SUMMARY OF ASEK ESTIMATES

SIKA Report 2000:3

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Preface

During 1998-99, SIKA worked to produce revised estimates for the communications sector at the request of the Government. This work was described in June 1999 in SIKA report 1999:6 "*Review of principles for social economic estimates and estimates in the transport sector"* (in Swedish).

This work has been carried out in collaboration with the traffic agencies, the National Environmental Protection Agency and the Swedish Transport and Communications Research Board. Researchers and other specialists have assisted by participating in seminars and working groups. A steering group (ASEK steering group) chaired by SIKA has led the work. Some parts of the proposals have been submitted to SIKA's scientific council for examination and comment. SIKA's agency group including representatives from the National Rail Administration, the Civil Aviation Administration, the Swedish Maritime Administration and the National Road Administration has then adopted the estimates that are now used in the ongoing planning review for the period 2002-2011.

This report is an abridged version of the report previously published and has been produced to meet the need for concentrated information on estimates. Please see the main report for more detailed information about the estimates and the underlying main arguments.

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Director

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1 Infrastructure planning and the estimates

One of the most important purposes in carrying out social economic estimates is to create a basis for decision-making with the ambition of providing a holistic picture of the large quantity of effects that a measure in, for instance, the transport sector gives rise to. The holistic perspective incorporated in this approach means that an attempt is made to treat all relevant effects in a similar way. This similar treatment - which is expressed in the use of the individuals' willingness to pay for various effects – reduces the scope for certain effects taking greater space than motivated by various forms of influence.

The social economic calculations are sometimes criticised. This criticism has, for instance, concerned assessments of future travel, underestimates of costs, production of effective alternatives, and that not all effects are quantified in the estimates. The criticism is often justified although on a number of points it is the case that an improvement of the estimates requires an improvement of the underlying basis for the estimates – not a change in the method of estimation as such.

The Government should therefore make explicit demands on annual reports and plan documents. The annual reports should include the outcome of costs, traffic and profitability for completed investments. A continual follow-up of outcomes creates a good incentive to ensure that the basis for decision-making is of high quality at the same time as data is generated which can be used as a basis for assessments of uncertainty.

Uncertainty and risk are not at present dealt with in a satisfactory way in social economic estimates. Methods need to be developed to be able to systematically assess and evaluate uncertainties and risks at the object and direction planning level. Easily available data is moreover lacking to make analyses of the size of important uncertainties and risks.

Estimate methods cannot provide answers to all questions that need to be investigated in order to carry out a fully comprehensive basis for decision-making. Within several areas, it has not been possible to produce estimates which reflect reality in a reasonable way. This is the case for instance, with the ways of evaluating natural and cultural values, the encroachment effects of the infrastructure and effects on localisation, employment and growth.

Even if the encroachment values are not estimated, it would be wrong, however, to claim that they are not taken into consideration. Greater attention is now given the natural and cultural values risk being destroyed when building new infrastructure. This is expressed inter alia in requirements that these values are to be described in environmental impact descriptions and that these descriptions are to be summarised in national plans and county plans. Moreover, more ambitious attempts are made to describe threatened values in pilot studies and road/railway investigations.

An important conclusion is that, when effects on natural and cultural values are described simply and clearly together with other consequences, there is a greater possibility to find other, better solutions. Sometimes, this search after better solutions leads to it being possible to avoid whole or parts of the negative effects by well-chosen measures. This may involve everything from small measures to avoid noise to tunnels, and major by-passes.

2 Estimates

2.1 Discount rate

A discount rate of 4 % should be applied. This is the same interest rate as that used before the latest ASEK review.

Considerable weight is placed in many textbooks on social economics on determining the interest rate level. There are two reasons for this: one is that the discount rate acts as an implicit required return and can affect the kind of investments that are profitable.

In principle, social economic profitability is an important criterion for whether a project is to be carried out. The discount rate is then a central parameter that determines the size of the frames to be made available for investments. In fact, however, the appropriation frames in the most recent political decisions have been at a considerably lower level than that motivated by the estimates as a profitable level.

The other reason for the interest rate being important is that it can affect the composition of the measures portfolio. This may, for instance, affect the long-term nature of the choice of measures and the balance struck between investment and maintenance.

The social discount rate should be applied to all costs and utilities that appropriation financed measures involve. Since the discount rate together with the tax factors in practice serves as a kind of required return, the level of the discount rate should be directly compared with the required return on public companies and public fee-financed operations. Investments in fee-financed activities should therefore be considered in relation to the required return of the activity in question.

