Strategic Decision Making Architectural Framework for Assessing Energy Efficiency Policies and Its Implications in Transportation

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Abstract- A multidimensional methodology, using strategic decision making architectural (SDMA) framework is employed in this research to assess the extent of transportation planning and related policy transformation, where the people largely depend on private vehicles for mobility. The assessment perspective for policy implications, identification of key drivers and constraints, the policy content taxonomy, and evaluation of strategic measures are employed in the SDMA to suggest policy classes, measures, and role of policy planners. The demographics, climate change, socio-economic factors, and technology are identified as the major drivers, and CO_2 reduction, capacity, system resilience, and demand are the constraints. The current transportation system can be appraised and examined by the framework and can be utilized as a direction that can lead to a more coherent application in the policy planning process of the transportation sector. The lack of public transportation availability, reliance on oil, high environmental pollution, commuting schedules, and traffic congestions, accidents due to driver behavior, and subsidies associated with transportation are the critical topics concerning transportation planning. The assent with modern standards and the possibility of expanding quantitative measures, together with the accessibility of entities suitable for transportation policy planning activities, an opportunity to tender statistical advice to users make SDMA methodology and framework a practical and assertive system in the planning of road transportation. Policy instruments and tools that involve policy regulations, pricing norms, and infrastructure investments require building new transport infrastructure (e.g., roads), up-gradation of present infrastructure and technology, or enhancing services related to the transport sector.

Keywords Transportation policies, policy action plan, strategies, energy efficiency, indicators, measures.

1. Introduction

The world is now facing an overwhelming number of interrelated social, environmental, and political crises, from the emergence of new infectious diseases, the proliferation of violence to an expanding economic gap between people, and rising levels of corruption. This creates a particular social and practical problem related to energy policy formulation, development, deployment, and continuance in any sector. That is, how to tackle the core issues related to policy – the energy access, security, transition, and so on. These challenges require satisfactory answers. In the present study, the road transportation sector is studied in detail to identify the need for energy efficiency strategies as well as to learn the impact of the proposed changes in the policy dimensions. The transport sector in any country has a vital role to play to accommodate the energy diversification, energy-saving and greenhouse gas (GHG) emissions reduction targets. Even though this study was carried out in Kuwait, the policy dimensions that are discussed can be applied not only to the country or region but also to any part of the world.

Kuwait has one of the highest per capita energy consumptions in the world, 14,251 kWh per capita [1]. The Ministry of Electricity and Water (MEW), the sole body meeting the national requirements of electricity and water,

accounts for 55% of the primary energy consumption by the power plants in Kuwait. The transport sector is one of the largest consumers of fossil fuel in Kuwait, and it accounts for approximately 19% of yearly consumption.

Most of the people in the country travel by private vehicles (85%). Public transport bus services are provided by a private company (City Bus) and state-owned Kuwait Public Transportation Corporation. Given Kuwait's rapid economic growth, low price of old vehicles, and easy access to loans to finance new vehicle purchases, the vehicle fleet is expected to continue to grow in the coming years, and this will not be matched by similar growth in the capacity of road networks and transport facilities. There is a need for the hour, thus, to find energy-efficient feasible and optimal solutions for the escalating problems of the transport sector. How to fulfil the growing energy demand as well as to control vehicle emissions have become major challenges to policymakers.

Energy sector policy formulation and strategies trusts essentially on strong data on total energy supply and demand for the country. The eminence and readiness of correct energy data changes extensively by sector and fuel and besides, there is no far-reaching resource for energy data and a comprehensive policy in Kuwait. Based on this background, the major objective of this study was formulated, which is, to ignite a spark on the need for energy policy strategies and corresponding data requirements in Kuwait in the expectation that instituting a wide-ranging database allied with the policy formation and constructing a national energy policy and efficiency strategy will be precedence for the country in the upcoming years.

1.1. Studies on formal practices and modeling approaches

[2] carried out a study to understand the significance of various energy policy planning studies and the evaluation of numerous GHG mitigation examinations. There are some papers published by different policy related journals, which offered experiential verification and the associated theory on energy studies, such as [3], [4], and [5]. Regarding the studies on energy subside and policy measures for the transportation sector, [6] contend that production subsidies for a particular sector enhanced the production of that sector, lessen unemployment, expand the wage rate in the sector, and develop utilization among rural and urban family units.

