Sustainable Road Financing in Developing Countries:

A Pragmatic Cost-Revenue Model

General methodology and examples for Ghana and Namibia

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Presentation Overview

1. explain the concepts of
   - "User contribution" versus
   - "Fund allocation"
2. life-cycle road network costing
3. present assessment methodology
4. illustrate with examples
   - Ghana (detail)
   - Namibia (results)
5. calculate performance indicators
6. conclusions

"Fund allocation"

- Guiding question: ***Are sufficient funds allocated for financing road network life cycle costs?***
  - Maintenance of current transport network
  - Extension / quality improvement
  - Asset replacement
- Sufficient funding for maintenance is **crucial for the sustainability** of FC projects
  (which often focus on rehabilitation / major reconstruction)
- Sources of funds (budget, users, donors) not as important as **adequacy** and **reliability** of funding

"User contribution" (cost recovery)

- Guiding question: ***To what extent does the user contribute towards road financing?***
  - Maintenance of current road network
  - Rehabilitation / extension / quality improvement
  - Asset replacement
  - Cost of capital / interest
- Crucial for
  - **Fiscal space**, donor dependency (-> poverty!)
  - Distortions in **resource allocation** (transport demand, choice of transport mode, "subsidies to the rich", environment, etc.)

Fund Allocation & User Contribution

- see KfW Policy Documents

  Sustainable Transport Financing: Strengthening market economy structures, calling for counterpart efforts

  (http://www.kfw-entwicklungsbank.de/EN/Service/Onlinelibr23/TopicsofDi.jsp)

Proposed assessment methodology

- estimate the entire **funding needs** of a country's road network → network life cycle costing
- assess the **extent to which users contribute** to network financing
- assess **available funding** for the road network

➢ calculate basic **performance indicators** (-> benchmarking)

Two Scenarios

- "**Base Scenario**": Maintaining theoretically “new” roads

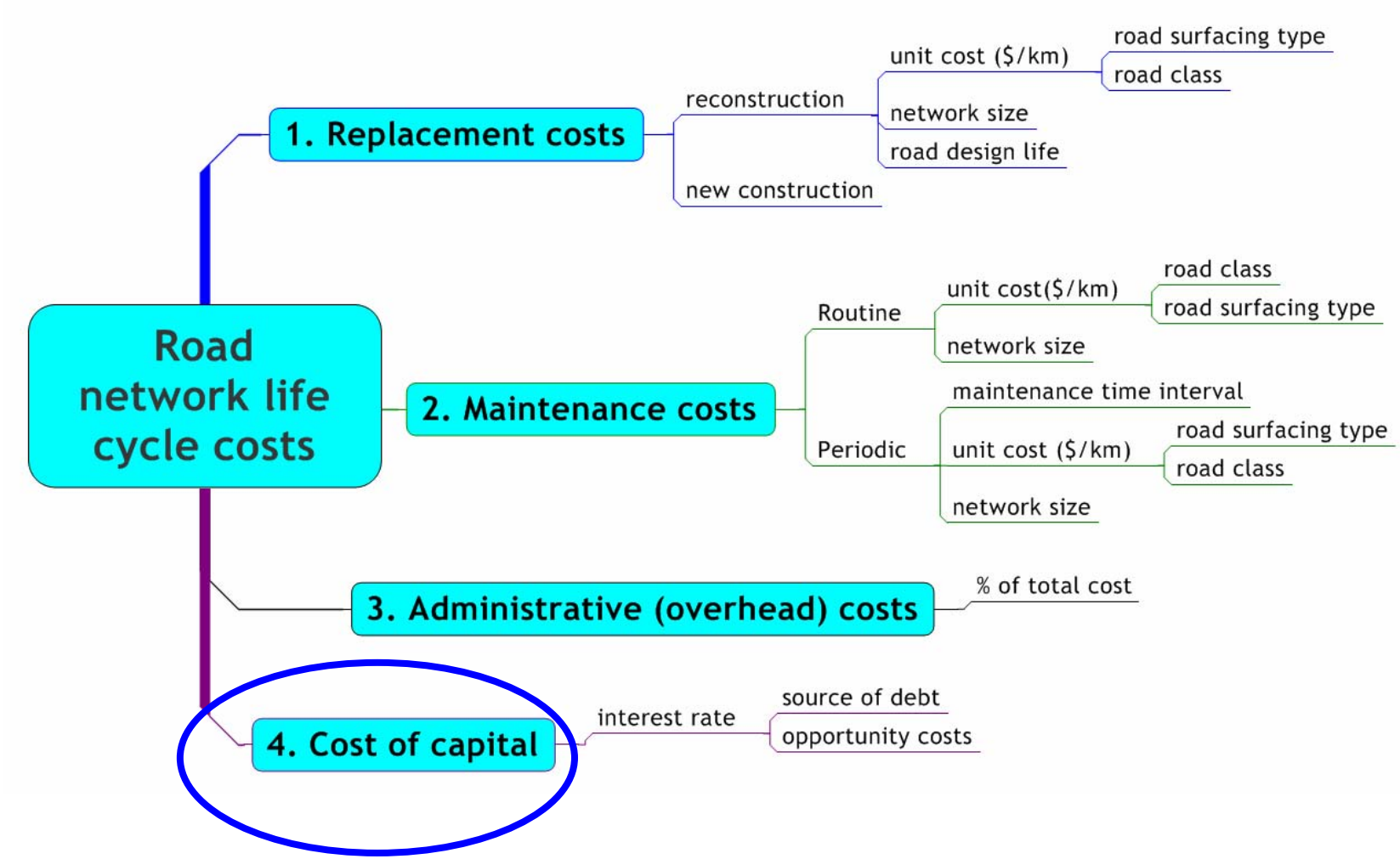
  → no rehabilitation or clearing of backlogs