2.2 Estimate period and lifetimes

Recommended lifetimes

Type of measure	*Lifetime*
New road	40-60 years*
New railway	60 years
National Road Administration:	
Surfacing of gravel road	15 years
Bypasses, “bottlenecks”; bus stops	40 years
Reconstruction	15 years
Permitted load, bridges	60 years
Permitted load, roads	15 years
Targeted road safety and environmental measures	20 years
Frostproofing	15 years
National Rail Administration:	
Rails	30 years
Points	20 years
Sleepers, wooden	30 years
Sleepers, concrete	50 years
Signal equipment, road protection	20 years
Signal equipment, other	30 years
Overhead line equipment	40 years

*) The National Road Administration will apply for *a maximum of* 60 years for roads in rural environments. For roads in or close to built-up areas, the National Road Administration will apply 40 years as a lifetime, with a possibility, however, of applying a longer lifetimes. In this case, this shall be motivated.

2.3 Tax factors

Tax factor I = 1.23 and tax factor II = 1.3. When both tax factor I and II are to be applied, 1.53 is used.

When calculating how the tax system affects valuation of public use of resources, two correction factors are applied – tax factor I and II.

The first tax factor takes into consideration that resources taken into use have a value that is determined by what the end consumers are prepared to pay. Value-added tax is charged on private goods. The value of production factors is therefore adjusted upwards by an average value-added tax factor of 1.23.

Tax factor I shall be applied to all cost items included in a social economic estimate. If, for instance, the National Road Administration builds a new road, the resources that are used to build the road are adjusted upwards by tax factor I. The costs for constructing and maintaining the National Rail Administration’s tracks shall also be adjusted upwards by tax factor I.

The other tax factor takes into consideration that the increase of tax revenues on the margin gives rise to welfare losses, for instance by individuals not working in the most effective employment. This tax factor is set at 1.3.

Tax factor II shall be applied to all increases and reductions of charges on the budget. This means that all costs and incomes relating to activities at the traffic agencies that are appropriation finances are to be adjusted upwards by tax factor II. Expenditure that is financed by charges is not to be adjusted upwards by tax factor II.

When both tax factor I and II are to be applied, which is the case for most of the National Road Administration and the National Rail Administration's resource inputs, the extra costs are to be added (0.3 + 0.23). This means that when both factor I and II are applied, a tax factor 1.53 is used.

2.4 Price level, start year and discount time

All utilities and costs should be expressed in 1999 prices.

All measures should be treated as if work on the object started on 1 January 2002.

All utilities and costs should be discounted to 1 January 2002.

This means that the items expressed in other price levels must be recalculated with the aid of the appropriate index. Recalculation has taken place with CPI for the utility and cost items dealt with within the framework of the most recent ASEK review.

The direction planning and the national plans will include ongoing projects and projects started and often concluded within the 2002-2011 plan period. In order to be able to use all social economic estimates as prioritisation tools, all objects must be treated in the same way with regard to the starting point.

All utilities and discounts must be discounted to the same time.

2.5 Valuation of accidents

Valuations per actual road accidents in SEK including tax factor I on relevant parts. 1999 prices.

	Material costs	*Risk valuation*	*Total*
Fatalities	1 300 000	13 000 000	14 300 000
Serious injuries	600 000	2 000 000	2 600 000
Not serious injuries	60 000	90 000	150 000
Damage to property	13 000		13 000

The valuation of accidents and accident risks involve considerable uncertainty. New research material with higher valuations has been discussed. The new basis has been found to be insufficient to motivate an increase of the valuation.

2.6 Valuation of air pollution

Valuation of the regional effects of emissions expressed in SEK per kg. 1999 prices.

	Valuation (SEK/kg)
NO_x	60
SO_2	20
VOC	30

Valuation of local effects of emissions expressed in SEK per exposure unit. 1999 prices.

	Valuation (SEK/exposure unit)
NO_x	–
SO_2	10
VOC	2
Particles	340

No values have been set for nitrous oxides pending the export seminar that is to be held within the framework of the SHAPE project in August 1999. *Until further notice*, a value is applied, expressed in SEK/kg, which was used in the former planning review. This value is SEK 49/kg which is shown in Table 2.1 below.