[7] carried out a detailed analysis of different aspects of the application of several energy efficient operation and maintenance policies appropriate exclusively for arid environmental conditions. In addition, [8] examined key emissions increase in 20 Latin American and Caribbean states into smaller modules connected with disparities in the fuel mixture, modal arrangement, GHG release coefficients, and transportation energy awareness, jointly with fiscal development. While considering the corresponding studies in the region especially, the Middle East and North Africa, (MENA) and Gulf Cooperation Council (GCC), [9] and [10] conducted the relationship analysis between GDP and emissions, for Turkey and Kuwait at the same time, [11] for MENA countries, and they identified that more CO_2 emissions direct to fiscal development. [12] analysed the fossil fuel utilisation and emissions in road transportation sector for the state of Kuwait using system dynamic modelling, and [13] for Turkey did similar studies.

Similar kinds of energy modelling studies were carried out in different parts of the world, even though not in GCC region. The study by Amheka, et al., [14] intends to deliver a unified model between GHG emissions reduction owing to urban behaviours and the sustainable energy, as a case study in Indonesia. The share of residential sector electricity consumption under renewable energy scenario and fossil fuel scenario was analyzed in the study. The study supported the preparation of a regional action plan for GHG emissions. A clear-cut energy management system utilising fuzzy logic control was suggested for analysing the energy demand and road traffic data by [15].

Morel et al., [16] studied the increasing penetration of renewable energy, especially the hydrogen as a fuel source. The need for formulating allied policy strategies was stressed by them. The necessity for imposing regulations, and associated market mechanisms for sustainable transformations, has to be considered by policy makers according to Duzgun et al., [17] and the study was carried out in Turkey. The policy for employing organized energy planning and strategies for Indonesia was carried out by Winarno et al. [18]. The functional set up and they discussed financial mechanism for the effective execution plan. The energy policies to provide a symptomatic analysis on market mechanism and administrative measures useful for energy transition and reduction of GHG was carried out by Banja and Jegard [19]. The system favourableness, the related administrative procedures were also discussed in their study.

From this literature, it is clear that, connected to the various financial systems associated with different countries; the literature review mostly designates that modest consideration has given to economies, especially in GCC and MENA region, even though this part is one of the major energy capitals in the world. Both the national and international level, numerous attempts have been reported in contemporary times to devise and implement different energy policies and associated strategies. However, the scrutinizing structure for these policy strategies for the road transportation system was ended after the initial attempts and in most of the cases; it is difficult to recognize a well-established national level energy policy. Our contribution addresses the above-mentioned issues and tries to suggest a robust and novel solution for the systems. Nevertheless, though the country, as well as the GCC and MENA territory, is endeavouring to develop and amend its economies, there are arguments related to fuel effectiveness and GHG emissions, especially with the road transport segment. Besides, energy consumption in transport is one of the most important sources of pollution in this region, which is missing proper policy strategies for energy effectiveness and emission reduction. To the best of our information, none of the available literature has concentrated on examining the policy aspect, allied to strategies development that are associated with energy utilization, environmental pollution, and allied economic improvement, in the region. Specifically, this study examines the policy impact of CO_2

emissions and energy utilization in the road transport sector on energy efficiency strategies and economic development. Therefore, this study is vital in terms of its novelty as MENA represents the second most polluted region in the world – behind South Asia – and the maximum CO_2 maker per dollar of output [20].

2. Methodology, data, and assumptions

The study followed a quantitative research methodology based on secondary data obtained from different government sources as well as published research works. Along with that, a survey was conducted to identify the travel behaviour and fuel use pattern of residents in the study area. The questionnaire for the survey is having 17 questions, which are of objective type questions. Among the participants, 54% were male and 46% were female. The gender diversification, age of participants, nationality, vehicle type, country of vehicle manufacture, age of the vehicle, type of fuel used, the average distance in kilometres drive per day, the average speed of journey per day, service intervals, trip characteristics, average time stuck in traffic a day, frequency of refuelling, cost of fuel, and trip frequency are the information collected from the participants. Besides, the collected and recorded data would analyse the effect of vehicle activity, total fuel use, traffic density, fuel cost, and income on energy consumption in the road transportation sector. Daily and monthly profiles were established for energy use in the road transportation sector and were used to validate by using dynamic system programming. The data collected were screened and verified for its correctness, authenticity, and accuracy. The sampling plan used for the survey was simple stratified cluster sampling to give equal opportunities for all sectors of data. To guarantee the quality of data collected from the survey, statistical tools such as coefficient of variation, standard error, standard deviation have been employed. The following Eqs. (1) and (2) were used for the calculation of total fuel use and energy demand for the transportation sector. The framework for estimating average and aggregate energy consumption for a given vehicle class i can be summarized by the ASIF identity [21]:

