Energy Consumption Reduction of Bangladesh using Nudge via Smart Grid

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Declaration

It is declared hereby that this thesis paper or any part of it has not been submitted to anywhere else for the award of any degree.

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Certification

This is to certify that this project entitled " **Energy Consumption Reduction of Bangladesh using Nudge via Smart Grid** " is done by the following students under my direct supervision.

This project work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering, Sonargaon University (SU) in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering.

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Abstract

A smart grid is a digitally intertwined electrical network which delivers electricity to consumers through a multidirectional controlling system. Such systems allow analysis, monitoring and communication within the power transmission network to increase efficiency, minimize energy consumption and maximize the use of power used between production to consumption.

The present power transmission system in Bangladesh is piled atop very old and rickety system, Bangladesh suffers from a massive load-shedding problem based on multifaceted issues.

Alongside improving on power generation capacity and moving towards a smart grid system, the country needs to consider and move towards an energy efficient culture using the smart grid systems in order to further reduce power shortage problem.

This paper will assess the effectiveness of behavioral science and nudge theory in developing an energy conscious culture to save energy waste.

The many examples of energy efficiency behaviors implemented around the world will be discussed in detail trying to find an approach appropriate for the country.

The intent of this paper is to draw the attention of policymakers, engineering researchers and professionals towards such passive and low-cost approaches that has high potential to become successful on a microeconomic and macroeconomic scale.

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ACKNOWLEDGEMENT

The report titled as on " **Energy Consumption Reduction of Bangladesh using Nudge via Smart Grid** " has been prepared to fulfil the requirement of our practicum program. In the process of doing and preparing our practicum report, we would like to pay our gratitude to some persons for their enormous help and vast co-operation.

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Chapter – 1

INTRODUCTION

1.1 Introduction

The scope of this paper concentrates on an approach to provide additional power supply by focusing on behavioral science aspects for a smart energy system that will reduce load shedding effectively. The idea is to use the consumer's habits and attitudes to encourage reduced the power usage and use the presently generated powers to their optimum usage.

The following paper will discuss the potential for implementing behavioral analysis, focusing especially with Dr. Richard Thaler's Noble prize winning 'Nudge Theory' [1].

Furthermore, the paper will draw comparison to different successful and failed efforts to implement behavioral science on the power sector [2] and try to recognize the observations.

The paper also intended to point out towards the potential of additional power to saved by this such a energy conscious culture and securing future power security. There is also future scope for further exploration and more in depth assessment regarding implementation of such a process on variable scale and proportion.

In Bangladesh, rapid urbanization, industrialization, and rising living standards have continuously increased the demand for electricity. Although power generation has expanded, load shedding remains a common issue, especially during peak hours.

One of the major challenges is inefficient electricity use by consumers, which largely stems from a lack of awareness and behavioral inertia. Infrastructure upgrades alone cannot fully resolve this issue, as peak demand and overconsumption remain fundamental problems.

This paper seeks to explore a new approach to improving energy efficiency and reducing load shedding by utilizing behavioral science, with Nudge Theory playing a key role.

According to this theory, subtle and positive behavioral cues—without restricting individual freedom—can influence decision-making. In the context of electricity usage, such "nudges" might include personalized feedback, comparative usage reports among neighbors, or timely reminders, all of which can encourage consumers to voluntarily modify their behavior.

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A critical component of this approach is the use of smart grid technology, which enables real-time monitoring, personalized messaging, and dynamic feedback systems. The combination of behavioral insights and technological advancements presents a promising path toward a more sustainable and efficient electricity usage culture.

This study analyzes both successful and failed international initiatives to understand how behavioral interventions have worked in the power sector and where their limitations lie. It also evaluates the practical relevance and potential impact of such strategies within the socio-economic, technological, and cultural context of Bangladesh.

Fostering an energy-conscious culture could help not only in reducing immediate load shedding but also in ensuring long-term national energy security.

The outcomes of this research aim to guide policymakers and relevant stakeholders on how to effectively implement such strategies at scale by integrating behavioral economics with smart technologies. Moreover, this opens new avenues for further extensive research in the future.

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METHODOLOGY

1.2 Methodology

1. Energy Efficiency and Conservation:

Implement Energy Efficiency Standards and Labels:

Introduce mandatory energy efficiency standards for appliances, lighting, and buildings to ensure that only energy-efficient products are sold and used.

Conduct Energy Audits:

Encourage businesses and individuals to conduct energy audits to identify areas where energy consumption can be reduced.

Promote Energy Management Programs:

Develop and implement energy management programs that provide guidance and support for businesses and individuals to optimize energy use.

Public Awareness Campaigns:

Launch public awareness campaigns to educate the public on energy-saving practices and the benefits of energy efficiency and conservation.

Policy and Regulatory Framework:

Develop and update energy and power policies and regulatory frameworks with the aim of energy efficiency and conservation.

Financial Incentives:

Offer financial incentives for adopting energy-efficient technologies and practices, such as subsidies for purchasing energy-efficient appliances or tax breaks for implementing energy-efficient measures in buildings.

2. Renewable Energy Transition:

Invest in Renewable Energy Infrastructure:

Invest in renewable energy infrastructure, such as solar, wind, and biogas power plants, to diversify the energy supply and reduce reliance on fossil fuels.

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Promote Decentralized Renewable Energy:

Encourage the development of decentralized renewable energy systems, such as solar home systems and biogas digesters, to provide energy access to underserved areas.

Support Research and Development:

Invest in research and development of new renewable energy technologies and solutions.

3. Specific Measures:

In the RMG Sector:

Implement energy-efficient technologies in dyeing processes, optimize lighting and cooling systems, and promote daylight harvesting.

In Buildings:

Improve window and wall insulation, seal doors and windows, and optimize HVAC systems.

In the Household:

Switch to energy-saving LED lights, turn off appliances when not in use, and optimize heating and cooling systems.

In Transportation:

Promote the use of fuel-efficient vehicles and public transportation.

In Industry:

Optimize machine processes and peripheral equipment to reduce energy consumption.

By implementing these measures, Bangladesh can effectively reduce energy consumption, improve energy security, and contribute to a more sustainable future.