For other substances, the valuation of the local effects of emissions per exposure unit is recalculated at the value per emitted kilogram *either* by using the result from the SHAPE project (Stockholm area and Södertälje) *or* the following formula for other areas:

$$Valuation / kg = 0.029 . F_v \sqrt{B} \; Valuation / exposure\ unit$$

F_v = Ventilation factor (depending on ventilation zone, see diagram 1.1 below)
B = Size of population

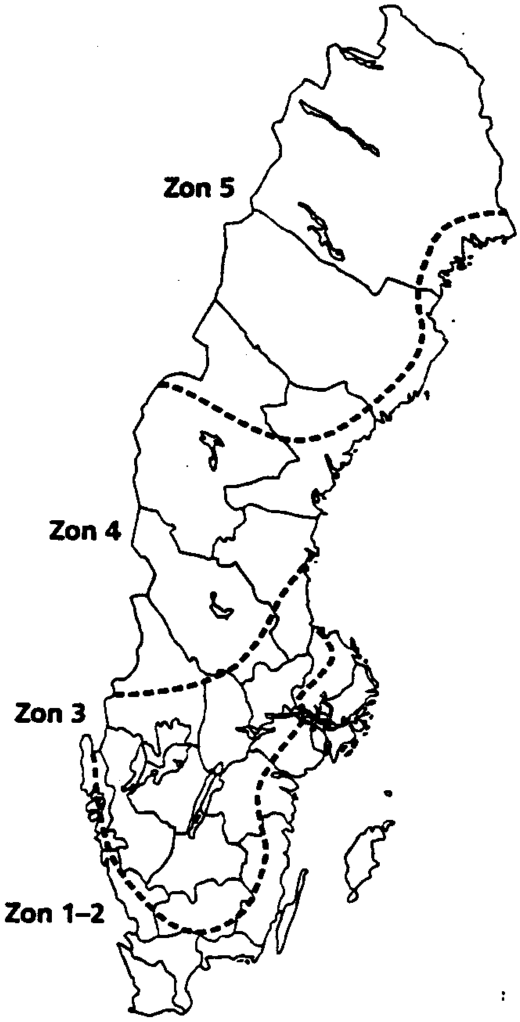
The resulting values for some built-up areas are shown together with previously applied NO_x valuation in Table 2.1

Table 2.1. Valuation of local effects of emissions expressed in SEK per kg Examples for some built-up areas in Sweden. 1999 prices.

	Size of population	*Ventilation factor*	*Valuation of local effects of emissions (SEK/kg)*			
	B	F_v	*Partiklar*	*VOC*	SO_2	NO_x
Stockholms inner city	SHAPE		7 600	45	220	(49)
Stockholms inner suburb	SHAPE		4 800	28	140	(49)
Stockholm outer suburb	SHAPE		1 900	11	60	(49)
Uppsala	120 000	1.0	3 400	20	147	(49)
Falun	36 000	1.4	2 600	15	71	(49)
Södertälje	57 000	1.0	2 300	14	70	(49)
Laholm	5 600	1.0	700	4	9	(49)

N.B. “SHAPE” means that the result is obtained directly from the SHAPE project, i.e. the above equation has not been used in the calculation.

The different ventilation zones with ventilation factors are shown below in a map.



Ventilation zone	Ventilation factor
1–2	1.0
3	1.1
4	1.4
5	1.6

Figure 2.1. Ventilation zones and ventilation factors for different parts of the country.

2.7 Valuation of carbon dioxide

CO_2 emission should be valued at SEK 1.50/kg per emission.

The set transport policy stage goal for emission of carbon dioxide serves as the basis for assessment of the new parameter value for carbon dioxide.

Model calculations based on forecast assumptions which underlie the so-called Situation analysis (SIKA Report 1998:8). produced the result that the carbon dioxide value based on the new valuation principle would need to be increased greatly to just over SEK 1 per kg emission. A new estimate based on changed forecasts for carbon dioxide emissions from the transport sector for 2010 that the traffic agencies later reported in their joint environmental report to the Government and otherwise on some revised estimate assumptions, has been carried out in connection with the national strategic analysis. (SAMPLAN 1999:2). The result is that the stage goal could be achieved with a carbon dioxide tax of SEK 1.50/kg emission.

2.8 Valuation of noise

Valuation of noise from road traffic. 1999 prices.

