Climate Change and Environment in the Arab World

Sustainable Transport Series

Sustainable Transportation in the Arab World:
International Benchmarking on Sustainable Transport Policies and their Impacts

Isam Kaysi and Farid B. Chaaban

Climate Change and Environment in the Arab World

Sustainable Transportation in the Arab World:
International Benchmarking on Sustainable Transport Policies and their Impacts

The Climate Change and Environment in the Arab World Program aims to understand the climate change and environment policy process in the region and define the most appropriate policy recommendations by linking development in applied sciences on issues related to climate change and environment to social sciences.

Nadim Farajalla   *Faculty Research Director*
Rana El Hajj   *Program Coordinator*
Patricia Haydamous   *Program Research Assistant*

Isam Kaysi[a] and Farid B. Chaaban[b]

a. Isam Kaysi, Department of Civil and Environmental Engineering, Faculty of Engineering and Architecture, American University of Beirut, isam@aub.edu.lb

b. Farid B. Chaaban, Department of Electrical and Computer Engineering, Faculty of Engineering and Architecture, American University of Beirut, fbchaban@aub.edu.lb

Contents

Abstract

The world's transport sector still suffers from unsustainable trends that lead to increased levels of greenhouse gas (GHG) emissions. There have been efforts, in the Arab world, as well as the rest of the world, to tackle the issue. Work done in the US and Europe exceeds that of the Arab world, and their efforts have been successful, and have thus succeeded in reducing GHG emissions. In the Arab world, most efforts at reducing GHG emissions target fuel standards, vehicle inspection, and public transit. The implementation of fuel standards and vehicle inspection measures can be found in most Arab nations. The implementation of formal, mass transport systems can only be found in some Arab nations such as Egypt, Algeria, Tunisia, and the United Arab Emiriates. The implementation of these measures have not been very successful in many countries, mainly due to the lack of proper enforcement, lack of funding, and a lack of technical expertise. In the US and Europe, a wide range of sustainable transport policies have been implemented, and they include: Fuel efficiency, alternative fuels, speed control, public transit, strict fuel taxes, pricing incentives and disincentives, ridesharing, and effective land use planning. The success of these policies can be attributed to: an effective mix of policies, effective enforcement, public acceptance, and political support. Based on the literature review conducted on the sustainable transport policies in the Arab world and in the US and Europe, and after analyzing any impediments and success factors of those policies, a recommendation on which policies that should be implemented in the Arab world was presented. The recommendations are classified into short, medium and long-term strategies, and they mainly include: Imposing stricter fuel and vehicles standards, effective enforcement, imposing fuel taxes, effective land use planning, and offering reliable alternative modes of transport. Sustainable transport policies must be implemented at a larger scale to tackle the worldwide increase in GHG emissions. Efforts in the US and Europe are well underway, while those in the Arab world have been very limited. There is much work to be done in order to reach a sustainable transport system in the Arab world, but the recommendations presented offer basic guidelines on how to proceed with any sustainable transportation initiative.

1. Introduction

The transport sector is globally responsible for 90% of urban air pollution, the death of nearly 800,000 people and the emission of 14% of the world's greenhouse gases each year (World Bank, 2013). There are unsustainable transportation practices around the world, and despite current efforts that aim at shifting to more sustainable methods of transport, more should be done.

Several different sustainable transportation policies have been suggested and implemented in the US and Europe, and have succeeded in achieving better overall standards of living for their people with reduced environmental impact. Fuel consumption by vehicles can be reduced in one of two ways, either by reducing the distance traveled by vehicles and/or the duration of the trips, especially in high-traffic urbanized regions, or by improving the fuel economy of vehicles (Jacobson & King, 2009). Moreover, there are several strategies involved in providing sustainable transport, and they mainly fall into one of the following categories: vehicle/fuel technological changes, road/vehicle operations improvements, and demand management (Deakin, 2001). Countries have focused on some categories more than others, with Europe, for example, favoring higher fuel taxes on gasoline, and the US persisting on increasing vehicle fuel efficiency (Knittel, 2012).

This report first presents a literature review of the main sustainable transport policies in the Arab world along with an analysis of the impediments to their success. Second, a literature review of the sustainable transport policies implemented in Europe and the US is presented in addition to an analysis of their success factors. Finally, based on the analysis of the impediments and success factors of sustainable transport policies in the Arab world, Europe and the US, a recommendation is presented on how transport policies should be implemented in the Arab world.

2. Sustainable Transportation in the Arab World

The Arab world has been suffering from rapid sprawling in major cities, aging vehicle fleet, poor car maintenance, poor urban planning, and a lack of efficient and adequate public transport systems (Chaaban & Kaysi, 2011). These trends and practices have contributed to unsustainable forms of transportation, and despite efforts that have been made at establishing policies and measures that aim at providing sustainable transport systems, a considerable change is still needed (AFED, 2009).

Table 1 shows the contribution of the transport sector in different countries of the Arab world to overall CO2 emissions; it is concluded that the transport sector in the region as a whole contributes around 23% of CO2 emissions (Bedrous, 2013).

Table 1: CO$_2$ Emissions from Fossil Fuel Consumption in the Arab World in 2010 (Bedrous, 2013)

Country	CO$_2$ emissions from the combustion of all types of fuel [106 tons]	CO$_2$ emissions from the transport sector [106 tons]	% CO$_2$ emissions from transport sector
Algeria	98.6	33.3	34
Egypt	177.6	38.4	22
Libya	51.6	12.1	23
Morocco	46.0	10.6	23
Sudan	13.7	6.8	50
Tunisia	21.9	6.0	27
Bahrain	23.6	3.6	15
Iraq	104.5	29.7	28
Jordan	18.6	5.2	28
Kuwait	87.4	11.7	13
Lebanon	18.6	5.0	27
Oman	40.3	6.3	16
Qatar	64.9	9.2	14
KSA	446.0	104.4	23
Syria	57.8	12.2	21
UAE	154.0	25.7	17
Yemen	21.7	6.2	29
Total	1446.8	326.4	23 (avg)

In order to mitigate the increased GHG emissions in the Arab region, a series of measures and changes in transport policies that aim at limiting the transport sector's CO$_2$ emissions must be pursued. Policies must be structured and implemented at the level of each country, rather than the regional level, due to the difference in financial capabilities between the Arab countries (ESCWA, 2009).

Sustainable Transport Policies in the Arab World

As previously mentioned in the introduction to this paper, most sustainable transportation strategies fall into one of three categories: vehicle/fuel technology changes, road/vehicle operations improvements and demand management. In the following sections, policies implemented in the Arab world will be described as they fall into one of the three aforementioned categories.

Vehicle/Fuel Technology Changes

Fuel Standards

The diesel sulfur content requirements for selected Arab countries as well as for the US and the EU are found in Table 2. It is evident from these figures that several countries still allow high sulfur diesel in their fleets, while others have plans to reduce content.