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NUDGE THEORY

1.3 Nudge Theory

The concept of Nudge proposed by Dr. Richard Thaler and Dr. Cass Sunstein in their book Nudge, published in 2008 is a relatively subtle strategic policy shift based on behavioral science, intended to encourage common public to make decisions which eventually leads them to their own betterment as well as helping the society and economy in general.

The writers' state, "A nudge is any aspect of the choice architecture that alters behavior in a predictable way without forbidding any options or significantly changing their economic incentives. A nudge must be easy and cheap to avoid." "By knowing how people think, we can make it easier for them to choose what is best for them, their families and society," wrote.

The aim of the science is based on the foundation of the human instinct to do the right thing and to subtly guiding them towards it. It helps the general people to make a positive decision rather than letting human nature come between making positive changes. Dr. Thaler, has been awarded the Nobel economics prize in 2017 for his contribution as the father of 'nudge theory' [1].

Some behavioral scientists believes such behaviors raises ''serious questions about the rationality of many judgments and decisions made by people''. Many experiments keeps on proving the odd realization that, ''human forecasts are flawed and biased'' and common people's ''decision making is not so great either'' [1].

This seemingly cheap approach has worked like miracle in many cases within the last decade. UK used the idea for improving the country's pension policy.

In 2012 the Government assigned employers to form an "automatic enrolment" scheme in 2012. By which the workers were automatically placed into a firm's scheme, and contributions would be de-ducted from their pay packet, unless they formally requested to be discontinued.

The concept was that auto enrolment would make saving the habitual default setting for the staffs, and thereby make it easier for them to the reasonable thing and hike up savings rates.

Since auto enrolment was introduced by the United Kingdom Government in 2012, as shown in Figure 1, the private sector pension schemes active membership has soared from 2.7 million in to 7.7 million with in 2016 [2].

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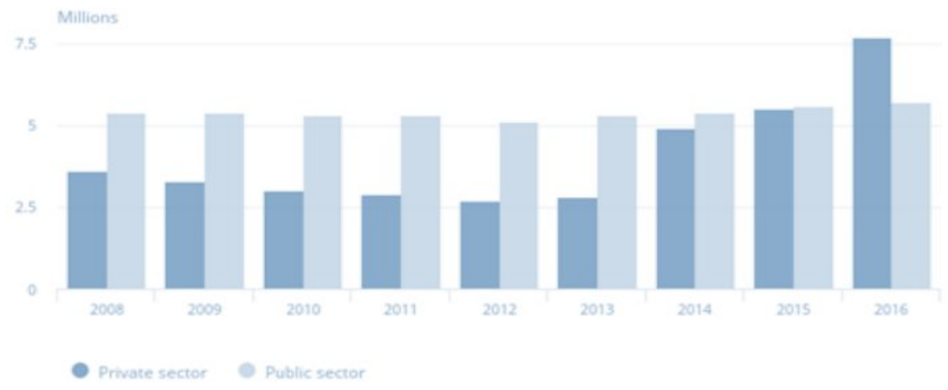


fig. 1.1 Active membership of occupational pension schemes by sector(2008-2016)

➢ **The graph from 2012 to 2025 is shown below:**



fig. 1.2 Active membership of occupational pension schemes by sector(2012-2025)

This graph shows a comparison of active membership in pension schemes in the private and public sectors in Bangladesh from 2012 to 2025 (in millions).

- Blue bars = Private sector
- Yellow bars = Public sector

In 2012, the number of members in the public sector was significantly higher, but the membership in the private sector has gradually increased over time.

Since 2019, the number of private sector members has grown rapidly and surpassed the public sector by 2025.

This indicates that interest in pension schemes in the private sector is increasing in Bangladesh.

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What's New in 2025: Expanded Scope of Nudge Theory

As of 2025, nudge theory has evolved beyond public policy into the digital and environmental domains, thanks to data analytics, smart technologies, and AI.

1. Digital Nudging

With the rise of digital platforms, nudges are now being integrated into apps, websites, and smart devices:

- Health apps remind users to drink water or take steps.
- Smart energy platforms notify users to reduce electricity usage during peak hours.
- E-commerce sites use social proof ("others also bought") to influence purchase decisions.

2. Green Nudges & Smart Grid Applications

Nudge theory is being used to promote sustainable environmental behavior:

- Smart meters in households provide real-time energy feedback to nudge users toward lower consumption.
- Tiered electricity pricing encourages consumers to shift usage to off-peak hours.
- Visual comparisons showing a user's energy use vs. neighbors' average often influence behavioral shifts.

3. Bangladesh Context in 2025

Bangladesh has started implementing nudge-based approaches in various sectors:

- Prepaid electricity meters nudge users to track and control their consumption.
- Smart grid pilot projects provide time-based usage feedback and suggest optimal usage times.
- Plastic bag bans with alternatives (e.g., jute bags) subtly push consumers to adopt eco-friendly habits.

4. AI-Powered Personalized Nudging

In modern systems, AI is used to analyze user behavior and provide customized nudges:

- Tailored electricity-saving tips based on individual usage patterns.
- Smart home devices suggesting optimized appliance use timing.
- Behavior-driven alerts (e.g., "You used 20% more electricity this week than last week").

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5. Post-COVID Behavioral Interventions

Post-COVID, nudges were crucial in public health campaigns:

- Floor markings for social distancing.
- Automatic sanitizer dispensers placed at high-contact locations.
- Visual signs promoting mask use and handwashing.

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Chapter – 2

SMART GRID OPERATION

2.1 Smart Grid Operation

A smart grid is an electricity network based on digital technology that is used to supply electricity to consumers via two-way digital communication [3].

Such a system allows monitoring, analysis, control and communication to improve efficiency, reduce energy cost and consumption while maximizing reliability of the energy supply chain.

The smart grid was introduced with the aim of overcoming the weaknesses of conventional analog electrical grids by using smart net meters. Smart grids are growing in popularity for their high efficiency prospective.

Introducing, internet access has made the smart grid the most practical and steadfast to implement. Smart grid allows users to communicate and understand consumer needs to meet their consumption patterns and behaviors [4].