  Idea: If donors were to help a country rehabilitate its (core) network:

  - ***Would the country be able to maintain it?***
  - ***To what extent will users pay for maintaining it?***
- "**Extended scenario**": Bringing existing road network to “good” condition

  →require rehabilitation and clearing backlogs

Cost Components



„Cost of capital" / interest

- Possible **interpretations / justifications**:
  - The government expects some **minimum return on investment** when building transport infrastructure (otherwise it invests the money elsewhere)
  - in order to improve transport infrastructure **the government takes a loan** that has to be serviced
  - The transport sector is perceived as a **business** that must generate returns on investment

„Cost Capital" / Interest
(continued)

- What is the "**right interest rate**"?
  - 0%: only loan repayment, no interest
  - 3%: "minimum" return on investment (ROI)
    (FC: 3% = minimum economic ROI for projects
    in very poor developing countries)
  - 6%: "normal" ROI
    (FC: 6% = normal economic ROI for projects in DCs)
  - > 6%: "business" ROI
- Interest rate used in examples: 0%

Example 1a – Ghana 2004 / 2005 (base scenario)

Costs / funding needs

- Routine Maintenance
- Periodic Maintenance
- Asset Replacement
- Financial cost

User contribution

- Vehicle Registration
- Vehicle Tax
- Fuel Tax
- International Transit
- Tolls

Ghana: Base Scenario COSTS

Road class	Network Size (2003)	Routine maint. costs		Asset replacement costs					Periodic maintenance costs					Total maint	Annual life-cycle costs	
Surface type	km	US$/ km/year	US$m /year	US$/km	years	US$m	US$/km /year	US$m /year	US$ /km	years	US$m	US$/km /year	US$m /year	US$m /year	US$m /year	Asset cost
Trunk Roads	**12,694**		**13.3**			**3,493.2**	**275,185**	**137.6**			**425.1**	**4,865**	**61.8**	**75.0**	**212.7**	**6.1%**
Asphalt	1,604	1,147	1.8	500,000	30	801.9	499,938	26.7	110,00	12	176.4	9,167	14.7	16.5	43.3	5.4%
Bituminous	4,733	1,043	4.9	300,000	30	1,419.9	300,000	47.3	23,000	9	108.9	2,556	12.1	17.0	64.4	4.5%
Gravel	6,357	1,022	6.5	200,000	20	1,271.4	200,000	63.6	22,000	4	139.9	5,500	35.0	41.5	105.0	8.3%
Urban Roads	**4,064**		**7.3**			**796.2**	**195,915**	**31.3**			**107.2**	**3,746**	**15.2**	**22.5**	**53.8**	**6.8%**
Asphalt	413	1,907	0.8	404,422	30	167.0	404,358	5.6	83,555	12	34.5	6,963	2.9	3.7	9.2	5.5%
Bituminous	1,522	1,907	2.9	227,342	30	346.0	227,332	11.5	27,580	9	42.0	3,064	4.7	7.6	19.1	5.5%
Gravel	2,129	1,700	3.6	133,02	20	283.2	133,020	14.2	14,436	4	30.7	3,609	7.7	11.3	25.5	9.0%
Feeder Roads	**32,611**		**13.0**			**872.8**	**26,764**	**43.5**			**149.1**	**1,190**	**38.8**	**51.8**	**95.4**	**10.9%**
Bituminous	1,214	470	0.6	141,333	30	171.6	141,351	5.7	16,224	9	19.7	1,803	2.2	2.8	8.5	4.9%
Gravel	17,766	470	8.4	30,000	20	533.0	30,000	26.6	6,324	4	112.4	1,581	28.1	36.4	63.1	11.8%
Earth	13,630	300	4.1	12,336	15	168.1	12,333	11.2	1,250	2	17.0	625	8.5	12.6	23.8	14.2%
Total	**49,369**		**33.6**			**5,162.2**	**104,564**	**212.5**			**425.1**	**9,800**	**115.8**	**149.4**	**361.8**	**7.0%**
Adm. costs			1.7					10.6					5.8	7.5	18.1	
Grand total			**35.3**			**5,162.2**		**223.1**			**425.1**	**9,800**	**121.6**	**156.8**	**379.9**	**7.4%**

Example 1b – Ghana (extended scenario)

Costs / funding needs

- Routine Maintenance
- Periodic Maintenance
- Asset Replacement
- ➢Clearing backlogs
- Interest

