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Comparing Carbon Dioxide Reduction Strategies in Iran and the European Union Transportation Sector

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Abstract: The transportation sector represents a major proportion of the global greenhouse gases (GHGs) emissions. Fossil fuels supply over 95% of total energy used by the world transportation sector and this sector is responsible for 23% of the world energy related GHGs emissions. Factors such as number of mobile sources (vehicles), variety of technologies, many consumers with various driving behaviour, and variety of fuels (from conventional to alternative with different quality) have caused a more complicated situation for decision makers aiming to develop policies of CO_2 emissions reduction in this sector. This study compares European and Iranian experience in developing carbon dioxide-related policies in transportation sector. Vehicle production in Iran has grown dramatically during the last decade. But, due to the high energy subsidies on the local market, weak technical regulations, and low access to new technologies, Iranian automakers have not enhanced the fuel efficiency of new products as their global counterparts. It is expected that fuel demand in Iran will grow along with the growth of the motorization rate and fuel efficiency level of the road fleet.

Benchmarking with the European policies along with the SWOT analysis has concluded four strategies as the core concept of this analysis: mandatory regulation versus voluntary agreement, CO_2 emissions versus fuel consumption regulation, approaching efficient fiscal policies (taxes for conventional and subsidies for low carbon fuels), and dieselization of the LDVs fleet. The fifth strategy, as national fuel economy regulation, should be addressed to coordinate the others. In this regards, a set of policy packages should be developed relating to governmental institutions. It should be mentioned that increasing public awareness should be addressed as the basic approach of any strategic roadmap in the country.

Key words: Transportation, CO_2, policy, Iran, European Union.

Introduction

US Environment Protection Agency reports that around 90% of the fuels consumed in the transportation sector are petroleum based – mainly gasoline and diesel (Harrington, 2008). So, the nearly complete dependence of the sector on oil products generates two sorts of concerns: security of oil supply, given the rising needs of transportation, and worries about climate change combined with the longer standing problems of congestion, noise and urban pollution (Capros et al., 2008).

Regarding the IPCC, the share of total GHG emissions by transportation has risen considerably. The growth rate of the sector is the highest among end-user sectors and reach around 12 Gt CO_2 eq/yr by 2050 (IPCC, 2014). The share of non-OECD countries was 36% in 2006 and the IPCC predicts that this will increase rapidly to 46% by 2030 if current trends continue (IPCC, 2007). The IEA reports that transport sector was responsible for producing 7.452 Gt of CO_2 and accounted with 23% of the total CO_2 emissions in 2014 (IEA, 2016).

Road transportation consumes much more energy for economic production than other modes. Distributing consumers and numerous vehicles has raised CO_2 intensity for both freight and passenger purposes. Improving energy efficiency for road transportation needs more complicated policies for the key players – from automakers to drivers. To limit emissions from this sector, policy makers should first and foremost consider measures to encourage or require improved vehicle efficiency. Policies to slow the increase in emissions are relatively ineffective in the short term, but it is sometimes suggested that such policies have been effective in the longer term (Jansen & Bakker, 2006).

Iran's vehicle industry experienced a huge growth at the beginning of the Fifth Five-Year Development Plan[1] (2011-2015). Number of Products hit over 1.6 million units (1.4 million of passenger cars) and the country 13th rank for vehicle producers in 2011. Local automakers have invested in establishing modern production lines under license of some well-known global brands (such as Peugeot, Renault, KIA, and so on). Technology transfer for new vehicles has resulted in empowering local automakers to design and develop new engines, bi-fuel vehicles and mass-production of passenger vehicles.

Because of lack of technology and weak policies for fuel prices in Iran, sector's fuel consumption is increasingly high and these issues result in high CO_2 emissions and air pollution. International Energy Agency reports that Iran emitted over 556 million tons of CO_2 as the eighth emitter country in 2014 (IEA, 2016). The Iran Department of Environment has introduced transportation sector as the main factor of air pollution in the big cities.

Methodology

We use comparative analysis to investigate the similarities and differences between macro social cases. The comparative method is traditionally qualitative and tends to be case-oriented, as opposed to variable-oriented (Ragin, 1987).

As Table 1 shows, three independent variables affect carbon dioxide emissions; hence, policymakers should address players with appropriate policies. Because of the variety of variables and the limitations of research activity, this paper focuses more on the vehicle industry.

