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Logistics Processes and Motorways of the Sea II

in Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine, Uzbekistan

Progress Report II – Annex 4

Cost-Benefit Analysis of Container Block Train Service Poti–Baku

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LIST OF ABBREVIATIONS

ADY	Azerbaijan State Railway
BCR	Benefit:Cost Ratio
CASPAR	Azerbaijan State Caspian Sea Shipping Company
CBA	Cost-Benefit Analysis
EIRR	Economic Internal Rate of Return
GEL	Georgian Lari (currency)
GR	Georgian Railway
GRaBTAM	Georgian Railway Block Train Appraisal Model
LRMC	Long-Run Marginal Cost
MOS	Motorways of the Sea (also MoS)
NPV	Net Present Value
NTK	Net tonne-kilometre(s)
SRMC	Short-Run Marginal Cost
TEU	Twenty-foot Equivalent Unit

1 EXECUTIVE SUMMARY

There is more than enough freight to support a regular daily block train service between Poti and Baku, with a departure from each of the two ports every day. This analysis compares the total cost of transporting 65,500 TEU annually in the without-project and with-project cases:

- Without-project: 15,000 TEU by the existing rail service, the reminder by road.
- With-project: All carried by the new block train service.

It is estimated that an investment of €14.5 million in new rolling-stock will be needed. Operating costs by rail are less than 20% of those by road. Consequently the capital investment is very easily justified. In any of the four scenarios used in this analysis, computed internal rates of return exceed 100%pa and benefit-cost ratios exceed 10.0.

It is recommended that negotiations be initiated between GR and ADY as soon as possible with a view to making the necessary investments and adjustments to timetables and operating procedures.

2 PROJECT SYNOPSIS

The proposal is to institute a regular block train service between the Georgian Black Sea port of Poti and the Azerbaijani Caspian Sea port of Baku. It would replace the transport of containers by ordinary train, and more significantly a proportion of container transport by road.

- A feasibility study of such a service was made in December 2010 under the Motorways of the Sea for the Black Sea and Caspian Sea (MOS) project. It concluded that:
- Bi-directional traffic potential for a container block train service exceeds 13Mt/year. This comprises cargoes that are already-containerised and those deemed suitable for containerisation in future.
- Of this potential traffic, 80% is transit trade between Europe (including Turkey) and Central Asia.
- Road transport is generally preferred for containers because of its shorter door-to-door transit time; better handling and other service; and artificially depressed road freight rates because of lax enforcement of vehicle weight limits.
- Poti Port is privately owned and efficiently run, with access to capital for further development. (Since the report was written 80% of Poti Seaport has been bought by APM Terminals, an arm of the A P Moller – Maersk Group, which has announced its intention to invest US$100M in the port over the next five years.)
- Realisation of traffic potential will be greatly enhanced when Poti's new container terminal is opened in 2014, allowing berthing of vessels of up to 6,000 TEU capacity. This will coincide with the planned completion of the new port at Alyat.
- Other desirable improvements include a) regular scheduling of existing ferry services from Ukraine and Bulgaria; b) in-port storage and intermodal facilities along with re-cycling of containers; c) more effective collaboration between the Georgian and Azerbaijani railway operators (GR and ADY); and d) addition of purpose-built container vessels to the Caspian Sea fleet[1].
- All sections of the railway line between Poti and Baku have spare capacity for a minimum of 12 cargo trains per day on the Georgian side of the border and 6 on the Azerbaijani side.
- An efficient international block train service depends on simplified border crossing arrangements; preferential scheduling to ensure adherence to schedule; adherence by all parties to agreed procedures and obligations; and arrangements to rapidly address problems or changed circumstances. Institutional barriers to efficient operation are likely to be as important as technical.
- The existing Poti-Baku rail travel time of 37-42 hours (including 5-6 hours for border procedures) can be reduced to 25-31 with improved operations and procedures.
- Possible investment needs include adaptation/upgrading of port and intermodal facilities; purchase/adaptation of railway wagons and handling equipment; inland facilities; IT systems; and skills development. These are not quantified or costed.

On the basis of the above, this cost-benefit analysis (CBA) is made of the basis of:

[1] The principal routes between Baku and Kazakjstan/Turkmenistan are monopolized by the state-owned Caspian Shipping Company (CASPAR) which has no container ships.

- A daily departure from each end of the route, with 3 days allowed for a round-trip including shunting and train assembly.
- A train comprises 2 locomotives and 56 flatcars[2], each with a tare of about 20t and a capacity of 2 TEUs.
- Most of the freight will be in transit, port-to-port, and therefore require no transfer from or to road vehicles for local collection or delivery. For the remainder there will be an additional cost fro handling and local road transport.
- Existing containerised rail traffic will transfer to the block train; the remaining capacity will be taken up by containers that would otherwise be carried by semi-trailers.

[2] Also known as platforms or flat wagons.

3 METHODOLOGY

The basis for the cost-benefit analysis (CBA) is a comparison of two cases: the with-project case and the without-project case. In the with-project case the block train service runs with an assumed frequency and an assumed utilisation factor. In the without-project case the same task is performed using a combination of the existing rail freight service and road haulage. In each case the total cost of performing the same task is projected over an appraisal period of 25 years. The difference between the two streams of costs represents the project's net benefits.

