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**Conference Paper**

## Energy, Carbon and Cost Benefits of Bus Network Optimisation in the City of Batumi, Republic of Georgia

51st Congress of the European Regional Science Association: "New Challenges for European Regions and Urban Areas in a Globalised World", 30 August - 3 September 2011, Barcelona, Spain

**Provided in Cooperation with:**

European Regional Science Association (ERSA)

*Suggested Citation:* Saunders, Michael (2011) : Energy, Carbon and Cost Benefits of Bus Network Optimisation in the City of Batumi, Republic of Georgia, 51st Congress of the European Regional Science Association: "New Challenges for European Regions and Urban Areas in a Globalised World", 30 August - 3 September 2011, Barcelona, Spain, European Regional Science Association (ERSA), Louvain-la-Neuve

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**Energy, Carbon and Cost Benefits of Bus Network Optimisation in the City of Batumi,  
Republic of Georgia**

*Michael James Saunders, PhD*

**Abstract**

The City of Batumi, Georgia had suffered from a complete disintegration in public transport after the collapse of the Soviet Union in the 1990s. However, recently the city has undergone a revival period that has seen investment in all municipal sectors, including public transport. The municipally owned bus company's bus fleet has been increased from 20 buses to 101 buses and has the potential to serve the entire 150,000 population of the coastal city. However, the initial route planning was not based upon the ability for passengers to transfer from one route to another; this created many inefficient parallel route sections. This inefficiency is affecting the company financially and causing additional energy use and carbon emissions. A study was commissioned by the City and Bus Company with the aid of the European Bank of Reconstruction and Development to optimise the bus routes and create a bus network that includes the ability to transfer from one route to another. The initial results have shown that at least 30% operational, energy and carbon savings can be achieved following a two year action plan that includes creation of a central transfer terminal and optimisation of bus routes. The new bus routes cover the same territory at even lesser intervals which also benefits the passenger. In addition, the citizen of Batumi will have complete access to the whole city via public transport, making the city more accessible for those reliant on public transport or who chose it over the motor vehicle.

## Background

Batumi is an ancient City on the black sea coast with a present day population of approximately 150,000 residents. It is also a new tourist destination with over half a million tourists visiting in 2010 and one million predicted by 2013.

Batumi's public transport sector comprises of a municipally owned bus company and private minibuses that serve the entire population. As of May 2010, the current breakdown of transport market share is as such:

Public Transport Type	Operating Fleet	Passengers Carried Daily	Market Share
<b>Municipal Bus</b>	55	33,000	35%
<b>Private Minibus</b>	250	60,000	65%

The City of Batumi has made a strategic decision to increase the level of service of its municipal bus fleet to replace almost all private minibus services. A new marketing manager was hired in 2010 and assistance has been provided by the EBRD by both financing the purchase of buses and assistance with development of the marketing strategy.

By November 2010 it is planned that the operating fleet will be increased by 26 buses to 81 buses. This would allow the bus company, under the current network, to carry an additional 16,000 passengers per day, provided the City reduces the number of Private Minibus licenses accordingly. This will, however, still leave the municipal bus company with only a 53% market share, which is far short of Batumi City's aims.

One of the main problems contributing to the low market share potential is that the current bus network is very inefficient. There are many parallel routes causing inadequate use of bus capacity and transport energy and producing additional unneeded carbon emissions. This problem will only be exacerbated as market share is further increased unless the network is optimised.