User contribution

- Vehicle Registration
- Vehicle Tax
- Fuel Tax
- International Transit
- Tolls

Ghana: Extended Scenario COSTS

Road Surface Type	Network Condition	Network Needs	Network Length [2003]		Cost of clearing backlog			Annual maintenance costs							Asset Replacement costs		Total Annual Costs
								Routine		Periodic				R+P			
			km	%	US$/km	US$m	US$m/yr	US$/km/yr	US$m/yr	US$/km	US$m	Years	US$m/yr	US$m/yr	US$/km	US$m/yr	US$m/yr
Asphatic			**2.017**	**4%**		**148,4**	**14,8**		**2,6**		**210,9**		**17,6**	**20,2**		**32,3**	**67,3**
	Poor	*Reconstruct*	*236*	*12%*	*446.568*	*105,6*	*10,6*	*1.572*	*0,4*	*95.216*	*22,5*	*12*	*1,9*	*2,2*	*446.568*	*3,5*	*16,3*
	Fair	*Overlay*	*415*	*21%*	*103.163*	*42,8*	*4,3*	*1.344*	*0,6*	*103.163*	*42,8*	*12*	*3,6*	*4,1*	*446.568*	*6,6*	*15,0*
	Good	*"Do nothing"*	*1.365*	*68%*				*1.244*	*1,7*	*106.640*	*145,6*	*12*	*12,1*	*13,8*	*446.568*	*22,2*	*36,0*
Bituminous			**7.469**	**15%**		**502,9**	**50,3**		**8,4**		**170,5**		**18,9**	**27,4**		**64,6**	**142,2**
	Poor	*Reconstruct*	*1.772*	*24%*	*253.945*	*450,1*	*45,0*	*1.186*	*2,1*	*23.144*	*41,0*	*9*	*4,6*	*6,7*	*253.945*	*15,0*	*66,7*
	Fair	*Resurface*	*2.283*	*31%*	*23.109*	*52,8*	*5,3*	*1.135*	*2,6*	*23.109*	*52,8*	*9*	*5,9*	*8,5*	*253.945*	*20,7*	*34,4*
	Good	*"Do nothing"*	*3.414*	*46%*				*1.089*	*3,7*	*22.484*	*76,8*	*9*	*8,5*	*12,2*	*253.945*	*28,9*	*41,2*
Gravel			**26.252**	**53%**		**1.371,5**	**137,2**		**18,5**		**282,9**		**70,7**	**89,2**		**104,4**	**330,7**
	Poor	*Reconstruct*	*14.857*	*57%*	*87.187*	*1.295,3*	*129,5*	*751*	*11,2*	*11.450*	*170,1*	*4*	*42,5*	*53,7*	*87.187*	*64,8*	*248,0*
	Fair	*Regravel*	*7.327*	*28%*	*10.399*	*76,2*	*7,6*	*638*	*4,7*	*10.399*	*76,2*	*4*	*19,0*	*23,7*	*87.187*	*27,3*	*58,7*
	Good	*"Do nothing"*	*4.068*	*15%*			*0,0*	*648*	*2,6*	*9.005*	*36,6*	*4*	*9,2*	*11,8*	*87.187*	*12,3*	*24,1*
Earth			**13.630**	**28%**		**92,5**	**9,3**		**4,1**		**17,0**		**8,5**	**12,6**		**11,2**	**33,1**
	Poor	*Reconstruct*	*7.088*	*52%*	*12.336*	*87,4*	*8,7*	*300*	*2,1*	*1.250*	*8,9*	*2*	*4,4*	*6,6*	*12.336*	*5,8*	*21,1*
	Fair	*Regravel*	*4.089*	*30%*	*1.250*	*5,1*	*0,5*	*300*	*1,2*	*1.250*	*5,1*	*2*	*2,6*	*3,8*	*12.336*	*3,4*	*7,7*
	Good	*"Do nothing"*	*2.453*	*18%*				*300*	*0,7*	*1.250*	*3,1*	*2*	*1,5*	*2,3*	*12.336*	*2,0*	*4,3*
Total			**49.369**	**100%**		**2.115,3**	**211,5**		**33,6**		**681,4**		**115,8**	**149,4**		**212,5**	**573,4**
Adm. Costs (5%)						105,8	10,6		1,7		34,1		5,8	7,5		10,6	28,7
Total with adm.						**2221,1**	**222,1**		**35,3**		**715,5**		**121,6**	**156,8**		**223,1**	**602,0**

Ghana: Life Cycle Costs

Road class/ surface type	Cost of clearing backlog		Annual maintenance costs	Annual Asset replacement costs	Annual life cycle costs
	Total	Over10years			
	US$m	US$m/year	US$m/year	US$m/year	US$m/year
Trunk roads	**1,271**	**127.1**	**75.0**	**137.6**	**339.7**
Asphalt	86	8.6	16.5	26.7	51.8
Bituminous	336	33.6	17.0	47.3	97.9
Gravel	848	84.8	41.5	63.6	189.9
Urban roads	**396**	**39.6**	**22.5**	**31.3**	**93.4**
Asphalt	62	6.2	3,7	5.6	11.8
Bituminous	122	12.2	7.6	11.5	31.3
Gravel	212	21.2	11.3	14.2	46.7
Feeder roads	**448**	**44.8**	**51.8**	**43.6**	**140.2**
Bituminous	45	4.5	2.8	5.7	13
Gravel	311	31.1	36.4	26.6	94.1
Earth	93	9.3	12.8	11.2	33.3
Total	**2,115**	**211.5**	**149.4**	**212.5**	**573.4**
Adm. Costs	105.8	10.58	7.5	10.6	28.7
Grand total	**2,221**	**222.1**	**156.8**	**223.1**	**602.0**