Only long-run marginal costs (LRMCs) are taken into account3. These are defined as costs that vary in proportion to a sustained change in traffic volume. They include the cost of expanding a fleet of vehicles or upgrading a road or railway line to cope with increased demand. Direct operating costs such as fuel, crew and vehicle maintenance are virtually all LRMCs. Infra-structure maintenance, especially for bridges and communications systems, is less responsive to traffic volume.

In the with-project case it is assumed that new rolling-stock will be bought. New locomotives will allow the scheduled services to be provided with a high degree of regularity and reliability; and new flatcars will allow loading and unloading to take place with minimal risk of damage or delay. But no additional track or other infrastructure will be required.

A simple Excel-based model has been constructed to project costs and benefits and compute performance indicators. It is called GRaBTAM (Georgian Railway BlockTrain Appraisal Model). It allows for almost all values to be changed so that a) the analysis can be updated as new or refined information becomes available; and b) the sensitivity of the results of the analysis to changed estimates or assumptions can be tested.

Costs and benefits are valued in two ways: financial and economic. Consequently there are two sets of tables that display the output of the model. The results are not substantially different. Financial values are based on prices actually paid for goods and services. Economic values represent actual consumption of resources, or opportunities foregone. They are estimated by adjusting financial values. An analysis using economic values gives a better indication of a project's performance from the point of view of the community as a whole, and therefore whether it should have public support.

[3] On the other hand, short-run marginal costs (SRMCs) are incurred only to accommodate an increase in traffic that does not require an increase in capacity. For example, additional fuel, maintenance and handling costs might result from a temporary improvement in asset utlisation. Marginal costs, whether long- or short-run, may also be called variable costs, incremental costs or avoidable costs. In this report 'variable cost' always refers to LRMC.

4 DEMAND

Official statistics show a total of 210,000 TEU handled at Poti in 2010, of which 46,000 were carried by railway. Included in this railway total were 17,000 TEU that originated in or were destined for Azerbaijan, Afghanistan or Central Asia. These are considered the prime candidates for transfer to the proposed block train.

The remaining 164,000 TEU that passed through Poti comprised:

- 92,000 that were carried to or from Poti by road. Available statistics do not dis-aggregation this volume by origin/destination.
- 72,000 that were 'backed'[4]. Available statistics do not disaggregate this volume by origin/destination or by the mode used for onward transport.

In the same year a total of 4.89Mt of international freight was moved on Georgia's roads. This included 1.33Mt that originated in or was destined for Azerbaijan, China, Afghanistan and Kazakhstan. This traffic may be assumed to travel to or through Baku and comprises, in unknown proportions:

- Containerised cargoes.
- Cargoes that have been stripped from 'backed' containers.
- Cargoes that have potential for containerisation.
- Cargoes that are not amenable to containerisation.

The first three of these categories are candidates for transfer to the proposed block train. It is assumed that 50% of this traffic, equivalent to more than 60,000 TEU per year, may reasonably be targeted for capture by the block train service.

According to the MoS study, the potential demand for transport of containerised cargoes between Poti and Baku is 13.3Mt per year, evenly balanced between east-bound and west-bound traffic. Kazakhstan and Turkey together account for 70% of this estimated demand. See Table 1 below, which is reproduced from the MoS feasibility study report.

Assuming an average load of 10t per TEU, the MoS feasibility study's estimate is equivalent to 20 times the capacity of a daily 2-way block train service, such as is being appraised. The existence of such a service is likely to generate additional demand, including cargoes that are re-routed to take advantage of cost and time advantages.

The likelihood of substantial traffic generation will be maximised by an uncompromising commitment to a daily service, meaning a daily arrival and daily departure at both ends of the route. Therefore the present analysis considers this option and no other, except for sensitivity purposes.

[4] 'Backing' means discharging or stripping an incoming container and sending the contents on as un-unitised cargo.

Table 1: Trade Potential of Poti-Baku Block Train (Tons)

Countries	Partner Countries	East bound	West bound
Georgia	Kazakhstan	19,415	112,604
	TRACECA South East	1,978	5,233
Azerbaijan	TRACECA/Cis North West	811,415	16,956
	TRACECA West	33,288	1,328
	Turkey	1,052,863	39,592
	Europe (non TRACECA & Cis)	335,513	24,903
TRACECA/Cis North West	Kazakhstan	1,007,496	1,649,092
	TRACECA South East	597,057	113,366
TRACECA West	Kazakhstan	18,795	32,151
	TRACECA South East	34,441	21,984
Turkey	Kazakhstan	334,338	1,416,343
	TRACECA South East	609,708	229,058
Europe (non TRACECA & Cis)	Kazakhstan	1,110,422	2,550,681
	TRACECA South East	635,567	486,653
Total		**6,602,297**	**6,699,943**

Computation based on Eurostat and International Trade Center databases – Trade 2008

5 PARAMETERS, ESTIMATES AND ASSUMPTIONS

The parameters that drive the GRaBTAM model are presented in Table 2 below. They are briefly discussed and explained in the following bullet points:

