go-green, sustainability, innovative state-of-the-art transport

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SUSTAINABLE GO-GREEN LOGISTICS SOLUTIONS FOR ISTANBUL METROPOLIS

Summary. Nowadays CO_2 emissions have exponentially increased over the last decade due to cities development and population growth. Logistics has a major impact, mainly negative, on the environment degradation. In this paper we focus on innovative "green" logistics solutions, which can be applied at the big city level, in economic and population expansion (emerging metropolis). That scope is to reduce simultaneously pollution and traffic congestion in agglomerated area. As an example we use a DHL Business Plan for Istanbul, aiming to implement a non- or little-polluting transport mode (by land and by sea) and estimative cost calculation that will be incurred by this challenging task. The final result of the research reveals that, although we expect to have higher cost for such a non polluting challenge, on the long run, the benefits of a durable go-green policy has higher impact in terms of money savings, environment protection and next generation life standards. As the output is positive, these results can be successfully applied to other cities or large very populated area, but analysis is needed to figure out which combination of schemes fitted for a particular location.

ZRÓWNOWAŻONE, TRWAŁE, EKOLOGICZNIE (GO-GREEN) ROZWIĄZANIA LOGISTYCZNE DLA ROZWIJAJĄCYCH SIĘ METROPOLII – PRZYPADEK ISTAMBUŁU

Streszczenie. W ciągu ostatniej dekady z powodu rozwoju miast i wzrostu liczby ludności wyraźnie uległa zwiększeniu emisja CO_2. Logistyka ma duży wpływ na te zmiany, które mają z kolei bardzo negatywne skutki i powodują degradację środowiska. W artykule skoncentrowano uwagę na innowacyjnych, „zielonych" rozwiązaniach logistycznych, które mogą być stosowane w metropoliach, przyczyniając się do redukcji zanieczyszczeń i kongestii. Przykładem takiego podejścia jest projekt DHL dla Istambułu, wykorzystujący przyjazne środowisku rozwiązania w transporcie lądowym i morskim oraz uwzględniający koszty związane z tymi przedsięwzięciami. Końcowy rezultat wskazuje, że pomimo konieczności ponoszenia wysokich kosztów związanych z tego rodzaju rozwiązaniami, redukującymi zanieczyszczenia i kongestię, w dłuższej perspektywie korzyści z polityki przyjaznej środowisku w postaci: oszczędności środków finansowych, poprawy ochrony środowiska i standardów życia mieszkańców będą większe. Również efekty gospodarcze są pozytywne i zachęcające. Rozwiązania DHL przedstawione w artykule mogą z powodzeniem być wykorzystane na całym świecie po ich dostosowaniu do konkretnej lokalizacji.

1. SUSTAINABLE GO-GREEN LOGISTICS

The classic logistics focused on producer-to-consumer movement of products, considering transportation, warehousing and inventory management (forward distribution) in central attention. Even "reverse" distribution, where consumer-to-producer movements become equally important (taking back products or packaging materials to avoid waste) are now not enough to avoid transport – environment conflicts. Freight carriers and their customers are interested mainly to provide transportation service with lower costs. Final consumers normally pay little attention to how the products were transported, congestion in cities, air and noise pollution. However, the environment of cities is negatively affected by the present organization of urban goods distribution. Go-Green logistics concept and schemes try to harmonize the efficient transport with environmental friendly urban logistics systems[1].

Environmental costs are often ”externalized”, and mainly or non-governmental organizations press on local communities to invest for landscape improvement. The current logistics sector is rather reluctant to radical innovations, and is dominated by a conservative approach to the ”green” strategy.

Biofuels is a key technical issue. Second generation biofuels are not based on crops, but on different natural materials, like cellulose from forest residues or energy forests. These have a higher energy yield per hectare than other crops and are therefore preferable. Currently there are research activities focused on gasifying biomass to *syngas* (CO and H_2) which in the next step of the Fischer - Tropsch process. Result is different kinds of hydrocarbons, e.g., synthetic diesel (F-T diesel) or petrol, methanol or methane, and process was successfully experimented in Poland for coal. The challenge is to develop a process that is robust enough to work efficiently also on more complex raw materials like biomass that contains material that can obstruct the combustion process (e.g. sulphur). Production of combustibles from biomass exists today in research phases in many countries. Also as pilot plant is produced hydrogen, used solar cells, thermal or wind energy and other forms of renewable energy.