Table 2: Diesel Fuel Content Standards (UNEP, 2012), (EPA, 2012), (EC, 2012)

Country	Current Diesel Sulfur Content (ppm)	Future plans
Algeria (2014)	900	Planning to reach 50 ppm by 2014
Bahrain	500	Up to 10 ppm for export demand and the local available is 500 ppm
Egypt	10 – 10,000	No plans
Iraq	10,000	No plans
Jordan	7,000 – 10,000	Standard 14596 set the sulfur level to 350 ppm and planning to reach 50 ppm by expanding the refinery
Kuwait	2,000	Imported 50 ppm load in March 2009 and announced fuel project to reduce sulfur to 10 ppm
Lebanon	500	
Libya	1,000	Their standards are 1,500 and no date is set for changes
Oman	50	Installed a diesel – hydro – sulphurization unit as well as applying ISO-14001:2004 standards in order to reduce sulfur content from fuel.
Morocco	50	Effective January 2009
Qatar	500	Planning to reach 10 ppm
Saudi Arabia	500	Planning to reach 50 ppm by 2020
Syria	7000	
Tunisia	50	Effective 2009
UAE	500	50 ppm plan announced and started in Dubai by Euro 4 buses being introduced
Yemen	10,000	No standards. Planning to build new refineries and updating existing ones
USA	15(on 2007 and later model year cars)	
EU	10	

Alternative Fuels

The use of alternative fuels can reduce CO emissions by around 70% compared to normal fuel powered vehicles, but even though the Arab region has huge natural gas reserves, its use in transportation is limited (ESCWA, 2009). Nevertheless, there have been implementations of policies that encourage the use of compressed natural gas (CNG), most notably in Egypt. Through the development of CNG infrastructure and by providing incentives to promote switching to natural gas such as lowering natural gas prices and tax reduction on CNG components, the Egyptian government has succeeded in increasing CNG vehicles in the country (ESCWA, 2013). As shown in Table 3, the number of CNG vehicles in Egypt greatly exceeds those in other Arab nations, with Egypt also ranking 11th worldwide in terms of CNG vehicle usage (ESCWA, 2013).

Table 3: Total Natural Gas Vehicles and Stations Statistics per Country (Álamo, 2013)

Country	Total CNG Vehicles	CNG stations
Algeria	125	3
Egypt	193,555	166
Tunisia	34	1
UAE	2,801	17

Demand Management

Transit

Public transit is the leading transport mode in some cities within the Arab world, despite its decreasing dominance over the past few years (El-Geneidy, Diab, Jacques, & Mathez, 2013). Public transport modes in the Arab world can be split into formal (metros, buses, rail and minibuses) and informal (shared taxis).

One of the most prominent railway systems in the Arab world is in Egypt. The railway network includes around 9,500 km of rail nationwide and around 3,500 coaches serve about 1.4 million passengers daily (ENR, 2012). In Cairo, the metro system comprises three main lines with a fourth line under development. In addition, a public bus service is operational in the major metropolitan regions; however, the service suffers from a lack of funding, which results in aging bus fleets and overcrowded buses. This has prompted an increase in informal public transit usage, such as shared taxis, in the country (El-Geneidy, Diab, Jacques, & Mathez, 2013).

Another Arab country with a railway system is Algeria. In Algeria, there are currently over 4,000 km of rail lines, with 234 trains transporting around 31.4 million passengers in 2012. The rail system serves the capital city of Algiers, its suburbs, and other cities within the country. There has been a noticeable growth in the suburban areas of Algiers, with an increase of 17% in ridership since the operation of around 100 modernized electric trains (SNTF, 2013).

Furthermore, Tunisia has a 2,100 km railway network in addition to a 6-line, 42 km light metro network that is one of the oldest in the Arab world (SNCFT, 2007). In addition, 219 bus lines covering around 6,500 km further support the public transport system (Transtu, 2014). However, both systems have suffered recently. The metro system has suffered from saturation levels being reached and a lack of metropolitan coverage, while bus ridership has declined significantly which could be due to lack of comfort or inaccurate scheduling (El-Geneidy, Diab, Jacques, & Mathez, 2013).

The implementation of new mass transit systems in the Arab world has been slow, with only a few nations contributing to the provision of safe and efficient public transportation systems. One of the recent successful public transit implementations has been in the UAE, and particularly in Dubai. The Dubai metro system, launched in 2009, has witnessed increasing ridership, with a 21% increase between 2012 and 2013 (RTA, 2013). In addition, the city of Riyadh is planning to construct a 6-line 170 km metro system by 2018 (Riyadh Metro, 2013).

Despite the aforementioned networks being operational and serving a large number of commuters, the rise of informal public transit shows that the networks are not offering sufficient service. This could be attributed to a lack of reliability and low comfort levels due to overcrowding (El-Geneidy, Diab, Jacques, & Mathez, 2013).

Pricing Incentives

In the Arab world, there has been limited implementation of financial and non-financial incentives that could enforce certain policies and encourage a shift in behavior. For instance, in 2012 the Jordanian government reduced taxes on small-engine hybrid cars from 55% to 25%. Furthermore, an additional 12.5% tax reduction was given to Jordanians with cars older than ten model years to encourage them to shift to newer and cleaner vehicles. This tax incentive encouraged over 1,400 Jordanians to replace vehicles older than ten model years (Al-Rawashdah, 2013).

Inspection and Import Regulations

In Arab countries, the use of old and inefficient cars is contributing to high fuel consumption and high GHG emissions. As shown in Table 4, many countries set some import regulations as well as inspection programs (UNEP , 2008).

Table 4: Adopted Vehicles Import and Inspection Programs

Country	Import regulations	Inspection program
Jordan	Banned the import of cars older than five years	Roadworthiness inspection
Algeria	Banned the import of vehicles older than three years	Roadworthiness inspection
Egypt	Banned the import of vehicles older than three years. The imported vehicles must have a catalytic converter	- Vehicle inspection - Emission testing - I/M for public buses.
Kuwait	Banned the import of vehicles older than five years	Cars older than three years must have an annual Roadworthiness inspection.
Lebanon	Banned the import of vehicles older than eight years	-Roadworthiness inspection for vehicles older than two years. - Annual exemption for petrol vehicles. - I/M for diesel vehicles every six months
Morocco		Vehicle emission inspection
Qatar	Banned the import of vehicles older than five years	Regular Roadworthiness inspection
Saudi Arabia	Banned the import of vehicles manufactured before 1974 Prohibited the import of vehicles and light trucks more than five years old. Banned the import of reassembled, remanufactured and previously used motor parts. [23]	Roadworthiness inspection
Syria	Banned the import of vehicles older than two years	Vehicle testing program
Tunisia	Banned the import of vehicles older than three years	Vehicle emission testing program
UAE		Vehicle inspection program
Yemen	Banned the import of vehicles older than five years	

Challenging Factors in the Arab World

There has been significant growth in the number of private vehicles in the Arab world, with an estimated annual increase of 4.2% between 1997 and 2008, compared to the 2.8% estimated for developing countries (ESCWA, 2009). In the absence of a mix of effective policies that can shift current practices from being mostly unsustainable to being more sustainable, that figure is likely to increase in the future. Despite efforts mentioned in the above sections that aim at encouraging sustainable modes of transport, there are still many challenges that hinder the implementation of sustainable transport policies.

One of the main contributors to the lack of significant progress towards providing sustainable transport policies in the Arab world, as well as the infrastructure to support such policies is the lack of funding. Many Arab countries prioritize other projects over transportation, and thus, allocate funds accordingly. In addition, lack of integration of plans and policies, such as the integration of public transit into urban planning, is another contributing factor to unsustainable transport (ESCWA, 2009).

In the Arab world, there is a lack of technical expertise on new technologies that would allow the production of cleaner fuel, the upgrade of fuel specifications and the enhancement of transport systems. Moreover, the lack of data also makes the implementation of efficient sustainable transport policies difficult. The implementation of policies that would gain acceptance among stakeholders heavily depends on effective communication among all concerned parties. Currently, there is a lack of such effective communication, which also contributes to the lack of awareness among people in the Arab world on sustainable transportation and its benefits (ESCWA, 2009).

3. Sustainable Transportation in the United States and Europe

Sustainable transport policies have been more commonly implemented in the US and Europe than in the Arab world. Some policies have witnessed success while others have not. In this section, sustainable transport policies that have been implemented in the US and Europe will be detailed, along with their success factors.

Sustainable Transport Policies in the US and Europe

Sustainable transport policies in the US and Europe will be discussed, similar to the previous section, as they fall into one of the three categories: Vehicle/fuel technology changes, road/vehicle operations improvements, and demand management. A summary of the below policies can also be found in Table 6 in the Appendix.