- A social discount rate of 12%pa is used for computing present values from projected streams of costs and benefits, and equated annuities from capital costs.
- The appraisal period is set at 2012-36, allowing full potential benefits to stream for at least 20 years.
- Capital expenditure will be required only for rolling stock. The track and other infrastructure has ample spare capacity. Investment is scheduled to occur within the first three years of the appraisal period. Cargo volume will ramp up to its full potential by the fourth year.
- Economic conversion factors are applied to financial costs to obtain economic costs (also known as resource costs or opportunity costs). They chiefly remove indirect taxes, which are considered transfer payments from transport operators and their customers to the Government.
- Bribes, estimated to be 9% of road hauliers' financial costs, might also be considered a transfer payment. But because of their corrosive effect on the economy, as well as on the moral, social and political fabric, a conversion factor of 1.00 is applied here.
- Transport entails external costs. The main external costs are associated with infra-structure construction and maintenance, accidents, congestion and pollution (including noise pollution and CO_2 emissions). The EU's Marco Polo calculator has been used to estimate average external costs for rail and road, net of a) infrastructure construction and maintenance, which are not included in the Marco Polo analysis; and b) CO_2 emissions, which have been estimated using other sources and applying the costs per tonne of emitted CO_2 that are recommended in the latest EU guidelines[5].
- The distance between Poti and Baku is 855km by rail and 920km by road. When the port is moved from Baku to Alyat the distance by both modes will be about 70km shorter by both modes. For this analysis distances of 785km (rail) and 850km (road) are used.
- Transit cargo travelling port-to-port will be handled once at each end, incurring similar costs whether carried b y rail or by road. But a proportion of containers carried by the block train will originate in or be destined for Baku or its environs, and will therefore need to be transferred from or to a road vehicle for the local part of the journey. Allowances are made for the extra handling and local transport costs.
- There is a mountainous section of the route where an extra locomotive may be needed to assist trains to cope with the gradients. The model allows for this, with an average incremental cost per assisted train. But in discussion with GR it was agreed that a block-train with two locomotives (a double-header) should not need assistance.
- The without-project scenario is defined in terms of the rail and road shares of the block train's annual capacity.
- Containers are specified in terms of their average tare and average payload per TEU. These averages cover 20' and 40' containers, full and empty.

[5] European Commission (Directorate General regional Policy), 'Guide to Cost-Benefit Analysis of Investment Projects', 2008.

- A block train is defined in terms of the number of locomotives and flatcars, the TEU capacity per flatcar and the average capacity utilisation factor. There is also a factor applied to the number of flatcars to allow each set to be left at either end of the route for unloading and loading, to be picked up by the next arriving locomotive(s) with minimal delay.
- Likewise a typical truck is defined in terms of its capacity, annual distance covered and utilisation factor.
- Capital costs (financial) are estimated for locomotives, flatcars and trucks, together with the expected life of each.
- Amortisation/depreciation costs[6] were provided by GR and the haulage industry without a full explanation of the method of calculation or the asset values to which they related. The model provides for two options: a) use of these data as provided; and b) use of the analyst's own estimates[7]. These options are identified as 'D' and 'E' in the model.
- GR's data included amortisation costs for infrastructure as well as rolling stock. Comparable figures for road transport are not available. Road permits account for a proportion of 'Other operational expenses', and it is assumed that these permits are priced so as to compensate the Government for additional construction and maintenance costs imposed by heavy goods traffic in Georgia. The same logic is applied to a proportion of the fees payable at the Azerbaijani border.

[6] Depreciation is a measure of the rate at which the value of an asset declines with age and with use. Amortisation is a broader measure comprising a) depreciation and b) the cost of capital tied up in the asset.

[7] These estimates are in the form of equated annuities using estimated asset values and lives and a social discount rate of 12%pa.

Table 2: GRaBTAM Parameters

Social discount rate		12%	pa	
Appraisal period:	from ...	2012		
	to	2036	[a]	
Time profile [b]	*2012*	*2013*	*2014*	
Investment	80%	20%		
Cargo volume		50%	80%	
Economic conversion factors				
General		0.80		
Civil works		0.80		
Rolling stock		0.80		
Fuel & lubricants		0.80		
Labour		1.00		
Fees & bribes		1.00		
External logistics costs		*Rail*	*Road*	
€/net tonne-km [c]		0.003	0.015	
CO_2 emission	*€/t of*	*CO_2 g/NTK*		
costs [d,e]	*CO_2*	*Rail*	*Road*	
Year 2010	25	23	70	
2020	40	22	65	
2030	55	20	60	
2040	70	18	55	
Distances (km)		*Rail*	*Road*	
Poti-Baku (1 way)		785	850	
Local delivery/collection [f]				
Proportion of cargo		15%		
Transfer cost		100	€/TEU	
Local transport cost		52	€/TEU	
Extra locomotive for hills [g]				
Incremental cost		0	€/train	
Without-project scenario				
Block train cargo would be carried by other means, as follows (TEU/y):				
Existing rail services		15,000		
Road haulage		50,480		