A modern smart grid system has the following capabilities:

- It can repair itself.
- It encourages consumer participation in grid operations.
- It ensures a consistent and premium-quality power supply that resists power leakages.
- It allows the electricity markets to grow and make business.
- It can be operated more efficiently [3]. Smart grid is useful for businesses, service sectors as well as precision and critical operations such as hospitals, re-search labs, etc. [5]. The base concept of smart grid system is aimed at automation and to track power consumption [6].

The architecture is often inter-connected to energy management software to estimate consumption and with information about current consumption, smart grid energy management

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can effectively identify and minimize the power consumption during peak-demand times and maximize the use of produced power available to the grid by rationalizing [7].

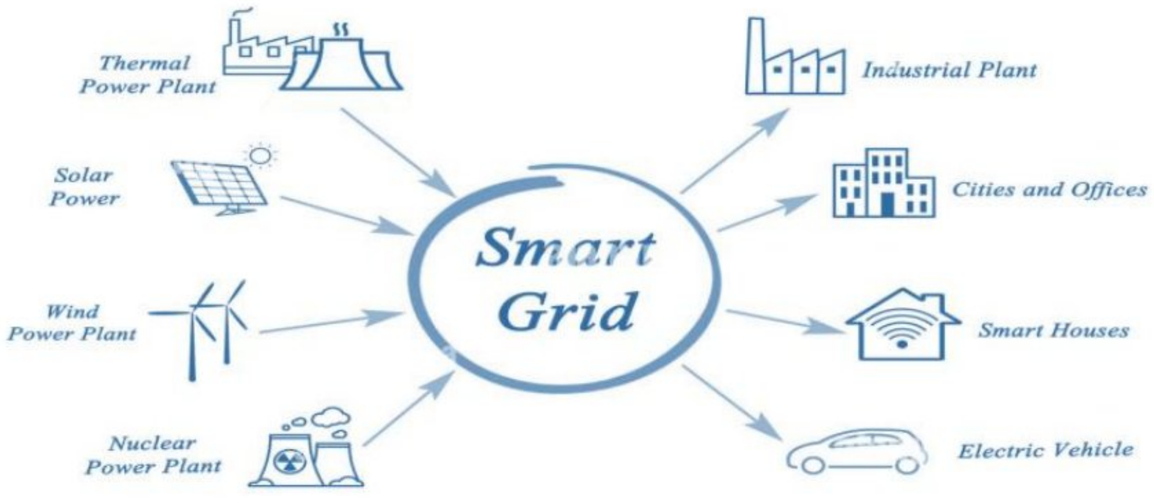


Fig. 2.1 Smart Grid

Overview

Applying "nudge" principles in the context of a smart grid involves using subtle, persuasive interventions to encourage desired energy consumption behaviors. These nudges can be implemented through various smart grid technologies and communication channels, aiming to shift consumer choices towards more sustainable and efficient energy use.

How Nudges are Applied in Smart Grids:

1. *Feedback and Information:*

Smart meters and in-home displays provide real-time feedback on energy consumption, allowing consumers to see their energy usage and make informed decisions. This information can be presented in various formats, such as charts, graphs, or simple alerts, to highlight energy saving opportunities.

2. *Social Norms and Peer Comparison:*

Nudges can leverage social norms by comparing a household's energy consumption to that of their neighbors or the average consumption for similar households. This can create a competitive and aspirational environment, encouraging consumers to reduce their energy use.

3. *Gamification and Rewards:*

Smart grid systems can incorporate gamification elements, such as points, badges, or rewards for energy saving behaviors. This can motivate consumers to adopt energy-efficient practices and reduce their electricity consumption.

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4. *Time-of-Use Tariffs and Dynamic Pricing:*

Smart grids can facilitate dynamic pricing, where electricity prices fluctuate based on demand and supply conditions. This can incentivize consumers to shift their energy consumption to off-peak hours, reducing load on the grid and potentially lowering electricity costs.

5. *Automated Demand Response (ADR):*

Nudges can be used to trigger automated demand response programs, where smart appliances and devices can be remotely controlled to reduce energy consumption during peak demand periods. This can help prevent grid overload and improve grid stability.

Examples of Nudge Implementation in Smart Grids:

Comparative Feedback:

Sending households a monthly energy consumption summary that compares their usage to their neighbors, highlighting energy-saving opportunities.

Alerts and Notifications:

Providing real-time alerts when a household's energy consumption reaches a certain threshold or when demand-side management programs are activated.

In-Home Displays:

Offering interactive dashboards that provide detailed information on energy consumption, allowing consumers to track their energy usage and identify areas for improvement.

Gamified Energy Saving Programs:

Implementing online platforms that reward energy-efficient behaviors with points, badges, or discounts.

Benefits of Applying Nudges in Smart Grids:

Reduced Energy Consumption:

Nudges can encourage consumers to adopt energy-efficient practices, leading to a reduction in overall energy consumption.

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Peak Demand Reduction:

By incentivizing off-peak energy consumption, nudges can help reduce peak demand on the grid, improving grid stability and reliability.

Enhanced Energy Efficiency:

Nudges can motivate consumers to invest in energy-efficient appliances and technologies, leading to long-term energy savings.

Improved Grid Performance:

By optimizing energy demand and supply, nudges can contribute to a more efficient and resilient smart grid.

Environmental Benefits:

Reduced energy consumption translates to lower carbon emissions and a more sustainable energy system.

Challenges of Applying Nudges in Smart Grids:

Data Privacy:

Collecting and analyzing energy consumption data requires careful consideration of data privacy and security.

Transparency and Trust:

Consumers must be made aware of how nudges are being used and how they can control their privacy to ensure trust and transparency.

Ethical Considerations:

Nudges should be designed to promote positive outcomes and should not be used to manipulate or exploit consumers.

Individual Differences:

Nudges may not be effective for all consumers, and it's important to tailor interventions to specific target groups.

By carefully considering these challenges and designing nudges that are transparent, ethical, and tailored to specific contexts, smart grids can leverage the power of nudges to promote more sustainable and efficient energy consumption.

