour@gonabad.ac.ir**

Abstract

Through this research strategies for sustainable production and market differentiation are studied and explored. By tapping into the potential of hydrogen, businesses can minimize environmental impact and carve a distinct identity in the market, cultivating a reputation for sustainability. This research aims to uncover how embracing hydrogen as a clean energy source can benefit businesses and contribute to broader environmental responsibility goals. Exploring successful green branding examples and consumer responses, insights are provided to enable businesses to implement green branding initiatives effectively, driving both ecological and economic sustainability in the Czech-Poland region. In the final stage of this research, three mathematical-conceptual models are developed for the implementation of green marketing in hydrogen energy production in both the Czech Republic and Poland regions, covering eco-friendly products and services, environmental responsibility, and corporate social responsibility (CSR).

Keywords: Hydrogen Energy; Green Branding; Sustainable Production; Market Differentiation; Czech-Poland Merchandise

INTRODUCTION

Green branding has emerged as a crucial strategy for businesses selling merchandise, demonstrating a commitment to sustainability, and minimizing environmental impact. By advocating for the use of renewable energy sources and eco-friendly practices, these companies can cultivate a robust reputation and appeal to environmentally conscious consumers. Recent years have witnessed numerous successful instances of green branding, showcasing the advantages of this approach. For instance, many enterprises have embraced renewable energy sources like solar or wind power to diminish their carbon footprint and underscore their dedication to sustainability. Others have instituted recycling programs or curtailed packaging waste to mitigate their environmental footprint [1-3].

This study investigates the potential of green branding for Czech-Poland merchandise, centered on the utilization of hydrogen energy. It explores the merits of employing hydrogen as a clean and sustainable energy source, illustrating how it can aid regional businesses in establishing a credible image of environmental stewardship. Additionally, it

scrutinizes successful green branding examples in other sectors, investigating how these strategies can be tailored to suit the requirements of Czech-Poland merchandise. Furthermore, it examines consumer response by gauging their willingness to pay for hydrogen-produced merchandise and assessing the impact of various incentives on producers' inclination towards hydrogen fuel adoption and fossil fuel reduction (Figure 1). Such analysis offers an impetus for producers to invest in green branding initiatives by showcasing the potential financial advantages of sustainability promotion [4-6].

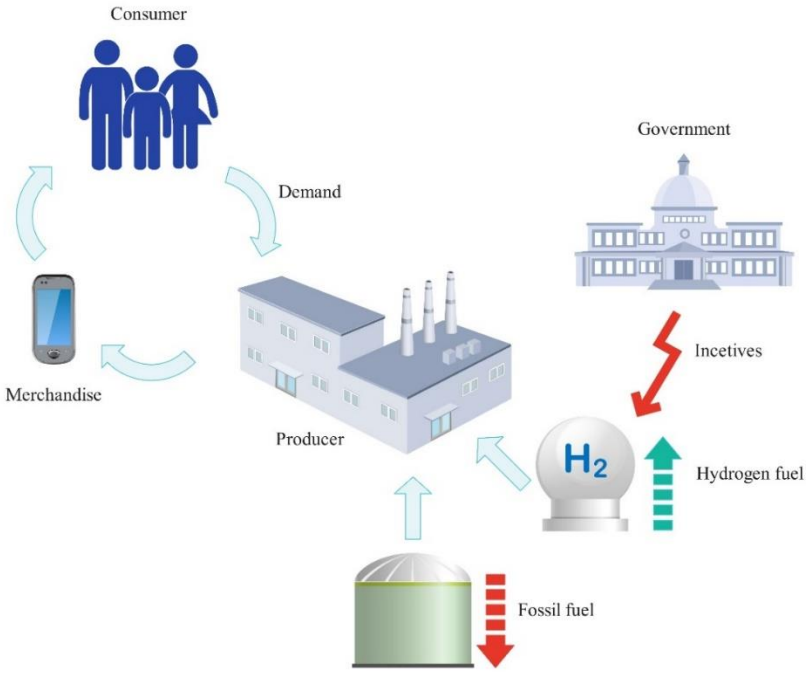


Figure 1. Customer-Producer-Government Relations in Green Branding of Hydrogen-Produced Merchandise

Overall, this research aims to demonstrate the importance of green branding and how it can be an effective way to promote sustainable practices, reduce the environmental impact of businesses that sell merchandise in the Czech-Poland region, and increase profits by appealing to environmentally conscious consumers [7].

Background

The Czech-Poland region has been facing a growing need to transition towards renewable energy sources and sustainable practices. As pictured in Figures 1 and 2, which show the share of energy consumption by source in Czech Republic and Poland, respectively (source: BP's statistical review of world energy 2021), both countries are heavily reliant on fossil fuels, which have a significant environmental impact and contribute to climate change [8].