Container specifications			
Tare per TEU		2.20	t
Average payload per TEU		7.80	t
Block train specifications			
Locomotives per train		2	
Platforms per train		56	
Capacity: TEU per platform		2	
Factor for platforms waiting		2.00	
Utilisation factor		0.80	
Truck specifications			
Capacity: TEU per truck		2	
Annual distance covered		60,000	km
Utilisation factor		0.80	
Asset capital costs (financial)			
Locomotives		1,300	€'000
Flatcars/platforms		20	€'000
Road vehicles (trucks)		25	€'000
Scrap value		20%	x cost
Asset life			
Locomotives		30	years
Platforms		50	years
Trucks		6	years
Amortisation option (D or E)		D	[h]
Train operations: with project			
Round-trip time per train		3	days
Trains per week (round-trips) ...		7	
Railway productivity: without project			
Task capacity/train/year		130,000	kNTK
Sensitivity tests			
0	Base Case		
1	Capital costs	20%	higher
2	Rail operating costs	20%	higher
3	Road operating costs	20%	lower
4	External costs incl CO_2	50%	lower
	Selected case	**0**	

Footnotes

a The model allows a maximum appraisal period of 40 years.

b Percentage of investment undertaken in each of the first 3 years of the appraisal period; and the proportion of potential benefits realised in each of those years. Full realisation of potential benefits by the 4th year is assumed.

c From the EC's Marco Polo calculator. 2010 figures factored by 1.05 for inflation, and by 0.95 to remove CO_2 emissions costs which are calculated separately following EC guidelines.

d The projected market price of CO_2 emissions permits is taken from EC guidelines.

e Emissions per tonne-kilometre in 2010 are estimated from various sources, and reduced at the rate of 7.5% per decade to allow for continuous development of greener technology.

f A proportion of block-train traffic will be for local delivery or collection, giving rise to additional costs for intermodal transfer and road transport. Where a container is transported several hundred km by road the same vehicle will collect/deliver en route at no additional cost.

g The incremental cost of an assist locomotive for the steepest section of the route.

h D = Data as peovided by GR and road hauliers.
E = Equated annuity computed here, incorporating depreciation and the cost of capital.

- Block train operations are defined by the scheduled round-trip time for a train and the number of scheduled round-trips per week. Seven round-trips per week means a daily departure from Poti and a daily departure from Baku.
- The productivity of the present train service, which is assumed to continue in the without-project case, is defined as the achievable annual task expressed in net tonne-kilometres (NTK). The same utilisation factor is applied as to the block train service.
- Four standard sensitivity tests are defined, all adverse to the proposed project: higher capital costs, higher railway operating costs, lower road operating costs and lower external costs.

There are some implicit assumptions too:

- Railway operating costs per NTK are the same on the Azerbaijani side of the border as in Georgia, the two railway systems having been part of a single system until 20 years ago.
- The annual cargo capacity of the block train service will remain unchanged throughout the appraisal period, irrespective of changing technologies and other sources of improved productivity.
- The block train service is competitive with road freight with respect to quality, speed and reliability. Rail freight is already competitive with respect to price, with a tariff equivalent to about €1,040 to carry a full TEU between Poti and Baku and return the empty box (including station fees). This is 20% below the normal tariff for the same service by truck.

6 OPERATING COSTS

Operating cost data have been supplied by GR and the road haulage industry (via the Ministry of Economic and Sustainable Development). Railway costs are shown in Table 3 and road costs in Table 4. The analyst has made a number of adjustments to ensure a) completeness; b) expression of all values in both financial and economic terms and at 2011 prices; and c) consistent treatment of rail costs and road costs:

- The tables show costs as supplied, in € per 1,000 NTK in the case of rail and in € per 1,000 TEU-km in the case of road. The latter are derived from cost estimates for a round-trip of 1,840km (Poti-Baku-Poti, before the shift of Baku port to Alyat).
- An estimate was made of the proportion of costs in each category which is both relevant to the analysis and variable with respect to cargo volume.
- In consultation with GR, cost data were used either for 2010, for 2011 (annualised) or for both years (averaged). This is explained in a footnote to the table.
- Amortisation costs for railway infrastructure, rolling stock etc are as supplied by GR; they include the cost of capital, but at a much lower rate than the social discount rate used in this analysis. The road haulage industry provided an estimate of vehicle depreciation costs; the analyst has added the inferred cost of capital to have a total amortisation cost.
- When amortisation option ‘E’ is selected (as explained above) an alternative set of rail amortisation cost estimates is used in the analysis, and the inferred cost of capital is added to the road depreciation costs.

Not surprisingly, variable costs are much lower for rail than for road. The difference is most dramatic for energy: diesel fuel costs are a full order of magnitude higher for road transport than electricity costs for rail transport. In part this is because GR buys electricity at less than €0.04 per kWh which, since Georgia depends mainly on hydro-electric power, is probably a true reflection of the marginal cost of production. But the main reason is that rail is inherently more energy-efficient. It is also a more efficient user of capital and labour.

Road hauliers also incur border crossing expenses (36% formal and 64% informal) that are alone equivalent to the whole variable cost of rail transport on this route.