$$F = \sum_i F_i = A\sum_i \left(\frac{A_i}{A}\right)\left(\frac{F_i}{A_i}\right) = A\sum_i S_i I_i = F \quad (1)$$

Where: F = total fuel use (megajoules [MJ] per year]; A = vehicle activity (vehicle kilometers [vkm] per year); I = energy intensity [MJ/vkm]; S = structure (shares of vehicle activity [percentage]); and i is an index of vehicle modes and classes. The travel distance factors considered were fuel cost, income, vehicle ownership, efficiency improvement, and traffic density. The energy demand was calculated using the equation,

Energy demand = Number of vehicles by technology type X Travel distance X Fuel economy (2)

Different possible scenarios – do minimum (base case scenario), 70/30 scenario and 50/50 scenario (partial efforts scenarios) - of enhancing the public transportation and simultaneously confining the growth of personalized vehicles showed a substantial decrease of nearly 70% in energy consumption and nearly 50% reduction in emission levels from the personalized modes of travel respectively were evaluated and analyzed. Thus from the analysis of desirable partial efforts scenarios, it has been found that achieving a modal split of 70:30 or 50:50 gives very good results in connection with fuel consumption and emission levels. The results point to the need for a set of recommendations for nationwide implementation, to prevent negative environmental impacts and damage to the environment in terms of GHG emissions, and moreover, to provide equal access to mobility. The consumption of road transport can be calculated by the following equation:

Energy per vehicle = (distance traveled/distance per unit of fuel) X energy per unit of fuel (3)

In addition, Eq. (3) is divided by the number of passengers in a vehicle that can fetch the energy per passenger. Based on the existing growth rate, the amount of fuel consumed by the road transport sector and the corresponding emission levels have been simulated.

2.1. Arguments and analysis

Even though the cost of transportation and associated energy expenses can be calculated, it is not dependent completely on fuel use and vehicle activities. The real cost and its effect on transportation are linked with health, infrastructure, and land use, cost of time delays, and cost of manufacturing. The health hazards and its treatment, which include, respiratory problems, obesity due to poor mobility, and injuries resulting from crashes, put pressure on the medical system of the countries and associated incurrence of cost and depletion of resources. The fuel burnt in idling while traffic jams and the cost of lost economic activity due to delays in traffic congestion are other major aspects of concern of cost for time delays. Hence, to address the energy-efficient policy framework for road transportation, one has to look for system efficiency, travel efficiency, and vehicle efficiency together. Hence, it extends outside practical and operational factors focused in utmost plans, examining the complete procedure in which SDM is employed.

3. Assessment perspective and criterion for the policy and its implications

The assessment was done by taking into consideration of the business economics, overall economics, and feasibility perspectives. Figure 1 summarizes the best practices that need to be incorporated to achieve the best attributes from different perspectives. While designing the business economic perspective, the profitability of the policy, service quality, traffic safety, the value of resources, and interest of the stakeholders are to be taken into consideration, reflecting both the critical roles that business economics and utility capabilities play in energy efficiency and the expansion of policy experiences in the transportation sector in recent years.

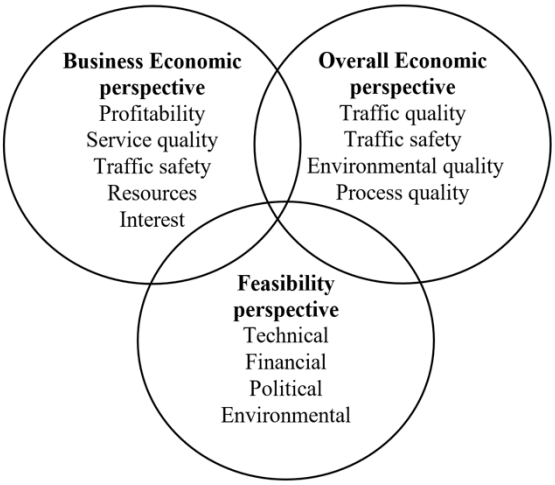

Fig. 1. Assessment perspective for the proposed policy implications.