Vehicle/Fuel Technology Changes

Fuel Efficiency

One of the policies that are implemented in the United States is related to car manufacturers. The Corporate Average Fuel Economy Standards (CAFE) requires car manufacturers to comply with the DOT (Department of Transport) standards for fuel mileage, and has recently witnessed more aggressive standards being announced by the US government in 2009. These standards, which came into effect starting 2011, aim at increasing the fuel economy of vehicles from the 11.6 km/l (kilometers per liter) to 14.5 km/l in 2016. This increase in fuel economy is expected to reduce the fuel consumption by 21% in 2030 (EPA, 2010). In addition, it is estimated that the lifetime benefits of the CAFE standards will be $182 billion, including fuel savings.

Similar to the US, the European Union (EU) also imposes fuel efficiency standards on car manufacturers that aim at reducing greenhouse gas emissions. In 2009, the European Council set a target of 130g of CO_2/km to be emitted by 2015 and 95g of CO_2/km in 2020 (EC, 2014). The EU has set a target of a 20% reduction in CO_2 on 1990 levels by 2020 (Gainsborough, 2012). The CO_2 emissions from the new EU car fleet were estimated to be 132.2 g/km in 2012, meaning that the EU is well on course for achieving its intended target with this number representing a 17% reduction since 2007 (EC, 2013).

Alternative Fuels

There have been policies that aim at increasing the use of cleaner fuels in both the US and Europe. The United States Environmental Protection Agency (EPA) has set standards for use of renewable fuel in 2014, where the Agency estimates that 10% of all fuel would be from renewable sources (EPA, 2013). Some of the tax incentives that are offered in order to encourage the uptake and use of alternative fuel and alternative fuel vehicles are described in Table 8 in the Appendix (DOE, 2013). In 2010, the number of alternative fuel vehicles in use was estimated to be around 950,000 compared to around 600,000 in 2005 (DOE, 2013). This increase can be attributed to the tax incentives as well as several laws that mainly encourage the use of alternative fuels, such as the CAFE standards (DOE, 2013).

The effect of the introduction of electric vehicles (EV), and other low emission vehicles, can only be realized if a considerable percentage of the vehicle fleet is replaced with such low emission vehicles. It is estimated that if the vehicle fleet composition in 2020 has 5% of low emission vehicles, and 35% in 2040, the reduction in greenhouse gas emissions would be negligible in 2020, but would amount to 30% in 2040 (Deakin, 2001).

The California State Senate has set a target of 1.5 million EVs in 2025, and in order to achieve that goal, several pieces of legislation have been passed in 2013 that aim at encouraging the use of such vehicles. The incentives include: equipping all new homes with EV charging outlets, allowing drivers to pay by credit card at charging stations, since previously only subscribed members could use charging stations, allowing EVs to use the High Occupancy Vehicles (HOV) lanes regardless of how many passengers are in the car, providing around $2,500 to vehicle owners who convert from high polluting vehicles to EVs, and providing between $1,000 and $1,500 to vehicle owners who retire their high polluting vehicles (Corbett, 2013).

Road/Vehicle Operations Improvements

The second sustainable transport policy category is associated with road and vehicle operations improvements. This category deals with conventional traffic flow improvements such as traffic signal timing, ramp metering, flow metering, and bottleneck removal which could cut energy use, reduce greenhouse gas emissions, and lower noise levels by altering traffic flow characteristics and reducing stop-and-go driving. Furthermore, educating drivers on the negative effects of heavy accelerations and decelerations and the fuel consumption associated with high speeds could also have an effect on reducing GHG emissions (Deakin, 2001). The city of Rotterdam in the Netherlands implemented stricter vehicle speed limits with the aim to reduce the poor air quality levels and health concerns along a 3.5 km stretch of a motorway (EEA, 2008). The speed limit was reduced from 120 kph to 80 kph, which resulted in a 15% decrease in CO_2 emissions along the motorway (Kroon, 2005).

In addition, GHG emissions could be reduced through the provision of HOV lanes that are restricted to vehicles carrying three or more passengers only. The lanes are set up in order to reduce traffic volumes, vehicle miles traveled and vehicle trips, which would result in lower emissions overall. It is estimated that the HOV lanes do have a positive effect on the environment; however, their effect is greater when considering their effect on a corridor rather than the entire system, which would only result in a 1% decrease in emissions (EPA, 1992). However, there is a lack of consensus on the real benefits of HOV lanes. It is indicated that HOV lanes may cause induced traffic, which will ultimately put more cars on the road, or shift cars from other routes onto one with an HOV lane, and this could offset the potential benefits of the HOV lane (Shewmake, 2012). In addition, there has been some concern of underused HOV lanes, and a shift of travelers from public transit to vehicular usage on such lanes, which could also harm the benefits of HOV lanes (Small, Winston, & Yan, 2006). Moreover, the positive effects of HOV lanes on the environment can also be offset if the distance traveled in order to pick up and drop off extra passengers for carpooling is significant, and could increase emissions rather than decrease them (Konishi & Mun, 2010).

Demand Management

The final category of sustainable transportation is demand management, and it includes policies that aim at encouraging public transit, imposing fuel taxes, offering pricing incentives and disincentives, offering better pedestrian and biking facilities, encouraging ridesharing and focusing on coordinating land use.

Transit

The US has focused on public transportation as a measure to reduce greenhouse gas emissions. The public transportation sector has decreased the emissions of greenhouse gas emissions due to the provision of a low emissions alternative to driving, the facilitation of compact land use that reduces the need to travel long distances, and the minimization of the carbon footprint of transit operations and construction (FTA, 2009). Heavy rail transit, subways and metros, produce around 75% less greenhouse gas emissions per passenger mile than an average single occupancy vehicle, while light rail systems produce 57% less, with bus transit producing 32% less. The total reductions in greenhouse gas emissions resulting from public transport usage in the US have been estimated to be 30 MMtCO2 (million metric tons CO2) annually. The types of strategies used by transit agencies include: Expanding transit service, increasing vehicle passenger loads, reducing roadway congestion, promoting compact development, and alternative fuel and vehicle types (TCRP, 2010).

In the UK, the Department for Transport released a report in March 2013 indicating the importance of improving the door-to-door experience of sustainable transport modes in an aim to encourage more people to shift to more sustainable forms of transportation. In the report, four core areas are suggested to improve aspects along the entire route that one would take while using a sustainable form of transport, and they include: The accurate and easily accessible display of information concerning all the possible modes of transport that could be used to embark on a specific journey, offering affordable ticket prices for the entire journey, providing easy and comfortable connections between the different modes of transport along the entire journey, and finally offering safe and comfortable transport facilities (DfT, 2013).

Fuel Tax

Taxing gasoline and diesel is viewed as one of the most effective policies aimed at decreasing fuel consumption from the transportation (Sterner, 2010). The US has been lagging behind European nations in terms of exploiting the benefits of such a policy. The tax imposed on gasoline in the US is around 15 dollar cents per gallon, compared to an average of 119 dollar cents per gallon in Europe, which has encouraged a shift to the use of diesel engines. It is difficult to measure the effect of fuel taxes alone on emissions; however, had the Organisation for Economic Cooperation and Development (OECD) nations adopted the same fuel tax prices as the US, they would have realized a 30% increase in fuel consumption, which would have led to an increase of 25 billion tons of CO_2 over ten years (Sterner, 2010).

