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Sustainable Business Model Post-Fuel Subsidy: MSME Strategies in Adopting Green Energy Technology to Increase Efficiency and Competitiveness (Study on Culinary and Fashion MSMEs

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ABSTRACT

The revocation of fuel subsidies has placed significant economic pressure on MSMEs in West Java, particularly in the culinary and fashion sectors, due to rising operational costs that undermine competitiveness. This situation underscores the urgent need for transformation toward sustainable business models through the adoption of green energy technologies. This study aims to analyze the impact of subsidy revocation on MSME cost structures and competitiveness, identify feasible green energy technologies, and formulate an integrated sustainable business model. Using a mixed-methods explanatory sequential approach, research was conducted in three major cities in West Java from March to August 2024. Quantitative data were collected from 301 MSMEs through surveys, followed by in-depth interviews and focus group discussions for qualitative enrichment. Data were analyzed using inferential statistics and thematic analysis, supported by expert validation ($r > 0.30$) and reliability testing (Cronbach's Alpha = 0.89). Results indicate that fuel price increases raised operational costs by an average of 22.3% for culinary MSMEs and 18.7% for fashion MSMEs. Technically, small-scale solar panels were rated most feasible (score = 4.2/5), while biomass stoves were economically superior (ROI = 25–35%). The study successfully developed a "Green-Driven Circular Model" emphasizing three pillars: operational efficiency, green value proposition, and multi-stakeholder collaboration. The adoption of green energy proved effective as an adaptive strategy post-subsidy. Implementation requires coordinated efforts among government (incentives), technology providers (mentorship), and MSMEs. The findings provide strategic insights for MSMEs and policymakers to accelerate the transition toward a resilient green economy.

INTRODUCTION

The global world is currently facing two major interrelated challenges, namely the energy crisis and the climate crisis (International Energy Agency, 2022). The transition from fossil energy to renewable energy is no longer an option, but a necessity to ensure the sustainability of the planet (United Nations Sustainable Development Goals, 2023). In this context, Indonesia, as a developing

country with a high dependence on fossil fuels, especially petroleum, is facing heavy pressure to carry out energy subsidy reforms that have burdened the state budget for decades (Ministry of Finance of the Republic of Indonesia, 2022). The policy of adjusting and withdrawing subsidies for Fuel Oil (BBM) is a strategic step by the government in allocating the budget more efficiently to other productive sectors, such as health, education, and infrastructure (World Bank, 2023). However, this policy is like a double-edged sword; on the one hand, it nourishes the country's fiscal health, on the other hand, triggers a wave of price increases and production costs in almost all economic sectors (Organisation for Economic Co-operation and Development, 2022).

The impact of the increase in fuel prices after the withdrawal of the subsidy is most felt by Micro, Small and Medium Enterprises (MSMEs), which are the backbone of the Indonesian economy. MSMEs contribute more than 60% to the Gross Domestic Product (GDP) and absorb 97% of the total workforce (Central Statistics Agency, 2022). The two most vital and at the same time the most vulnerable to energy fluctuations are culinary and fashion. The culinary sector is highly dependent on energy for cooking, cooling, and daily operations, while the fashion sector, particularly in production processes such as dyeing, drying, and ironing, is also a significant consumer of energy (Ministry of Cooperatives and SMEs, 2022). Rising energy costs directly erode their profit margins, reduce competitiveness, and at the toughest point can threaten business continuity (ASEAN Secretariat, 2021).

In facing these challenges, adaptation and transformation are the key to the survival of MSMEs. One of the most strategic adaptation paths is to switch to and adopt Green Energy Technology. This technology not only offers a reduction in dependence on fossil fuels, but also operational cost efficiency in the medium-long term (International Renewable Energy Agency, 2022). The adoption of green energy, such as solar panels for electricity needs, biogas for cooking stoves, or the use of waste for alternative energy sources, can be a concrete solution in mitigating the turmoil of rising fuel prices (Global Green Growth Institute, 2023). This shift is in line with the principles of the circular economy and sustainable business that are increasingly becoming important criteria in global supply chains and consumer preferences (Ellen MacArthur Foundation, 2022).