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ENERGY SECTOR IN BANGLADESH

2.2 Energy Sector in Bangladesh

Bangladesh faces nationwide power outage during the summer season due to nationwide power cuts known as load shedding. As shown in figure 2, the country's projected energy demand to grow twice the size of 2013's by the year 2025.

As per official statistics available in Bangladesh power development board (BPDB), present installed generation capacity as of 1 March 2017 total installed capacity 13179MW and derated capacity 12578MW while the maximum generations on the year 2016.

The share of segmented supply of Bangladesh's power are shown in figure 3 shows a huge dependence on natural gas and biowaste alongside coal and hydropower.

Natural gas and coal as limited resources, this is no way a sustainable solution in the long run.

While load shedding has been a recurring feature of the country's power, it is mostly attributed to prolonged negligence, inappropriate implementation, system inefficiency, unplanned urbanization, massive system loss and lack of planning. Steady power supply system is a critical pillar in a growing nation and various the development factors rely on it.

In addition to that, the nation's reserve of natural gas is expected to be depleted by the year 2020. The solitary coal mine available is under development and that reserve is expected to expire somewhere around 75 to 80 years after it starts to produce coal.

Also in recent times the proposed coal powered Rampal power station and the Ruppur Nuclear Power Plant projects has received widespread opposition from the general population as well as the global environmental groups [8].

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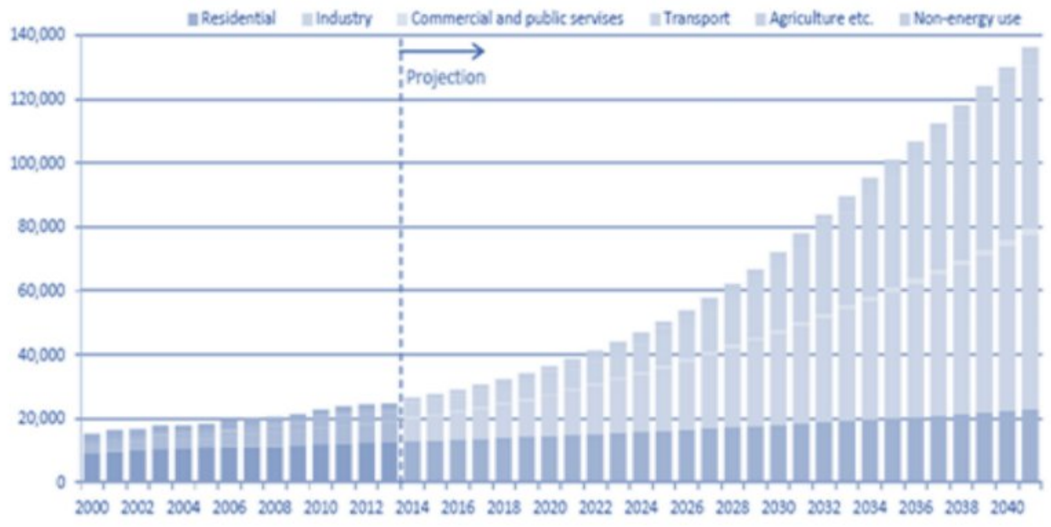


Fig. 2.2 Energy consumption projection

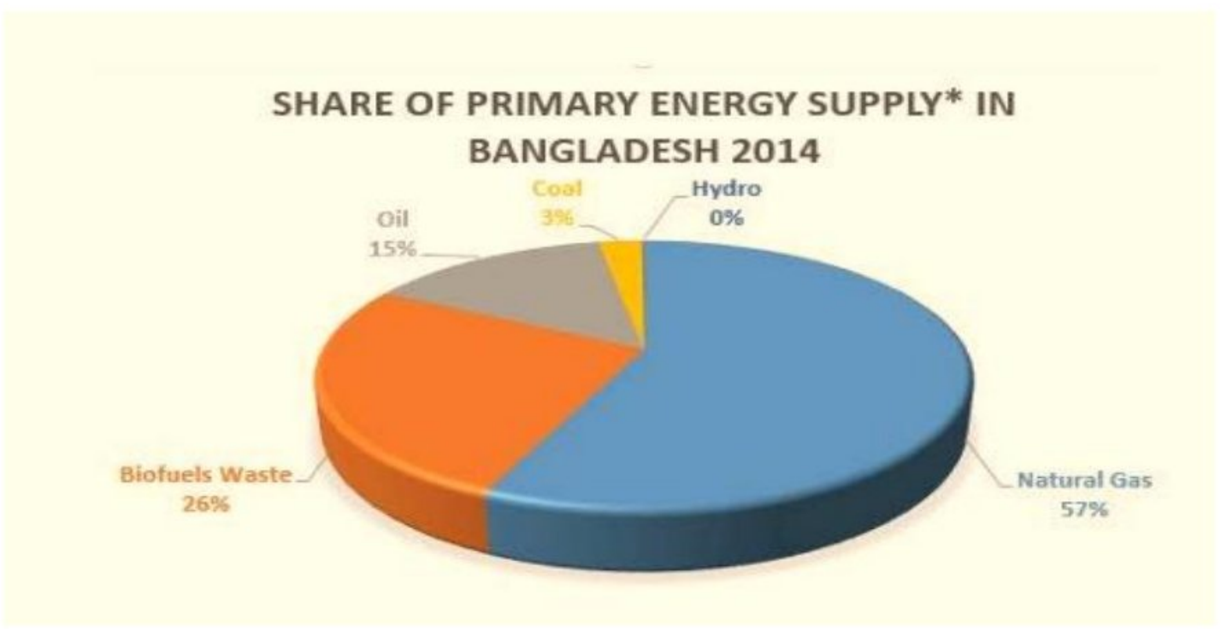


Fig. 2.3 Bangladesh primary energy sectors(2014)