The European Union Emissions Trading Scheme/ System (ETS) is a major pillar of EU climate policy. The EU ETS currently monitor and annually report their carbon dioxide emissions, covers more than 10,000 installations (trading ”credits” from the national allowance plans). The European Union approach is really innovative, taking into account to reduce SOx, NOx and CO_2 emissions at the same time (minus 40% reduction below 1990 emissions levels, by December 2020), and prop production of biofuels, natural gas, hydrogen. Also proposed energy conservation measures, not only because of the limited amount of natural resources available, but also because it can reduce noxious emissions and decelerate global warming.

Last United Nations Climate Summit **(**May 2009, Copenhagen) adopted, even unanimously, actions” to reduce CO_2 emissions. In order to avoid climate change to global level, all nations decided to militate for zero-carbon societies.

2. BARRIERS TO “GREEN” LOGISTICS ACCEPTANCE

The issue of environmental technologies and alternative sources of fuels are very complex not only from a technical point of view, but mainly for customers, governmental/ local authority and investors financial behaviour. One of the main barrier or taking-up of the environmental technologies was said to be the fear of transport sellers and buyers that the adopting of these technologies the costs/prices for the transport will be very high. The logistics sector focuses rather on short-term market perspectives. The persons responsible for deciding on the take-up of environmental friendly technologies in logistics are often not aware of any long-term cost benefits.

[1] Go(ing)-green concept was first mentioned in 1987 at the level of the United Nation-sponsored Brundtland Commission’s “Our Common Future as the movement towards sustainability”. The notion includes stronger alignment with “green” practices and sustainable business activities. It is widely used in different fields of human activities, including biology (next-generation bio-pharmacy).

Apart from the lacking availability of some alternative fuels, also the current fuel supply infrastructure is adapted to traditional fuels (gasoline and diesel, gas). Modifications of this infrastructure are costly (for example to implement hydrogen-oxygen plant, or for electrical car) and need to be considered in the overall assessment of environmental alternatives, particularly from architecture and logistics consideration. The storage of alternative for long period of time requires certain storage conditions, and cannot be mixed with traditional fuels. Consequently, extra tanks for the storage of alternative fuels have to be rented by the fuel supplying companies, and specific infrastructure of deposits is needed. As a result, the main barrier does not lie in the technology itself but in production capacities and logistics. From this follows also the psychological reluctance of customers to buy these technologies (e.g. logistics for new trucks) as they are not fully convinced of their practicability and chance of survival on the market.

Park of motorized road vehicles has a substantial contribution to air pollution, also to congestion or for traffic accidents. In 2001, European Commission estimated that 44% of the goods are transported through the road network and 78% of the passengers. New vehicle propelled technologies, changes in physical car distribution systems and integrated schemes of transport can substantially reduce negative environmental impacts.

Long-term and large investment for rail transports - in general advantageous in environmental terms compared with trucks and planes - is another major priority. In central and eastern Europe rail transport reduced activity due to the lack of bulk transportation. Now train of high speed are economically possible and sophisticated rail control systems are applicable. Different legal requirements for train transport in the European countries constitute a major impediment for increasing international forward transport. The European Train Control System (ETCS) might prove solutions in this direction. However, the investment loops linked with existing technology and adapted to facilitate inter-European compatibility in the rail latest technology industry are approximately 30 years.

Until now for the shipping sector one of the most important barriers to take-up of environmental technologies was the lacking of legal framework and the political approaches towards emission reduction. The current tendency is that ships are required to increase speed to remain competitive, and still holistic approach to promote environmentally friendly technologies in the shipping sector is postponed. The attempts to use other fuels into naval transportation and storage in special docks than heavy oil are limited.

The aviation industry is confronted with the problem of combating of all air noxas and noise. In order to reduce CO_2 and noise the Advisory Council for Aeronautical Research in Europe (ACARE created by the European Commission), Association of European Airlines (AEA), International Association of Charter Airlines (IACA) introduced world-wide scale ETS norms. Planes tested alternative fuels as biofuels, inclusively from bacteria medium.