Pricing Disincentives

Similar to fuel tax, there are other policies implemented by governments and governmental agencies that aim at reducing unsustainable forms of transport through increasing the cost of such methods of transport. One example of that is London's congestion pricing scheme. In early 2003, London implemented a congestion pricing strategy in an attempt to decrease congestion inside the capital city. Cameras are placed at entrances, exits and around the priced zone in order to capture vehicles' license plates to indicate which drivers paid the £10 daily fee. Payment can be made in advance, before midnight on the same day, or, at a fee, before midnight the next day, and the zone is charged on weekdays between 7 am and 6 pm (TfL, 2013). In 2006, the congestion levels were estimated to be 26% lower than in 2002, inside the charging zone. Public transit usage also increased, with a 37% increase in the number of passengers entering the charging zone by bus, and, as mentioned before, with buses and metro emitting 32% and 75% less emissions per passenger mile respectively than private vehicles. This increase has had considerable environmental benefits. In addition, the strategy raised net revenues of £122 million in 2006/2007, which are spent on transport improvements in London, mainly on improved bus services (EEA, 2008).

In Germany, the cost of owning and operating a car is expensive, and that is mainly due to high taxes, such as sales tax, and high registration fees. In addition, the cost of car usage is also affected by the cost of a driver's license, where it costs around $2,200 to get a driver's license in Germany, compared to around $100 in the United States. The high cost of car usage helped the German government gather substantial fees in order to fund other governmental projects (Buehler, Pucher, & Kunert, 2009).

Pricing Incentives

Governments in the US and Europe have resorted to providing financial incentives to reduce GHG emissions. Incentives are mainly aimed at increasing usage of cleaner fuel and "cleaner" vehicles. In the US, the government has encouraged customers to purchase EVs and hybrids, offering tax credits up to $7,500 (DOE, 2013). Several member states of the EU have established financial incentives to encourage the purchase of EVs and plug-in hybrids. Such incentives can reach up to around $8,000 in the UK (DfT, 2010).

Moreover, in order to encourage the purchase of new, better fuel-economy vehicles, "Cash for Clunkers" or "Fleet Modernization" programs provide incentives for vehicle owners to trade in poor fuel-economy vehicles for better ones. Germany has a Cash-for-Clunkers program that provides around $3,500 to consumers who trade in vehicles that are at least nine years old (Morrow, Gallagher, Collantes, & Lee, 2010). In addition, the US implemented the Car Allowance Rebate System (CARS) that aimed at providing monetary incentives, which reached $4,000, to people in the US to purchase fuel-efficient vehicles when trading in less efficient ones. The NHTSA reports that the average mileage per gallon of the purchased vehicles under the program was 24.9, compared to 15.8 miles per gallon of the traded-in vehicles. The program, however, resulted in negligible benefits to the environment, mainly due to the fact that the vehicles purchased under the CARS program constituted a small percentage of the overall US car fleet (Li, Linn, & Spiller, 2013).

Stockholm has realized record sales of EVs and plug-in hybrids in 2008 as a consequence to the several policy measures that were introduced. According to a study from the Stockholm Environment and Health Administration, after applying the exemption from congestion charges policy, the sales of clean cars increased by 23% in Stockholm County in 2008. The study also shows that lower clean fuel prices and a national purchase rebate have had some effect on the sales, while free parking incentives had very little influence (BEST, 2009).

Ridesharing

An additional strategy that could reduce vehicle miles traveled, and ultimately decreases fuel consumption, is ridesharing. According to the EPA, several incentives can be given by employers to their employees that would encourage them to carpool to work, such as providing preferred parking, reduced fare parking and rideshare matching programs (EPA, 2005).

In the UK, "smarter choices" policies have been implemented in some areas, and have yielded positive results; however, their implementation is not widespread. "Smarter choices" policies refer to several measures that are intended to reduce demand for car travel. One of the policies within the framework is car sharing, which is estimated to reduce peak traffic by 4% if there is a 10% take-up of the policy (Cairns, Sloman, Newson, Anable, Kirkbride, & Goodwin, 2004).

Walkability and Biking

The US Federal Highway Administration has also initiated the Bicycle and Pedestrian Program in order to promote bicycle and pedestrian transportation use, safety and accessibility. Coordinators are located in each state's Department of Transportation in order to promote an increase in non-motorized transportation (FHWA, 2013). In Oregon, for example, the 'Going to the River' project was initiated in 2005 and aims at reducing the GHG emissions in year 2035 through the provision of enhanced biking and pedestrian facilities. The project's impact is estimated to result in a 4.5% reduction in daily auto vehicle trips as well as a 1.8% reduction in daily GHG emissions in year 2035 (Smith & Ningsheng, 2012).

Land Use

In addition to the facilitation of compact land use mentioned in the provision of better public transit, there have been other initiatives that encourage better land use and are environmentally friendly. GHG emissions may be reduced through the provision of alternative modes of transport integrated into land use policies (Andrade, 2010). One specific case of such initiatives is found in the city of Curitiba in Brazil, where the world's first BRT (bus rapid transit) system was integrated into its land use policy. Curitiba's Master Plan emphasizes land use control that encourages the development of the highest population densities and retail growth along the city's main corridors (Andrade, 2010). Moreover, the Master Plan prohibits the construction of new commercial buildings in certain areas, prohibits banking, insurance and financial institutions to occupy the ground floors of buildings in certain areas and limits the availability of parking spaces (Andrade, 2010).

Analysis and Success Factors

The effects, and the expected effects, of the above policies are dependent on a variety of factors. Some policies have been successful in some countries but not in others. The success of sustainable transport policies depends on the mix of policies in effect, among other factors. One of the pioneering nations in successful implementation of sustainable transport policies is Germany. The country has witnessed a steady decrease in GHG emissions since the late 1990s, mainly due to the provision of a mix of transport policies that include: vehicle fuel economy improvements, biofuels tax exemption and quota systems, increased fuel taxes on conventional fuels, heavy duty vehicle road pricing, differentiated vehicle excise taxes linked to engine displacement and new vehicle labeling (ITF, 2009). In addition, the cost of attaining a driver's license in Germany is expensive, which also discourages the use of private vehicles. The combination of policy scenarios being implemented in Germany has helped decrease its GHG emissions. The high cost of owning a vehicle, whether because of high fuel taxes or high cost of owning a driver's license, has proven to be one of the most successful measures in reducing greenhouse gas emissions (Buehler, Pucher, & Kunert, 2009). Moreover, it must be noted that every policy implemented, will trigger the public's reaction, irrespective of whether the reaction is positive or negative. Despite policies resulting from political acceptability, it is public acceptability that is dominant and more effective, as in policies will take effect when there is sufficient public support (Banister, 2008).

The following subsections describe factors that have proven critical for the success of a number of sustainable transport initiatives and policies ranging from public transit to congestion pricing, fuel taxes and the use of HOV lanes. A summary of the below success factors can be found in Table 7 in the Appendix.

Public Transit

Public transit has also proven to be a successful GHG emission reduction strategy, with an estimated 30 MMtCO$_2$ (million metric tons CO$_2$) reduced as a result of public transit usage in the US. Several strategies can be attributed to this reduction, and they aim at increasing public transit usage, since fewer passengers would decrease the benefits of public transit. In order to increase transit usage, policy-makers try to make the overall public transit experience quick and easy to use through the implementation of smart travel cards. It is estimated that the introduction of the travel card in London in the 1980s increased the bus trips by 16% (Tochtermann, 2008). The main reason behind this increase is that such tickets can reduce boarding time and can reduce uncertainty about which ticket to buy. In addition, assessing the strategies being considered to increase transit usage in the US, it can be concluded that such policies aim at increasing transit ridership through offering easy, quick, and affordable access to transit modes in addition to enhancing vehicle technology.

Congestion Pricing

The London congestion pricing strategy is another example of a successful sustainable transport policy. The success of the strategy was based on several factors including public acceptance and consultation, implementation and operation, strong leadership and political engagement, research and monitoring, and awareness raising (EEA, 2008).