Table 3: Rail Freight Operating Costs

Rail costs	GEL'000		€/1000NTK [a,b,c]					Variable €/1000 NTK		
	2010	2011[d]	2010	2011[d]	Ave	%	[e]		Economic	
Capital amortisation [f]										
Infrastructure										
Track	18,793	10,453	1.30	1.00	1.17	67%	A	0.78	0.63	9%
Bridges	4,115	2,980	0.28	0.28	0.28	10%	A	0.03	0.02	0%
Signals	1,232	841	0.09	0.08	0.08	10%	A	0.01	0.01	0%
Electrical	8,535	5,907	0.62	0.59	0.61	67%	A	0.41	0.33	5%
Rolling stock										
Locomotives	21,713	15,865	1.50	1.51	1.51	95%	A	1.43	1.15	17%
Freight wagons	20,287	13,373	1.40	1.27	1.35	95%	A	1.28	1.03	16%
Other (freight share)	2,917	2,177	0.20	0.21	0.20	67%	A	0.14	0.11	2%
Operations										
Electricity	18,680	15,637	1.36	1.57	1.45	100%	1	1.57	1.25	19%
Diesel oil	7,234	5,004	0.50	0.48	0.49	0%	1	0.00	0.00	0%
Labour	50,692	30,373	3.51	2.89	3.25	30%	1	0.87	0.87	13%
Handling & storage	4,263	3,364	0.30	0.32	0.31	100%	1	0.32	0.26	4%
Overheads	18,291	23,656	1.27	2.25	1.68	30%	1	0.68	0.54	8%
Maintenance										
Infrastructure	767	2,343	0.05	0.22	0.12	50%	1	0.11	0.09	1%
Rolling stock	3,321	5,518	0.23	0.53	0.35	80%	1	0.42	0.34	5%
Total	180,840	137,491	12.61	13.21	12.87			8.04	6.61	
Equivalent to €/TEU/1000km								80	66	

Footnotes

a Task in million net tonne-km (NTK) ……. 6,228 in 2010 and ….. 4,523 in 2011 (9 months).

b Exchange rate (GEL/EUR) …… 2.32

c Electric trains are estimated to be responsible for …….. 95% of the freight task.

d January-September

e 0 = 2010 figure, 1 = 2011 figure, A = Average of 2010 & 2011.

f An alternative estimate has been made as follows... For rolling-stock, an equated annuity using 2011 capital costs and a discount rate of 12%pa; for infrastructure and other assets the data provided have been factored by …….. 2.5 to allow for methodological differences and a hgher discount rate in the present analysis.

Table 4: Road Freight Operating Costs

Road costs	€/TEU Poti-Baku [a]	€/TEU /1000km [b]	Variable %	Variable €/TEU /1000km	Variable Economic	
Capital amortisation [c]						
Vehicle						
Depreciation	65.70	38.65	95%	36.71	29.37	5%
Capital return		24.69	95%	23.46	18.77	3%
Operations						
Fuel	562.30	330.76	95%	314.23	251.38	45%
Lubricants	29.20	17.18	95%	16.32	13.05	2%
Permits, insurance	73.00	42.94	50%	21.47	21.47	4%
Driver's wages	87.60	51.53	95%	48.95	48.95	9%
Driver's expenses	51.10	30.06	95%	28.56	22.84	4%
Maintenance etc	105.80	62.24	80%	49.79	39.83	7%
Overheads	73.00	42.94	30%	12.88	10.31	2%
Border crossing expenses						
Official	65.70	38.65	100%	38.65	38.65	7%
Unofficial	116.80	68.71	100%	68.71	68.71	12%
Total €/TEU/1000km	1,230	748		660	563	

Footnotes

a Costs for a round-trip with a full container and an empty as backload.

b Normalised to 1000km with addition of the cost of capital invested in the vehicle, computed as the difference between i) an equated annuity to amortise the vehicle's capital cost over its expected life and ii) depreciation as reported by the industry.

c Depreciation figures are as provided by the industry. The row labelled 'Capital return' is the difference between those provided figures and an equated annuity using the capital cost and asset life listed under parameters and a discount rate of 12%pa.

7 RESULTS

By combining all the above estimates and assumptions one has a 25-year projection of the cost of carrying out a defined transport task in the without-project case, and another for carrying out the same task in the with-project case. The first 10 years of this projection are presented in four tables at the end of this document:

Amortisation/depreciation costs	*Financial*	*Economic*
Data as provided by GR and the road hauliers ('D' option)	Table 7	Table 9
Estimated by the analyst (Option 'E')	Table 78	Table 10

At the bottom of each table is a set of standard economic performance indicators:

- Economic internal rate of return (EIRR).
- Net present value (NPV).
- Benefit:cost ratio (BCR).

In all four cases the proposed block-train project is shown to be socially very profitable – so much so that the EIRR is a meaningless figure. These results should be read with the following remarks in mind:

- It has been assumed, in consultation with GR, that investment in the block-train service will not extend beyond rolling-stock. No provision has been made for additional investment in infrastructure or equipment.
- It is possible to make only broad estimates of the long-run marginal cost of running freight trains on railway tracks and heavy goods vehicles on roads.
- Maintenance costs for railway infrastructure and rolling-stock are based on actual expenditure in 2010 and the first three quarters of 2011. This level of expenditure may not be enough to keep the assets in good condition throughout their expected economic lives.
- The estimated variable proportion of each cost category is the result of judgement rather than analysis.

Summary results of the Base Case analysis and sensitivity tests are presented in Table 5 and 6 below.