Go-green projects can also meet with administrative barriers. Different bureaucratic requirements for land, maritime or air operations in different countries were cited as a barrier for further promotion of international freight transport and the shift to another transport modes. The combination of road and rail transport via truck-rail-wagons can also be rendered difficult, using nowadays rail standards. Furthermore, different administrative regulations at the national level impede the smooth running of international rail and sea transport (e.g. the example of different materials to be used in fire extinguishers).

3. GO-GREEN LOGISTICS SOLUTIONS FOR ISTANBUL

Goals and project objectives

Istanbul (has officially over 13 million populations) is the main economic city of Turkey. It is a strategic seaport for international transport, with a bridge linking Europe and Asia transport system.

Istanbul is facing with the following key challenges: high traffic congestion, increased pressure to reduce CO_2 emissions, noise pollution, and very specific division of the city into European and Asian

sides by Bosphorus strait. The *Deutsche Post DHL Consulting Project 2009 for Istanbul city hall*[2] summarized the causal link between goals and performance criteria for Project as hereunder:

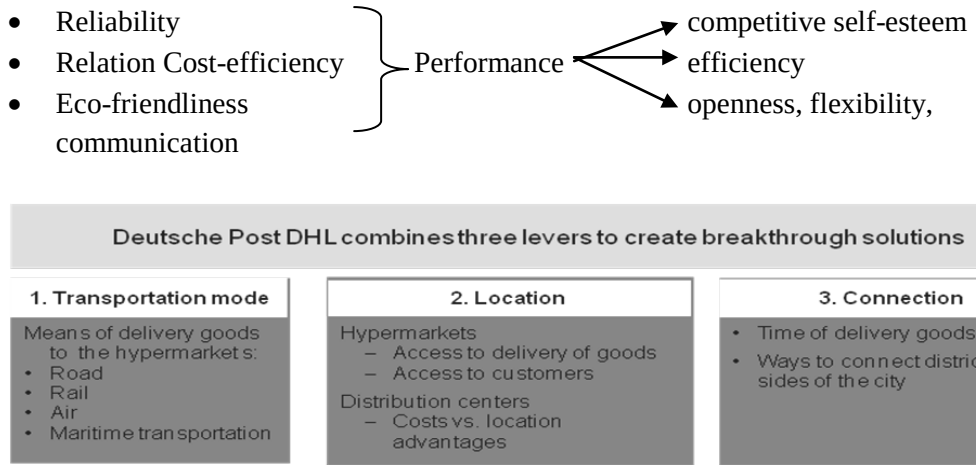

Fig. 1. General overview of go-green solutions provided by DHL
Rys. 1. Ogólny zarys rozwiązań według koncepcji Go-Green w projekcie Deutsche Post DHL

In the DHL study combinations of levers *lead to six solutions, three of them qualify for further investigation* (trucks powered with compressed natural gas, trucks powered with electricity and cargo ferries, trucks powered with electricity and cargo ferries). These indeed are state of the art solutions for a green environment, where the CO_2 are substantially reduced.

Table 1

Innovative go-green solutions for Istanbul

Transportation mode	Location	Connection	Further investigation?
Trucks powered with compressed natural gas (CNG)	Priority is closeness to highways Customers may also reach hypermarkets via public transport	All deliveries during night-time Use of Fatih Sultan Mehmet Bridge to connect East and West	Powerful ways to tackle CO_2 emissions No positive influence on traffic congestion
Trucks powered with electricity and cargo ferries	Priority is closeness to the river Customers may also reach hypermarkets via public transport	Use of Bosporus Strait to connect East and West	Reduction in CO_2 emissions Reduction in congestion
Trucks powered with electricity and cargo trams	Priority is closeness to tram tracks Customers may also reach hypermarkets via public transport	Cargo trams used for main part of the route Electric trucks used for last mile	No CO_2 emissions Reduction in congestion

[2] Andrei Angheluta was project manager for one of the 22 teams involved in this project. This was a public shared project between several teams located in different countries in Europe. January 2010.