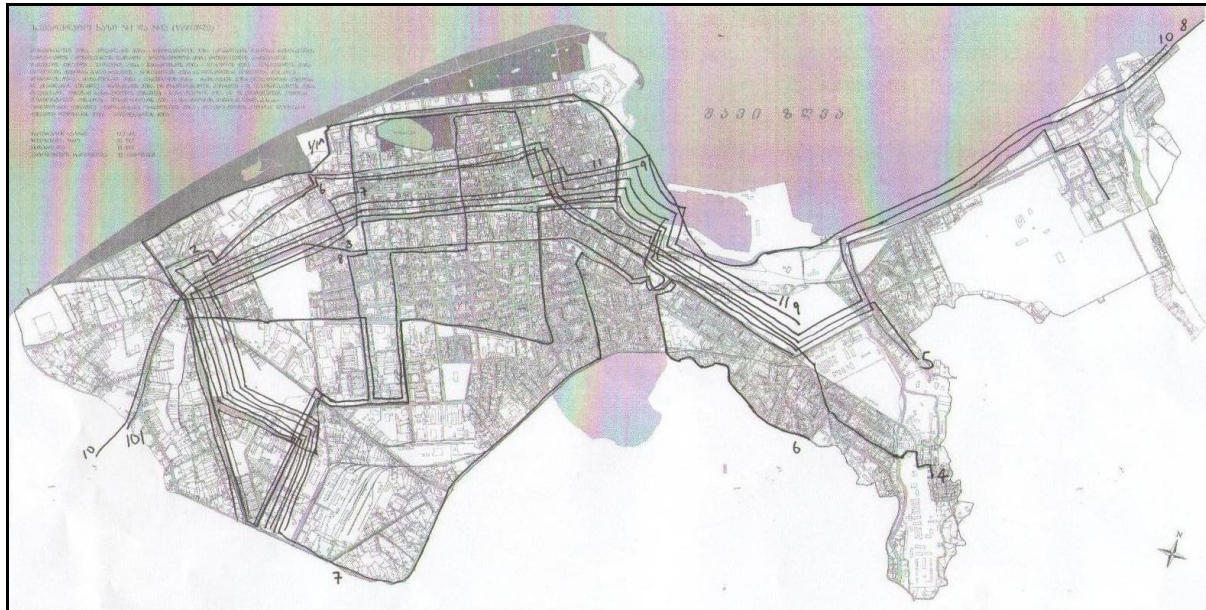
## Network Optimisation

The aim of bus network optimisation is to either:

- a) Increase the level of bus service offered to citizens, using the same resources
- b) Keep the same level of service but reduce resources i.e. buses, fuel, labour etc.

Batumi currently does not have a typical bus network. A bus network, by the very name network, implies that bus routes are connected to each other and therefore all networks require transfer points or terminals. In Batumi's case, one central terminal is required and other transfer points can occur at normal bus stops. A good transfer system also requires a ticketing system, something that Batumi has not had in place until mid 2011. A ticketing system allows for

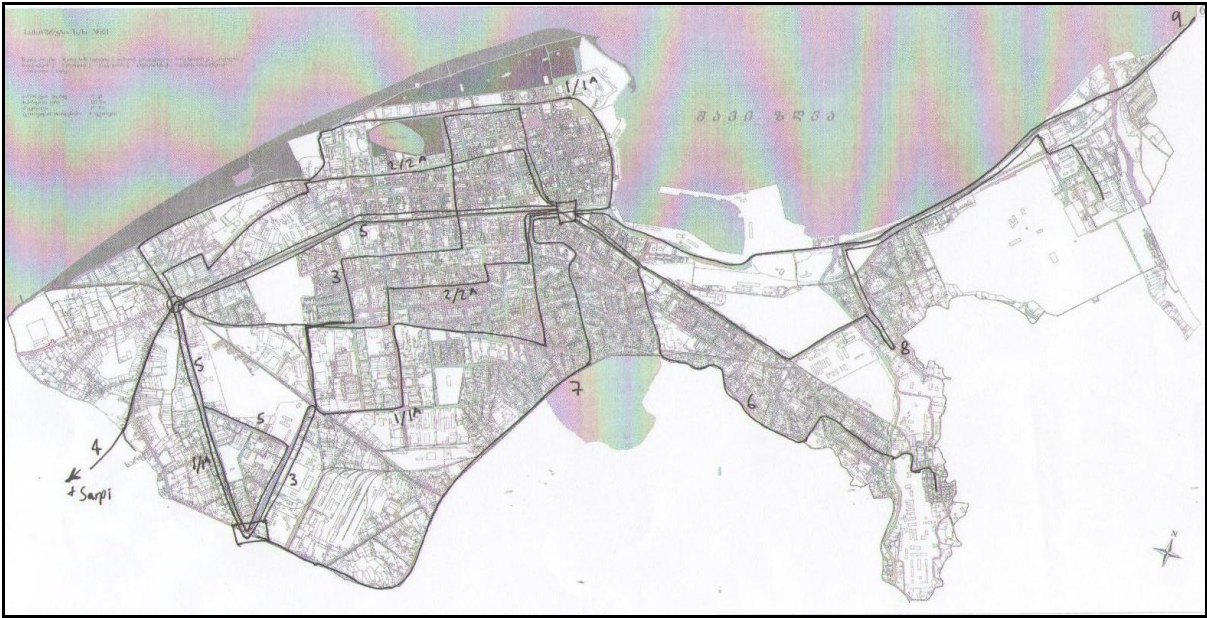
passengers to transfer from one bus to another for reduced or no additional cost during a time limit. The following route map shows the existing situation of Batumi Bus network:



**Figure 1 Existing Route Plan**

In total there are 12 routes and in some locations up to 8 routes have parallel sections. This causes unnecessary additional bus-kilometers, which increase the total running costs and also limit lowering the interval for buses running on parallel lines because of the congestion created when 8 different bus lines have to stop at the same bus stops.