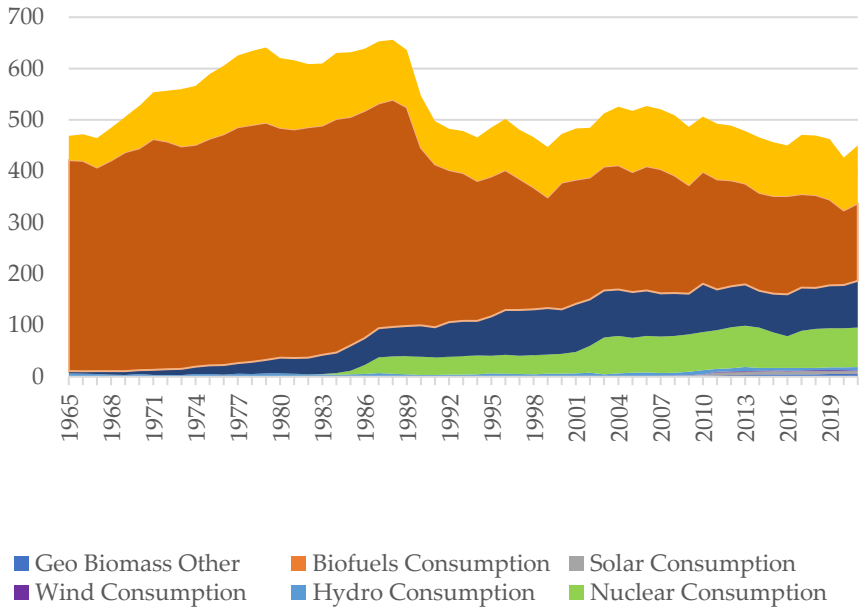


Figure 2. share of energy consumption by source in Czech from 1965 to 2021 (Source: BP's statistical review of world energy 2021)

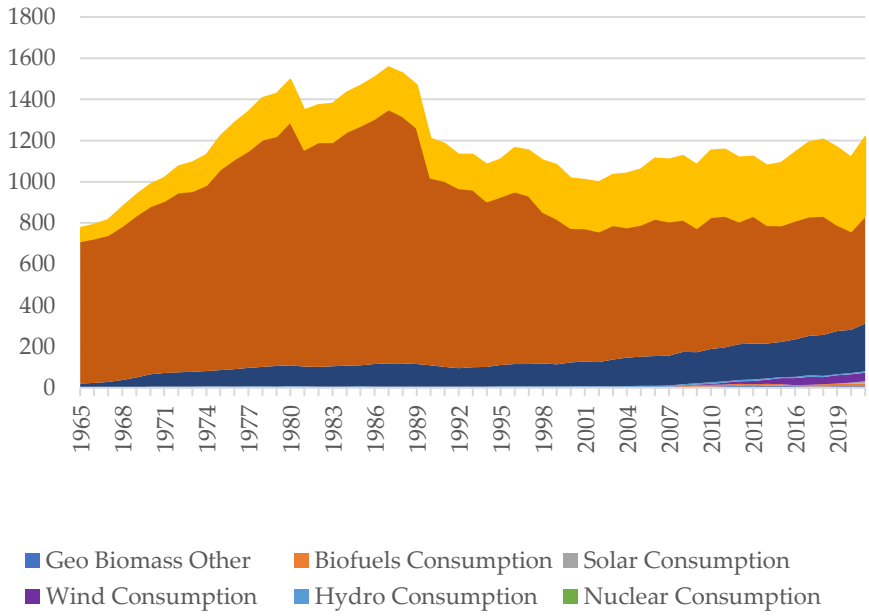


Figure 3. share of energy consumption by source in Poland from 1965 to 2021 (Source: BP's statistical review of world energy 2021)

Hydrogen energy has emerged as a promising alternative to traditional fossil fuels. Hydrogen is a clean and sustainable energy source that produces only water vapor when used as fuel. The production of hydrogen can also be done using renewable energy sources such as wind or solar power. This makes it an attractive option for businesses looking to reduce their environmental impact [9].

Additionally, consumers are becoming more environmentally conscious and are increasingly seeking out sustainable products. Therefore, the concept of green branding has become more attractive every day. Green branding is an effective way for businesses to promote their commitment to sustainability and appeal to environmentally-conscious consumers. By adopting sustainable practices and promoting their use of renewable energy sources, businesses can build a strong reputation and attract new customers who prioritize environmental responsibility [10].

Several successful examples of green branding initiatives have been seen in different industries. For instance, many clothing and fashion brands have implemented sustainable production practices and reduced their carbon footprint by using renewable energy sources. Other businesses have introduced recycled or biodegradable packaging materials to minimize waste and reduce their environmental impact [11]. In this context, this investigation aims to explore the potential of green branding initiatives for Czech-Poland merchandise based on the consumption of hydrogen energy. By promoting the use of hydrogen in the production process and marketing products as environmentally friendly, businesses can build a strong reputation and appeal to environmentally conscious consumers. This could lead to increased profits and a reduced environmental impact in the region [12].