Underground transportation pipeline systems	Customers may also reach hypermarkets via public transport	Connection trough extensive network of underground pipes	Reduction in congestion and CO_2 emissions Too expensive to install
Trucks powered with fuel cells	Priority is closeness to highways	Use of Fatih Sultan Mehmet Bridge	Still in development Too expensive
Air delivery	Priority is closeness to airfields	Helicopters are used to drop containers with self-navigation system	Reduction in congestion Too expensive Not developed yet

Source: Deutsche Post DHL Consulting Project 2009 for Istanbul City Hall

Project description

3.1. Logistic concept based on gas-powered trucks

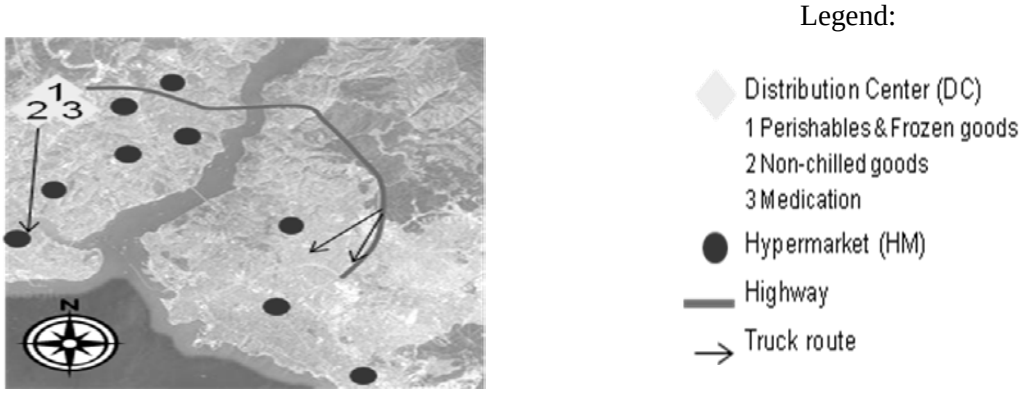

Fig. 2. Localisation of logistic centre in Istanbul – overview for 3.1. case (gas-powered trucks)
Rys. 2. Lokalizacja centrów dystrybucyjnych na obszarze Istambułu – wariant 3.1. wykorzystujący pojazdy wyposażone w silniki na paliwo gazowe

Analysis: All DCs are located in the European part in the district with the lowest land price (Eyup). All deliveries are made by trucks using a highway (incl. the bridge) and main roads.

Reliability: No effect on traffic congestion, put additional pressure on existing roads and bridges. This imply high dependency on traffic situation (less time control of deliveries).

Eco-friendliness: Reduction of CO_2 and overall pollution up to 40% in comparison with conventional vehicles. Medium reduction of noise.

Cost-efficiency: Initial investment is with 30% higher than for conventional trucks. Low fuel costs, but need fuel stations.

Evaluation: Reduced CO_2 emission. Noise reduction. Concept already tested. Widespread availability of natural gas stations. Does not overcome challenge of congestion. Additional pressure on roads and bridges. Higher initial investment than for conventional trucks.

3.2. Cargo trams transport to city-center combined with electric-powered trucks

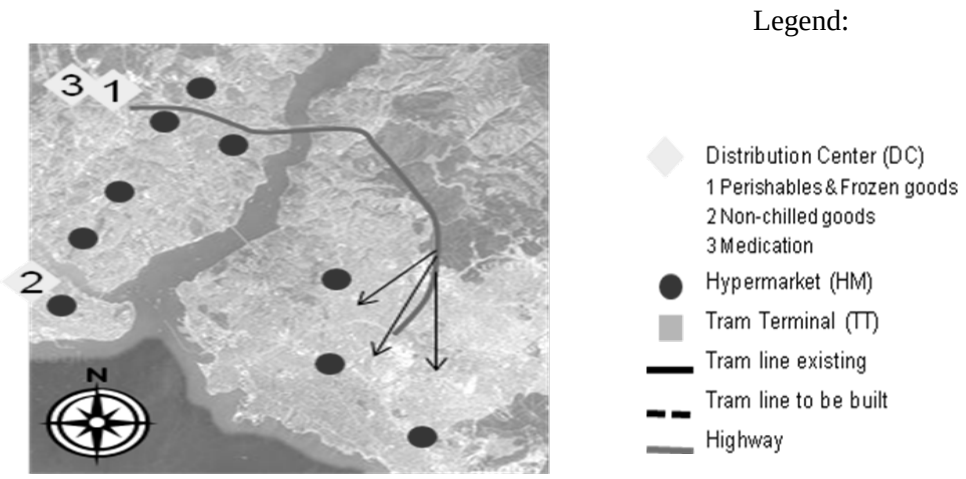

Fig. 3. Localisation of logistic centre in Istanbul – overview for 3.2. case (electrics power trucks)
Rys. 3. Lokalizacja centrów dystrybucyjnych na obszarze Istambułu – wariant 3.2. wykorzystujący w transporcie dowozowo-odwozowym samochody z silnikami elektrycznymi

Analysis: DC-2 is near the starting point of the tram line. DC-1 and DC-3 are near the end of projected tram line and close to highway in order to deliver goods to the Asian side by electric trucks.