Outdoors and indoors (Facade reduction = 25 dBA)		*Only indoors*	*Only outdoors*	
Noise (dBA) Equiv. .level outdoors	*Noise cost (SEK/exposed/year)*	*Noise cost (SEK/exposed/year)*	*Noise (dBA) Ekquiv. level outdoors*	*Noise cost (SEK/exposed/year)*
50	0	0	25	0
51	130	50	26	80
52	260	100	27	160
53	400	160	28	240
54	540	220	29	320
55	690	280	30	410
56	840	340	31	500
57	990	400	32	590
58	1150	460	33	690
59	1320	530	34	790
60	1500	600	35	900
61	1680	670	36	1010
62	1870	750	37	1120
63	2080	830	38	1250
64	2320	930	39	1390
65	2590	1040	40	1550
66	2920	1170	41	1750
67	3350	1340	42	2010
68	3950	1580	43	2370
69	4760	1910	44	2850
70	5800	2320	45	3480
71	7070	2830	46	4240
72	8550	3420	47	5130
73	10200	4080	48	6120
74	11950	4780	49	7170
75	13890	5560	50	8330

Valuation of railway noise is calculated according to the following equation:

$$BV = 3{,}7(70+t)^{1{,}1}\left(e\left(0{,}18(N-45)^{0{,}88}\right)-1\right)$$

BV = Noise valuation
t = number of trains per day
N = maximum level indoors, dBA

2.9 Valuation of time in passenger transport

Valuation of time for private journeys per hour in SEK. 1999 prices.

		Regional journeys (<100 km)	*Long journeys (>100 km)*
Travelling time		35	70
Service frequency	< 10 minutes	60	29
	11 - 30 minutes	19	29
	31 - 60 minutes	17	29
	61 - 120 minutes	10	15
	>120 minutes	6	7
Connection time	all means of transport except air travel	70	140
	Air travel		120
Time delayed			130

Valuation of time for business travellers who do not change means of transport. Per hour in SEK including tax factor I on relevant parts. 1999 prices.

		Car	*Air*	*Train (>100 km)*	*Train (<100 km)*	*Bus/coach*
Travelling time		190	150	140	110	110
Service frequency	< 60 minutes		120	100	100	60
	61 – 120 minutes		100	70	70	60
	> 120 minutes		80	60		50
Connection time			180	280	220	220
Time delayed			230	230	220	220

2.10 Valuation of time in freight traffic

Valuation of time in freight transport for different categories of goods. SEK per tonne and hour and SEK per vehicle hour. Excluding tax factors. 1999 prices.

Bulk/part loads	*B u l k*		*P a r t*	*l o a d s*			*All**
Value (SEK/kg)	*n/a*	*n/a*	*> 25*	*< 25*	*> 25*	*< 25*	
Density (kg/m³)	*> 1.0*	*< 1.0*	*> 0.6*	*> 0.6*	*< 0.6*	*< 0.6*	
Time value (SEK/tonne hour)	0.23	0.20	14.3	0.7	18.6	0.5	
Goods value (SEK/tonne)	2 100	1 800	128 500	6 400	167 300	4 500	*17.7 lb* *7.6 jvg*
Freight time for loaded railway truck	5.4	4.6	328	16	430	12	*19*
Freight time for average lorry	3.3	2.8	203	10	264	7.1	*28*
Freight time for lorry without trailer							7.9
Freight time for lorry with trailer							41.2

*) Total values for all categories of goods. Supplementary material is to be developed to verify the values.

Valuation of *delay times* for freight transport by railway is retained. In analyses of *delay times*, or whether there is information on delay risks for rail transport as well, the following values are used.

Valuation of risk reduction for different groups of goods. SEK per tonne and pro mille. 1999 prices.

Bulk/part loads	*B u l k*		*P a r t*	*l o a d s*			*All**
Value (SEK/kg)	*n/a*	*n/a*	*> 25*	*< 25*	*> 25*	*< 25*	
Density (kg/m³)	*> 1.0*	*< 1.0*	*> 0.6*	*> 0.6*	*< 0.6*	*< 0.6*	
SEK/tonne/pro mille	1.0	1.5	2.8	1.4	9.2	1.4	3.3

*) Total values for all groups is uncertain. Supplementary material will be produced to verify the values.

Valuation of risk reduction for different groups of goods. SEK per tonne to achieve risk-free transport (on assumption of constant marginal risk valuation). 1999 prices.