A new plan has been drafted, which requires 3 less routes and covers an identical territory. The new plan requires construction of a central terminal. It is envisaged that the new route plan could be implemented over a one to two year period, together with public consultation and involvement. The new route plan draft is included below:



**Figure 2 Proposed New Route Plan**

A comparison table of the two route plans is given below and includes increasing the intervals in the new plan on roads that previously had many parallel routes to allow for uptake of passengers that were previously carried by more buses on these parallel routes. The total yearly estimated kilometres are summarised at the end of the table and this illustrates the approximate percentage operational savings possible through introduction of the new route plan (all routes assume a simplified average velocity of 17km/hour and a 16 hour day):

Existing Route Plan				New Route Plan			
Route #	KMs	Interval	Buses	Route #	KMs	Interval	Buses
1/1a	19,5/20,1	10	7/7	1/1a	19,5/20,1	10	7/7
2	18	10	7	2/2a	11	10	4/4
3	16,6	15	7	3	11	10	4
4	17,6	15	7	4	45	15	11
5	14,9	12	6	5	7	5	5
6	17.,4	15	7	6	5	10	2
7/7a	11	20	2/2	7	8	10	3
8	25	13	6	8	8	10	3
9	17,3	15	5	9	7	15	2
10	32	20	4				
11	21,2	10	8				
101	52,4	20	6				
<b>Total KMs</b>	<b>8 Million</b>	<b>11.6 Av.</b>	<b>81</b>	<b>Total KMs</b>	<b>5 Million</b>	<b>10.8 Av.</b>	<b>52</b>
<b>Passenger Capacity</b>		<b>49,000 per day (53%)</b>		<b>Passenger Capacity</b>		<b>49,000 per day (53%)</b>	

Operational savings from the new route plan are approximately **37.5%** or **GEL 1.7 Million** on the forecast 2011 operational costs. In addition the overall average bus interval is reduced in the new plan with an express service on the busiest route that has only a 5 minute interval.

The above table shows a comparison for obtaining an approximate 50% market share; however the municipal transport company together with Batumi City is aiming for a 95% market share. Obtaining this share and a comparison with the baseline scenario will be discussed in the following sections.

## **Network Terminal Options**

A terminal is vital for the success of the bus network and this section covers briefly bus terminal options under consideration by Batumi City and illustrates the simplicity of various terminal possibilities.