Reliability: Effect on congestion: helps to reduce congestion in the European part, but does not solve the main problem – the chokepoint in Fatih Sultan Mehmet Bridge.

Eco-friendliness: No CO2 emissions (use of electrical vehicles only). Reduction of overall pollution, medium noise reduction.

Cost-efficiency: High initial investments: building of new tram line, buying cargo trams (about 3 million euro per tram) and electric trucks. Additional equipment for loading/unloading of goods. Low fuel and maintenance costs.

Evaluation: Reduced traffic congestion, accidents, injuries and fatalities. Reduced traffic exhaustion and noise. Reduced petroleum fuel consumption. Increased control over delivery schedules. High initial investment. Does not help with the main chokepoint. Main part of the transport still on the road.

3.3. Cargo ferries, last mile by electric-powered trucks

Analysis: All distribution centers are located in the Asian side, where Ferry Terminal-2 is also located. FT-2 holds a central position for making all the deliveries by water.

Reliability: Effect on congestion: Traffic situation greatly improved – do not utilize bridges (the main chokepoints of Istanbul).

Eco-friendliness: No emission for CO_2 due to electric trucks and small amounts from ferries. Sufficient noise-reduction from electric trucks, no road pollution from ferries.

Cost-efficiency: Initial investment high, price for one electric truck is around £90 000.

Evaluation: High reduction of congestion. High reduction of CO_2 emissions and noise. Low maintenance and fuel costs. Clear advantage of using solar/wind technologies for ferries in the long-run. Weather dependency for ferry transport. High initial investment for buying/leasing electric trucks and *ferry*.

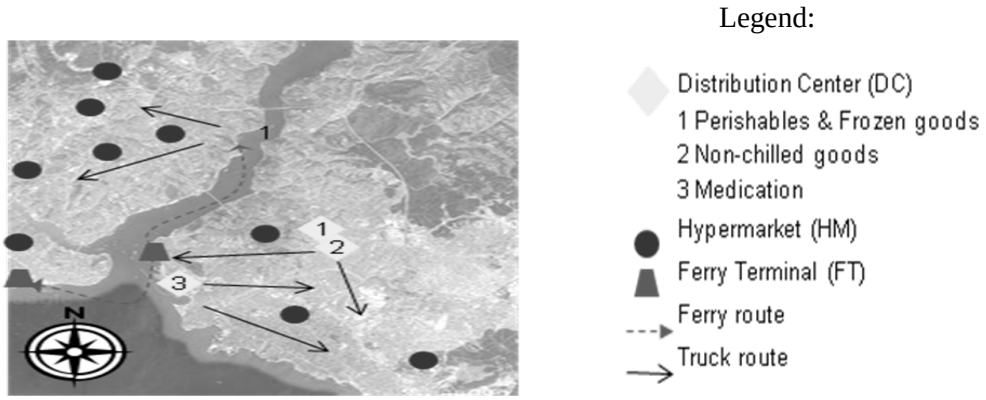

Fig. 4. Localisation of logistic centre in Istanbul – overview for 3.3. case (cargo ferries and electric-powered trucks)

Rys. 4. Lokalizacja centrów dystrybucyjnych na obszarze Istambułu – wariant 3.3. integrujący przewozy promowe i transport dowozowo-odwozowy wykorzystujący pojazdy z silnikami elektrycznymi

Based on objective criteria and subjective weighting, the winning solution is a 3.3. based on cargo ferries. A major problem is the total cost of project implementation.

Table 2

Initial investment

Items	**Number**	**Cost (EUR)**
Land for distribution center	3	10.940.950
Electric trucks (12 tonnes)	99	9.403.954
Car ferries (each can hold 30 trucks)	6	10.514.400
Total	-	**30.859.304**

Profit per year: 16.250.000 EUR [1)]

ROI = 1,9 years

Estimated using current traffic

The return on investment **(**ROI**)** was calculated based on demand structure, total number of pallets (inbounded & outbounded) related to this demand, and initial investment/costs (Appendix, table 3-6).