Programming Results

Eco-Friendly Products and Services

The primary objective of this MATLAB program (Code S.1) is to illustrate and compare the combined index for green marketing and eco-friendly products and services between the Czech and Polish cases. By generating hypothetical data, performing a simple computation, and visualizing the results through contour plots, the program aims to provide insights into the environmental sustainability efforts in these two countries. To initiate the analysis, a 2D space is defined using the meshgrid function, forming X and Y coordinates. Hypothetical data for the green marketing index and the eco-friendly products and services index is then generated for both Czech and Polish. These values, though hypothetical in this example, would typically be based on real-world measurements or comprehensive computations. A critical step involves a simple computation, multiplying the green marketing index with the eco-friendly index separately for both the Czech and Polish cases. This computation yields a combined index, serving as an integrated metric to gauge the overall environmental impact of green branding and hydrogen energy initiatives in each country [13–15].

The computations of the schemes are represented in Equations 1 and 2.

CombinedIndex_Czech = GreenMarketingIndex_Czech . EcoFriendlyIndex_Czech;* (1)

CombinedIndex_Poland = GreenMarketingIndex_Poland . EcoFriendlyIndex_Poland;* (2)

The program concludes with the creation of contour plots (Figure 4) for the Czech and Polish cases. The contour plots vividly depict the spatial distribution of the combined index, emphasizing areas where the synergy between green marketing and eco-friendly practices is most pronounced. Adjustments to the figure properties enhance visualization and facilitate a clear understanding of the comparative analysis. Through this MATLAB program, stakeholders can gain a nuanced understanding of the combined environmental impact of green marketing and eco-friendly products and services in the Czech and Polish cases. It serves as a versatile tool for decision-makers, allowing them to identify areas of success, potential improvements, and the overall effectiveness of sustainability initiatives in these regions. The program provides a foundation for more sophisticated analyses and deeper insights into the complex relationship between green branding, hydrogen energy, and eco-friendly practices in different geographical contexts.

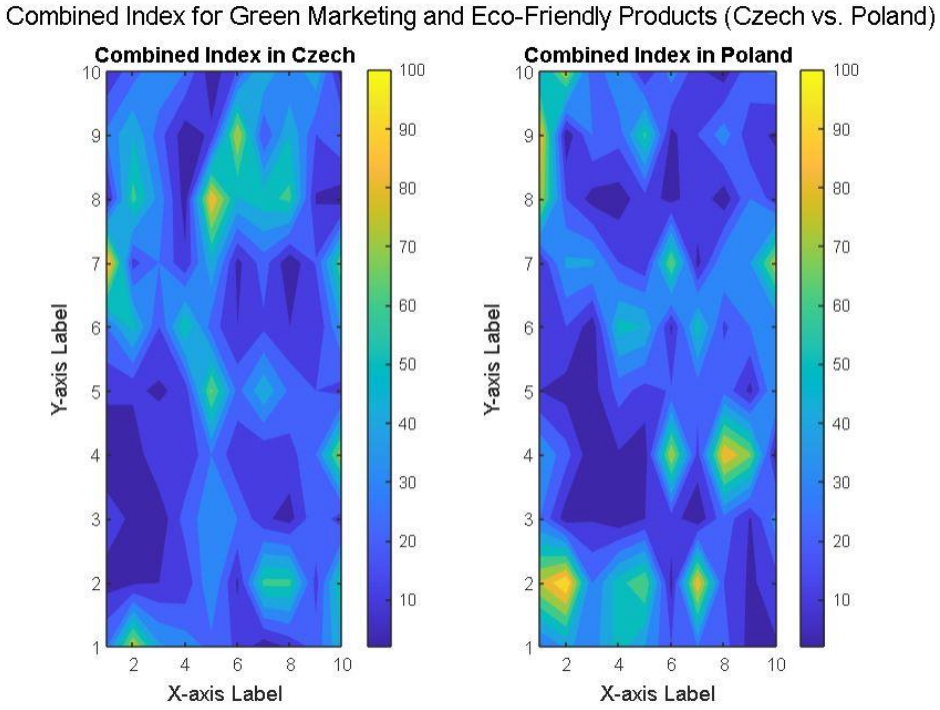


Figure 4. The outputs of Eco-Friendly Products and Services as per Czech Republic and Poland countries in green branding of hydrogen production

Environmental responsibility

The primary goal of the program is to assess and compare the environmental sustainability of the Czech Republic and Poland based on key factors, including carbon footprint, water usage, and waste generation. The program employs a mathematical model to calculate an Environmental Sustainability Score for each country, reflecting the weighted contributions of these factors. The ultimate aim is to provide insights into the relative impact of different environmental aspects, helping to identify areas for improvement and guide sustainable practices [16].