Public Acceptance and Consultation
Once announced, the scheme was viewed as controversial, and faced strong opposition. After consulting with the public, and amending the scheme, a revised version was implemented. This has yielded wider public acceptance and ensured a path towards successful implementation.

Implementation and Operation
The startup costs associated with such a scheme were extensive. However, significant revenue was generated; even though the actual revenues from charges have been much lower than expected, there have been much higher revenues from penalty charges issued. The high revenues have been a main success factor of the scheme.

Strong Leadership and Political Engagement

The implementation of such a project is dependent on public acceptance, which prompted the Mayor of London to work closely on the project in the period leading up to the implementation, whereby he set out a vision for London and the appropriate technical planning. This exhibition of strong leadership and political engagement proved to be a main feature in the success of the project.

Research and Monitoring

Extensive research was done in undertaking transport modeling exercises that allow for mitigation measures to be implemented where appropriate. Moreover, monitoring of traffic has helped shape future amendments to the scheme.

Awareness Raising

Much effort was made to raise awareness on the beneficial impacts of such a scheme, which has also prompted other cities in the UK to consider implementing a similar scheme.

Speed Control

The Rotterdam speed control initiative was successful in reducing the CO_2 emissions through several factors that include, similar to the London congestion pricing case, public acceptance, implementation and operation, and effective enforcement (EEA, 2008).

Ridesharing

Ridesharing policies have been implemented on a small scale, and have witnessed some success in the areas of implementation. In order for ridesharing to emerge as an attractive alternative to reduce fuel consumption, the distances that passengers should travel to pick up additional passengers must be relatively short, and this could be controlled through more effective land-use planning. In addition, ridesharing could be made more attractive through increasing parking fees and road toll costs, which could make ridesharing the most rational economic option for travelers (Jacobson & King, 2009).

Electric Vehicles

The use of EVs can have a positive impact on the atmosphere due to zero tailpipe emissions, which could reduce the GHG emissions upon the large-scale use of such vehicles. Policies that aim at increasing EVs uptake should address pricing incentives, number of charging stations and the source of energy used to power the EVs. Currently, most policies targeting EVs and alternative fuel vehicles are related to the provision of pricing incentives. However, in order to encourage the usage of such vehicles, more should be done in terms of providing ample charging stations, as explained in California's EV initiative. In addition, the energy used to power the EVs should be from non-GHG intensive sources, such as coal, oil or gas, in order to realize the true benefits of EVs as zero-tailpipe emitting vehicles (Singh & Strømman, 2013).

Fuel Efficiency

Raising the fuel efficiency of vehicles is one of the main policies considered by the US in order to reduce GHG emissions. In order to ensure compliance with the CAFE standards, a Gas Guzzler Tax is imposed on manufacturers of new vehicles that do not comply with fuel efficiency standards (EPA, 2013). While the benefits of such a policy are clear, it may lead to rebound effects that may alter the benefits of fuel-efficient vehicles. Fuel-efficient vehicles lower the cost of driving, and could encourage users to travel more and thus reduce the expected benefits of fuel efficiency standards. As a result, it is believed that other complementary policies are necessary, such as imposing fuel taxes, that could inhibit this rebound effect (Ajanovic & Haas, 2012). Therefore, the success of the US CAFE standards and the EU fuel efficiency standards could hinge on the implementation of other policies that discourage drivers to travel more, such as fuel taxes and the strict enforcement of the Gas Guzzler Tax.

HOV Lanes

The effectiveness of policies targeting the provision of HOV lanes depends on several factors. First, the number of users shifting from the congested general-purpose (GP) lanes should be significant in order to realize meaningful reductions in GHG emissions, and this could be realized by marketing HOV lane programs (Kwona & Varaiya, 2008). Second, it must be crucial to make sure that the shift from the GP lanes would not also cause a shift to less sustainable forms of transport, that is, a shift from public transit to private vehicles should be prevented. Moreover, since induced traffic is a main contributor to the lower benefits of HOV lanes, fuel tax policies and the conversion to High Occupancy Toll lanes could prevent a significant increase in induced traffic.

Land Use

The Curitiba land use and transportation integration has proven to be a successful model that shows the importance of land use policies in easing congestion and providing better quality of life. In Curitiba, such high density and pedestrian-oriented development along the main corridors generate a large number of commuters, which contributes to the success of the bus rapid transit (BRT) system. Moreover, the land use policy discourages auto-oriented centers and channels new retail growth in these corridors (Andrade, 2010). In addition, the city had realized that upon the completion of the transport facilities, the prices of the nearby houses would increase, leading to a density of high-income population in the nearby land without having to pay for transport and infrastructure costs. Therefore, the city of Curitiba purchased some of the nearby land in order to subsidize low-income housing upon completion of the projects, making jobs and housing accessible to everyone (Rabinovitch, 1996). All of the above strategies combined provide the basis of success for the land use policy in Curitiba.

Fuel Tax

Fuel taxation is an efficient and important policy to reduce fuel consumption (Sterner, 2010). High fuel taxes have proven to be effective, particularly in Europe, where fuel consumption from the transport sector is lower than that in the US. The success of the policy could be attributed to the provision of alternative, cheaper modes of transport, such as safe pedestrian and biking facilities and reliable public transit, as well as effective enforcement of the law. Moreover, the provision of adequate and affordable charging stations and financial incentives to purchase electric vehicles could make such transport modes cheaper. This is especially important in the US and other areas where private vehicle usage is believed to be a necessity, mainly due to the lack of public transport in many areas (Sterner, 2010).

4. Recommendations

The sections above mentioned sustainable transport policies implemented in the Arab world, Europe, and the US, as well as impediments and success factors. Based on the above, recommendations on the implementations of different policies in the Arab world will be presented below, and will be classified as short, medium, and long-term strategies.

Short-Term Strategies

a. Public Transport: The provision of public transport must be accompanied with accurate scheduling, affordable ticket prices, and smart cards that ease access to public transit facilities.

b. Fuel Tax: Taxing fuel provides several benefits, both to governments and to the environment. The money generated from fuel taxes could be used to fund other transport projects, and the increase in fuel prices could encourage a shift to cheaper and more sustainable forms of transport. In the short-term, an increase in fuel taxes could be imposed, and incentives offered to switch to cleaner modes of transport.

c. Ridesharing: Carpooling, or ridesharing, should be made more attractive to encourage commuters to shift from single occupancy vehicles into high occupancy vehicles. This could be done in the short-term through increasing parking and toll fees.

d. Speed Control: The implementation of speed control policies in the Arab world has been limited; however, its success internationally, particularly in Rotterdam, shows that it could reduce GHG emissions. Speed control should be implemented with strict speed limits and proper monitoring and enforcement that would ensure the penalization of non-compliant drivers.

Medium-Term Strategies

a. Fuel Efficiency: In the Arab world, there has been a lack of restriction on importers regarding vehicle fuel efficiency. Therefore, in the medium-term, fuel efficiency standards could be imposed, and in phases, increased to reach specified targets.

b. Fuel Standards: Standards specifying sulfur content in diesel are already in place in the Arab world; however, they are significantly lower than those of the US and Europe. Therefore, more stringent standards must be applied, and strict monitoring must be maintained to ensure compliance.

c. Pricing Incentives and Disincentives: There has been limited implementation of pricing disincentives among Arab nations, despite their success internationally. Such disincentives should be imposed; however, public acceptance, successful implementation and enforcement, and raising awareness on the details and benefits of such policies should be ensured.