Approach

Vehicle Industry

Production of low-carbon vehicles in the EU accelerated after the ratification mandatory regulation in April 2009 (EC 443/2009). The annual CO_2 reduction rate was about 1% until 2007 (the industry's voluntary reduction agreement). But after ratifying the mandatory regulation, this rate has increased significantly to approximately 4% per year from 2008 to 2013 (ICCT, 2014). According to mandatory regulation, the fleet average annual CO_2 emissions target for automakers is defined as 130 $grCO_2$/km by 2015 (compared with 161 $grCO_2$/km in 2005) and 95 $grCO_2$/km by 2020. EEA reports that, the CO_2 rate of the segment hit 127.0 $grCO_2$/km in 2013 (two years earlier than 2015). Continuing this trend, new cars sold in the EU in 2016 had CO_2 average emissions of 119.5 $grCO_2$/km, which was 8.0% below the 2015 target (EEA, 2016). According to the EEA, despite increasing vehicle mass, dieselization and improved vehicle technology are two main reasons for greater fuel-efficiency in the EU (EEA, 2014).

Standardizing fuel consumption of LDVs in Iran started in 2006 with the issuing of ISIRI No. 4241-2. This standard was derived from the similar European standards, 80/1268/EEC, 93/116/EEC, and 99/100/EEC. ISIRI 4241-2 was developed based on fuel consumption, while European standards use carbon dioxide as the basic index. First and second editions of ISIRI 4241-2 have not been implemented successfully in reducing fuel consumption and CO_2 emissions in the Iranian LDVs fleet. According to the Vehicle Quality Enhancement Law, the average fuel consumption of passenger cars should have been reduced to 6.95 lit/100 km in 2011. This rate hit 7.93 lit/100 km and 7.4 lit/100 km for gasoline and bi-fuel (CNG and gasoline) vehicles in 2011 respectively. The local automakers were not successful to hit national targets in fuel consumption (Figure 1). Factors such as lack of proper technologies, non-coordination among the players and economic factors (such as sanctions) are the key reasons for the issue (ISQI, 2016).

The third edition of the ISIRI 4241-2 published in 2015, was derived from the European standards of EC 443/2009 and EU 510/2011. The new version of the standard was enforced from the beginning of 2016.

[1]Mid-term national Iranian strategic plans that is prepared by the Government and ratified by the Parliament every five years.

Table 1: Affecting variables on fossil fuels consumption and CO_2 emissions in the transportation sector

Independent variables	*Main factors*	*Subjects/Policy instruments*	*Indicators/measures*	*Actors*
Vehicle industry (vehicle supply side)	Fuel consumption efficiency (distance travelled with determined consumed fuel)	Fuel prices National standards International standards	Vehicles' fuel economy Power engine technology Vehicle weight Fuel price	Government; automakers
	Number of vehicles	Demand side (local and international market)	Number of vehicles per 1000 population Number of hybrid vehicles in car fleet	Automakers
Consumer (demand side)	Land use	Land-use planning Transportation planning	Vehicle miles of travel (VMT) Population density Transit trip capture rate	Government; local authorities
	Demand management	Local regulations Local infrastructures	Tele-working; Developing information and communication technology	Government
	Financial systems	Local regulations (e.g. taxes, subsidies and insurance costs)	Carbon tax (in EU); Removing fossil fuel subsidies (in Iran)	Government
	Driving behaviour	Drivers' technical knowledge Traffic management	Vehicle miles of travel (VMT) Shifting gears Traffic management systems	Government; local authorities; consumers
	Vehicle age	Households' financial situation Local regulations (e.g. loans for new cars)	Average car fleet age	Government; consumers
	Vehicle maintenance	Drivers' technical knowledge Fuel and lubricant prices Local regulations	Environmental friendly products Fuel price	Consumers
Fuel supply side	Conventional fuels	Technology used in refineries Local regulations Fuel prices	Carbon content of the fossil fuels Gasoline and gas-oil quality and quantity Fuel price	Government; refineries; producers of alternative fuels; automakers
	Alternative fuels	Technologies for fuel production Engine technologies Local regulations Fuel prices	Carbon content of the alternative fuels Variety of available fuels Fuel price	