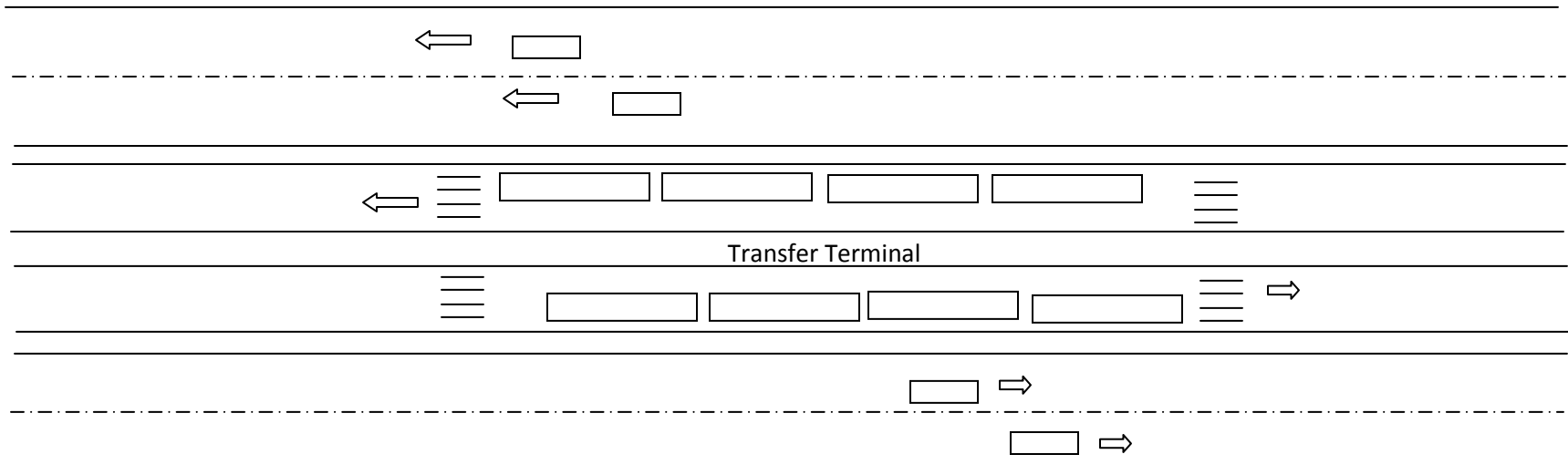


Figure 3 Optimal locations for central passenger transfer terminal

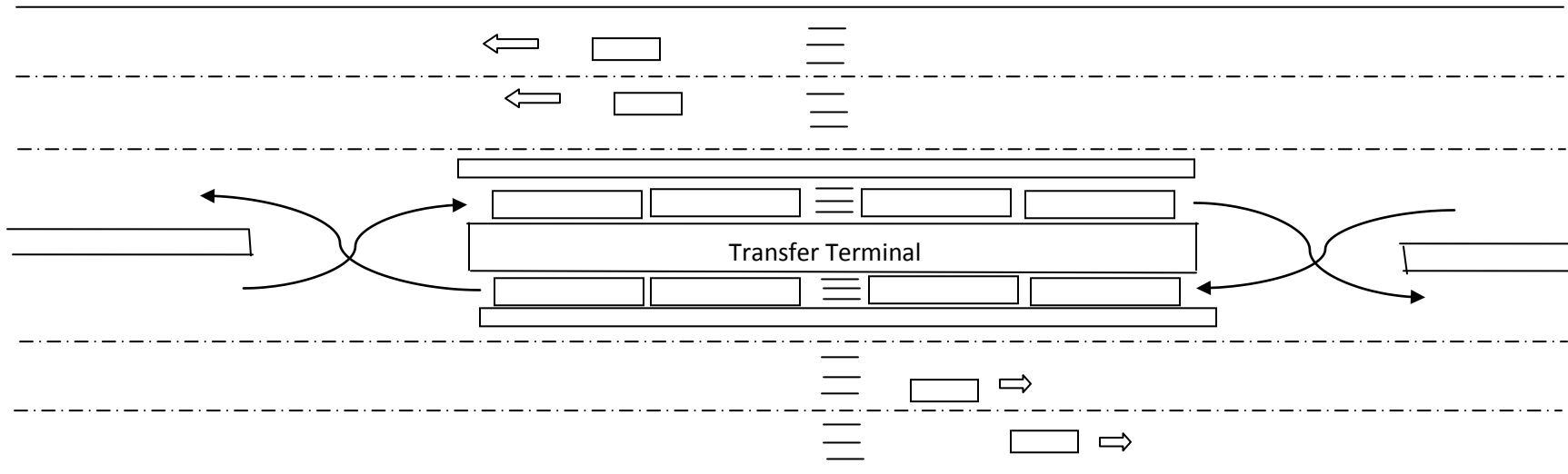


## Possible Transfer Terminal Designs:

### *Street Centre Transfer Terminal Design:*



### ***Street Centre Transfer Terminal Design (Doors Open Onto Terminal):***



**Figure 4 Example of simple transfer terminal design**

## Comparison with Baseline Scenario

The following table illustrates the advantages of the new network compared with the existing network when aiming to achieve a 95% market share:

	Existing Network		New Network	
<b>Market Share</b>	53%	95%	53%	95%
<b>Private Minivans</b>	176	19	176	19
<b>Buses</b>	81	145	52	93
<b>Million KMs</b>	8	14.3	5	9
<b>Passengers</b>	49,000 per day	88,000 per day	49,000 per day	88,000 per day
<b>Average Interval</b>	11.6	6.5	10.8	6
<b>Operational Cost</b>	4.4 Million GEL	7.9 Million GEL	2.75 Million GEL	4.9 Million GEL
<b>Diesel (Litres)</b>	1.6 Million	2.87 Million	1 Million	1.79 Million
<b>CO2 Emissions</b>	4,300 tonnes	7,700 tonnes	2,700 tonnes	4,800 tonnes

The following table illustrates the efficiencies created by the new network:

	Diesel Savings	CO2 Reduction	Operational Savings
<b>53% Market Share</b>	600,000 Litres	1,600 tonnes	1.65 Million GEL
<b>95% Market Share</b>	<b>1.6 Million Litres</b>	<b>2,900 tonnes</b>	<b>3 Million GEL</b>

## **Conclusions**

The municipal transport company currently has at its disposal 101 buses. With the new network and an aim to achieve a 95% market share while assuming a reserve of 15% leaving 86 buses for operation, the municipality only requires an additional 7 operational buses. This is a dramatic improvement over the current network which would require an additional 59 buses (843% increase) to achieve the same market share. In addition to the reduced capital costs, the operational costs, energy and carbon savings are enormous with the new network. The new network achieves 37.5% efficiency over the current network for operational costs, energy use and carbon emissions. This represents a potential 3 Million Lari (1.25 Million Euro) savings, 1.6 million diesel reduction and a 2,900 tonne reduction in CO2 emissions. Batumi City will be well placed to set an example for the region by following plans to achieve these savings by 2013.

## **Acknowledgements**

The author would like to acknowledge input from the Director of Batumi Bus, Gia Loria, the Mayor's Office of Batumi, represented by Robert Chkeidze, Hans Houtsma of Houtsma Consultants and the EBRD.