Table 5: Summary Results for Amortisation Option D

		Base Case	Capital +20%	Railway costs +20%	Road costs – 20%	External costs – 50%
Financial	EIRR (%pa)	135%	116%	133%	114%	124%
	NPV (€M)	179	176	175	145	159
	BCR	14.2	11.7	13.9	11.5	12.7
Economic	EIRR (%pa)	121%	104%	119%	103%	110%
	NPV (€M)	156	153	153	127	137
	BCR	12.4	10.1	12.1	10.0	10.8

Table 6: Summary Results for Amortisation Option E

		Base Case	Capital +20%	Railway costs +20%	Road costs – 20%	External costs – 50%
Financial	EIRR (%pa)	138%	119%	136%	117%	127%
	NPV (€M)	184	181	180	148	164
	BCR	14.6	12.0	14.3	11.8	13.0
Economic	EIRR (%pa)	125%	107%	123%	106%	113%
	NPV (€M)	161	158	157	131	141
	BCR	12.8	10.5	12.9	10.4	11.2

8 CONCLUSIONS

Even if the extent of investment in the block-train service and its operating costs have been substantially underestimated, the proposal appears to be justified economically. It should be proceeded with as soon as possible, together with complementary measures to ensure efficient operation. In particular:

- Negotiations should be commenced with the Azerbaijani authorities regarding border formalities, port access and handling within the port.
- Railway timetables and procedures on both sides of the border should be reviewed to ensure that the block-train service suffers no delays (other than those caused by emergencies).

Table 7: Results for Base Case, Financial Values and Amortisation Option D

Case: **Base Case** *€'000 at constant 2011 prices*

Without Project	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Railway costs										
Incremental infrastructure costs										
Amortisation [a]	0	112	112	112	112	112	112	112	112	112
Maintenance	0	50	50	50	50	50	50	50	50	50
Incremental operating costs										
Energy for train operation	0	185	185	185	185	185	185	185	185	185
Labour	0	102	102	102	102	102	102	102	102	102
Rolling stock amortisation [a]	0	319	319	319	319	319	319	319	319	319
Rolling stock maintenance	0	50	50	50	50	50	50	50	50	50
Handling & storage	0	38	38	38	38	38	38	38	38	38
Overheads etc	0	80	80	80	80	80	80	80	80	80
Local delivery/collection	0	342	342	342	342	342	342	342	342	342
Extra locomotive for hills	0	0	0	0	0	0	0	0	0	0
External logistics costs										
CO2 emissions	0	172	288	376	391	407	422	437	452	465
Other costs	0	353	353	353	353	353	353	353	353	353
Road costs										
Vehicle costs										
Amortisation [a]	0	554	1,167	1,575	1,575	1,575	1,575	1,575	1,575	1,575
Operation	0	6,477	13,649	18,430	18,430	18,430	18,430	18,430	18,430	18,430
Maintenance	0	751	1,582	2,136	2,136	2,136	2,136	2,136	2,136	2,136
Other costs to operator										
Administration	0	194	409	553	553	553	553	553	553	553
Border crossings	0	1,619	3,411	4,606	4,606	4,606	4,606	4,606	4,606	4,606
External logistics costs										
CO2 emissions	0	305	670	941	977	1,013	1,048	1,082	1,116	1,149
Other costs	0	2,202	4,639	6,265	6,265	6,265	6,265	6,265	6,265	6,265

With Project	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Railway costs										
Incremental infrastructure costs										
Amortisation [a]	0	245	393	491	491	491	491	491	491	491
Maintenance	0	108	173	216	216	216	216	216	216	216
Capital costs										
Rolling stock	11,616	2,904	0	0	0	0	0	0	0	0
Incremental operating costs										
Energy for train operation	0	403	645	806	806	806	806	806	806	806
Labour	0	223	357	446	446	446	446	446	446	446
Rolling stock depreciation[not applicable: rolling stock capital costs are already included in the analysis]										
Rolling stock maintenance	0	108	173	216	216	216	216	216	216	216
Handling & storage	0	82	132	165	165	165	165	165	165	165
Overheads etc	0	174	278	348	348	348	348	348	348	348
Local delivery/collection	0	746	1,194	1,493	1,493	1,493	1,493	1,493	1,493	1,493
Extra locomotive for hills	0	0	0	0	0	0	0	0	0	0
External logistics costs										
CO2 emissions	0	172	288	376	391	407	422	437	452	465
Other costs	0	771	1,234	1,542	1,542	1,542	1,542	1,542	1,542	1,542
Total without-project costs	0	13,903	27,446	36,513	36,565	36,615	36,666	36,715	36,764	36,809
Total with-project costs	11,616	5,938	4,867	6,099	6,115	6,130	6,145	6,161	6,176	6,188
Net project benefits	-11,616	7,965	22,579	30,414	30,450	30,485	30,520	30,554	30,588	30,621

Economic performance indicators

Economic internal rate of return (EIRR) ……	135% pa
Net present value (NPV) ……	179 € million
Benefit : cost ratio (BCR) ……	14.18

a Amortisation costs as provided by GR and the road hauliers (option D).