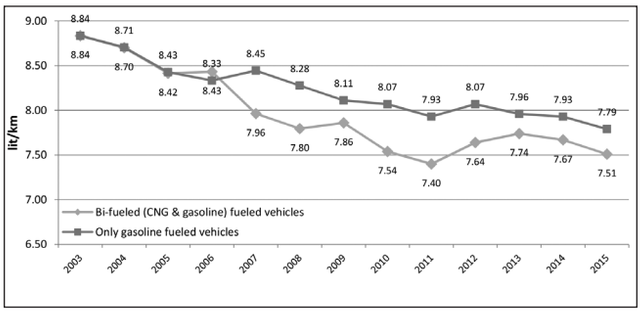

Figure 1: Average gasoline consumption per capita of new locally produced passenger vehicles in Iran (2003-2015). *Source*: ISQI, 2016

Because of weak price policies during the last decades (e.g. high subsidies for consumers), the Iran's vehicle industry has not had enough driver for fuel efficiency other than national regulations and technical standards. The exclusive market for local automakers has diminished the role of fuel price in producing low carbon vehicles.

Vehicle Consumers (Demand Side)

The passenger car market of the EU is nearly mature, whereas Iran has an emerging market. The number of cars per one thousand inhabitants (motorization rate) in the EU has grown more slowly than in Iran (Table 2). The motorization rate in Iran has increased dramatically by over 160% in ten years. Capros et al. (2008) predict this rate for the EU-27 to reach 710 in 2030.

Table 2: Motorization rate in Iran and the EU in 1999, 2009 and 2011

	1999	*2009*	*2011*
Iran	54	141	170
EU-27	412	473	486

Source: IFCO, 2013; EEA, 2011 and Eurostat, 2017

It is expected that the number of passenger vehicles grow depending on economic growth and Iran's population. Thus, LDVs' fuel demand will increase accordingly.

Growing rate of fuel consumption has a serious treat potential in a highly subsidized economy. According to Iran Hydrocarbon Balance, the Iranian government paid over 93.7 billion USD as energy subsidies to the country's economy in 2014 and the transportation sector has received over 38.7% of this amount (MOP & IIES, 2015). It should be added that the government has had to pay subsidies increasingly in recent years coinciding with the growth of motorization in the country (e.g. gasoline and diesel fuel subsidies have grown over 300% and 400% respectively from 2000 to 2011). The World Bank argued that the huge proportion of total energy subsidies in Iran not only distorts consumer choice and obscures state accounts, but is the cause of significant environmental damage (World Bank, 2004).

Fuel Supply Side

Conventional fossil fuels and petroleum products (i.e. gasoline and diesel) account for over 94% of energy consumed in road transportation in the European Union (EU-28) in 2014. Most of the remaining 4% belongs to renewables (e.g. biofuels) and nearly 0.8% belongs to gas (European Union, 2016). For Iran, and according to the IFCO, conventional fuels (gasoline and diesel) and natural gas accounted for over 85 and 14% of energy consumption of road transportation in 2011 respectively (IFCO, 2013).

The fuels' quality is critical for any conservation programme, and sulfur content is the basic parameter of gasoline and diesel quality to meet higher levels of both emissions and fuel consumption standards (Tables 3 and 4) (ACEA et al., 2013). The ACEA reports that fuel sulfur content dramatically reduces the efficiency,

Table 3: Sulfur content levels of different European emissions standards for the LDVs (ppm)

	Euro 1	*Euro 2/Euro 3*	*Euro 4*	*Euro 5/Euro 6*
Gasoline	1000	150	30	10
Diesel	2000	300	50	10

Source: ACEA et al., 2013

Table 4: Time schedule for implementation of emissions regulations in LDVs for EU and Iran

	2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
EU			EURO 5				EURO 6
	EURO 4						
Iran	EURO 2						EURO 4

Sources: ICCT, 2012; AQCC, 2013; Iran DoE, 2014

lifetime and durability of NO_x storage traps of catalysts (Blumberg et al., 2003).

Desulfurization from gasoline and diesel has been a critical issue in Iranian refineries as well. The Air Quality Control Co. (Subsidiary of the Tehran Municipality) conducted a survey on the gasoline and diesel distributed in Tehran. Sampling from a number of gas stations randomly in different times showed that the sulfur content of most of the samples were much over the standard limit (Air Quality Control Co., May 2013). It should be noted that preparing light fuel is necessary for diesel LDVs penetration policy in Iran.