The methodology involves a systematic approach to computing the Environmental Sustainability Score for both the Czech Republic and Poland. The mathematical model integrates three crucial environmental factors, each weighted according to its significance [17]:

Carbon Footprint (CF):

Represents the amount of carbon dioxide emitted, measured in metric tons.

Weighted by a factor of 0.5.

Water Usage (WU):

Quantifies the consumption of water resources, measured in cubic meters.

Weighted by a factor of 0.3.

Waste Generation (WG):

Reflects the production of waste, measured in tons.

Weighted by a factor of 0.2.

The Environmental Sustainability Score (ESS) is then calculated using the following formula (Equation 3).

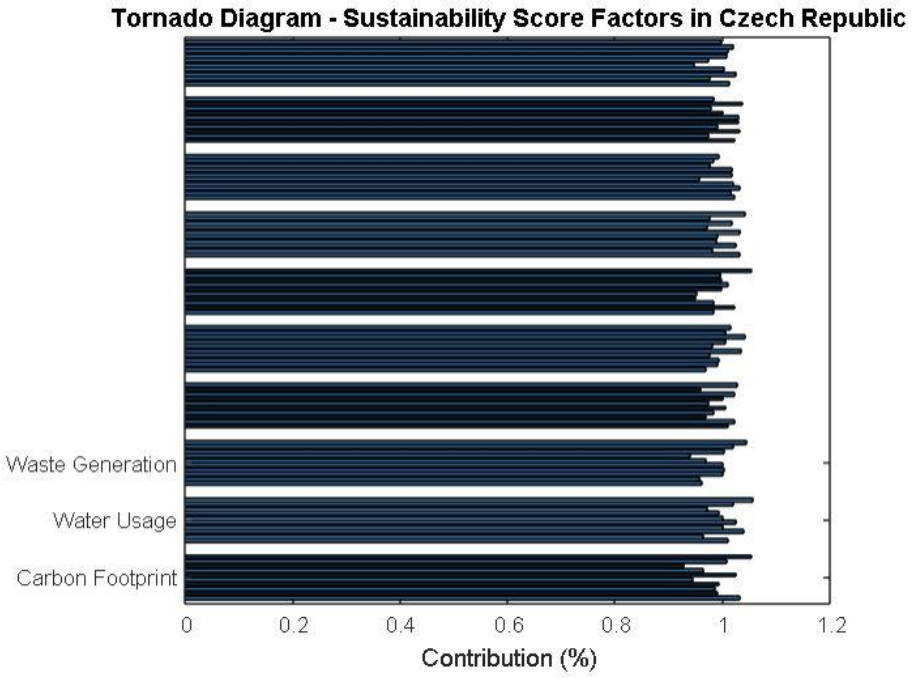
$$ESS = WeightCF \times CF + WeightWU \times WU + WeightWG \times WG \quad (3)$$

To enhance the interpretability and coherence of the scores, a logarithmic transformation is applied (Equation 4).

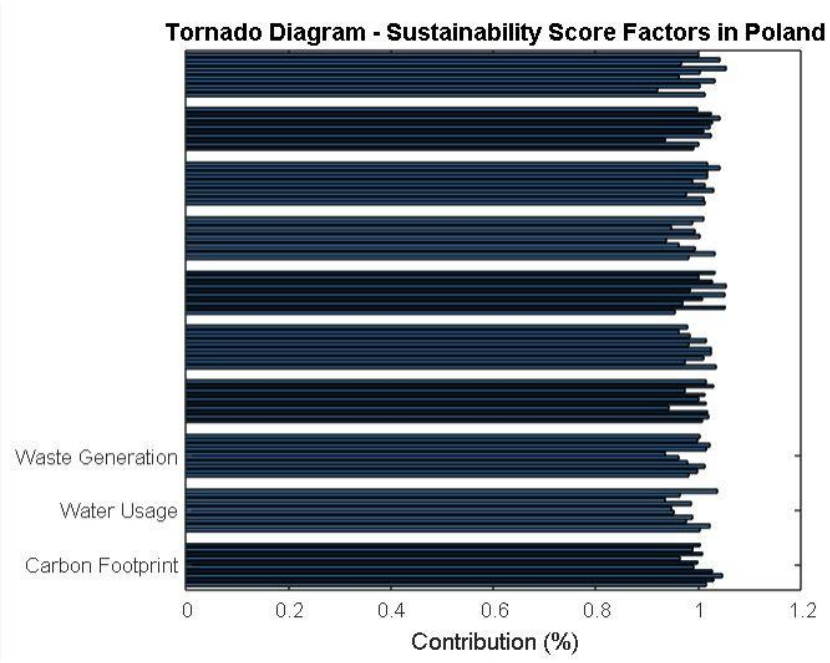
$$ESSTransformed = log(ESS+1) \quad (4)$$

The program aims to capture the nuanced relationships between these environmental factors and their collective impact on sustainability.