The technical, financial, political, and environmental feasibility perspective has to be assessed before designing any policy for transportation. Also, the traffic quality, safety, process quality, and environmental quality need to be assessed. In the present study, the policymakers are persuaded to match the best practice policies presented here by exploring any policy or technology option that makes significance in the situation that they are intending. Table 1 details the key drivers and constraints that were considered while analyzing the policy options in the transport sector. Here too, the different perspectives such as user, government, and society and its major drivers – Incurred costs, time, quality, mobility, environment, service and expenses, network and infrastructure, land use planning, policy and regulations, and technology and innovation were considered.

Once the constraints are identified, the various strategic measures are to be established and recognized. For that purpose, the indicators for transport energy efficiency is vital. Table 2 shows the possible identified indicators for the study area. To select the indicators, the infrastructure improvement, driver efficiency, and effectiveness increase in driving, optimization of schemes, and advancement of principles are selected as related guidelines that are very much applicable to this region. After the drivers, constraints, indicators, its measures and effects are identified, the policy options and scenarios can be discussed, formulated, and evaluated. Based on these arguments in mind, the various policy options related to energy efficiency strategies for the road transportation sector are discussed in the ensuing section.

For any policy, to the country or region, should address the safety and security achievement, with sustainability in transportation, that exemplify the market, balancing the economic, social, technical and environmental needs, and above all, receptive to the individual and the government. This can be met by taking a long-term view of the reform processes and key policy arguments in the transport sector and its subsectors.

Table 1. Key drivers and constraints in the transport sector

Perspective	Major driver	Constraints
From the user	Incurred costs	Transport cost
		Inventory cost
		Social cost
		Other associated costs
		Shift cost
	Time	Traveling time
		Vehicle speed
		Lead time
		Mode speed
	Quality	Reliability
		Flexibility and location
		Transparency
		Traceability and accessibility
		Security and interdependency
		Rate and level of shift
		Driver behavior
From the Society	Mobility	Congestion
		Safety
		Demand and distribution
	Environment	Air quality
		Emission
		Noise
From the government	Service and expenses	Frequency
		Destination
		Service orientation
		Price
	Network and Infrastructure	Terminals
		Inter-operability
		capacity
		maintenance
		Shortage of skilled personnel
	Land use planning	Location of residence
		Buffer zones for parking
	Policy and regulations	Lane priority
		Fleet length
		Standardization of traffic measures
	Technology and innovation	Electric vehicles and heavy trucks
		Alternative fuel
		Power train
		aerodynamics
		Conventional traffic management

3.1. Policy options and conditions for the strategic development of transportation planning

The development of policy is linked with a decision support system for the sustainable energy-efficient transportation system. The flow chart depicting the sustainable energy-efficient transportation decision support system is presented in Fig. 2.

Table 2. Evaluation of strategic Measures

Indicators	Guidelines	Measures
Transport final energy consumption by sector and by mode	Infrastructure improvement	PPP for transport management
Emissions of GHG and other pollutants		Access management
Vehicle fleet meeting emission and fuel efficiency standards	Increase driver efficiency and effectiveness in driving	Efficiency and intensity relationships
Fuel prices and taxes	Optimization of schemes	Optimized networks
Exceed in air quality due to traffic	Advancement of principles	Improved driver training
Passenger/freight transport volume and modal shift		Registration of environmentally friendly vehicles
EE and specific CO_2 emissions		Logistics movement process streamlining
		Clean vehicle technology

To identify the goals and establish the objectives, the coordination between different governmental agencies in an integrated way is essential. The physical changes that are needed for energy consumption reduction in transportation is not an easy task as far as Kuwait is considered, at the same time, the policy legislations, regulations, and public actions to induce the energy consumption reduction are possible. The meaning of policy options in this context is the legislative and administrative instruments from the governmental side to achieve the intended outcome based on their actions. Once the support system developed, the policy content and its taxonomy can be decided. The identified policy content taxonomy is presented in Fig. 3.