CNG has a proper potential as an alternative fuel in the local Iranian market. Launching rationing of gasoline, along with increasing the second quota to 0.43 USD in June 2007, decreased the gasoline demand in Iran. The IFCO reports that gasoline consumption in the sector decreased from 146.8 MBOE in 2006 to 119.6 MBOE in 2011 (–18.5%). Despite the decline for gasoline, total energy consumption of the LDVs fleet continued to grow during the period. This means that CNG compensated for gasoline's share of total energy demand.

Lessons Learned from the EU

Mandatory Regulations versus Voluntary Agreements

After the voluntary agreement from 2003 to 2007, mandatory regulation succeeded in reaching 2015 CO_2 emissions targets in 2013. The ICCT reports that the annual CO_2 reduction rate was about 1% until 2007 (the industry's voluntary reduction agreement). After ratifying the mandatory regulation, this rate increased significantly to approximately 4% per year from 2008 to 2013 (ICCT, June 2014). It is expected that the EU will hit its 2020 targets on time. Since the transportation sector is responsible for a quarter of Europe's GHG emissions, reaching these targets will have a significant impact on meeting the EU's climate change commitments.

Deploying CO_2-based Regulations

Defining carbon dioxide as the index of both environmental and fuel consumption performance has helped in harmonizing intersectional policies of the transportation sector. CO_2 emissions reflect the fuel consumption of vehicles and translate fuel economy calculating methods into one language. In addition, environmental reporting helps manufacturers' performance meet their commitments. Finally, vehicle consumers can evaluate their own share in this procedure.

This approach in the EU has clarified the tasks of each player in the policy packages (see Table 4). EU regulations do not emphasize any specific technology. European automakers have decreased CO_2 emissions of new vehicles through combined strategies (such as dieselization, hybrid vehicles, bio-fueled vehicles, etc.).

The third that is the latest version of the national Iranian standard has been revised based on the CO_2 emissions (ISIRI, 2015). Approaching this standard helps Iranian entities to meet national targets more precisely.

Approaching Efficient Fiscal Policies

EU member countries manage market behaviour through fiscal mechanisms such as taxes and subsidies. They also inform the cost-effectiveness preferences of new vehicles through unique signs and labels. So, consumers are propelled to choose less fuel-consuming vehicles through mechanisms such as car tax.

Incentives, such as super credit, lead automakers to produce LCVs. On the other hand, manufacturers exceeding limits have to pay defined fines. Along with these mechanisms, there are some fiscal incentives for the research and development of high-tech vehicles (such as hybrids).

Fuel pricing has been a strong policy instrument in the success of the EU's CO_2 emissions reduction policies. Taxes nearly make up over half of retail price in the EU. The GIZ named the EU as a high tax region in terms of fuel prices (GIZ, 2014).

Dieselization

Despite more carbon content in diesel than gasoline, burning one litre of diesel produces more energy than the same amount of gasoline. Therefore, it is expected to emit 10-30% less CO_2 in comparison with gasoline. According to European Environment Agency, despite increasing vehicles mass in the EU, dieselization is one of the main reasons for meeting the 2015 target two years early (EEA, 2014). Introducing diesel LDVs to Iran's road fleet can help to diversify the fuel basket, on the one hand, and enhance outcomes for fuel efficiency strategies on the other.

Using Integrated Policies

The European Union implemented an integrated CO_2 emissions policy in the LDVs segment successfully. Through meeting the objectives, both economic growth and environmental quality have been improved in the