The tornado diagrams (Figure 5) generated for both the Czech Republic and Poland visually represent the percentage contributions of carbon footprint, water usage, and waste generation to their respective environmental sustainability scores. The distinct colors assigned to each bar in the tornado diagrams enhance the visual appeal and aid in the differentiation of factors.The diagrams reveal insights into the relative significance of each environmental component in shaping the overall sustainability profile of each country. These visualizations serve as valuable tools for decision-makers and environmental practitioners to identify focal points for improvement and prioritize interventions.



(a)



(b)

Figure 5. The results of tornado diagram for sustainability score factors in (a) Czech Republic and (b) Poland.

Corporate Social Responsibility (CSR)

The goal of this program is to evaluate and compare the performance of organizations in the Czech Republic and Poland using the Triple Bottom Line (TBL) framework. The TBL

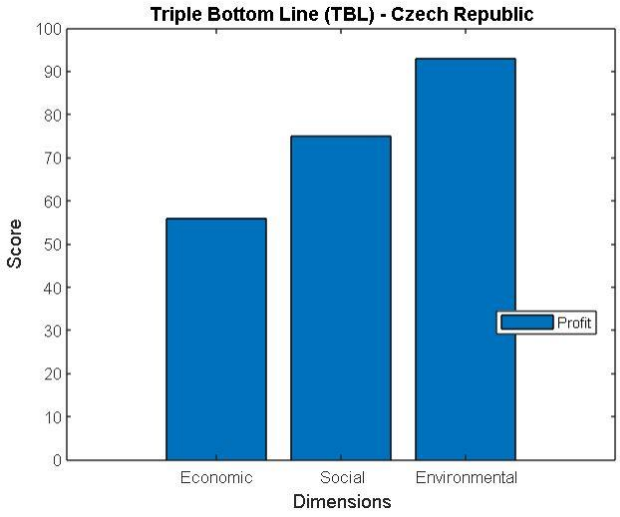
framework assesses organizations based on three dimensions: economic, social, and environmental. By analyzing these dimensions, the program aims to provide insights into the sustainable business practices and overall performance of organizations in these countries [18].

The program utilizes randomly generated data representing the scores for each dimension (economic, social, and environmental) for organizations in the Czech Republic and Poland. Specifically, the scores for the economic, social, and environmental dimensions are generated using the randi function within the specified range (Code S.3). The TBL score for each country is then computed by summing up the scores from each dimension. Mathematically, the TBL score is calculated using Equation 5 [19].

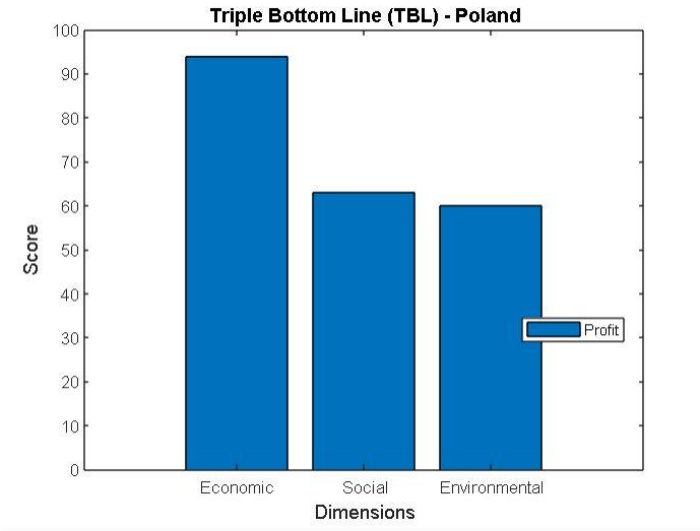
$$TBL\ Score = Profit\ (Economic) + People\ (Social) + Planet\ (Environmental) \quad (6)$$

After computing the TBL scores, the program creates stacked bar charts to visualize the TBL scores for both the Czech Republic and Poland. Each bar in the chart represents the TBL score for a specific dimension, allowing for easy comparison across dimensions and countries.

The program generates stacked bar charts illustrating the TBL scores for both the Czech Republic and Poland across the economic, social, and environmental dimensions (Figure 6). These visualizations provide a clear understanding of how organizations in each country perform in terms of economic profitability, social responsibility, and environmental sustainability. Additionally, the program displays the computed TBL scores for both countries, enabling a quantitative comparison of their overall performance. By analyzing these results, stakeholders can gain insights into the strengths and areas for improvement of organizations in each country concerning sustainable business practices. Overall, the program facilitates the evaluation and comparison of organizational performance using the TBL framework, contributing to informed decision-making and fostering sustainable development initiatives in the Czech Republic and Poland.



(a)



(b)

Figure 6. The outcomes of TBL computations in (a) Czech Republic and (b) Poland.