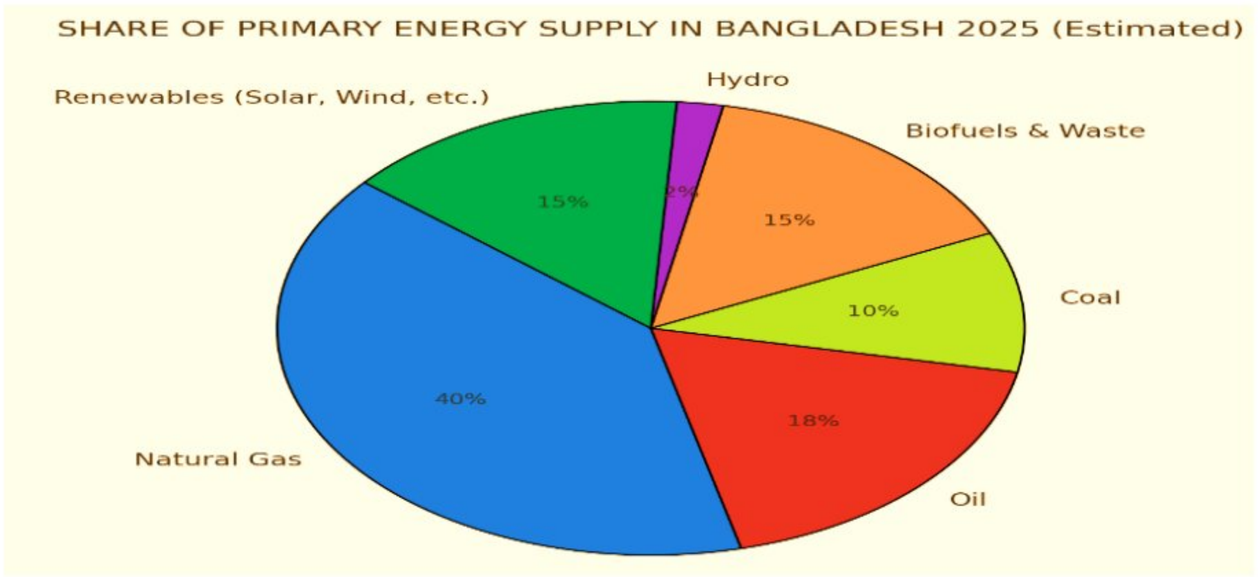


Fig. 2.4 Bangladesh primary energy sectors(2025)

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Bangladesh's Vision 2021a promises renewable generation capacity share become 5% by 2015 and 10% by 2021. Bangladesh is currently offering many financial incentives for renewable energy businesses.

As of 2014, Bangladesh's gross electric generation from renewable sources are 145GWh. Bangladesh has major limitations for renewable energy expansion, which includes availability of land and meteorological circumstances.

Power Sector Master Plan (PSMP) 2016 considered the country's maximum renewable energy (power generation) potential up to 3,700MW. If the Variable Renewable Energy (VRE), such as solar PV or wind potential is developed connected to the grid, Bangladesh will gain about 4,200GWh per year.

Even though, this amount is limited in comparison with the total grid generation energy (estimated 82,000GWh in 2020), but it is a promising quantity of additional support for the struggling power generation struggling to meet the growing demand.

An estimated power generation capacity of the solar rooftop and solar home systems are 860GWh and 115GWh respectively [8].

Energy Sector in Bangladesh:

As of 2025, Bangladesh's energy sector has made significant strides, yet continues to face critical challenges. While traditional problems like load shedding, dependency on fossil fuels, and system inefficiency persist, recent years have seen new developments in renewable energy adoption, infrastructure modernization, and energy diversification.

Progress and Potential in Renewable Energy

- The government's Vision 2021 aimed to achieve 10% power generation from renewable sources by 2021. Although this target was not fully met, considerable progress has been made.
- Over 6 million solar home systems (SHS) have been installed, especially in rural areas, reducing reliance on grid electricity.
- Solar rooftop systems are gaining popularity in urban areas for residential and commercial use.
- The introduction of net metering policies now allows users to sell excess electricity generated by solar panels back to the national grid.

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LNG Import and Energy Diversification

- With natural gas reserves nearly depleted, Liquefied Natural Gas (LNG) imports have become essential for meeting national energy demand.
- LNG offers a short- to mid-term solution but increases reliance on foreign energy markets.
- The government is pursuing a diversified energy strategy involving LNG, renewables, coal, and nuclear power to ensure long-term stability.

Nuclear Power Project Advancement

- The Rooppur Nuclear Power Plant is nearing completion and is set to add approximately 2,400 MW to the national grid.
- This will be the country's first nuclear power facility, contributing to energy diversification despite concerns from environmentalists and civil society.
- The project symbolizes a major leap in technology and long-term energy capacity.

Digitalization and Smart Grid Initiatives

- The power sector is gradually transitioning to a smart grid system for more efficient energy distribution.
- Prepaid metering, remote monitoring, and load management are already being implemented in urban zones.
- These initiatives aim to reduce system loss, enhance consumer transparency, and improve overall grid reliability**.**

Challenges and Future Recommendations :

Key Challenges

- Heavy dependence on imported fuels such as LNG.
- Limited land and climate constraints for expanding renewables.
- Political and bureaucratic delays in energy projects.
- Weak infrastructure in electricity transmission and distribution.

Strategic Recommendations

- Increase investment in renewable energy research and innovation.
- Expand public-private partnerships (PPP) in the energy sector.
- Promote grid-integrated solar and wind farms.
- Enforce building codes and energy efficiency measures.
- Ensure policy continuity and institutional reform for better project implementation.

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Chapter – 3

APPROACH

3.1 Approach

It is well documented that people are prone to making welfare-based decisions whether it's self-beneficial or for public welfare. A large number of European citizens support environmental protection part of a social responsibility as well as a personal goal, yet only few have adopted a green behavior; for example, to switch towards public transportation from personal (European Commission 2011).

Heuristics and biases (H&B) research program have catalogued long list of widely considered systematic cognitive biases and flawed inconsistent motivations which lead to illogical choices [9]. The quest for tracking down a detailed list of human cognitive biases to draft a map of human bounded rationality by H&B programs, was a notion proposed by Simon (1956, 1978).