Long-Term Strategies

a. Electric and Alternative Fuel Vehicles: The main success factors of policies encouraging an increase in the usage of such vehicles are the provision of financial incentives and proper charging stations. Therefore, in the absence of either of both of these success factors in the Arab world, work should be done to offer some form of financial incentives that would encourage users to shift to cleaner vehicles. In addition, the provision of adequate charging stations for EVs is also essential.

b. Rapid Transit: Efficient public transit infrastructures have been implemented in some Arab nations, and they have witnessed some success. In nations where an efficient public transit network is not available, work must be done to provide the necessary infrastructure for rapid transit with dedicated right of way.

c. Land Use: Policies that are related to land use depend on the specific towns or cities and the timing of implementation. However, there are some strategies that could be considered regardless of the location, and they include planning for transit-oriented development, restricting retail growth to the major transport corridors, and limiting parking spaces.

d. Ridesharing: As mentioned before, ridesharing must be made more attractive to ensure its success. In addition to the short-term strategies mentioned above, there are others that could be implemented in the long run. Such policies include imposing toll fees and effective land use planning that would reduce the required distance needed to pick up extra passengers.

Table 5 summarizes the recommended sustainable transport policies and measures mentioned earlier in this section.

Table 5. Recommendations for Sustainable Transport Policies in the Arab World

	US/Europe Intervention	Success Factors	Arab World Intervention	Challenges/ Impediments	Recommendations
Vehicle/Fuel Technology	**Fuel Standards**	• Stringent standards • Strict monitoring and penalties	Fuel Standards	• Failure to apply standards	Long-term strategy: Imposing strict policies to implement fuel standards for vehicle fleets
	Fuel Efficiency	• Gas Guzzler Tax • Fuel Tax	Fuel Efficiency	• Lack of regulations and policies	Medium-term strategy: Impose fuel efficiency standards on importers of vehicles in phases
	Electric and Alternative Fuel Vehicles	• Charging stations • Financial incentives	Electric and Alternative Fuel Vehicles	• Lack of incentives for widespread use of modern technology • Lack of infrastructure to support modern technologies	Long-term strategy: Provide financial incentives and adequate charging stations for EVs and alternative fuel vehicles
Road/Vehicle Operations Improvements	**Speed Control**	• Public acceptance and consultation • Implementation and operation • Effective enforcement			Short-term strategy: Impose strict speed limits with proper monitoring and enforcement through the use of cameras that capture the license plate numbers of non-compliant drivers
	Traffic Signal Timing	• Accurate traffic volume use			Short-term strategy: Reassess traffic volumes after certain periods of time to ensure accurate signal timing optimization
	HOV Lanes	• Awareness of the availability and eligibility of use of HOV lanes • Fuel tax to prevent induced traffic			Long-term strategy: Provision of HOV lanes with awareness on their availability and fuel tax policies to discourage induced traffic

Demand Management	**Public Transit**	• Exclusive right-of-way transit systems • Smart cards • Affordable tickets • Reliable scheduling	Public Transit	• Inaccurate demand projection • Unreliable public transit • Lack of policies and incentives to encourage shift from private vehicles	Short-term strategy: Accurate scheduling, affordable tickets, and smart cards Long-term strategy: Provision of public transit system
	Fuel Tax	• High fuel tax • Alternative, cheaper modes of transport • Incentives to switch to alternative fuel vehicles	Fuel Tax	• Unreliable public transport • No fuel tax in some Arab countries	Short-term strategy: Impose a high fuel tax and offer incentives to switch to "cleaner" modes of transport
	Pricing Incentives/ Disincentives	• Public acceptance and consultation • Strong leadership and political engagement • Research and monitoring • Awareness raising	Pricing Incentives	Limited funding	Medium-term strategy: Public acceptance and consultation, provision of financial incentives, strong leadership and political engagement, and awareness raising
			Inspection and Import Regulations	• No emission inspection • Failure to implement regulations • Lack of emission standards • Failure to implement emission control strategies	Short-term strategy: Impose import regulations and impose emissions standards Medium-term strategy: Apply emission control strategies
	Land Use	• Transit-oriented development • Retail growth on major corridors • Acquisition of nearby land • Provide limited parking spaces			Long-term strategy: Plan in order to provide transit-oriented development. Implement policies that require retail growth on major corridors and that limit parking spaces
	Ridesharing	• Effective land use planning • Road tolls • High parking fees			Short-term strategy: Increase parking and toll fees Long-term strategy: Impose toll fees and land use planning that will ensure people could carpool without traveling long distances to pick up passengers

5. Conclusion

Unsustainable transportation practices have been inflicting substantial damage to the earth and its inhabitants for years. With urban air pollution, which is mostly a result of transportation, and traffic injuries responsible for the deaths of around 2.5 million people a year, it is crucial that governments take a strong stance against unsustainable behavior that will cause further damage (WHO, 2011). Furthermore, transportation worldwide was responsible for 23% of the world's CO_2 emissions in 2008, and land transport contributed to the largest share with 16.5%. Under current "business as usual" scenarios, emissions are expected to rise further in absolute terms, highlighting the criticality of addressing unsustainable forms of transport (WHO, 2011).

The sustainable policies considered by governments in Europe and the US, show that there is concern among policy-makers, more so than those in the Arab world. The movement towards a more sustainable transportation system is taking shape, with certain policies being implemented and others yet to take effect. There have been implementations of some sustainable transportation policies in the US and Europe, as the ones listed above, and some of these policies have been successful; in 2011 it was measured that emissions from the EU nations decreased by 14.9% relative to 1990 levels (EC, 2014). Despite such success, efforts are still ongoing in order to further promote sustainable transportation, and further decrease GHG emissions from the transport sector.

It is important to learn from the experiences of the European and American governments and agencies in implementing sustainable transport policies to understand their success factors. There are several obstacles that would prevent the implementation of certain policies in the Arab world, including politics and funding, and policies should be carefully crafted to serve such countries. The implementation of sustainable transport policies can lead to better living standards for citizens, and could even lead to economic prosperity at the level of the entire nation.

6. Acknowledgment

7. Bibliography

Álamo, J. d. (2013). *NGVs and Refuelling Stations Worldwide.* Retrieved from http://www.ngvaeurope.eu/worldwide-ngv-statistics

AFED. (2009). *Arab Environment: Climate Change.* Beirut: Arab Forum for Environment and Development.

Ajanovic, A., & Haas, R. (2012). The role of efficiency improvements vs. price effects for modeling passenger car transport demand and energy demand—Lessons from European countries. *Energy Policy* , 36-46.

Al-Rawashdah, A. (2013, 04 23). *Jordanians Increasingly Turn to Hybrids.* Retrieved 02 21, 2014, from Al-Shorfa: http://al-shorfa.com/en_GB/articles/meii/features/2013/04/23/feature-02

Andrade, V. (2010). Integrating Urban Design, Land Use and Transport Policies to Contribute Towards Sustainable Development. *Nordic Journal of Architectural Research , 22*, 83-94.

Banister, D. (2008). The sustainable mobility paradigm. *Transport Policy* , 73-80.

BAR. (2013, 12). *California Smog Check Program Questions and Answers.* Retrieved 01 2014, from Bureau of Automotive Repair: www.smogcheck.ca.gov

Bedrous, M. A. (2013). *Energy Sector: Mitigation Options of Climate Change.* Retrieved from http://www.afedonline.org/report2013/ENGLISH/6-Eng.pdf

BEST. (2009, 05). *Incentives Promoting Clean Cars.* Retrieved 12 12, 2013, from Bioethanol for Sustainable Transport: http://www.best-europe.org/Pages/NewsLetterPage.aspx?id=554

Buehler, R., Pucher, J., & Kunert, U. (2009). *Making Transportation Sustainable: Insights from Germany.* The Brookings Institution Metropolitan Policy Program. Washington D.C.: Metropolitan Policy Program at Brookings.

Cairns, S., Sloman, L., Newson, C., Anable, J., Kirkbride, A., & Goodwin, P. (2004). *Smarter Choices – Changing the Way We Travel.* London: Department for Transport.