4. GO-GREEN SOLUTIONS OVERVIEW

Public transportation, but also personal vehicles are nowadays an important factor of life standard, with important economic-financial and political issues. In this article we are focusing on buses, trains, planes and ferries/boats, but suggestions expand to public transportation into the intensively populated area or large community of people.

In a rapidly growing economy like Turkey, metropolis Istanbul is face with difficult problems of transport and environment. The municipality understand that expensive logistics solutions for city

supply chain are substantial part of public costs. Solution detected in the present article was to locate all distribution centres in Asian side, and all deliveries to be made by water (not utilize bridges). In that way emission of CO_2 and noise smog are small due to electric trucks and ferries usage. Clear advantage of this logistic reorganization will multiply in the next years, using proper solar and wind technologies for ferries.

Go-green is not a ”futuristic solution”, and is focused on actions that can be developed within the business, transport sellers and buyers community or private – public (municipality) partnership.

N. Geroliminis and C. F. Daganzo summarised “green” logistics solution for few agglomerated area and countries pathfinder legislative framework, as follows (see details on References):

- Copenhagen - City goods ordinance for capacity management
- Sweden - Environmental zones
- United Kingdom - Low emission zones
- Brussels – Lorry dedicated routes
- Rotterdam - Electric vehicle city distribution system
- Osaka - Electric vans(vehicles)
- Zurich - Cargo tram coordinated system
- Berlin - Goods traffic platform transport (public-private partnership)
- Stockholm - Logistical centre for coordinated transports congestion
- Barcelona - Multiple use lanes; Online parking information mitigation
- Paris, Barcelona, Rome - Night delivery schemes
- London - Congestion charging
- Germany - Truck toll system
- New York, Vancouver - Internet port-information systems
- Tokyo – Advanced information systems
- Amsterdam - Floating distribution centre water use
- Venice - Waterborne traffic management decision support system.

There are several conclusions and results achieved with this project that were presented in this paper:

a. Go-green scheme must be *adapted to the applicable solution* both of the municipality level, or transport forwarder. Each transport provider needs to identify its own possibilities to improve the environmental performance of transport. Their projects and for machinery factories should be adapted to the circumstances of the respective local infrastructure. For example, Flexiwaggon Co. manufactured a train-wagon with possibilities to facilitates quick moving of large numbers of trucks over large distances by rail. The low position of the wagon makes it possible to load and unload on gravelled areas so that no specific terminal is needed. Projects also have to be adapted to the respective transport mode. Some states, such as Scandinavian countries, have a far more dense hydrogen supply infrastructure than other countries. It was mentioned that environmentally friendly technical solutions are more available for city transports than for long-haul transports where reliable technical alternatives still need to be identified and tested.
b. Future oriented for *environmentally friendly solution* does not need to concern only to alternative fuels or vehicle issues. For example, the diesel consumption of trucks transporting cooled and frozen foods could be reduced by means of a new cooling mode using liquid carbon dioxide instead of diesel fuel. This does not emit CO_2 in the atmosphere. Commercial CO_2 is recycled from chemical processes, e.g. on ammonia production (69% of recovered European CO_2), fermentation (22% of all European CO_2), ethylene oxide production (4% of recovered European CO_2), natural wells (where suitable geological prevail). Therefore all commercial CO_2 is also an environmentally beneficial product.