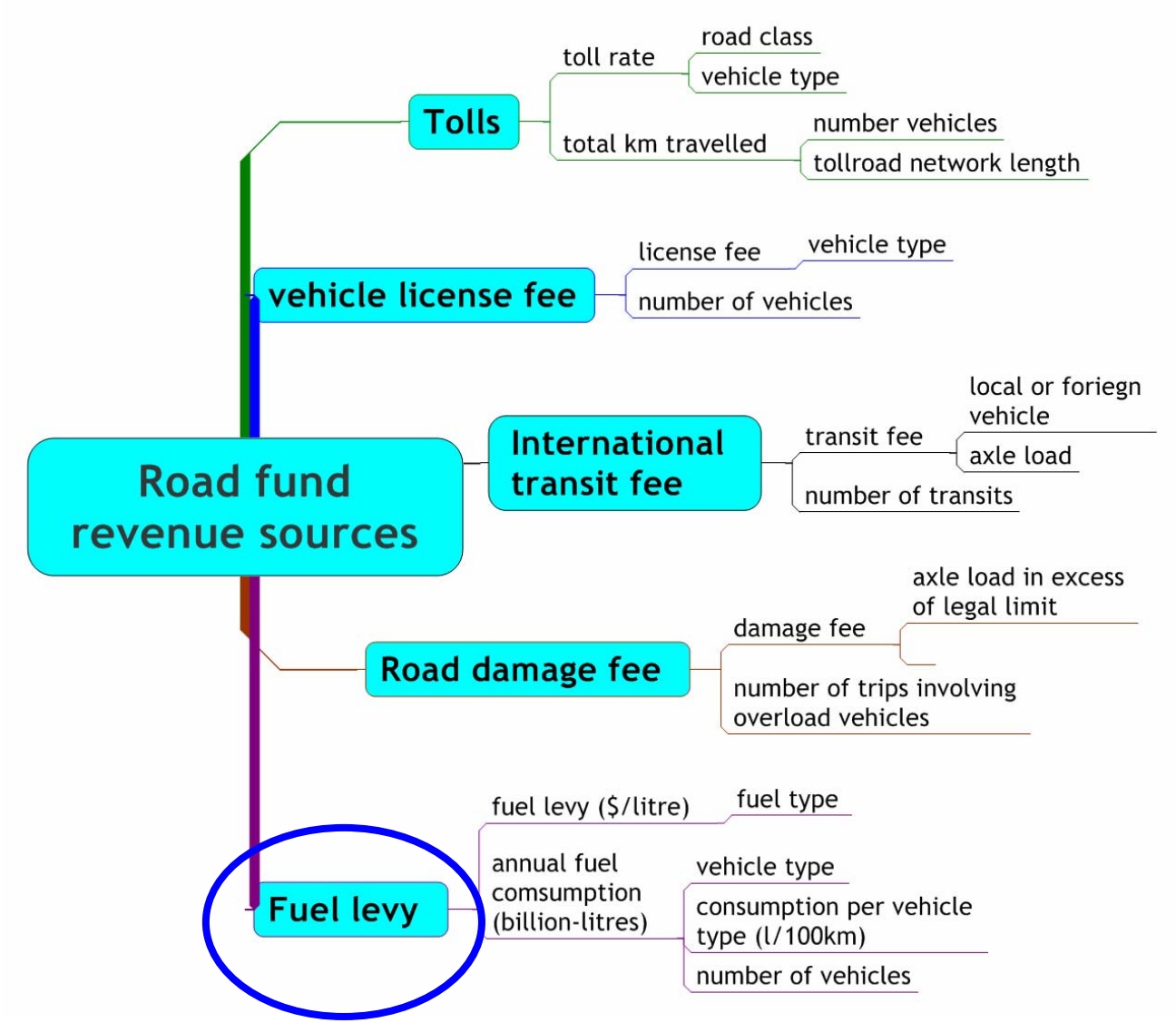
Namibia:
Estimated Costs – base scenario

Road class	Network size(2003)	Asset replacement costs				Routine maint. costs		Periodic maint. costs			Total maint	Annual life-cycle costs	
Surface type	km	US$ /km	US$m	years	US$m /year	US$/km	US$m	US$/km	years	US$m	US$m	US$m	%Asset cost
Trunk Roads	**3,944**		**879.8**				**10.2**			**20.2**	**30.4**	**59.7**	
Bituminous	3,944	223,077	879.8	30	29.3	2,574	10.2	46,154	9	20.2	30.4	59.7	6.8%
Main Roads	**9,599**		**1,070.7**				**5.9**			**38.8**	**44.7**	**93.2**	
Bituminous	1,392	223,077	310.5	30	10.4	2,574	3.6	46,154	9	7.1	10.7	21.1	6.8%
Gravel	7,935	94,615	750.8	20	37.5	283	2.2	19,692	5	31.3	33.5	71.0	9.5%
Salt	75	94,615	7.0	15	0.5	283	0.0	18,308	5	0.3	0.3	0.8	10.8%
Earth	197	12,000	2.4	15	0.2	283	0.1	1,540	2	0.2	0.2	0.4	15.4%
District Roads	**28,695**		**1,737.8**				**8.5**			**75.0**	**83.4**	**172.4**	
Bituminous	141	223,077	31.5	30	1.0	2,574	0.4	46,154	9	0.7	1.1	2.1	6.8%
Gravel	16,361	94,615	1,548.0	20	77.4	283	4.6	19,692	5	64.4	69.1	146.5	9.5%
Salt	145	94,615	13.7	15	0.9	283	0.0	18,308	5	0.5	0.6	1.5	10.8%
Earth	12,048	12,000	144.6	15	9.6	283	3.4	1,540	2	9.3	12.7	22.3	15.4%
Total	**42,238**		**3,688.3**		**166.8**		**24.5**			**134.0**	**158.5**	**325.4**	**8.8%**
Adm. costs					8.3		1.2			6.7	7.9	16.3	
Total with dam.					**175.2**		**25.7**			**140.7**	**166.4**	**341.6**	**9.0%**