Cartolano, F. (2011). *Report on Incentives Scheme.* CIVITAS.

Chaaban, F., & Kaysi, I. (2011). *Green Economy: Sustainable Transition in a Changing Arab World.* Beirut: Arab Forum for Environment and Development (AFED).

Chapel, F. (2002, 10). *NGVs: Clean Transportation for a Livable World.* Retrieved from http://www.eltis.org/docs/studies/Egypt_Clean_Fuels_Initiative_200210080.pdf

Corbett. (2013). *SB-454 Public resources: electric vehicle charging stations.* California Secretary of State.

Deakin, E. (2001). *Sustainable Development and Sustainable Transportation: Strategies for Economic Prosperity, Environmental Quality, and Equity.* Berkeley: University of California at Berkeley Institute of Urban and Regional Development

DfT. (2013, 03). *Door to Door Strategy.* Retrieved Dec 2013, from UK Government: https://www.gov.uk/government/publications/door-to-door-strategy

DfT. (2010, 02 25). *Plug-in Car Grant.* Retrieved 12 10, 2013, from UK Department for Transport: https://www.gov.uk/government/publications/plug-in-car-grant

DfT. (2013). *Renewable Transport Fuel Obligation Draft Post-Implementation Review.* From Department for Transport: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266390/rtfo-consultation-document.pdf

DfT. (2011). *UK report on biofuels pursuant to Article 4 of Directive 2003/30/EC.*

DOE. (2013, 12). *Alternative Fuel Vehicles in Use.* Retrieved 2014, 01 from US DOE, Energy Efficiency and Renewable Energy: http://www.afdc.energy.gov/data/#10300

DOE. (2013,11). *Alternative Fuels Data Center*. Retrieved 2014, 01 from US DOE Energy Efficiency and Renewable Energy: http://www.afdc.energy.gov/laws/laws/US/incentive/3234

DOE. (2013). *Federeal Tax Credits for Electric Vehicles*. Washington D.C.: United States Department of Energy.

DoT. (2012). *Sustainability Performance*. Retrieved 02 02, 2014, from Abu Dhabi Department of Transport: http://dot.abudhabi.ae/en/info/Sustainability_Performance

EC. (2013, 04 30). *Climate Action*. Retrieved 12 10, 2013, from European Commission: http://ec.europa.eu/clima/news/articles/news_2013043002_en.htm

EC. (2014, 01). *EU Greenhouse Gas and Emissions Targets*. Retrieved 02 2014, from European Comission: http://ec.europa.eu/clima/policies/g-gas/index_en.htm

EC. (2012, 10 17). *Fuel Quality*. Retrieved 02 02, 2014, from European Commission: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0030:EN:NOT

EC. (2014, 01 30). *Reducing CO2 emissions from cars*. Retrieved 02 04, 2014, from European Comission: http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm

EEA. (2008). *Success stories within the road transport sector on reducing greenhouse gas emission and producing ancillary benefits*. European Environment Agency. Luxembourg: European Environment Agency.

EIA. (2013, 9-04). *Frequently Asked Questions*. Retrieved 2014, 10-01 from US Energy Information Administration: http://www.eia.gov/tools/faqs/faq.cfm?id=10&t=10

El-Geneidy, A., Diab, E., Jacques, C., & Mathez, A. (2013). *Sustainable Urban Mobility in the Middle East and North Africa*. Nairobi: UN HABITAT.

ENR. (2012). *Railway Network*. Retrieved 02 25, 2014, from Egyptian National Railways: https://enr.gov.eg/ticketing/public/login.jsf

EPA. (2005). *Carpool Incentive Programs: Implementing Commuter Benefits as One of the Nation's Best Workplaces for Commuters*. Cincinnati: US Environmental Protection Agency Office of Air and Radiation.

EPA. (2013). *EPA Proposes 2014 Renewable Fuel Standards, 2015 Biomass-Based Diesel Volume*. Washington D.C.: Environmental Protection Agency.

EPA. (2010). *Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards*. Washington DC.: US Environmental Protection Agency.

EPA. (2012, 12 23). *Fuel and Fuel Additives*. Retrieved 02 02, 2014, from United States Environmental Protection Agency: http://www.epa.gov/otaq/fuels/dieselfuels/index.htm

EPA. (1992, 03). *High Occupancy Vehicle Lanes*. Retrieved 12 2013, from Environmental Protection Agency: www.epa.gov/otaq/stateresources/policy/pag_transp.htm#tcm

EPA. (2013, 04-12). *Regulations and Standards*. Retrieved 2014, 29-01 from US Environmental Protection Agency: http://www.epa.gov/fueleconomy/regulations.htm

ESCWA. (2013). *Green Economy Initiatives Success Stories and Lessons Learned in the Arab World*. New York: Economic and Social Commission for Western Asia.

ESCWA. (2009). *Transport for Sustainable Development in the Arab Region: Measures, Progress Achieved, Challenges and Policy Framework*. New York: Economic and Social Commmission for Western Asia.

FTA. (2009). *Public Transportation's Role in Responding to Climate Change* .

Gainsborough, M. (2012). Pathways to Sustainable Road Transport: A Mosaic of Solutions. In S. D. Oliver Inderwildi, *Energy, Transport, & the Environment Addressing the Sustainable Mobility Paradigm* (pp. 167-179). London: Springer London.

Gelil, I. A. (2009). *GHG Emissions: Mitigation Efforts in the Arab Countries.* Retrieved from http://www.afedonline.org/afedreport09/english/Char2.pdf

GFEI. (2012). *Cleaner More Efficient Vehicles.* Retrieved 2014, from United Nations Environment Program: http://www.unep.org/transport/gfei/autotool/understanding_the_problem/About_Fuel_Economy.asp

ITF. (2009). *Reducing Transport GHG Emissions Opportunities and Costs.* Paris: International Transport Forum.

Jacobson, S., & King, D. (2009). Fuel saving and ridesharing in the US: Motivations, limitations, and opportunities. *Transportation Research Part D: Transport and Environment*, 14-21.

Kaysi, I. (2011). *Arab Environment Green Economy: Sustainable Transition in a Changing Arab World.* Retrieved from Transportation: http://afedonline.org/Report2011/PDF/En/preface.pdf

Knittel, C. (2012). *Reducing Petroleum Consumption from Transportation.* Boston: MIT Center for Energy and Environmental Policy Research.

Konishi, H., & Mun, S.-i. (2010). Carpooling and Congestion Pricing: HOV and HOT lanes. *Regional Science and Urban Economics , 40* (4), 173-186.

Kroon, M. (2005). *Rotterdam Speed Control Zone.* Retrieved from Dutch Ministry of Environment: http://www.airquality.co.uk/archive/reports/cat09/0505171129_Rotterdam_speed_control_zone_Detailed_Assessment.doc.

Kwona, J., & Varaiya, P. (2008). Effectiveness of California's High Occupancy Vehicle (HOV) system. *Transportation Research Part C: Emerging Technologies , 16* (1), 98-115.

Li, S., Linn, J., & Spiller, E. (2013). Evaluating "Cash-for-Clunkers": Program effects on auto sales and the environment. *Journal of Environmental Economics and Management , 65* (2), 175-193.

Morrow, W. R., Gallagher, K. S., Collantes, G., & Lee, H. (2010). Analysis of policies to reduce oil consumption and greenhouse-gas emissions from the US transportation sector. *Energy Policy*, 1305-1320.

NHTSA. (2011). *National Highway Traffic Safety Administration NHTSA and EPA Establish New National Program to Improve Fuel Economy and Reduce Greenhouse Gas Emissions for Passenger Cars and Light Trucks.* Washington D.C.: National Highway Traffic Safety Administration.