Kahneman states (2003) words, the goal of his research with Tversky and other proponents of the H&B program was: "To obtain a map of bounded rationality, by exploring the systematic biases that separate the beliefs that people have and the choices they make from the optimal beliefs and choices assumed in rational-agent models." Simon (1978) himself cited experimental outcomes with ''striking departures'' from the behavior expected by reasoning and rationality as proof that standard theories of rationality often do not ''provide a good prediction, not even a good approximation of actual behavior''.

However, he thereby sided side with the H&B program's view of human choice as systematically flawed and Suggesting to ''understand today many of the mechanisms of human rational choice'' [10].

The simple heuristics (SH) research program targeted towards exploring cognitive mechanisms that directs rational decision-making working under limited computational capacity, restricted information, and uncertainty employs to make satisfying good decisions.

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SH does not ignore people's tendency towards making poor decisions now and then, however, unlike the H&B program it does not feature such behaviors as flaws in mind instead, it proposes bounded rationality concept giving human reasoning and decision making a model.

SH highlights that despite avoiding some information and shunning extensive calculations, the overall result is fairly good inferences, choices, and decisions when applied in the proper limited contexts while considering there are many aspects that can effectively undermine the results from various aspects and often can be unforeseen [11].

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NUDGING IN PRACTICE

3.2 Nudging in Practice

Corinna Fischer proposed for a psychological model that seeks to explain what types of feedback about energy-efficient goods can lead to a reduced energy consumption behavior. The author tentatively posits that the most successful feedback combines these features;

1. It's given frequently and over a long

2. It provides an appliance-specific breakdown

3. It's presented in a clear and appealing way and

4. It uses computerized, interactive tools [9].

There is no exact definition of a nudge, and policies incorporated under the title varies largely. Hence Thaler proposed an extensive compilation of hypothetical situations for nudges, with general hypotheses as "social influence" and "social pressures". It's not a new concept but it is by far the widest and encompassing as follows: [1]

1. Nudges are planned by policy makers playing choice architects to steer public behavior away from implied behavior by cognitive shortcoming towards their eventual goal or partiality (e.g. smart life choices, savings, healthy food).

2. Nudges seeks to realize this influence by exploiting empirical documents on human cognitive shortcomings in deliberation and choice, without shifting the financial encouragements (disincentives).

3. Nudges do not affect the features over which people have explicit preferences (e.g. lifestyle, taste, convenience, money, status, etc.), but rather the features that people would naturally claim not to care about (e.g. place in a list, default, framing).

4. Behavioral changes brought about by nudge should be reversible easily, allowing the picker to act otherwise with his/her choices [12].

Even this definition is not undisputed, ironically objected by Sunstein as he thought it "imprecise." However, this can be useful as for observing the situation in a macroeconomic level.

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During the administration of President Barack Obama in USA and in David Cameron in UK introduced a dedicated team of experts to assist the policymakers on using behavioral nudges to chaperon the citizens on new policy changes and their implementation.

The immediate success of that initiative has been widely successful and the model can be adopted and replicated for Bangladesh as a real-life example.

nudging include posters on BRTC buses in Dhaka to discourage sexual harassment, and simple interventions like handwashing soap and water in schools to promote handwashing. These nudges, like providing readily available soap and posters with clear messages, subtly influence behavior without imposing restrictions.

Nudging to Combat Sexual Harassment:

Posters on BRTC buses:

The Behavioural Insights Team placed posters in buses with messages designed to address barriers to bystander intervention in sexual harassment cases. The posters were user-tested on bus passengers to ensure clarity and attractiveness, with messages placed near doors, the driver, and above seats.

Impact:

The posters were found to increase the proportion of men who reported witnessing sexual harassment and were more likely to engage the conductor, while also decreasing the proportion of women who reported experiencing it, suggesting the posters influenced attitudes towards sexual harassment.

Nudging to Promote Handwashing:

Handwashing infrastructure:

Save the Children's Resource Centre provided basic handwashing infrastructure (soap and water) in primary schools, with no additional messaging or education.

Impact:

Direct observation showed a significant increase in handwashing with soap among school children, from 4% at baseline to 68% the day after the intervention, and 74% at 2 and 6 weeks post-intervention.

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Nudging for Health Behaviors:

Healthy food placement:

LinkedIn placing healthier food options at eye-level or near checkouts in grocery stores or schools can nudge people towards healthier choices.

Small plate sizes:

Using smaller plates in restaurants can subtly encourage people to eat less, reducing food waste while maintaining satisfaction.

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Chapter – 4

RELATED WORKS

4.1 Related Works

The infamous ‘Save More Tomorrow’ (SMarT) program was successful to increase employee savings rates from 3.5% to 13.6% within a period of 40 months even though in the other two conditions savings rates remained stagnant. Johnson & Goldstein (2003), in their paper titled, ‘Do Defaults Save Lives?’ demonstrates default choices can have phenomenal positive impact on organ donation affirmation.

Countries where people were asked to opt-out of organ donation were highly compliant than the ones which required to actively opt-in to become a donor. Kallbekken, Saelen and Hermansen (2012) conducted an experiment on the electric appliance consumers in Norway labeling products with their lifetime energy consumption and found a visible consumer shift towards energy saving appliances [2].

During the Brexit and 2016 US Election campaigns, it has come out that behavioral methods were being employed to nudge voter bias in large scale.

There have been many other well documented researches conducted among controlled groups focusing on various aspects focusing on the health, economics, finance and work efficiency.

However, if we take in consideration the many successes and a growing larger scale of the control group growing towards a larger population, the success ratio is irrefutable proof of the necessity to consider nudge as an impactful tool for policymakers going forward.

With that in consideration, it is fair to propose smart and carefully planned macroeconomic scale policies with well-intended consequences are becoming more prominent and needs to be looked into carefully.

Further Research and Practical Implications:

Over the past decade, the incorporation of behavioral economics, particularly nudge theory, into public policy frameworks has gained substantial momentum across the globe. Policymakers are increasingly recognizing that traditional policy instruments—such as legislation, taxation, or

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subsidies—are often insufficient to induce sustained behavioral change. Instead, subtle psychological interventions, or "nudges," have demonstrated considerable success in influencing public choices in a cost-effective and non-coercive manner.