Namibia:
Needed Costs – extended scenario

Road class / Surface type	Network condition	Network needs	Network length [2003]	Cost of clearing backlog		Over 10 years
			km	US$/km	US$m	US$m/yr
Trunk roads			**3,944**		**64**	**6.5**
Bituminous			**3,944**		**64**	**6.5**
	Poor	*Reconstruction*	*237*	*223,077*	*53*	*5.3*
	Fair	*Overlay*	*2,209*	*5,128*	*11*	*1.3*
Main roads			**9,599**		**131.1**	**13.2**
Bituminous			**1,392**		**35**	**3.5**
	Poor	*Reconstruct*	*139*	*223,077*	*31*	*3.1*
	Fair	*Overlay*	*868*	*5,128*	*4*	*0.4*
Gravel			**7,935**		**94**	**11.4**
	Poor	*Reconstruct*	*794*	*94,615*	*75*	*7.5*
	Fair	*Reseal*	*4,920*	*3,938*	*19*	*1.9*
Salt			**75**		**1**	**0.1**
	Poor	*Reconstruct*	*8*	*94,615*	*1*	*0.1*
	Fair	*Regravel*	*47*	*3,662*	*0*	*0.0*
Earth			**197**		**0**	**0.1**
	Poor	*Reconstruct*	*20*	*12,000*	*0*	*0.0*
	Fair	*Regravel*	*122*	*770*	*0*	*0.0*
District roads			**28,695**		**917.2**	**91.7**
Bituminous			**141**		**8**	**0.8**
	Poor	*Reconstruct*	*34*	*223,077*	*8*	*0.8*
	Fair	*Resealing*	*27*	*5,128*	*0*	*0.0*
Gravel			**16,361**		**824**	**82.4**
	Poor	*Reconstruct*	*8,508*	*94,615*	*805*	*80.5*
	Fair	*Regravel*	*4,908*	*3,938*	*19*	*1.9*
Salt			**145**		**7**	**0.7**
	Poor	*Reconstruct*	*75*	*94,615*	*7*	*0.7*
	Fair	*Reshape*	*44*	*3,662*	*0*	*0.0*
Earth			**12,048**		**78**	**7.8**
	Poor	*Reconstruct*	*6,265*	*12,000*	*75*	*7.5*
	Fair	*Reshape*	*3,614*	*770*	*3*	*0.3*
Total			**42,238**		**1,112.5**	**111.3**
Adm. Costs (5%)					*55.6*	*5.6*
Total with adm.					**1,168.1**	**116.8**

Revenue Components



"Fuel tax"

- To calculate the user contribution from fuel tax has to be perceived as:

Ex-pump sales price

minus

"normal sales price" *

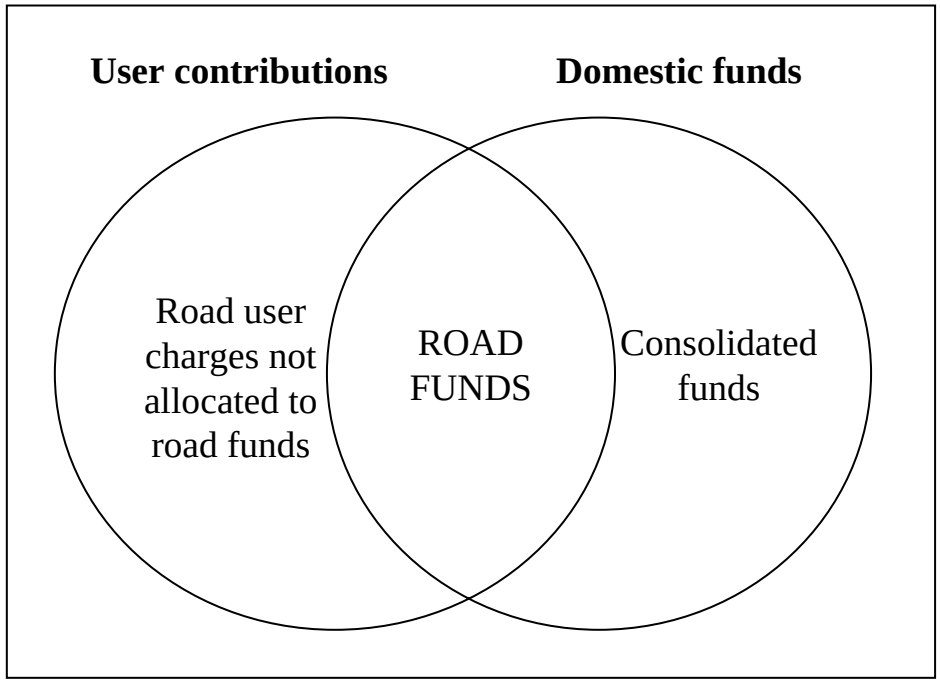
* see *International Fuel Prices 2005*:
„Normal Sales Price“ of unsubsidized fuel (which means „mineral fuel“ is sold under normal market conditions comparable to „mineral water“, including VAT etc., but without special import taxes and specific fuel taxes)

"Fuel tax" (continued)