Table 8: Results for Base Case, Financial Values and Amortisation Option E

Case: **Base Case** *€'000 at constant 2011 prices*

Without Project	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Railway costs										
Incremental infrastructure costs										
Amortisation [a]	0	281	281	281	281	281	281	281	281	281
Maintenance	0	50	50	50	50	50	50	50	50	50
Incremental operating costs										
Energy for train operation	0	185	185	185	185	185	185	185	185	185
Labour	0	102	102	102	102	102	102	102	102	102
Rolling stock amortisation [a]	0	637	637	637	637	637	637	637	637	637
Rolling stock maintenance	0	50	50	50	50	50	50	50	50	50
Handling & storage	0	38	38	38	38	38	38	38	38	38
Overheads etc	0	80	80	80	80	80	80	80	80	80
Local delivery/collection	0	342	342	342	342	342	342	342	342	342
Extra locomotive for hills	0	0	0	0	0	0	0	0	0	0
External logistics costs										
CO2 emissions	0	172	288	376	391	407	422	437	452	465
Other costs	0	353	353	353	353	353	353	353	353	353
Road costs										
Vehicle costs										
Amortisation [a]	0	907	1,912	2,582	2,582	2,582	2,582	2,582	2,582	2,582
Operation	0	6,477	13,649	18,430	18,430	18,430	18,430	18,430	18,430	18,430
Maintenance	0	751	1,582	2,136	2,136	2,136	2,136	2,136	2,136	2,136
Other costs to operator										
Administration	0	194	409	553	553	553	553	553	553	553
Border crossings	0	1,619	3,411	4,606	4,606	4,606	4,606	4,606	4,606	4,606
External logistics costs										
CO2 emissions	0	305	670	941	977	1,013	1,048	1,082	1,116	1,149
Other costs	0	2,202	4,639	6,265	6,265	6,265	6,265	6,265	6,265	6,265

With Project	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Railway costs										
Incremental infrastructure costs										
Amortisation [a]	0	613	981	1,227	1,227	1,227	1,227	1,227	1,227	1,227
Maintenance	0	108	173	216	216	216	216	216	216	216
Capital costs										
Rolling stock	11,616	2,904	0	0	0	0	0	0	0	0
Incremental operating costs										
Energy for train operation	0	403	645	806	806	806	806	806	806	806
Labour	0	223	357	446	446	446	446	446	446	446
Rolling stock amortisation[not applicable: rolling stock capital costs are already included in the analysis]										
Rolling stock maintenance	0	108	173	216	216	216	216	216	216	216
Handling & storage	0	82	132	165	165	165	165	165	165	165
Overheads etc	0	174	278	348	348	348	348	348	348	348
Local delivery/collection	0	746	1,194	1,493	1,493	1,493	1,493	1,493	1,493	1,493
Extra locomotive for hills	0	0	0	0	0	0	0	0	0	0
External logistics costs										
CO2 emissions	0	172	288	376	391	407	422	437	452	465
Other costs	0	771	1,234	1,542	1,542	1,542	1,542	1,542	1,542	1,542
Total without-project costs	0	14,743	28,678	38,006	38,057	38,108	38,159	38,208	38,257	38,302
Total with-project costs	11,616	6,306	5,455	6,835	6,851	6,866	6,881	6,897	6,912	6,924
Net project benefits	-11,616	8,437	23,222	31,171	31,207	31,242	31,277	31,311	31,345	31,378

Economic performance indicators

Economic internal rate of return (EIRR) ……	138% pa
Net present value (NPV) ……	184 € million
Benefit : cost ratio (BCR) ……	14.58

a Amortisation costs as estimated for this analysis (option E).

Table 9: Results for Base Case, Economic Values and Amortisation Option D

Case: **Base Case** *€'000 at constant 2011 prices*

Without Project	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Railway costs										
Incremental infrastructure costs										
Amortisation [a]	0	90	90	90	90	90	90	90	90	90
Maintenance	0	40	40	40	40	40	40	40	40	40
Incremental operating costs										
Energy for train operation	0	148	148	148	148	148	148	148	148	148
Labour	0	102	102	102	102	102	102	102	102	102
Rolling stock amortisation [a]	0	256	256	256	256	256	256	256	256	256
Rolling stock maintenance	0	40	40	40	40	40	40	40	40	40
Handling & storage	0	30	30	30	30	30	30	30	30	30
Overheads etc	0	64	64	64	64	64	64	64	64	64
Local delivery/collection	0	342	342	342	342	342	342	342	342	342
Extra locomotive for hills	0	0	0	0	0	0	0	0	0	0
External logistics costs										
CO2 emissions	0	172	288	376	391	407	422	437	452	465
Other costs	0	353	353	353	353	353	353	353	353	353
Road costs										
Vehicle costs										
Amortisation [a]	0	443	933	1,260	1,260	1,260	1,260	1,260	1,260	1,260
Operation	0	5,394	11,366	15,348	15,348	15,348	15,348	15,348	15,348	15,348
Maintenance	0	601	1,266	1,709	1,709	1,709	1,709	1,709	1,709	1,709
Other costs to operator										
Administration	0	155	327	442	442	442	442	442	442	442
Border crossings	0	1,619	3,411	4,606	4,606	4,606	4,606	4,606	4,606	4,606
External logistics costs										
CO2 emissions	0	305	670	941	977	1,013	1,048	1,082	1,116	1,149
Other costs	0	2,202	4,639	6,265	6,265	6,265	6,265	6,265	6,265	6,265