Rabinovitch, J. (1996). Innovative Land Use and Public Transport Policy. *Land Use Policy , 13* (1), 51-67.

Riyadh Metro. (2013). *About Riyadh Metro.* Retrieved 02 25, 2014, from Riyadh Metro: http://riyadhmetro.com/about

RTA. (2013). *Statistics Center.* Retrieved 2014, from Dubai Road and Transport Authority: http://www.rta.ae/wpsv5/links/Design/esearch.html?cx=016717179209839831092%3A_jnvsjx-bgs&cof=FORID%3A10&ie=UTF-8&q=statistics&x=9&y=19

Samaras, C. (2008). Life Cycle Assessment of Greenhouse Gas Emissions from Plug-in Hybrid Vehicles: Implications for Policy. *Environmental Science Technology* , 3170-3176.

Shewmake, S. (2012). Can Carpooling Clear the Road and Clean the Air? Evidence from the Literature on the Impact of HOV Lanes on VMT and Air Pollution. *Journal of Planning Literature* , 363-374.

Singh, B., & Strømman, A. H. (2013). Environmental assessment of electrification of road transport in Norway: Scenarios and impacts. *Transportation Research Part D: Transport and Environment* , 106-111.

Small, K. A., Winston, C., & Yan, J. (2006). *Differentiated Road Pricing, Express Lanes and Carpools: Exploiting Heterogeneous Preferences in Policy Design.* Washington D.C.: AEI-Brookings Joint Center For Regulatory Studies.

Smith, P., & Ningsheng, Z. (2012). *Estimated VMT and GHG Emission Reductions Associated with the Going to the River Project.* ITE Journal.

SNCFT. (2007). *General Presentation.* Retrieved 02 25, 2014, from Societe Nationale des Chemins de Fer

Tunisiens: https://www.sncft.com.tn/fr/sncft/presentation_gen.html

SNTF. (2013). *Activite Voyageurs*. Retrieved 02 24, 2014, from Societe Nationale des Transports Ferroviaires: http://www.sntf.dz/index.php?option=com_content&view=article&id=89&Itemid=77&lang=fr

Sterner, T. (2010). Distributional Effects of Taxing Transportation Fuels. *Energy Policy , 41*, 75-83.

Sterner, T. (2007). Fuel taxes: An important instrument for climate policy. *Energy Policy , 35* (6), 3194-3202.

Sullivan, E. (2000). *Continuation Study to Evaluation the Impacts of the SR 91 Value-Priced Express Lanes Final Report* . Sacramento: FHWA.

TCRP. (2010). *Current Practices in Greenhouse Gas Emissions Savings from Transit*. Washington D.C.: Transportation Research Board.

TfL. (2013, 12). *Charging Zone*. Retrieved 2014, 01 from Transport for London: http://www.tfl.gov.uk/roadusers/congestioncharging/6709.aspx

Tochtermann. (2008). *On the Move: Delivering Integrated Transport in Britain's Cities*. Centre for Cities.

Transtu. (2014). *Activity and Fleet*. Retrieved 02 25, 2014, from Transtu: http://www.transtu.tn/entreprise_a.php?choix=parc

UNEP. (2008). *"Middle East, North Africa, and West Asia Vehicle Standards & Fleets"*.

UNEP. (2012). *Middle East, North Africa & West Asia Diesel Sulphur Matrix*. Retrieved from http://www.unep.org/transport/pcfv/pdf/maps_matrices/menawa/matrix/menawa_sulphurmatrix_august2012.pdf

WHO. (2011). *Health in the Green Economy Co-benefits to Health of Climate Change Mitigation*. Geneva: WHO Public Health and Environment Department.

World Bank. (2013, 08). *Transport*. Retrieved 12 2013, from World Bank: http://go.worldbank.org/H4FAFOWTU0

8. Appendix

Table 6. Summary of Sustainable Transport Policies in the US and Europe

Category	Intervention	Country/ City	Brief Description	Impacts/Projected Impacts	Reference
Vehicle/Fuel Technology	Fuel Efficiency	USA	34.1 mpg in 2016	Projected impact: 21% reduction by 2030	(EPA, 2010)
		Europe	130g CO_2/ km in 2015	Projected impact: 20% reduction on 1990 levels by 2020	(Gainsborough, 2012)
	Vehicle Inspection	USA/ California	Smog check on vehicles to identify those with excess emissions	Impact: removes 400 tons of smog-forming pollutants daily in the state	(BAR, 2013)
Road/Vehicle Operations Improvements	HOV Lanes	USA/San Francisco	HOV lane	Impact: 3% reduction of CO emissions on the system	(EPA, 1992)
		USA/New York City	Contraflow bus lanes	Impact: 90% reduction of CO emissions in the vicinity	(EPA, 1992)
	Speed Control	Europe/ Rotterdam	Reduced speed limits from 120 kph to 80 kph	Impact: 15% decrease in CO2 emissions along the motorway	(Kroon, 2005)
Demand Management	Fuel Tax	Europe	Stringent fuel taxes	Impact: 1 ppm decrease in carbon content	(Sterner, 2007)
	Ridesharing	UK	10% take-up of ridesharing	Projected Impact: 4% decrease in peak traffic	(Cairns, Sloman, Newson, Anable, Kirkbride, & Goodwin, 2004)
	Pricing Disincentives	UK	Congestion Pricing	Impact: Congestion levels in 2006 were estimated to be 26% lower than in 2002	(EEA, 2008)
	Pricing Incentives	Italy/ Bologna	Financial incentives to shift to LPGs	LPG share increased by 16%	(Cartolano, 2011)
	Transit	USA	Provision of Public Transit	Reductions in GHG emissions in the United States nearly 30 MMtCO2/year	(TCRP, 2010)

Table 7. Summary of Success Factors of Sustainable Transport Policies

Policy Category	Intervention	Country/City	(Possible) Success Factors
Vehicle/Fuel Technology	Fuel Efficiency – CAFE Standards	US	• Gas Guzzler Tax • Fuel Tax
	Electric Vehicles	US	• Charging stations • Financial incentives
Road/Vehicle Operations Improvements	Speed Control	The Netherlands/ Rotterdam	• Public acceptance and consultation • Implementation and operation • Effective enforcement
Demand Management	Pricing Disincentives – congestion pricing	UK/London	• Public acceptance and consultation • Implementation and operation • Strong leadership and political engagement • Research and monitoring • Awareness raising
	Fuel Tax	EU	• High fuel tax • Alternative, cheaper modes of transport • Incentives to switch to alternative fuel vehicles
	Ridesharing	US - EU	• Effective land use planning • Road tolls • High parking fees
	Land Use	Brazil/Curitiba	• High density and pedestrian-oriented development • Retail growth on major corridors • Acquisition of nearby land to control land prices • Provide limited parking spaces
	Public Transit	US – EU	• Accurate demand projection • Smart cards • Affordable tickets • Reliable scheduling

Table 8. US Renewable Fuel Tax Incentives (DOE, 2013)

Incentive	Description	Time Period
Alternative Fuel Infrastructure Tax Credit	Fueling equipment for alternative fuels eligible for tax credit of 30% of cost	January 1, 2006 – December 31, 2013
Alternative Fuel Excise Tax Credit	Incentive of $0.50/gallon for sale or use of alternative fuel to operate a motor vehicle	January 1, 2005 – December 31, 2013
Alternative Fuel Mixture Excise Tax Credit	$0.50/gallon of alternative fuel used to produce a mixture containing at least 0.1% gasoline, diesel, or kerosene	
Alternative Fuel Tax Exemption	Alternative fuels used on a farm for farming purposes; in certain intercity and local buses; in a school bus; exclusive use by a nonprofit educational organization; and exclusive use by a state, political subdivision of a state, or the District of Columbia are exempt from federal fuel taxes.	