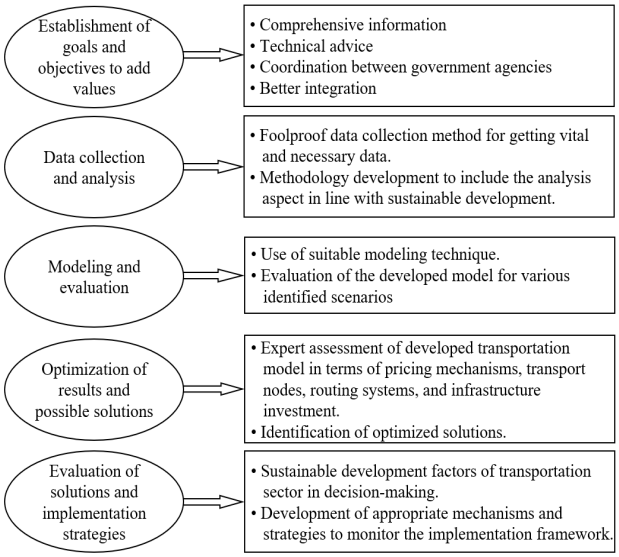

Fig. 2. Flow chart for sustainable energy-efficient transportation decision support system.

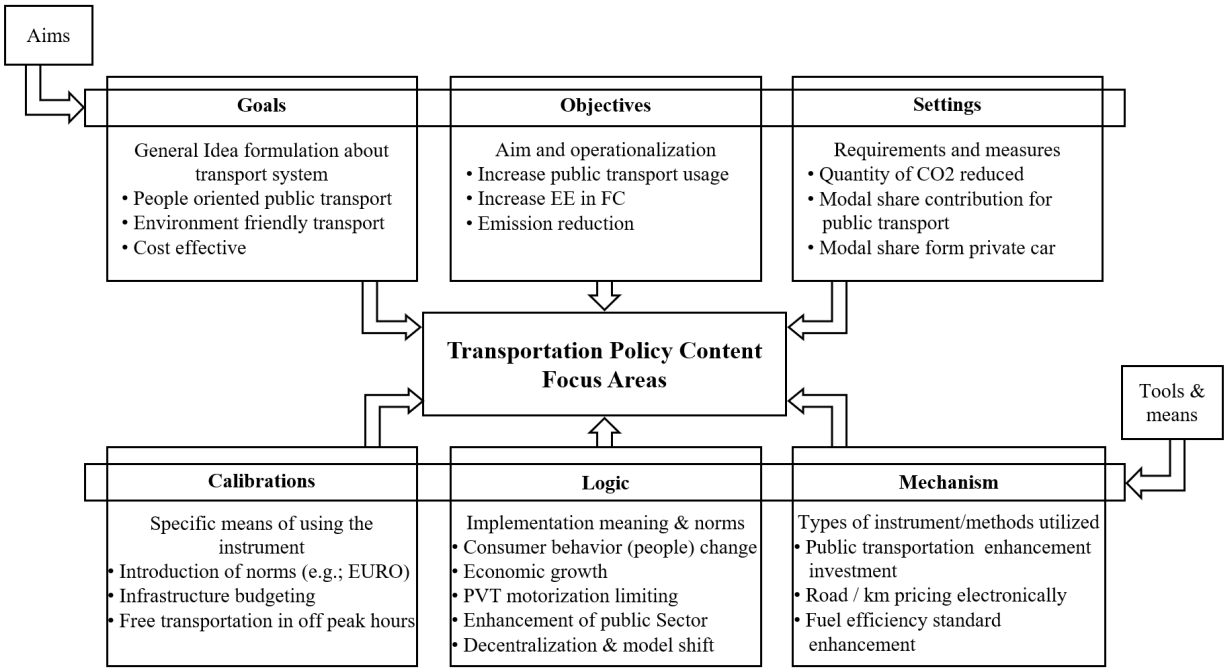

Fig. 3. Policy content taxonomy

The policy content taxonomy has two major aspects that are aims and tools and means. The aim or the focal areas that are essential are, goals, objectives, and settings while the tools and means consist of calibrations, logic, and mechanism. The people-oriented public transportation in an environmentally friendly, cost-effective way is the goal for this policy content. The major distinct calibration features that are listed to be tested for its effectiveness are the introduction of emission norms for the country, the infrastructure budgeting, and the free transportation offer by public transportation facilities in off-peak hours. Once those mentioned above for its feasibility, the implementation means and norms have to be finalized. They include the people's behavior to change, the economic growth in the country, and the enhancement of the public sector. For this, investment in public transportation needs to be enhanced along with fuel efficiency standards.