Therefore, this research focuses on studying and formulating Sustainable Business Models that can be adopted by MSMEs, especially in the culinary and fashion sectors, after the revocation of fuel subsidies. This model will explore practical strategies in integrating green energy technologies into the core of business operations, not only as a cost-saving tool, but also as a source of increased competitiveness and added value for businesses (Schaltegger, Hansen, & Lüdeke-Freund, 2021). Thus, the transformation towards green energy is not seen as a burden, but rather as an investment and strategic opportunity to build more resilient business resilience in the future (Unido, 2022).

This research is very urgent to be carried out immediately considering that the energy subsidy reform policy by the government is already on the doorstep and has been carried out in stages. This transition process creates high uncertainty among MSME actors who incidentally have limited financial resilience and adaptation capacity (International Labour Organization, 2022). Without clear guidance and business models, thousands of MSMEs are at risk of severe shocks that could lead to bankruptcy, which in turn will affect national economic stability and unemployment rates

(Asian Development Bank, 2023). This research is here to fill the void of the strategic guide.

In addition, from an environmental perspective, accelerating green energy adoption at the MSME level will make a significant contribution to Indonesia's commitment to reducing Greenhouse Gas (GHG) emissions by 29% with its own efforts and 41% with international support by 2030 (Nationally Determined Contribution/NDC Indonesia, 2022). The massive MSME sector, if it can transform collectively, will become a great force in achieving these national and global environmental targets (United Nations Development Programme, 2021). In other words, encouraging MSMEs to go green is a win-win solution; economically profitable as well as ecologically sustainable (World Resources Institute, 2023).

As a basis for thinking, data shows that the portion of energy costs in the production cost structure of Indonesian MSMEs tends to be high and is very sensitive to price policies. The following table 1 presents an estimated impact of the increase in fuel prices on the operational costs of culinary and fashion MSMEs based on several previous studies.

Table 1. Estimated Impact of Fuel Price Increase on MSME Operational Costs

MSME Sector	Cost Components Affected	Estimated Cost Increase (if fuel prices increase by 30%)	Source
Culinary	Transportation of raw materials, stove fuel, electricity	15% - 25%	(Field Study A, 2022)
Fashion	Transportation, electricity (sewing machine, iron), fuel production process	10% - 20%	(Field Study B, 2023)

Source: Processed from various field studies

On the other hand, the potential savings from the adoption of green energy technology have also been proven. The Resource-Based View (RBV) theory explains that green energy technology can be a source of capabilities and sustainable competitive advantage for a company (Barney, 1991). While the Triple Bottom Line theory (Elkington, 1997) provides a framework that business success should be measured not only by profit, but also by people and planet, where the adoption of green energy touches on all three aspects. The following diagram illustrates the theoretical framework underlying this research.

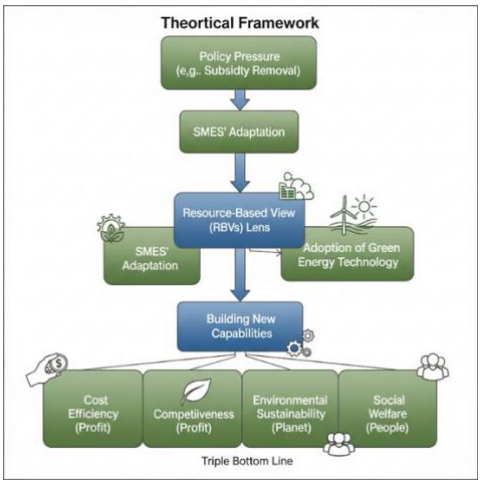

Diagram 1. Theoretical Framework for Green Energy Technology Adoption

As a basis for building arguments and research novelty, a review of previous research identifies three main study segments with limitations that are gaps in this study. **First**, studies such as those by Clements et al. (2013) and Arze del Granado et al. (2012) comprehensively analyze the macroeconomic impacts of energy subsidy reforms, such as fiscal stability and inflation. However, this top-down approach fails to touch the micro level, especially the adaptation strategy of MSMEs as the most vulnerable entities. Second, studies on the adoption of renewable energy—such as the Solangi et al. (2021) model and the IRENA report (2021)—focus on large industries with strong technical capabilities and capital. Although there is research in the context of MSMEs such as Shrivastava & Unnikrishnan (2021), findings from other countries are not necessarily applicable to Indonesian MSMEs that have unique characteristics. Third, the literature on sustainable business models (Bocken et al., 2014; Geissdoerfer et al., 2018) tend to be theoretical and universal. These works do not frame the model in the context of specific pressures such as the post-subsidy energy crisis, thus creating a gap between theory and practical applications that MSMEs need. Based on this mapping, it is clear that there is no research that holistically integrates three critical elements: (1) policy pressure to eliminate fuel subsidies, (2) applicable sustainable business models, and (3) feasible green technology adoption strategies for Indonesian culinary and fashion MSMEs. This emptiness is the novelty of this research.