Evaluation

To assess the success of the proposed green branding initiative, several evaluations will be conducted. Firstly, an analysis will be undertaken on the level of adoption of sustainable production practices and green branding initiatives among businesses in the Czech-Poland region. This will include tracking the number of businesses that have incorporated hydrogen energy into their production processes, as well as the number of businesses that have adopted green branding initiatives. Secondly, a survey will be conducted to assess customer interest and engagement in sustainable products and their willingness to pay for hydrogen-produced merchandise. This will allow an understanding of customer behavior towards sustainable products and the determination of the potential market demand for hydrogen-produced merchandise. Thirdly, the financial impact of the proposed green branding initiative on businesses in the Czech-Poland region will be evaluated. This will involve tracking the financial performance of businesses that have adopted sustainable production practices and green branding initiatives and comparing it with the financial performance of businesses that have not adopted these practices. By doing so, the potential financial benefits of adopting green branding initiatives can be determined. Lastly, periodic reviews of the implementation plan will be conducted to identify any areas for improvement and to ensure that the initiative remains relevant and effective in achieving its goals. Overall, the evaluation of the proposed green branding initiative will enable an assessment of the effectiveness of the initiative in promoting the adoption of sustainable production practices and green branding initiatives in the Czech-Poland region. By doing so, areas for improvement can be identified, and any necessary adjustments can be made to ensure that the initiative achieves its objectives. The structure of the evaluation process is demonstrated in Figure 7 [20–22].

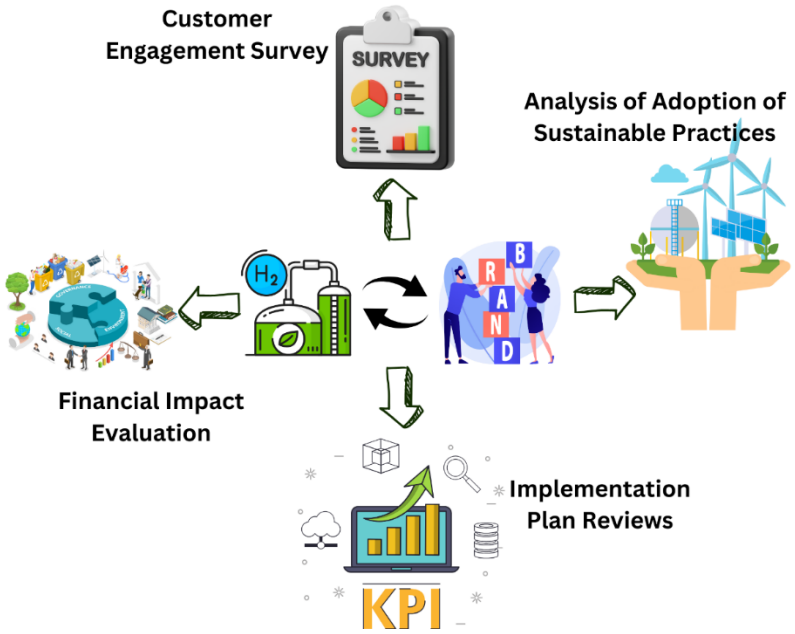


Figure 7. The schematic plan of green branding of hydrogen energy production in both Czech-Poland.

CONCLUSION

In conclusion, the adoption of sustainable production practices and green branding initiatives is becoming increasingly important for businesses to remain competitive and contribute to global efforts towards environmental sustainability. The proposed green branding initiative aims to promote the adoption of these practices in the Czech-Poland region, specifically by encouraging businesses to incorporate hydrogen energy into their production processes and by incentivizing them to adopt green branding initiatives. Through the achievement of the main objectives of this study, it is believed that the proposed green branding initiative will have a positive impact on both the environment and the economy. By promoting sustainable production practices, businesses can reduce their environmental impact in the region and attract environmentally conscious customers. Moreover, the adoption of green branding initiatives can help businesses differentiate themselves from their competitors, increase their market share, and potentially increase profits. The evaluation of the proposed green branding initiative will enable an assessment of the effectiveness of the initiative in achieving its goals and identify any areas for improvement. By doing so, it can ensure that the initiative remains relevant and effective in promoting the adoption of sustainable production practices and green branding initiatives in the Czech-Poland region.

CONFLICT OF INTERESTS

The authors confirm that there is no conflict of interests associated with this publication.