3.2. Strategic decision-making architecture (SDMA) for transportation planning

When the policy content is finalized, strategic decision-making architecture for transportation planning and allied development can be performed (Fig. 4). The energy supply and demand network model needs to be made for transportation planning as the preliminary step. This is followed by the identification of major drivers and system constraints. The demographics, climate change, socio-economic factors, and technology are identified as the major drivers, and CO_2 reduction, capacity, system resilience, and demand are the constraints. The communication with constituent system parameters and drivers and evaluation of alternative scenarios is the third step, which is followed by the determination of outputs.

After the strategic decision-making, architecture finalization; transport policy development can be made. The policy instruments and tools, policy intervention and focus, policy responses, expected policy outputs and outcomes are the important steps that need to be considered while developing the transport policies [22]. The schematic of this development is represented in Fig. 5. It would be good if the policymakers made use of performance-based planning philosophy [23], in which, the systematic monitoring of the state variables of the transportation system that allow structural transformations have to be identified and to orient them for the decision making the process. In the present situation, the state variables of the transportation system have been identified, and they can be made use of by the authorities. Hence, it will be beneficial to use the performance-based planning philosophy. Given the range of involvements regarding policies, mechanisms, responses, and outcomes, an effortless means to regularize the effect of transport policies is to deliberate how policies influence the welfare of individuals in the country, or the industry and other sectors, by all potential means.

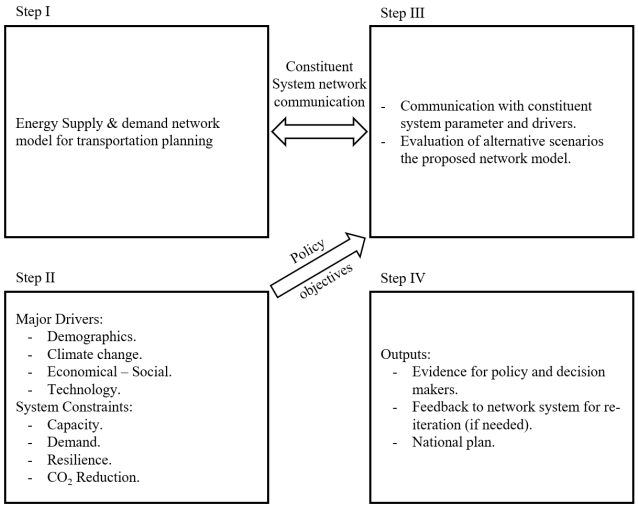

Fig. 4. SDMA for transportation planning and development

Policy instruments and tools that involve policy regulations, pricing norms, and infrastructure investments require building new transport infrastructure (e.g., roads), up-gradation of present infrastructure and technology, or enhancing services related to the transport sector. The fuel subsidies or levis to inspire modal options and related transport behavior especially, fare concession for students in public transport, road tolls, parking fares in cities, fuel taxes, and clean transport subsidies while using alternative fuels are all included in the pricing norms. Policy regulations comprise implemented mechanisms or systems to decrease emissions (e.g., emission standards) directly or to systematize the transport sector.