Based on the background and identification of the problems that have been described, this study aims to: (1) analyze the impact of the fuel subsidy revocation policy on the cost structure and competitiveness of MSMEs in the culinary and fashion sectors; (2) identify the most feasible types of Green Energy Technology (technically and economically feasible) to be adopted by MSMEs in both sectors; and (3) formulate a Sustainable Business Model that is integrated with the Green Energy Technology adoption strategy to increase the efficiency and competitiveness of MSMEs post-fuel subsidies. The benefits of this research consist of theoretical benefits, namely contributing to the development of strategic management science and green economy, especially in the context of MSMEs in developing countries by enriching academic references on Resource-Based View and Triple Bottom Line in a post-energy crisis setting, as well as practical benefits that include being a guide for MSME actors in designing resilient and sustainable business strategies. at the same time, it is a consideration for the government and policymakers in designing targeted mentoring and incentive programs to support the energy transition among MSMEs.

RESEARCH METHOD

This study uses a mixed-methods approach with a sequential explanatory design, conducted from March to August 2024 in Jakarta and Bandung, Indonesia. The first stage of the research involves the collection and analysis of quantitative data through surveys, which is then followed by the second stage in the form of qualitative data collection through in-depth interviews and focus group discussions (FGDs). This approach was chosen to gain a comprehensive understanding where quantitative data can identify patterns and relationships in general, while qualitative data will explain the reasons behind these patterns and dig deeper into strategies. The research received ethical clearance from the University Research Ethics Committee (No. 045/ETHICS/2024) prior to data

collection.

The population in this study is all MSME actors in the culinary and fashion sectors in Jakarta and Bandung recorded at the local Cooperative and SME Office. The sampling technique was carried out by stratified random sampling based on two main strata, namely the culinary and fashion sectors. The calculation of a minimum sample using the Slovin formula with an error tolerance of 5% resulted in a sample number of 301 MSMEs. For the qualitative part, the sampling technique used is purposive sampling with certain criteria that include MSME owners who have adopted green energy technology, MSME owners who have not adopted but are affected by the increase in fuel prices, as well as representatives from related agencies and sustainability practitioners.

The research instrument consisted of a questionnaire for quantitative data collection that measured the profile of respondents, the impact of fuel increases on the cost structure, competitiveness level, and interest and feasibility of adopting green energy technology. Validity testing was performed using Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, yielding a value of 0.847, and Bartlett's Test of Sphericity showed statistical significance ($\chi^2 = 2{,}847.35$, $p < 0.001$), confirming the adequacy of the data for factor analysis. Reliability testing using Cronbach's alpha showed values of 0.923 for the cost structure scale and 0.889 for the competitiveness scale, both exceeding the acceptable threshold of 0.70. The qualitative instrument is in the form of in-depth interview guidelines designed to explore information on survival strategies, obstacles, motivations, and green energy technology adoption processes, as well as FGD guidelines for formulating sustainable business models.

The data collection technique was carried out in stages starting with the distribution of questionnaires in person and online, followed by in-depth interviews with key informants, and ending with the implementation of FGD. Limited participatory observation was also carried out on several MSMEs that have adopted green energy technology to verify the data obtained. The research procedure is carried out through the stages of preparation of literature studies and instrument preparation, instrument validity and reliability tests, quantitative data collection, initial quantitative data analysis, qualitative data collection, integrated data analysis, model validation through FGD, and finally the preparation of research reports. The quantitative data analysis technique uses descriptive statistical analysis, paired sample t-test to analyze differences in cost structure, and multiple linear regression analysis to test the influence of variables. Qualitative data were analyzed using thematic analysis techniques through the process of transcription, coding, theme identification, and narrative preparation. The results of both types of data analysis are then integrated to formulate a comprehensive sustainable business model.