- Calculation from Ghana example:

	Cost items	Unit	Diesel	Super gasoline	Comments
(0)	Crude Oil Price (barrel) f.o.b.	USD / barrel	77,00	75,00	09/2006
(1)	Crude Oil Price (liter) f.o.b.	USD / liter	0,48	0,40	
(2)	Refinery and distribution costs; Industry and dealer margins	USD / liter	0,19	0,18	Ghana National Petroleum Authority, 2005
(3)	Sales tax or VAT	USD / liter	0,10	0,08	VAT 15%
(4) = (1)+(2)+(3)	**"Normal Sales Price" of unsubsidised fuel**	**USD / liter**	**0,77**	**0,66**	
(5)	Ex-pump price	USD / liter	0,89	0,83	
(6) = (5)-(4)	**"User contribution"**	**USD / liter**	**0,12**	**0,17**	used to calculate user contribution
(7)	Road fund levy	USD / liter	0,07	0,07	GRF, 2006

Ghana:
User Contribution vs Domestic Funds



---The model ignores donor funds

Ghana: User contribution

Vehicle population		Vehicle registration rev.			Vehicle inspection revenues			Users contribution through fuel levy			International transit revenues			Toll revenues			Road fund
Vehicle type	No. of vehicles	Regd. Veh.	Fee	Reve-nues	Vehicles inspected	Fee	Reve-nues	Road levy	Consum-ption	Reve-nues	No. int. transits	Fee	Reve-nues	No. of trips	Toll rate	Reve-nues	Total
	[2005]		US$	US$m		US$	US$m	US$/litre	Metric Tonnes	US$ m		US$	US$m		US$	US$ m	US$m
Motor Cycles	112,379	15,136	5.6	0.08	89,903	2.2	0.20	0.17	633,381	148.8				3,237,413	0.02	0.07	151.7
Cars	427,267	29,635	21.97	0.65	341,814	2.2	0.75				179,521	2.2	0.39	12,308,704	0.05	0.68	
Pickup /Light Bus	48,783	8,715	32.95	0.29	39,026	3.3	0.13	0.12	928,534	134.4	76,917	2.4	0.19	1,405,340	0.09	0.12	137.8
Heavy Bus	107,417	5,585	43.94	0.25	85,934	3.8	0.33				59,660	4.4	0.26	3,094,468	0.14	0.44	
Light Trucks	37,463	2,457	55.6	0.14	29,970	3.3	0.10				20,509	2.6	0.05	1,079,234	0.20	0.21	
Medium Trucks	16,637	963	72.2	0.07	13,310	4.4	0.06				9,183	4.4	0.04	479,279	0.20	0.09	
Heavy Trucks	13,731	1,379	131.8	0.18	10,985	11.0	0.12				7,236	5.5	0.04	395,563	0.44	0.17	
Total	**763,677**	**63,870**		**1.66**	**610,942**		**1.69**			**283.3**	**353,026**		**0.98**	**22,000,000**		**1.80**	**289.4**

Ghana: Road Fund Revenue

Vehicle population		Vehicle registration rev.			Vehicle inspection revenues			Road fund fuel levy revenues			International transit revenues			Toll revenues			Road fund
Vehicle type	No. of veh.	Regd. Veh.	Fee	Reve-nues	Vehicles inspected	Fee	Reve-nues	Road levy	Consum ption	Rev.	Int. transits	Fee	Reve-nues	trips	Toll rate	Reve -nues	Total
	[2005]		US$	US$m		US$	US$m	US$/litre	Metric Tonnes	US$m		US$	US$m		US$	US$m	US$m
Motor Cycles	112,379	15,136	5.6	0.08	89,903	2.2	0.20	0.07	633,381	57.3				3,237,413	0.02	0.07	60.2
Cars	427,267	29,635	21.97	0.65	341,814	2.2	0.75				179,521	2.2	0.39	12,308,704	0.05	0.68	
Pickup /Light Bus	48,783	8,715	32.95	0.29	39,026	3.3	0.13	0.07	928,534	72.3	76,917	2.4	0.19	1,405,340	0.09	0.12	75.7
Heavy Bus	107,417	5,585	43.94	0.25	85,934	3.8	0.33				59,660	4.4	0.26	3,094,468	0.14	0.44	
Light Trucks	37,463	2,457	55.6	0.14	29,970	3.3	0.10				20,509	2.6	0.05	1,079,234	0.20	0.21	
Medium Trucks	16,637	963	72.2	0.07	13,310	4.4	0.06				9,183	4.4	0.04	479,279	0.20	0.09	
Heavy Trucks	13,731	1,379	131.8	0.18	10,985	11.0	0.12				7,236	5.5	0.04	395,563	0.44	0.17	
Total	**763,677**	**63,870**		**1.66**	**610,942**		**1.69**			**129.7**	**353,026**		**0.98**	**22,000,000**		**1.80**	**135.8**

100% of user contribution

100% of user contribution

46% of user contribution

100% of user contribution

100% of user contribution

Ghana: User Contribution and Domestic Funds

Sources	Domestic funds US$m	Users contribution US$m
Fuel	129.60	283.30
Vehicle registration	1.66	1.66
Vehicle inspection	1.69	1.69
International transits	0.98	0.98
Tolls	1.80	1.80
Consolidated funds	49.40	
Total	**185.13**	**289.43**