Table 5: Comparing Iranian and EU CO_2 policy parameters

Subject	*Iran*	*European Union*
Availability of fossil fuels	Having 9.3% of oil and 18.2% of natural gas proven reserves in 2014	Importing over 85% of its fossil fuel consumption
Energy intensity	High	Low
International commitments	No	Yes (Kyoto Protocol)
Developing fuel-consumption standards	Yes, but need upgrading (fuel consumption target for 2011 is 6.95 lit/100 km)	Yes (fuel consumption targets for 2015 are 5.6 lit/100km for gasoline and 4.9 lit/100 km for diesel)
Defining CO_2 as a fuel consumption index	Yes (INSO 4241-2 3rd Ed. 2015)	Yes (Directive 89/458/EC)
Defining CO_2 specific target	Yes (190 $grCO_2$/km by 2012 and 100 $grCO_2$/km by 2025)	Yes (130 $grCO_2$/km by 2015 and 95 $grCO_2$/km by 2020)
Using fuel-consumption labelling	Yes (most of the local cars labelled *D* and lower)	Yes (mostly *A* and *B* grades)
Diesel-fuelled vehicle penetration	No (but under planning)	Over 50% of LDVs market share
Natural gas-fuelled vehicle penetration	15.6% of LDVs' market share	A few in some countries, such as Italy and Germany (less than 1%)
Incentives and / or penalties	No (just limitations, such as prohibition on importing over 2500 cc vehicles)	Yes, super credit as incentive (for $\leq$50 $grCO_2$/km) and excess emissions premium as penalty (for$\geq$130 $grCO_2$/km)
Alternative propulsion technologies (such as HEVs, PHEVs and BEVs)	Limited (just CNG)	Yes
Fuel quality in terms of CO_2 reduction	Weak (e.g. high sulfur content)	Standard conventional and alternative fuels
Fuel pricing mechanism	High fuel subsidies; Subsidy Reform Plan based on the Persian Gulf F.O.B. price	High fuel taxation; Base price plus 19% VAT plus eco tax & excise tax (e.g. in Germany)
CO_2-based motor vehicle tax	No; Just base tax (equal to 1% of the car's price) and some municipality levies	Yes; Annual circulation tax for registered cars: base tax (2 €/100cc for gasoline and 9.5 €/100cc for diesel) plus CO_2 tax

region. Ricardo-AEA and Cambridge Econometrics reported that the innovations made for meeting the 95 gr CO_2/km target for new vehicles would add about 1,000 EUR to the price of the average car in 2020. But the extra cost would be offset in less than three years via fuel savings of about 400 EUR per year. This regulation could bring extra economic advantages by creating 350,000 to 400,000 jobs in Europe (Ricardo-AEA and Cambridge Econometrics, 2013).

It could be concluded that the EU has stopped the increasing trend in the segment's CO_2 emissions through implementing the three policy packages of *technology-base, fuel-base* and *fiscal-base* (Figure 2). In fact, the successful implementation of Regulation No. 443 is not because it is mandatory. However, consonant policies for all players (including supply and demand of both fuel and vehicles) have been the reasons.

SWOT as a Strategic Planning Instrument

Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis originates from business management literature in the 1980s (Markovska et al., 2009). This instrument has been used for strategy formation given a specific system boundary (from the range of a region or country to an organizational concept) and from both internal and external perspectives (Karrpi et al., 2001).

Sample Data Collection

For gaining the most reliable results, I developed a questionnaire within 71 questions relating to the four SWOT areas. Table 6 includes the main subjects of the questionnaire. The SWOT here focuses on the light duty vehicles' (LDVs) segment of Iran's transportation sector.

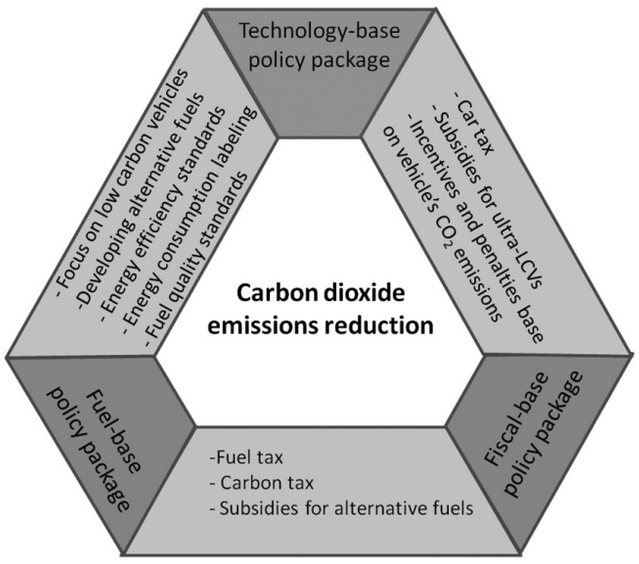

Figure 2: Conceptual model for CO_2 emissions reduction policies in the LDVs segment of the EU.

The questionnaire was distributed among think-tanks and authorities in the field of fuel consumption and fuel standardization in the Iran's vehicle, including the Ministry of Industry, Mining and Trade (MIMT), the Iranian Fuel Conservation Company (IFCO), the Iranian National Standard Organization (ISIRI), the Iranian Standards and Quality Inspection Company (ISQI), the Iranian Department of Environment (Iran DOE), and the Environmental Section of both main Iranian automakers (i.e. Iran Khodro Co. and SAIPA).