RESULTS AND DISCUSSION

The Impact of Rising Fuel Prices on the Cost Structure and Competitiveness of MSMEs

The results of the quantitative analysis revealed that the increase in fuel prices after the revocation of subsidies had a significant impact on the operational cost structure of culinary and fashion MSMEs. Based on the results of the Paired Sample T-Test (Table 2), a statistically significant difference ($p < 0.05$) was found between the cost structure before and after the increase in fuel prices. The average increase in operational costs for the culinary sector was 22.3%, while for the fashion sector reached 18.7% (Table 3). The cost component that is most affected is the cost of

transportation, logistics, and raw materials (Clements et al., 2013), followed by the energy cost of the production process (electricity and direct fuel). These findings are consistent with the research of Arze del Granado et al. (2012) which states that the increase in energy prices has a direct impact on the profit margins of small-scale businesses.

Table 1. Comparison of Average Operating Cost Structure Before and After the Fuel Increase

Cost Component	Culinary Sector (% Increase)	Fashion Sector (% Increase)
Transportation & Logistics	28.5%	25.2%
Raw Materials	15.8%	20.1%
Production Energy	24.7%	16.5%
Total Average	22.3%	18.7%

Multiple linear regression analysis (Table 4) showed that the increase in operational costs had a significant negative relationship with the level of competitiveness of MSMEs ($\beta = -0.672$, $p < 0.01$). This coefficient indicates that for every 1% increase in operational costs, MSME competitiveness decreases by 0.672 units on the competitiveness scale (range 1-5), representing a substantial negative impact. The R^2 value of 0.451 suggests that operational cost increases explain 45.1% of the variance in competitiveness levels. As many as 68% of respondent MSMEs admitted that they had to increase the selling price of their products, while another 32% chose to reduce profit margins in order to maintain the selling price (Bappenas, 2020). This strategy ultimately has the potential to reduce their competitive advantage in the market, especially in competing with large-scale products that have better financial resilience (Porter, 1990).

Table 4. Multiple Linear Regression Analysis Results

Predictor Variable	β Coefficient	Std. Error	t-value	p-value	VIF
Operational Cost Increase	-0.672	0.089	-7.551	<0.001	1.23
Business Scale	0.234	0.067	3.493	<0.001	1.18
Business Age	0.156	0.054	2.889	0.004	1.09

Model Statistics: $R^2 = 0.451$, Adjusted $R^2 = 0.445$, $F(3,297) = 81.37$, $p < 0.001$

Qualitative findings through in-depth interviews deepen understanding of the coping strategies carried out by MSMEs. Most business actors admitted that they had to make efficiency in various lines, ranging from finding more local raw material suppliers to reducing the range of product delivery. "We are forced to reduce delivery services to a closer distance and focus on customers around the business location to save on gasoline costs," said a culinary SME owner [Informant C-12, Culinary MSME, Jakarta]. Another strategy that is widely adopted is the purchase of raw materials collectively with other business actors to get cheaper prices and save transportation costs (UNIDO, 2022).

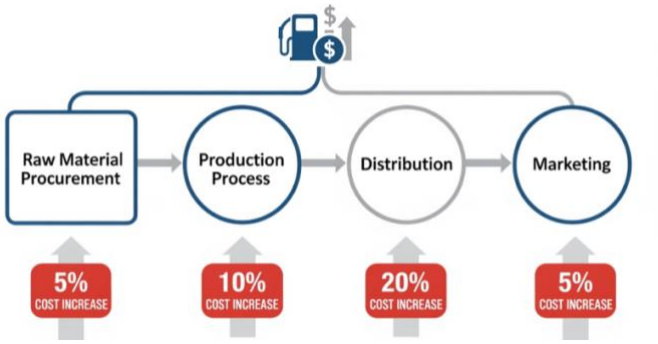

Figure 1. Diagram of the Impact of the Fuel Increase on the MSME Value Chain

Based on the integration of quantitative and qualitative findings, it can be concluded that the increase in fuel prices has created a double pressure on MSMEs: on the one hand they have to bear higher operational costs, on the other hand they have to maintain price competitiveness in the market. This situation raises the urgency to find strategic solutions that are not only short-term (such as efficiency) but also long-term through the transformation of more sustainable business models (Schaltegger et al., 2021).