Performance indicators

Primary

Performance indicator	Ghana	Namibia
Users contribution in relation to		
(a) routine maintenance costs	861.5%	603.9%
(b) total maintenance costs	193.7%	93.4%
(c) total costs (base scenario)	76.2%	43.3%
(d) total costs (extended scenario)	48.1%	32.3%
Domestic funds as in relation to		
(a) routine maintenance costs	551.3%	785.8%
(b) total maintenance costs	124.0%	121.5%
(c) total costs (base scenario)	48.7%	56.4%
(c) total costs (extended scenario)	30.8%	42.0%
Domestic funds as share of users contribution	53.8%	130.1%

Performance indicators

Secondary

Performance indicator	Ghana	Namibia	Unit
Road density	0.21	0.05	km/km2
Users contribution per vehicle	379.0	800.9	US$/year
Users contribution as share of GDP	3.3	2.7	%
Users contribution per capita	13.8	72.9	US$/year
Domestic funds as share of GDP	2.1	3.5	%
Road maintenance costs in relation to total road costs	39.3	46.4	%
Road maintenance costs as share of GDP	1.7	2.9	%
Total road costs as share of GDP	4.3	6.2	%
Affordable network (with domestic funds)	35.7	56.4	%
Affordable network (with users contribution)	76.2	43.3	%

Conclusion

- Road users are paying more than is allocated for roads
- High cost of deferred maintenance (upto 40% of network life-cycle costs)
- On average 1.5-2.0% of GDP – for maintenance costs
  4.5-6.0% of GDP --for total road costs
- Maintaining an affordable network size is crucial requirement for sustainable road financing

THANK YOU

--- additional slides ---

Ghana: Extended scenario (detailed)