Over 41 of completed questionnaires were collected. According to EFE and IFE matrix calculations, there are several improving potentials for fuel consumption and CO_2 emissions reductions in Iran's transportation sector. Sectors' fuel efficiency targets are achievable through deploying proper strategies. Thus, related breakthroughs would be tangible for all of the stakeholders.

On the other hand, the gap between Iranian and EU emissions levels may grow wider if policymakers neglect these potentials. The present situation regarding available technologies for car and fuel production, fiscal mechanisms and public awareness have prepared a *window of opportunity* for policymakers to reduce energy consumption and CO_2 emissions in Iran's transportation sector.

Results

Developing the SWOT Matrix

Matching external (individual opportunities and threats) and internal (strengths and weaknesses) factors leads us to proper strategies that have critical roles in effective strategy formation. According to the nature of the study system and related internal and external factors, the strategies will be Aggressive (SO Strategies), Conservative (WO Strategies), Competitive (ST Strategies) and Defensive (WT Strategies) (David, 2011). The SWOT matrix looks for feasible alternative strategies.

Strategy Number One: Low-carbon Vehicles Production Act

This is a conservative strategy that uses internal strengths to avoid or reduce the impacts of external threats and relies on its internal competencies.

Energy intensity in the transportation sector has not been improved along with economic development in the country. So, under new international regimes, the industry has to improve carbon efficiency to meet

Table 6: SWOT analysis of Iran's transportation sector: Light-Duty Vehicles' (LDVs) segment

Strengths	**Weaknesses**
• Vehicle manufacturing technology and experienced workforce in Iran • Experience of designing new engines with more fuel-efficiency in Iran • Relative development of CNG infrastructure in Iran • Supportive regulations for fuel-efficiency (Targeted Subsidy Reform Plan) in Iran • Current fuel-controlling system through fuel smart card in Iran • Support of local automakers by the Iranian government • Learning from the technological advantages of CO_2 reduction in the EU	• Weakness of the Iran's vehicle industry in meeting national fuel consumption regulations • Weak relation of Iran's vehicle industry to fuel conservation policy makers • Limited financial resources of Iran's vehicle industry • Driving old and over-consuming LDVs in Iran • Low fuel price in comparison with regional and European countries • Lack of a comprehensive fuel pricing mechanism • Weak fuel-efficiency of new local LDVs • Weak development of CNG stations across the whole country • Weak national regulations to reduce carbon in the transportation sector
Opportunities	**Threats**
• Availability of low-carbon vehicles technologies in the world (such as hybrid and electric vehicles) • Availability of technologies for fuel conservation in new vehicles (such as diesel and turbocharged vehicles) • Availability of new low-carbon fuels • Availability of huge hydrocarbon reserves in Iran (energy security) • Improvement of fuel quality produced in Iranian refineries • Learning from financial mechanisms in the EU • Monopole market for the local automakers • High tariffs for imported cars • Public awareness about fuels and low-carbon vehicles	• Limitations in fuel quality and fuel variety in Iran • Low cost-effectiveness of very low-carbon vehicles (such as hybrid and electric) • No reliable strategic foreign partners and investors to help Iranian automakers produce LCVs • Negative effect of sanctions and political situations • High energy intensity and increasing demand for energy in the segment • Inefficient fuel pricing mechanism in Iran • Fluctuation of the world oil price • Lack of CO_2 emissions reduction regulations in Iran • International CO_2 emissions regimes (post-Kyoto)

both local standards of air pollution and also export requirements of new vehicles.

Strategy Number Two: Clean Power Alternative Fuels

This is an aggressive strategy that uses internal strengths to take advantage of external opportunities.

Iran and the EU have the same reasons for approaching alternative fuels: environmental concern and energy security. Regarding huge natural gas reserves as a lower polluting fuel, Iran's vehicle industry switched from LPG to CNG. The IFCO reports that over 1.7 million bi-fuelled LDVs (CNG and gasoline) were registered in Iran by 2011 (IFCO, 2013). Owing to the International Association for Natural Gas Vehicles, 2,268 natural gas refuelling stations were established in the country by 2015 (The International Association for Natural Gas Vehicles, 2014).