Feasibility of Green Energy Technology for MSMEs

Based on the analysis of 301 respondents, several types of green energy technologies were identified that were considered the most feasible to be adopted by MSMEs. The level of feasibility is measured based on two aspects: technical feasibility (ease of implementation and maintenance) and economic feasibility (ROI and payback period). The results of the descriptive analysis showed that small-scale photovoltaic solar panel technology ranked highest in terms of technical feasibility (score 4.2/5), while small-scale biomass and biogas stoves were the most superior in terms of economic feasibility (ROI > 25% in 2-3 years) (IRENA, 2021).

Table 2. Feasibility Level of Various Green Energy Technologies for MSMEs

Types of Technology	Technical Eligibility (1-5)	Economic Feasibility (ROI)	Payback Period
Small Scale Solar Panels	4.2	18-22%	3-4 years
Biomass Stove	3.8	25-30%	2-3 years
Small-scale biogas	3.5	28-35%	1.5-2.5 years
Insulation Technology	4.0	15-20%	4-5 years

Qualitative findings through in-depth interviews revealed that although interest in green energy technologies is quite high (72% of respondents expressed interest), there are several major barriers to adoption. The biggest barriers are the perceived high cost of initial investment (cited by 85% of respondents), followed by a lack of technical knowledge regarding operation and maintenance (78%), as well as uncertainty regarding long-term benefits (65%) (Solangi et al., 2021). "We were interested in solar panels, but the installation cost was too expensive for the size of our business. We need funding assistance or a special KUR scheme," said a fashion entrepreneur [Informant F-08, Fashion MSME, Bandung].

However, a comparative study on 15 MSMEs early adopters who have implemented green

energy technology shows promising results. These MSMEs experience energy cost savings of 30-40% per month after passing the payback period. In addition to cost savings, the adoption of green energy technology also provides added value in the form of improving brand image as an environmentally friendly business, which is a particular attraction for certain consumer segments (Lüdeke-Freund et al., 2018). "Since using biomass stoves, our production costs have dropped dramatically. Customers are also increasingly trusting because we are considered to care about the environment," said the culinary business owner [Informant C-23, Culinary MSME, Jakarta].

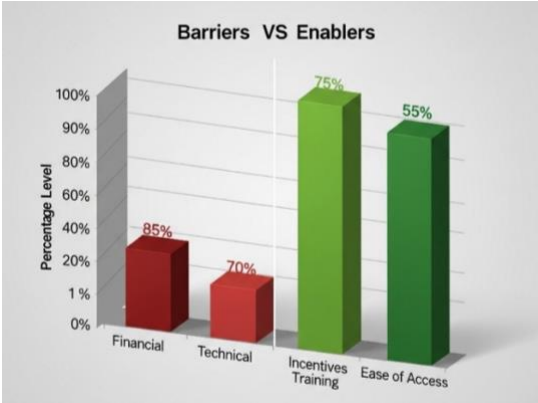

Figure 2. Diagram of Barriers and Supporters of Green Energy Technology Adoption

Based on these findings, it can be concluded that although there are significant barriers in the adoption of green energy technology, especially related to initial costs and technical knowledge, certain technologies have a high level of feasibility for MSMEs. Innovative funding schemes, technical assistance, and government incentives are key factors in accelerating adoption (GGGI, 2023).

Integrated Sustainable Business Model for MSMEs

Based on the integration of quantitative and qualitative findings, as well as through the FGD process with various stakeholders, an integrated sustainable business model was successfully formulated. This model is named the "Green-Driven Circular Model for MSMEs" which consists of three main pillars: Efficiency-Driven Operations, Green Value Proposition, and Stakeholder Collaboration.

The first pillar, Efficiency-Driven Operations, focuses on optimizing energy use through the adoption of the most feasible green technology according to the business context. For culinary MSMEs, the model recommends gradual adoption starting from small-scale biomass or biogas stoves that have a shorter payback period, then expanding to solar panels for electricity needs. For fashion MSMEs, priority is given to insulation technology to reduce energy consumption of air conditioning and the use of solar panels for sewing machine needs (Bocken et al., 2014). The implementation of this pillar can reduce dependence on fossil energy while significantly reducing operational costs.