Road Class	Network Condition	Network Needs	Network Length [2003]		Cost of clearing backlog			Annual maintenance costs							Asset Replacement costs		Total Annual Costs
								Routine		Periodic				R+P			
			km	%	US$/km	US$m	US$m/yr	US$/km/yr	US$m/yr	US$/km	US$m	Years	US$m/yr	US$m/yr	US$/km	US$m/yr	US$m
TRUNK ROADS			**12.694**	**26%**		**1.271**	**127,1**		**13,3**		**425**		**61,8**	**75,0**		**137,6**	**339,7**
Asphalt & PCC			1.604	13%		86	8,6		1,8		176,4		14,7	16,5		26,7	51,9
	Poor	*Reconstruct*	*104*	*7%*	*500.000*	*52*	*5,2*	*1.147*	*0,1*	*110.000*	*11,5*	*12*	*1,0*	*1,1*	*500.000*	*1,74*	*8,0*
	Fair	*Overlay*	*308*	*19%*	*110.000*	*34*	*3,4*	*1.147*	*0,4*	*110.000*	*33,9*	*12*	*2,8*	*3,2*	*500.000*	*5,13*	*11,7*
	Good		*1.192*	*74%*				*1.147*	*1,4*	*110.000*	*131,1*	*12*	*10,9*	*12,3*	*500.000*	*19,86*	*32,2*
Bituminous			4.733	37%		336	33,6		4,9		108,9		12,1	17,0		47,3	98,0
	Poor	*Reconstruct*	*994*	*21%*	*300.000*	*298*	*29,8*	*1.043*	*1,0*	*23.000*	*22,9*	*9*	*2,5*	*3,6*	*300.000*	*9,94*	*43,3*
	Fair	*Resurface*	*1.657*	*35%*	*23.000*	*38*	*3,8*	*1.043*	*1,7*	*23.000*	*38,1*	*9*	*4,2*	*6,0*	*300.000*	*16,57*	*26,3*
	Good	*"Do nothing"*	*2.083*	*44%*				*1.043*	*2,2*	*23.000*	*47,9*	*9*	*5,3*	*7,5*	*300.000*	*20,83*	*28,3*
Gravel			6.357	50%		848	84,8		6,5		139,9		35,0	41,5		63,6	189,9
	Poor	*Reconstruct*	*4.043*	*64%*	*200.000*	*809*	*80,9*	*1.022*	*4,1*	*22.000*	*88,9*	*4*	*22,2*	*26,4*	*200.000*	*40,43*	*147,7*
	Fair	*Regravel*	*1.805*	*28%*	*22.000*	*40*	*4,0*	*1.022*	*1,8*	*22.000*	*39,7*	*4*	*9,9*	*11,8*	*200.000*	*18,05*	*33,8*
	Good	*"Do nothing"*	*509*	*8%*				*1.022*	*0,5*	*22.000*	*11,2*	*4*	*2,8*	*3,3*	*200.000*	*5,09*	*8,4*
URBAN ROADS			**4.064**	**8%**		**396,4**	**39,6**		**7,3**		**107,2**		**15,2**	**22,5**		**31,3**	**93,4**
Asphalt & PCC			413	10%		62	6,2		0,8		34,5		2,9	3,7		5,6	15,5
	Poor	*Reconstruct*	*132*	*32%*	*404.422*	*53*	*5,3*	*1.907*	*0,3*	*83.556*	*11,0*	*12*	*0,9*	*1,2*	*404.422*	*1,78*	*8,3*
	Fair	*Overlay*	*107*	*26%*	*83.556*	*9*	*0,9*	*1.907*	*0,2*	*83.556*	*9,0*	*12*	*0,7*	*1,0*	*404.422*	*1,45*	*3,3*
	Good	*"Do nothing"*	*173*	*42%*				*1.907*	*0,3*	*83.556*	*14,5*	*12*	*1,2*	*1,5*	*404.422*	*2,34*	*3,9*
Bituminous			1.522	37%		122	12,2		2,9		42,0		4,7	7,8		11,5	31,3
	Poor	*Reconstruct*	*487*	*32%*	*227.342*	*111*	*11,1*	*1.907*	*0,9*	*27.580*	*13,4*	*9*	*1,5*	*2,4*	*227.342*	*3,69*	*17,2*
	Fair	*Resurface*	*396*	*26%*	*27.580*	*11*	*1,1*	*1.907*	*0,8*	*27.580*	*10,9*	*9*	*1,2*	*2,0*	*227.342*	*3,00*	*6,1*
	Good	*"Do nothing"*	*639*	*42%*				*1.907*	*1,2*	*27.580*	*17,6*	*9*	*2,0*	*3,2*	*227.342*	*4,84*	*8,0*
Gravel			2.129	52%		212	21,2		3,6		30,7		7,7	11,3		14,2	46,7
	Poor	*Reconstruct*	*1.575*	*74%*	*133.023*	*210*	*21,0*	*1.700*	*2,7*	*14.436*	*22,7*	*4*	*5,7*	*8,4*	*133.023*	*10,48*	*39,8*
	Fair	*Regravel*	*192*	*9%*	*14.436*	*3*	*0,3*	*1.700*	*0,3*	*14.436*	*2,8*	*4*	*0,7*	*1,0*	*133.023*	*1,27*	*2,6*
	Good	*"Do nothing"*	*362*	*17%*				*1.700*	*0,6*	*14.436*	*5,2*	*4*	*1,3*	*1,9*	*133.023*	*2,41*	*4,3*
FEEDER ROADS			**32.611**	**66%**		**448,3**	**44,8**		**13,0**		**149,1**		**38,8**	**51,8**		**43,6**	**140,2**
Bituminous			1.214	4%		45	4,5		0,6		19,7		2,2	2,8		5,7	13,0
	Poor	*Reconstruction*	*291*	*24%*	*141.333*	*41*	*4,1*	*470*	*0,1*	*16.224*	*4,7*	*9*	*0,5*	*0,7*	*141.333*	*1,37*	*6,2*
	Fair	*Surface*	*231*	*19%*	*16.224*	*4*	*0,4*	*470*	*0,1*	*16.224*	*3,7*	*9*	*0,4*	*0,5*	*141.333*	*1,09*	*2,0*
	Good	*"Do nothing"*	*692*	*57%*				*470*	*0,3*	*16.224*	*11,2*	*9*	*1,2*	*1,6*	*141.333*	*3,26*	*4,8*
Gravel			17.768	54%		311	31,1		8,4		112,4		28,1	36,4		26,6	94,2
	Poor	*Reconstruction*	*9.239*	*52%*	*30.000*	*277*	*27,7*	*470*	*4,3*	*6.324*	*58,4*	*4*	*14,6*	*18,9*	*30.000*	*13,86*	*60,5*
	Fair	*Regravel*	*5.330*	*30%*	*6.324*	*34*	*3,4*	*470*	*2,5*	*6.324*	*33,7*	*4*	*8,4*	*10,9*	*30.000*	*7,99*	*22,3*
	Good	*"Do nothing"*	*3.198*	*18%*				*470*	*1,5*	*6.324*	*20,2*	*4*	*5,1*	*6,6*	*30.000*	*4,80*	*11,4*
Earth			13.630	42%		93	9,3		4,1		17,0		8,5	12,8		11,2	33,1
	Poor	*Reconstruct*	*7.088*	*52%*	*12.336*	*87*	*8,7*	*300*	*2,1*	*1.250*	*8,9*	*2*	*4,4*	*6,6*	*12.336*	*5,83*	*21,1*
	Fair	*Reshape*	*4.089*	*30%*	*1.250*	*5*	*0,5*	*300*	*1,2*	*1.250*	*5,1*	*2*	*2,6*	*3,8*	*12.336*	*3,36*	*7,7*
	Good	*"Do nothing"*	*2.453*	*18%*				*300*	*0,7*	*1.250*	*3,1*	*2*	*1,5*	*2,3*	*12.336*	*2,02*	*4,3*
Total			**49.369**	**100%**		**2115,3**	**211,5**		**33,6**		**681,4**		**115,8**	**149,4**		**212,5**	**573,4**
Adm. Costs (5%)						105,8	10,6		1,7		34,1		5,8	7,5		10,6	28,7
Total with adm.						**2221,1**	**222,1**		**35,3**		**715,5**		**121,6**	**156,8**		**223,1**	**602,0**

Data Sources:

1. Analyse der Staatsausgeben- Presentation by Dr. Gerhard Metschies at GTZ Eschborn, June 17, 2004
2. MRT, RSDP Review Reports 2001-4, Ghana.
3. Heggie, I.G., (2004*). Preparing a Road Financing Plan*. Course Notes for Senior Road Executive program at the University of Birmingham, UK.
4. International Monetary Fund, (January 2004). Ghana Petroleum Pricing Formula.
5. GHA (Ghana Highway Authority), (2005). *Cost per Kilometre of Key Road Works.* Unit Cost Estimates from the Ghana Highway Authority, Accra-Ghana.
6. NRFA (National Road Fund Administration) (December, 2004). *Five-Year Business Plan April 2004 to March 2009.* Third Draft., Windhoek, Namibia.