With Project	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Railway costs										
Incremental infrastructure costs										
Amortisation [a]	0	196	314	393	393	393	393	393	393	393
Maintenance	0	86	138	173	173	173	173	173	173	173
Capital costs										
Rolling stock	11,616	2,904	0	0	0	0	0	0	0	0
Incremental operating costs										
Energy for train operation	0	323	516	645	645	645	645	645	645	645
Labour	0	223	357	446	446	446	446	446	446	446
Rolling stock depreciation[not applicable: rolling stock capital costs are already included in the analysis]										
Rolling stock maintenance	0	86	138	173	173	173	173	173	173	173
Handling & storage	0	66	105	132	132	132	132	132	132	132
Overheads etc	0	139	222	278	278	278	278	278	278	278
Local delivery/collection	0	746	1,194	1,493	1,493	1,493	1,493	1,493	1,493	1,493
Extra locomotive for hills	0	0	0	0	0	0	0	0	0	0
External logistics costs										
CO2 emissions	0	172	288	376	391	407	422	437	452	465
Other costs	0	771	1,234	1,542	1,542	1,542	1,542	1,542	1,542	1,542
Total without-project costs	0	12,354	24,365	32,412	32,463	32,514	32,565	32,614	32,662	32,708
Total with-project costs	11,616	5,714	4,508	5,651	5,666	5,682	5,697	5,712	5,727	5,740
Net project benefits	-11,616	6,640	19,857	26,761	26,797	26,833	26,867	26,902	26,935	26,968

Economic performance indicators

Economic internal rate of return (EIRR) ……	121% pa
Net present value (NPV) ……	156 € million
Benefit : cost ratio (BCR) ……	12.37

a Amortisation costs as provided by GR and the road hauliers (option D).

Table 10: Results for Base Case, Economic Values and Amortisation Option E

Case: **Base Case** *€'000 at constant 2011 prices*

Without Project	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Railway costs										
Incremental infrastructure costs										
Amortisation [a]	0	225	225	225	225	225	225	225	225	225
Maintenance	0	40	40	40	40	40	40	40	40	40
Incremental operating costs										
Energy for train operation	0	148	148	148	148	148	148	148	148	148
Labour	0	102	102	102	102	102	102	102	102	102
Rolling stock amortisation [a]	0	637	637	637	637	637	637	637	637	637
Rolling stock maintenance	0	40	40	40	40	40	40	40	40	40
Handling & storage	0	30	30	30	30	30	30	30	30	30
Overheads etc	0	64	64	64	64	64	64	64	64	64
Local delivery/collection	0	342	342	342	342	342	342	342	342	342
Extra locomotive for hills	0	0	0	0	0	0	0	0	0	0
External logistics costs										
CO2 emissions	0	172	288	376	391	407	422	437	452	465
Other costs	0	353	353	353	353	353	353	353	353	353
Road costs										
Vehicle costs										
Amortisation [a]	0	726	1,530	2,066	2,066	2,066	2,066	2,066	2,066	2,066
Operation	0	5,394	11,366	15,348	15,348	15,348	15,348	15,348	15,348	15,348
Maintenance	0	601	1,266	1,709	1,709	1,709	1,709	1,709	1,709	1,709
Other costs to operator										
Administration	0	155	327	442	442	442	442	442	442	442
Border crossings	0	1,619	3,411	4,606	4,606	4,606	4,606	4,606	4,606	4,606
External logistics costs										
CO2 emissions	0	305	670	941	977	1,013	1,048	1,082	1,116	1,149
Other costs	0	2,202	4,639	6,265	6,265	6,265	6,265	6,265	6,265	6,265

With Project	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Railway costs										
Incremental infrastructure costs										
Amortisation [a]	0	491	785	981	981	981	981	981	981	981
Maintenance	0	86	138	173	173	173	173	173	173	173
Capital costs										
Rolling stock	11,616	2,904	0	0	0	0	0	0	0	0
Incremental operating costs										
Energy for train operation	0	323	516	645	645	645	645	645	645	645
Labour	0	223	357	446	446	446	446	446	446	446
Rolling stock amortisation[not applicable: rolling stock capital costs are already included in the analysis]										
Rolling stock maintenance	0	86	138	173	173	173	173	173	173	173
Handling & storage	0	66	105	132	132	132	132	132	132	132
Overheads etc	0	139	222	278	278	278	278	278	278	278
Local delivery/collection	0	746	1,194	1,493	1,493	1,493	1,493	1,493	1,493	1,493
Extra locomotive for hills	0	0	0	0	0	0	0	0	0	0
External logistics costs										
CO2 emissions	0	172	288	376	391	407	422	437	452	465
Other costs	0	771	1,234	1,542	1,542	1,542	1,542	1,542	1,542	1,542
Total without-project costs	0	13,153	25,478	33,733	33,785	33,836	33,886	33,936	33,984	34,030
Total with-project costs	11,616	6,008	4,979	6,240	6,255	6,271	6,286	6,301	6,316	6,329
Net project benefits	-11,616	7,145	20,499	27,494	27,530	27,566	27,601	27,635	27,668	27,701

Economic performance indicators

Economic internal rate of return (EIRR) ……	125% pa
Net present value (NPV) ……	161 € million
Benefit : cost ratio (BCR) ……	12.75

a Amortisation costs as estimated for this analysis (option E).