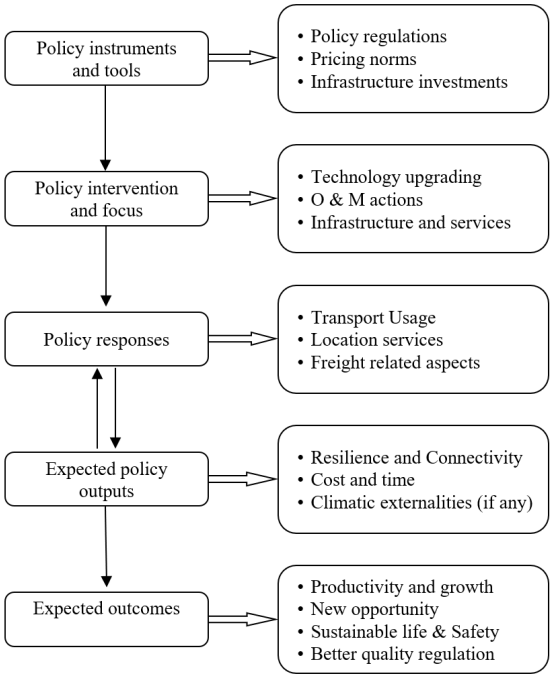

Fig. 5. Transport Policies and Developmental platform

The above categorizations of the major objectives of policies are mainly to encourage economic growth and to assist better access to transport services for people, and above all, to improve sustainability by trimming down environmental vulnerability. The scope at which these goals can be attained relies on the behavioral patterns that the people or society following in terms of modal selections. Table 3 presents the suggested policy classes and measures, based on the analysis that was carried out using the steps explained in the previous flow chart (Fig. 5).

The private vehicles users may switch to public transportation if the public transportation system in the country is accessible and well established. The government needs to place a priority on public transportation to assist in solving city congestion problems and to encourage people to drive green. The suggested policy classes, measures, and role of policy planners are depicted in table 3.

3.3. Optional energy efficiency enhancement policies for transportation planning

To address the range of issues that are important while looking at the energy efficiency in the transport sector, the following suggestions may be considered by the policy planners.

3.3.1. Improvement in public transportation logistics

The investment should be made to improve the public transportation logistics scientifically, to enhance fuel efficiency and reduce emission. In addition, public transportation can be made attractive by providing tax incentives to buses, such as onetime acquisition tax, tonnage tax, and capacity tax.

3.3.2. Implementation of system efficiency standards

It will be economically beneficial to look for improving the present system, rather than constructing new infrastructure. In this way, the policy of congestion pricing of vehicles for city traffic can be implemented at peak hours. This will reduce emissions as well as fuel consumption. Here, a discount can be given to vehicles with energy efficiency technologies.

3.3.3. Planning for the mass transit system

The network for mass transit system such as metro rail, need to be planned since the culture of personal vehicle transportation needs to be extricated from cities. In addition, the development of new residential cities and commercial locations are to be integrated with this mass transit system to increase ridership and reform transit pricing.

3.3.4. Operational efficiency enhancement for drivers

The operational efficiency of vehicle drivers needs to be enhanced by adopting driver education, training, and enforcement programs. The driving behavior is one of the important factors that reduce fuel efficiency and thus increase vehicular emission by a considerable amount.

Table 3. Suggested policy classes, measures, and role of policy planners

Classes	Measures and Role
Policy attributes	▪ Fuel taxes, fuel charges, Levis on pollution, natural resources usage. ▪ Certificate for using standardized systems.
Policy drivers	▪ Tax exclusion, minimal interest loans as investment incentives. ▪ Subsidies for using alternative technologies. ▪ Removal of detrimental and unreasonable subsidies in the sector. ▪ Long-term warranty for loans, credit assurance, as a control in investment.
Policy establishments	▪ Law/regulations - strict enforcement of penalty, norms, prohibitions. ▪ Compulsory targets meeting ▪ Governance and organizational capability enhancement- administrative translucency, execution, and imposition, responsibility
Policy investments	▪ Infrastructure development. ▪ Sustainable transport policy planning. ▪ Capacity building and development. ▪ Research and development for innovative solutions.

3.3.5. Fuel economy enhancement in vehicles

The fuel economy standards for vehicles in the country can be made stringent as advised by the International Energy Agency's (IEA) global fuel initiative. At the same time, the synchronization of new standards with the contemporary ones needs to be estimated in the country to facilitate the manufacturers 'conformity with new standards, since, 100% of the vehicles are imported in the country.

3.3.6. Economic incentives for energy-efficient vehicles

Economic incentives can be offered to vehicles that use energy-efficient vehicle technologies, -such as electric vehicles, alternative fuel vehicles- in the form of tax credits. This action will encourage people to use more energy-efficient vehicles, and hence, the fuel price stabilization can also be achieved complimentary.

3.3.7. Development of standard for import of vehicles

The import of used vehicles and new vehicles to the country should meet the standards that are by the energy efficiency policy. This enforcing needs to be done by a coordinated approach.

3.3.8. Disincentivization of the use of inefficient vehicles

The use of inefficient vehicles (high fuel consuming ones, highly polluting) can be discouraged by adopting disincentivization strategies such as higher fuel taxes

annually while going for certification, and excess additional taxes on vehicles.