REFERENCES

1. Us, Y., Pimonenko, T. and Lyulyov, O., 2023. Corporate Social Responsibility and Renewable Energy Development for the Green Brand within SDGs: A Meta-Analytic Review. Energies, 16(5), p.2335.
2. Chaudhari, S. and Moharir, P., Sustainable Brands–Initiatives for Affordable and Clean Energy. JournalNX, pp.97-105.
3. Nuuttila, N., 2024. P2X & green hydrogen as the fuel of the future: a road map for innovation adaptation and energy transition in sustainable energy technology and heating: case: Oilon.
4. Baquero, J.E.G. and Monsalve, D.B., 2024. From fossil fuel energy to hydrogen energy: Transformation of fossil fuel energy economies into hydrogen economies through social entrepreneurship. International Journal of Hydrogen Energy, 54, pp.574-585.
5. Hassan, Q., Sameen, A.Z., Salman, H.M., Jaszczur, M., Al-Hitmi, M. and Alghoul, M., 2023. Energy futures and green hydrogen production: Is Saudi Arabia trend?. Results in Engineering, 18, p.101165.
6. Simão, L. and Lisboa, A., 2017. Green marketing and green brand–The Toyota Case. Procedia manufacturing, 12, pp.183-194.
7. Yusaf, T., Mahamude, A.S.F., Kadirgama, K., Ramasamy, D., Farhana, K., Dhahad, H.A. and Talib, A.R.A., 2023. Sustainable hydrogen energy in aviation–A narrative review. International Journal of Hydrogen Energy.
8. BP's statistical review of world energy 2021, https://ourworldindata.org/
9. https://Statista.com
10. Stehlík, K., Tkáč, M. and Bouzek, K., 2019. Recent advances in hydrogen technologies in the Czech Republic. International Journal of Hydrogen Energy, 44(35), pp.19055-19060.
11. Bouzek, K., Paidar, M. and Stehlík, K., 2022. Hydrogen Technologies in The Czech Republic. In Hydrogen in an International Context (pp. 73-97). River Publishers.
12. Bednarczyk, J.L., Brzozowska-Rup, K. and Luściński, S., 2022. Opportunities and limitations of hydrogen energy in Poland against the background of the European Union energy policy. Energies, 15(15), p.5503.
13. Qureshi, F., Yusuf, M., Kamyab, H., Vo, D.V.N., Chelliapan, S., Joo, S.W. and Vasseghian, Y., 2022. Latest eco-friendly avenues on hydrogen production towards a circular bioeconomy: Currents challenges, innovative insights, and future perspectives. Renewable and Sustainable Energy Reviews, 168, p.112916.
14. Sharma, S., Agarwal, S. and Jain, A., 2021. Significance of hydrogen as economic and environmentally friendly fuel. Energies, 14(21), p.7389.
15. Pareek, A., Dom, R., Gupta, J., Chandran, J., Adepu, V. and Borse, P.H., 2020. Insights into renewable hydrogen energy: Recent advances and prospects. Materials Science for Energy Technologies, 3, pp.319-327.
16. Ingaldi, M. and Klimecka-Tatar, D., 2020. People's attitude to energy from hydrogen—from the point of view of modern energy technologies and social responsibility. Energies, 13(24), p.6495.

17. Ishihara, A. and Ota, K.I., 2018. Environmental Impact Factors Associated with Hydrogen Energy. In Fuel Cells and Hydrogen (pp. 257-269). Elsevier.

18. Andrews, J., Doddathimmaiah, A.K., Ali, S.M. and Akbarzadeh, A., 2005. Solar hydrogen systems for remote area power supply from a triple bottom line perspective. technology, 10, p.11.

19. Ahmed, W. and Sarkar, B., 2019. Management of next-generation energy using a triple bottom line approach under a supply chain framework. Resources, Conservation and Recycling, 150, p.104431.

20. Barreto, L., Makihira, A. and Riahi, K., 2003. The hydrogen economy in the 21st century: a sustainable development scenario. International Journal of Hydrogen Energy, 28(3), pp.267-284.

Supplementary file

Code S.1

```
% Sample Data and Computation (Replace with your actual data and computations)
[X, Y] = meshgrid(1:10, 1:10);
% Hypothetical data for green marketing index
GreenMarketingIndex_Czech = randi([1, 10], 10, 10);  % Replace with actual data
GreenMarketingIndex_Poland = randi([1, 10], 10, 10); % Replace with actual data
% Hypothetical data for eco-friendly products and services index
EcoFriendlyIndex_Czech = randi([1, 10], 10, 10);  % Replace with actual data
EcoFriendlyIndex_Poland = randi([1, 10], 10, 10); % Replace with actual data
% Example deep computation (replace with your actual computations)
% For demonstration purposes, let's consider a simple computation.
CombinedIndex_Czech = GreenMarketingIndex_Czech .* EcoFriendlyIndex_Czech;
CombinedIndex_Poland = GreenMarketingIndex_Poland .* EcoFriendlyIndex_Poland;
% Create Contour Plots
figure;
% Contour Plot for Czech Case
subplot(1, 2, 1);
contourf(X, Y, CombinedIndex_Czech, 'LineColor', 'none');
title('Combined Index in Czech');
xlabel('X-axis Label');
ylabel('Y-axis Label');
colorbar;
% Contour Plot for Poland Case
```

```
subplot(1, 2, 2);
contourf(X, Y, CombinedIndex_Poland, 'LineColor', 'none');
title('Combined Index in Poland');
xlabel('X-axis Label');
ylabel('Y-axis Label');
colorbar;
% Adjust figure properties for better visualization
sgtitle('Combined Index for Green Marketing and Eco-Friendly Products (Czech vs. Poland)');
```