c. Furthermore go-green approach is revolutionary because is based on *new legal-administrative regulations* and *politically-based decisions*. For example, to impose for car/lorry providers' new environment and technical criteria of performances should first clarify legally binding targets for factories of freight vehicles (manufacturers of vehicles should be able to choose among different engines construction technologies), as well as the required environmental performance (emission limits for noxas, fuel consumption, etc.). Such requirements would also thwart the economic strategy of healthy competition in freight transport.
d. An alternative or additional measure to command-and-control measures are *Emissions Trading Scheme (ETS)*, which leaves even more leeway to the manufacturers and users of transport vehicles. At the EU level, relatively new members of Union (Vysegrad Group, Romania, Bulgaria, Baltic states) try to avoid abrupt reduction of their air emissions, asking some time for adaptation for its economies on market mechanisms. Some countries proposed to provide capital for specific NO_x-reducing projects/technologies in specific funds dedicated to partially finance NO_x reduction. As in case of Norway, the companies can get money from this fund.
e. The basic conclusions were that *environment approach is an individual and collective task*. Each company is responsible for the purchase/development of technologies, public procurement, etc. They should and could develop solutions and consider concrete steps to take up environmental transport technologies which fits into the company's portfolio. Even though these steps may be first small steps, they are important as they may lead to knowledge and experience that can stimulate new projects and approaches. Furthermore, to use and spread of environmental technologies more professional contacts should be set up among companies and institutions having a stake in the development of these projects, such as companies buying and selling transports, universities, technology developers/sellers, local communities, or policy makers etc.

APENDIX. *Source: Deutsche Post DHL Consulting Project 2009 for Istanbul city hall*

Table 3

Demand structure

District Name	Population	Demand
EUROPEAN SIDE		
Zone I		
SISLI (All)	314,684.00	94 405,20
SISLI (1) 60% of Area	188,810.40	56 643,12
SISLI (2) 40% of Area	125,873.60	37 762,08
KAGITHANE	418,229.00	125 468,70
BESIKTAS	191,513.00	57 453,90
BEYOGLU	247,256.00	74 176,80
Total		*351 504,60*
Zone II		
FATIH	455,498.00	*136,649.40*
Total		488 154,00
ASIAN SIDE		
Zone III		
USKUDAR	529,550.00	158,865.00
KADIKOY	550,801.00	165,240.30
MALTEPE	415,117.00	124,535.10
Total general		448 640,40

Table 4

Distribution of pallets/inhabitant per month

Product type	Number of pallets per inhabitant per month
Perishable frozen goods	0.067867868
Non perishable	0.047256145
Medication	0.00115124

Table 5

Workings on Investment and Estimated Profit for ROI

	Initial Investment (Land, 3DC)			
Distribution Centre	Warehouse size (sqm)	DC location	Euro/sqm	**Total DC Cost (€)**
Non-Chilled DC	15,000	Umraniye (Asia Side)	270	4,044,000
Perishables DC	25,000	Umraniye (Asia Side)	270	6,740,000
Medication DC	365	USKUDAR (Asia Side, D6)	430	156,950
Total	**40,365**			**10,940,950**
	Initial Investment (99 Electric Trucks)			
Distribution Centre	Total No. of Trucks (12T)	Cost (€)/Ele Truck (12T)	**Total Truck Cost (€)**	
Non-Chilled	40	95,403	3,784,449	
Perishables	57	95,403	5,435,113	
Medication	2	95,403	184,392	
Total	**99**		**9,403,954**	
	Initial Investment (6 Car Ferries)			
	Each Car Ferry can hold 30 Electric Trucks (12t)			
Cost (€)/Car Ferry	Total No. of Trucks	**Total Costs (€)**		
1,752,400	6	**10,514,400**		
	Estimated Profit from Metro Group Turkey			
METRO Group Turkey Sales (€) in 36 Hypermarket in 2008	**Sales in 9 HM**	5% Margin	**Estimated Profit/Year**	
1,300,000,000	325,000,000		**16,250,000**	

Table 6

Total Number of Electric Trucks Needed

	Total No. of Perishables Goods pallets/month	Total No. of Non-Chilled Goods pallets/month	Total No. of Medication Goods pallets/month
European side	33,130	23,068	562
Asian side	30,448	21,201	516
TOTAL	63,578	44,269	1,078

Pallets PER DAY			
	European side	**Asian side**	**Total**
Perishables	1,069	982	2,051
Non-Chilled	744	684	1,428
Medication	18	17	35

No. of Trucks Deliveries PER DAY			
We take 12-tons truck, 18 pallets per truck, so EVERY DAY we n			
	European side	**Asian side**	**Total**
Perishables	59	55	114
Non-Chilled	41	38	79
Medication	1	1	2

Total No. of Trucks Need/day			
Assume each truck would transport 2 times a day within 8 hours shift			
	European side	**Asian side**	**Total**
Perishables	30	27	57
Non-Chilled	21	19	40
Medication	1	1	2
		Total No. of Trucks	**99**

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