3.3.9. Implementation of an awareness campaign

Periodical awareness campaign can be done for drivers and society at a community level, to emphasize the link between good driving practices and operations that give importance to safety and fuel efficiency.

3.3.10. Proper land usage for transportation planning

Infrastructure development largely depends on proper land usage. Thus, an integrated approach in land use planning will help the transportation planning for policymakers to attain the vision of fuel consumption reduction and energy efficiency enhancement.

3.4. Operational approach and measurement of success

Based on the suggestions provided for optional energy efficiency enhancement policies for transportation planning, the priorities can be identified and acted upon by the policy makers. The transport infrastructure should be for fostering national integration, encouraging supply and demand network by offsetting the national economy, incorporating national, regional and global market through appropriate trade facilitation and sectoral reforms. While addressing the energy efficiency enhancement for planning, the endorsement of environmentally and socially complete advancement will persist of significance, focusing the key issues that are mentioned above. Consistent with the contests recognized above and the suggested response, some exclusive Policy Strategic Performance Indicators (PSPI) can be developed that will serve as the foundation for the authorities assess the accomplishments under the proposed policies and strategies, which will focus on supporting the transformation process.

4. Policy implications and concluding remarks

This study is remarkable for two reasons; firstly, the topic of road transportation planning is not as deeply researched for the GCC region, especially in Kuwait even though the topic is very much vital because of the prevailing environmental and social conditions. Secondly, where this study improves on previous studies of transportation planning in other parts of the world is in the methodology used. Attempting to resolve technical and logical aspects systematically, for the transportation planning of Kuwait and the GCC region, the SDMA framework in the study makes use of different steps. The assessment perspective for policy implications, identification of key drivers and constraints, the policy content taxonomy, and evaluation of strategic measures are employed in the SDMA to suggest policy classes, measures, and role of policy planners. The existing transportation system influencing factors are well addressed in the present framework as a reference to policymakers for recommending policies, at the same time; the gaps in the existing system may be identified and can be filled by adding or extending a new tier to the present steps.

Generally, price is a major, indisputable factor of fuel demand globally. However, a major concern in the region is the fuel subsidy. The subsidies can be effectively utilized for enhancing the quality of infrastructure, capacity building, and development and for innovative research and development process for the country. The policy planners should have a positive outlook linked with these reformations. Hence, the policy planner can increase the effectiveness of subsidies credibly with subjective perception. Thus, the economic efficiency of the suggested policies should be the major criteria of evaluation for planners, followed by energy efficiency.

In the study, the lack of public transportation availability, reliance on oil as a sole fuel source, high vehicle pollution, commuting schedules, and associated traffic congestions, safety, and accidents due to driver behaviour, and subsidies associated with transportation are considered as the important issues about transportation planning. The effectiveness and bureaucratic hindrances should follow the criteria, as mentioned earlier. In addition, the rapid change in the technology and the associated consumption patterns are taken care of by the planners while evaluating and formulating the policies. The acquiescence with contemporary benchmark and the prospect of elaborating quantitative measures, along with the accessibility of documents convenient for transportation policy planning activities, and the opportunity to offer statistical advice to users make the SDMA methodology and framework a practical and aggressive system in the policy planning for the road transportation. Policies and strategies involving transport energy efficiency, practice diverse points, extending from enhancements in the technical performing of vehicles - mainly compliance, developing emissions standards - to modal shifts to more energy-efficient means. The SDMA framework in these features can be a future direction for this study. Based on these aspects, we, therefore, recommend investing in the capacity building of energy advisers and policy implementation bodies, especially in developing social competencies for the country. Hence, the need for an efficient policy regulation that incentivizes the people's behaviour favourable to energy efficiency measures in a multi-stakeholder and inter-institutional context can be achieved. There is a need for multi stake holder and inter institutional governing framework that overlook efficient regulations along with strategies for the transportation energy sector which, includes the behavior element and associated incentivization measures. This governing framework is supposed to encompass a multifaceted set of economic, legal, environmental, and political perceptions of policy formulations. In addition to this, the information and awareness campaign for public, for better participation and by promoting the purchase of energy efficient vehicles, is indispensable for enhancing and creating a system that help to achieve the suitable policy regulations.

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