Code S.2

```
% Sample Data (Replace with your actual data)
[X, Y] = meshgrid(1:10, 1:10);
% Hypothetical data for environmental factors in Czech Republic
CarbonFootprint_Czech = randi([50, 100], 10, 10);  % Replace with actual data (in metric tons of CO2)
WaterUsage_Czech = randi([100, 200], 10, 10);  % Replace with actual data (in cubic meters)
WasteGeneration_Czech = randi([5, 15], 10, 10);  % Replace with actual data (in tons)
% Hypothetical data for environmental factors in Poland
CarbonFootprint_Poland = randi([50, 100], 10, 10); % Replace with actual data (in metric tons of CO2)
WaterUsage_Poland = randi([100, 200], 10, 10);  % Replace with actual data (in cubic meters)
WasteGeneration_Poland = randi([5, 15], 10, 10);  % Replace with actual data (in tons)
% Define weights for each environmental factor
Weight_CarbonFootprint = 0.5;
Weight_WaterUsage = 0.3;
Weight_WasteGeneration = 0.2;
% Compute Environmental Sustainability Score
SustainabilityScore_Czech = Weight_CarbonFootprint * CarbonFootprint_Czech + ...
                        Weight_WaterUsage * WaterUsage_Czech + ...
                        Weight_WasteGeneration * WasteGeneration_Czech;
SustainabilityScore_Poland = Weight_CarbonFootprint * CarbonFootprint_Poland + ...
                         Weight_WaterUsage * WaterUsage_Poland + ...
                         Weight_WasteGeneration * WasteGeneration_Poland;

% Apply a complex function to the Sustainability Score (e.g., logarithmic transformation)
SustainabilityScore_Czech = log(SustainabilityScore_Czech + 1);
SustainabilityScore_Poland = log(SustainabilityScore_Poland + 1);

% Calculate the sum of each environmental factor in Czech Republic and Poland
Sum_Czech = sum(SustainabilityScore_Czech(:));
Sum_Poland = sum(SustainabilityScore_Poland(:));

% Calculate the percentage contribution of each factor
Contribution_Czech = SustainabilityScore_Czech / Sum_Czech * 100;
Contribution_Poland = SustainabilityScore_Poland / Sum_Poland * 100;

% Tornado Diagram for Czech Republic
figure;
barh(Contribution_Czech, 'FaceColor', [0.2 0.4 0.6]);
```

```
    set(gca, 'YTickLabel', {'Carbon Footprint', 'Water Usage', 'Waste Generation'}, 'YTick', 1:3,
'FontSize', 10);
    title('Tornado Diagram - Sustainability Score Factors in Czech Republic');
    xlabel('Contribution (%)');

    % Tornado Diagram for Poland
    figure;
    barh(Contribution_Poland, 'FaceColor', [0.2 0.4 0.6]);
    set(gca, 'YTickLabel', {'Carbon Footprint', 'Water Usage', 'Waste Generation'}, 'YTick', 1:3,
'FontSize', 10);
    title('Tornado Diagram - Sustainability Score Factors in Poland');
    xlabel('Contribution (%)');
```

Code S.3

```
    % Sample Data (Replace with your actual data)
    Profit_Czech = randi([50, 100], 1, 1);  % Economic dimension
    People_Czech = randi([50, 100], 1, 1);  % Social dimension
    Planet_Czech = randi([50, 100], 1, 1);  % Environmental dimension

    Profit_Poland = randi([50, 100], 1, 1);  % Economic dimension
    People_Poland = randi([50, 100], 1, 1);  % Social dimension
    Planet_Poland = randi([50, 100], 1, 1);  % Environmental dimension

    % Calculate TBL score
    TBL_Czech = [Profit_Czech, People_Czech, Planet_Czech];
    TBL_Poland = [Profit_Poland, People_Poland, Planet_Poland];

    % Define dimensions and labels
    TBL_Dimensions = {'Economic', 'Social', 'Environmental'};

    % Create bar chart for Czech Republic
    figure;
    bar(TBL_Czech, 'stacked');
    title('Triple Bottom Line (TBL) - Czech Republic');
    xlabel('Dimensions');
    ylabel('Score');
    set(gca, 'xticklabel', TBL_Dimensions);
    legend('Profit', 'People', 'Planet', 'Location', 'Best');

    % Create bar chart for Poland
    figure;
    bar(TBL_Poland, 'stacked');
    title('Triple Bottom Line (TBL) - Poland');
    xlabel('Dimensions');
    ylabel('Score');
    set(gca, 'xticklabel', TBL_Dimensions);
    legend('Profit', 'People', 'Planet', 'Location', 'Best');

    % Display TBL scores
    disp('Triple Bottom Line (TBL) Scores:');
    disp(['TBL Score for Czech Republic: ', num2str(TBL_Czech)]);
    disp(['TBL Score for Poland: ', num2str(TBL_Poland)]);
```