The share of bi-fuel (gasoline and CNG) locally produced passenger vehicles should have reached 30% of total local car production, according to the Fourth FYDP (2005-2009). The target was hit by 24% in 2011, despite governmental support from the vehicle industry. It should be emphasized that the CNG passenger car fleet has played a key role in Iran's energy security in the sector.

Strategy Number Three: Improving Fuel Quality Used for the LDVs Fleet

This is a WO strategy that aims at improving internal weaknesses by taking advantage of external opportunities (competitive strategy).

Fuel quality, along with the technology of internal combustion engines (ICE) and emission-reducing parts, is the most significant factor in emissions reduction in the vehicles. Related regulations and standards ensure that air quality emissions from vehicles will be significantly reduced.

Any programme for improving fuel efficiency might be failed without proper fuel quality. It should be noted that preparing light fuel is necessary for diesel LDVs penetration policy in Iran.

Strategy Number Four: Rationalizing Fuel Price Policy for LDVs

This strategy is a defensive strategy where the system uses defensive tactics for reducing internal weaknesses and avoiding external threats.

Fuel pricing mechanisms are completely different in Iran and the EU. Iran's economy has suffered from energy subsidizing for a long time. However, energy prices in Europe have usually been calculated following market mechanisms and fuel taxes usually account for over half of the retail price in the EU (Proost, 2008; IEA, 2013, 2015). It should be added that developing biofuel production in the EU has the support of direct and indirect subsidies.

Removing subsidies is very complicated in Iran because of the close relation of the inflation rate and fuel (especially gasoline) prices. Iranian people look at gasoline prices as an index of public expenses, so increasing fuel prices have psychological effects on the society. Approaching this policy has led to high energy intensity and weak energy efficiency in all sectors such as transportation. Increasing prices by removing subsidies in the short-term has caused serious social and political issues. Hence, the government has to use more conservative fuel policies in the long-term.

Strategy Number Five: Developing a National Fuel Economy Policy

This strategy appears in the WT quadrant, like strategy number four.

As noted before, Iran's economy is highly energy intensive. It is expected that the number of passenger vehicles to grow depending on economic growth and Iran's population. Thus, LDVs' fuel demand will increase accordingly. As Iran's vehicle industry benefits from a monopole and isolated local market, in a highly subsidized fuel price atmosphere and also in a growing market, neither consumers nor producers do not prioritize fuel conservation.

Iran's transportation sector suffers from the lack of a national strategy for fuel consumption reduction. That comprehensive strategy should cover the required policies for all the players of three sides of vehicle industry, consumers and fuel supply side.

Conclusion

The high potential of energy efficiency in Iran needs great support from all the players from government to people. Iranian policymakers can benchmark some lessons from their European counterparts. Given that implemented strategies in Iran can confront with specific limitations, individual solutions should be conducted (Table 7).

Effective and consonant function of related policies in three sectors of vehicle industry technologies, fuel supply and finance can ensure policymakers that low carbon strategies are successful in Iran. European experience implies with the simultaneous favour to both environmental issues and sustainable energy supply for transportation sector. Implementing low carbon policies in Iran's transportation sector requires attracting public trust more than anything else. This needs increasing public awareness to strategic and long term social, ecological and economic benefits against the policies' costs. Previous experiences show strong potential of social tensions after starting Subsidies Reform Plan programmes. While, social resilience can be controlled

Table 7: Limitations for deploying carbon reduction strategies in Iran's light duty vehicles fleet

	Limitation	*Description*	*Solution*
Strategy No. 1	High expenditures for investment	Costly investment for technology transfer and producing LCVs	Improving subsidies mechanisms (shift from fuel to producing LCVs)
Strategy No. 2	Weak infrastructures	Costly capital investment	• Long term loans • Supporting private sector
Strategy No. 3	Improving quality against cost-effectiveness of fuels' final price	Improving fuel quality requires technology transfer and investing in old refineries	• Rationalizing fuel price • Increasing public awareness • FDIs to improve local refineries
Strategy No. 4	Social and economic consequences	• Inflation • Political resistance	• Communication • Increasing public awareness • Strong political support
Strategy No. 5	Public likely oppose	• Inflation • Economic concerns	• Communication • Increasing public awareness • Strong political support

more smoothly through close communication with public in one side and contributing people in policy making cycle on the other.

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