Allcott and Rogers (2014) conducted a notable large-scale randomized controlled trial in the United States involving over 600,000 households. Participants received customized energy reports comparing their household electricity consumption with that of their neighbors. This low-cost peer comparison intervention led to a sustained reduction of energy usage by approximately 2%, an outcome that, when aggregated at the national level, equates to a substantial energy savings.

Similar applications of behavioral strategies have emerged in other developing countries. In rural India, behavioral interventions promoting the adoption of cleaner cooking stoves—through default settings, social norm messages, and small incentives—led to significant improvements in uptake. These findings point to the critical potential of nudges in low-resource settings, particularly in sectors like energy, where infrastructural limitations pose serious constraints.

In the context of Bangladesh, where the energy sector suffers from demand-supply mismatches, transmission losses, and overdependence on fossil fuels, behaviorally-informed energy conservation policies could be instrumental. Targeted nudges such as default enrollment in energy-saving programs, time-sensitive billing, or real-time usage feedback can help reduce peak-hour loads and encourage the adoption of renewable alternatives like solar home systems and rooftop photovoltaics.

Beyond the energy sector, nudge theory has also been successfully applied in domains like health (e.g., default flu vaccination appointments, simplified nutrition labels), finance (e.g., default pension contribution schemes), and education (e.g., SMS-based attendance reminders). These interventions share a common feature: they restructure the choice architecture in subtle but powerful ways without restricting freedom of choice.

Limitations and Scope for Future Research:

Despite the promising outcomes associated with behavioral interventions, their effectiveness is often context-specific. A nudge that succeeds in one cultural or institutional setting may fail in another due to differences in social norms, literacy levels, or infrastructural capacities. This presents a particular challenge for countries like Bangladesh, where any large-scale policy design must be sensitive to socio-economic diversity and systemic limitations.

Therefore, future research must focus on conducting context-sensitive randomized controlled trials (RCTs) to determine the efficacy and adaptability of various behavioral strategies in the

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Bangladeshi context. Collaborations between policymakers, behavioral scientists, and local institutions are essential to co-design and pilot these interventions. Moreover, emerging technologies such as artificial intelligence and data analytics offer new opportunities to personalize and scale nudges efficiently.

The ethical dimension of nudging also warrants careful consideration. Transparency, accountability, and respect for individual autonomy must be upheld when designing behavioral interventions, particularly those that may affect large population groups.

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CAUTIONS

4.2 Caution

Hausman & Welch states in, 'Debate: To Nudge or not to Nudge' Nudges that fail (2010)" Nudges are ways of influencing choice without limiting the choice set or making alternatives appreciably costlier in terms of time, trouble, social sanctions and so forth.

They are called for because of in individual decision-making, and they work by making use of those flaws" [10].

Tom Goodwin argues in his paper, Why We Should Reject 'Nudge' (2010) how nudge is ineffective for sustainable and long-term changes to solve society's 'big problems' such as climate change and public health. With governments involved and as executors of such ideas, often can use their own agenda on people rather than using the behavioral science issues for betterment of civilians [11].

It can also be argued that "nudge is not enough", viewing people as inefficient information processor and volatile to be exploited for the just reason preaches utilitarian consequentialism. Utilitarianism preaches "the greatest good for the greatest number" while Consequentialism preaches "ends justify the means" [13].

Utilitarian consequentialism defines actions as ethical if they achieve a positive outcome for the most people no matter what one must do to achieve those ends [14].

Such approach has proven to be dangerous and historically used to by fascistic regimes. However, it should not be confused with genuine discussions of utility or consequence, which is the approach to make the best out of available resources. This should be the approach to achieve productive ends through non-destructive means for the betterment of people [15].

Costa & Kahn (2010) found out the energy company Opower employed nudge approach in California, USA which failed due to the resident political conservatives, who do not believe in global warming and actually increased their electricity consumption in reactance and resistance to the campaign.

It shows that there can be many unforeseen and unrelated obstacles appearing in practicality. Adversities like this should be expected and sentiments should be considered to avoid similar backlash from the citizens [14].

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The theoretical and ethical debates surrounding *nudge theory* are becoming increasingly prominent, especially when it is applied in real-world policymaking. According to Hausman and Welch, nudge is a strategy that can influence behavior without directly infringing on individual freedom. However, it often works by exploiting *cognitive weaknesses*, which raises moral concerns. This becomes particularly problematic when governments or authorities use those vulnerabilities to serve their own interests.

Tom Goodwin’s critique highlights that while the nudge approach may be effective for small behavioral changes, it tends to fall short in addressing large-scale societal issues such as climate change or public health crises. This is because the core of the nudge method is to "gently push" individuals rather than initiating any deeper transformation of their behavior or mindset.

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RECOMMENDATIONS

4.3 Recommendations

Following are some suggestions learnt through historical examples that are fit to be applied for Bangladesh's current scenario, however should not be limited to as there could be many aspects that can be explored for further impact.

a) Alternative to social marketing campaigns:

Government's throughout the world has used social marketing as a preferred tool of choice to persuade citizens to move away from old habits.

Oftentimes new laws are introduced to support such campaigns results. In the 1990s, Irish government tried to persuade people to reuse plastic bags but not until government imposed levied tax on sale, they found success (Collins et al. 2003: 37).

Researchers have noticed the inadequacy of social-marketing campaigns often fail to change customs (Cialdini et al. 1991) which are attributed to several of psychological factors.

Psychologists learned shock tactics can reduce effectiveness of a massage as recipients tend to focus more on developing psychological coping mechanisms to handle their fears than on removing the actual danger (Witte & Allen 2000).

It has been proven, social marketing campaigns can be ineffective if a message mistakably destabilizes personal self-esteem by stigmatizing behavior (Maio et al. 2007) or introducing a sense of shame and guilt (Brennan & Binney 2010) [16].

Moreover, social marketing campaigns can trigger recalcitrant or defiant behavior, especially if the message is perceived to come from an untrusted source, challenge 'our identity' and 'our way of life', or violate the recipient's sense of agency and autonomy – a process Brehm (1966) referred to as 'reactance'.