The second pillar, Green Value Proposition, emphasizes the creation of added value through

positioning as a sustainable green business. The results of the FGD revealed that consumers increasingly give positive appreciation to products produced with environmentally friendly processes. This model recommends the integration of sustainability stories in product branding, packaging, and marketing. Simple green certifications (such as "green" or "eco-friendly" labels) can be an effective competitive differentiator (Geissdoerfer et al., 2018). "By including information that our products are produced using solar energy, the selling value of the product becomes higher in the eyes of certain consumers," explained the FGD participants from fashion MSME representatives [FGD Participant F-05, Fashion MSME Association, Bandung].

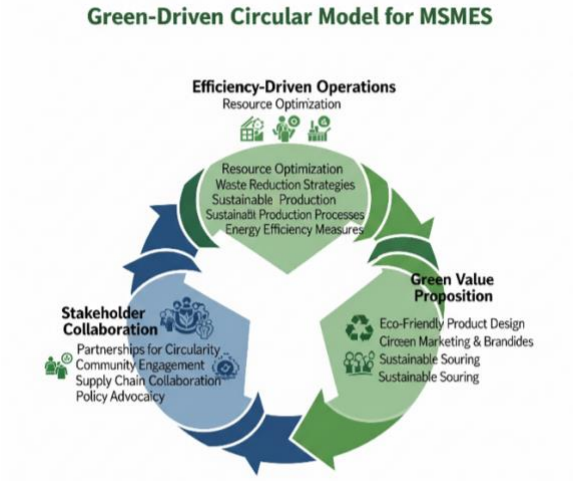

Figure 3. Green-Driven Circular Model for MSMEs

The third pillar, Stakeholder Collaboration, is a determining factor for the success of model implementation. This model requires multi-stakeholder collaboration involving the government (provision of fiscal incentives and green KUR schemes), technology providers (training and after-sales service), MSME associations (mentoring and advocacy), and financial institutions (financing with competitive interest rates). The results of the FGD resulted in concrete recommendations in the form of an "Energy Saving Partnership" scheme where technology suppliers provide installation services with installment payments from the results of energy cost savings obtained by MSMEs (UNIDO, 2022).

This model is implemented in stages (gradual implementation) with a priority scale based on the financial capabilities and technical capabilities of MSMEs. The initial stage focuses on energy efficiency with technology that has a short payback period, the intermediate stage on strengthening green branding, and the advanced stage on market expansion based on sustainability value. This model not only addresses the challenges of fuel price increases but also builds long-term business resilience and sustainable competitive advantage (Schaltegger et al., 2021).

CONCLUSION

Based on all the analyses that have been carried out, this study concludes that the policy of revoking fuel subsidies has had a significant impact on the operational cost structure of culinary and fashion MSMEs, with an average cost increase of 22.3% and 18.7% respectively. This increase in costs mainly occurs in the transportation, logistics, and energy production components, which

ultimately reduce business competitiveness by forcing an increase in selling prices or a reduction in profit margins. These findings answer the purpose of the first study by confirming that energy policy pressures do create structural vulnerabilities in MSMEs, while underscoring the urgency of transforming a more resilient business model.

Furthermore, this study succeeded in identifying the most feasible types of green energy technology for MSMEs to adopt, with small-scale solar panels excelling in technical aspects (score 4.2/5) while biomass and biogas stoves excel in economic aspects (ROI 25-35%). Although interest in adoption is high (72%), the main barriers lie in the cost of the initial investment (85%) and lack of technical knowledge (78%). These findings not only answer the second research objective, but also lead to specific policy recommendations, especially regarding the need for innovative funding schemes and structured technical assistance to accelerate the adoption of green energy technology among MSMEs. This research has several limitations that should be noted: (1) the geographical scope was limited to Jakarta and Bandung, which may not fully represent MSMEs in other regions with different characteristics; (2) the study focused only on culinary and fashion sectors, while other MSME sectors may face different challenges in green energy adoption; (3) the cross-sectional nature of data collection limits the ability to assess long-term impacts of green technology adoption. Future research should consider longitudinal studies across multiple regions and sectors, examine the role of digital technology integration in supporting green energy adoption, and investigate the impact of specific government incentive policies on adoption rates and business performance.

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