Keeping in mind the limited success of social marketing campaigns, the British government embraced the nudging concept more integral to their approach to change citizen behaviors for the betterment of society in general [17].

Ministry of Power, Energy & Mineral Resources, Bangladesh currently runs many awareness advertisements on print and electronic media. There is no evident data how successful these social campaigns are. However, checking the ministry's verified facebook page with nearly 11.5 million likes, it was evident the posts are not well received with higher portion of miffed reactions showing evident reactance and defiance to such recommendations as shown in figure 4 [18].

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Fig. 4.1 Social media campaign to save energy.

b) Feedback on consumptions:

The USA based electricity company Opower (previously Positive Energy) uses social normative messages comparing a person's electricity usage to that of their neighbors to reduce electricity consumption. Schultz (2007) found the use of normative messages with injunctive emoticons effective at reducing consumption. Allcott (2011) estimates this program reduces consumption by around 2% for Opower's customers [20].

Under the program, users with high consumption were provided with tips to reduce consumption whereas low power users were thanked for their cooperation.

c) Developing industrial safety awareness:

Michael J. Aminoff suggests and implored on raising electrical safety awareness to be applied through behavioral science [20]. It has been observed that, electrical safety programs and their impacts almost certainly relies on the human aspects rather than system faults.

Considering the history of the country's several industrial accidents resulting from |lack of awareness towards safety first culture, such a program can prevent accidents by reducing human errors [21].

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d) Social appreciation:

The Opower experiment observed, the social appreciations among the energy aware population impacted on the users that reduced their usage. The model can be replicated on a national scale where the citizens are praised for their energy reduction [22].

If a common awareness can be raised for power preservation, the social standards and expectations can be a powerful motivator on a national scale to reduce power consumption trends. Due to self-motivation as the reasoning comes from within the users themselves, this has a higher impact compared to campaigns.

Bangladesh government already has many national awards (e.g. for high taxpayer) and the same model can be used to appreciate green industries approach as well as users on various locals.

e) Passive awareness:

Users well informed about environmental consequences of power wastage are found to be more compliant to energy reduction campaigns compared to lesser aware citizens.

Historically Bangladesh have successfully improved their population rate, basic education for children, childcare awareness, etc.

projects through multilevel awareness approach and the empirical data proves that the country's citizens are more likely to be compliant to such issues if explained duly instead of the mass marketing approach [20].

The authors ran a Randomized controlled trials (RCT) where residential electricity customers saw price increases, with households in the treatment group receiving high-frequency information displays that gave information about usage and prices.

This lowering of information acquisition costs allowed identification of the marginal information effect. Households only experiencing price increases reduced demand by 0-7% whereas those also exposed to information feedback reduced by 8-22%, depending on the amount of advance notice.

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Chapter – 5

CONCLUSION

5.1 Conclusion

The scope of this work was to point out the significance of introducing behavioural science to improve upon consumer's attitude to reduce power consumption on a macroeconomic and microeconomic scale.

A many successful examples and various ways to approach the issue under multiple framework has been discussed. The users based on their background and identity needs to be sorted in groups and Smart grid systems are the best ways to observe such data.

The additional significance of approach has been demonstrated though real life examples and failing approaches currently in operation.

The proposed methodology offers an understanding of how different user groups as well as individuals approach power usage differently and how they can be encouraged to be environmentally aware [23].

The primary goal of this article is to instigate a comparative discussion of the pros and cons of introducing such policy in the country's current situation [24].

Further debates based on empirical evidence on the ongoing workings as well as possible side-effects of nudge and boost policies will improve this discussion in future. Presently, many arguments are unavoidably conceptual.

The authors of this paper have contributed to this abstract discussion by examining the essential rules related to nudge and boost policies, probing into the rationality between policy and theory, alongside sceptically bearing in mind the ethical implications.

The core intent of this work was to try to optimistically improve the energy sector standard in Bangladesh as well as other countries as well, however minimal it is but effective none the less.

As Bangladesh continues its transition towards a digitally connected and energy-dependent economy, the relevance of behavioral interventions in shaping power consumption habits has

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only grown stronger. The integration of Smart Grids and Internet of Things (IoT) technologies has opened up new avenues for real-time data collection, demand-side energy management, and tailored user engagement. This digital transformation enables a more accurate segmentation of consumers based on behavioral, demographic, and socioeconomic variables—an essential prerequisite for implementing effective nudges.

In 2025, with urbanization accelerating and energy demand doubling since 2013, the stakes are significantly higher. The government's ongoing efforts through Vision 2041 and updated Power Sector Master Plans emphasize clean energy, digital monitoring, and decentralized solutions. However, these policies still lack the behavioral component that ensures long-term adoption and user-driven change. This paper advocates for the institutionalization of behaviorally informed policymaking bodies within ministries and utility agencies to address this gap.

Bangladesh, as a signatory to the Paris Agreement and active participant in Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action), has clear international obligations. Behavioral science offers a complementary strategy to meet emissions targets by promoting low-energy lifestyles, increasing the uptake of renewable solutions, and reducing reliance on fossil fuels. Policymakers must therefore align behavioral strategies with national climate action plans and seek technical cooperation from global institutions for capacity building and implementation.

A nuanced behavioral strategy must account for the ethical implications of influencing individual decisions. In a culturally diverse country like Bangladesh, the same nudge may be perceived differently across regions, income groups, or educational backgrounds. Ensuring transparency, opt-out flexibility, and public dialogue is essential to maintain citizen trust. Furthermore, participatory governance models involving local communities, civil society, and academia can ensure that nudges remain context-sensitive, culturally appropriate, and socially inclusive.

This research has demonstrated that behavioral science is not merely a conceptual novelty, but a practical and impactful tool for energy policy innovation. While challenges remain—ranging from infrastructural limitations to the need for interdisciplinary collaboration—the path forward is promising. The coming years demand policy strategies that are human-centric, data-driven, and ethically sound.

Ultimately, as Bangladesh approaches its centenary as a nation in 2071, sustainable energy behavior will play a defining role in its socioeconomic resilience. Leveraging behavioral insights today is a small but strategic step toward that long-term vision.

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