Bulk/Part loads	*B u l k*		*P a r t*	*l o a d s*			*All**
Value (SEK/kg)	*n/a*	*n/a*	*> 25*	*< 25*	*> 25*	*< 25*	
Density (kg/m³)	*> 1.0*	*< 1.0*	*> 0.6*	*> 0.6*	*< 0.6*	*< 0.6*	
Lorry	26	37	71	35	230	34	83
Train	53	76	145	72	468	70	170
Sea	43	61	116	58	376	56	136
Air	48	69	130	65	422	63	153

*) Total values for all groups is uncertain. Supplementary material will be produced to verify the values.

2.11 Costs in passenger transport

Capacity and costs for train transport 2010 including tax factor I. 1999 prices.

Type of train	*Least no. of passengers*	*Cost at least train size SEK/km Km/min*		*Marginal cost*		*Occupancy rate*
		SEK/km	*SEK/min*	*SEK/passen-ger km*	*SEK/passen-ger min*	
Express train	300	25	107	0.08	0.29	60 %
Interregional train	200	12	48	0.06	0.17	50 %
Commuter train	200	16	44	0.09	0.17	40 %
Diesel train	70	7	28	0.09	0.26	50 %
Night train	200	30	93	0.08	0.19	50 %

The overhead addition has been calculated by the same method as previously and is SEK 0.12/passenger km for long-distance travel and SEK 0.04/passenger km for short-distance travel

Vehicle-dependent transport costs for bus and coach transport including tax factor I. 1999 prices

		SEK per year
Urban services	Normal	245 000
	Bogie	300 000
	Articulated	375 000
Regional services	Normal	220 000
	Bogie	275 000
	Articulated	335 000
Long-distance services		*)

*) Included in the costs depending of time and distance.

Time-dependent transport costs for bus and coach transport including tax factor I. 1999 prices

		SEK per hour
Urban services	Normal	280
	Bogie	280
	Articulated	280
Regional services	Normal	260
	Bogie	260
	Articulated	260
Long-distance services		210

Distance-dependent dependent transport costs for bus and coach transport including tax factor I. 1999 prices.

		SEK per km
Urban services	Normal	7.25
	Bogie	7.50
	Articulated	8.05
Regional services	Normal	6.60
	Bogie	6.90
	Articulated	7.25
Long-distance services		7.30

Costs for car transport including tax factor I. 1999 prices.

Cost item	*SEK*
Petrol price, SEK per litre	2.80
Diesel price, SEK per litre	3.40
Tyre price, SEK per tyre	500
New car price, SEK per car	162 000

2.12 Costs for freight transport

Costs for lorry transport. 1999 prices.

Estimate parameter	***New value excluding tax factor I I***	***New value including tax factor I I***	***Comment***
New vehicle prices, SEK			
Lorry without trailer	750 000	922 000	Heavy distribution and equipment
Lorry with trailer	1 590 000	1 957 000	Weighted 3+4 axles 5/6 and 3+3 semi 1/6
Capital cost, SEK/hour			
Lorry without trailer	61	75	
Lorry with trailer	95	117	Weighted equipment 1/3 remote and semi 2/3
Fuel prices SEK/litre			
Diesel excluded taxes, MK1	1.53	1.88	CO2 +diesel tax Total: 2.67 Average price 99 for hauliers: 4.20
Driver's wage (Swede), SEK/running hour for vehicle including social security charges			
Lorry	147	180	
No. of persons per lorry	1.2	1.2	
Person hour cost/lorry	176	216	
Tyre cost (new equipment cost for a full set of tyres)			
Lorry with trailer	72 300	87 300	Weighted 3+4 axles 5/6 and 3+3 semi 1/6
Lorry without trailer	27 250	33 500	½ local distrib. and ½ equipment, vehicle

Estimates/parameters in STAN system for operating costs. Excluding tax factor I but including all taxes and charges. 1999 prices

Transport mode		*SEK/tonne-km*	*SEK/tonne-hour*
Road-lorry – standard	(l)	0.1120	12.329
Road-lorry – long-distance	(t)	0.1000	11.000
Railway – standard	(j)*	0.1010	4.470
Railway – long-distance	(y)	0.0700	2.290
Railway – combi	(k)	0.0920	3.580
Ship – domestic	(s)	0.0019	0.372
Ship – European	(e)	0.0027	0.512
Ship – Overseas	(o)	0.0033	0.666
Ship – Lorry ferry	(m)	0.0150	9.140
Ship – Rail ferry	(i)	0.0060	2.450
Ship – Domestic (inland) water	(v)	0.0049	0.210
Air – Freight	(f)	1.9000	2 500
Air – pax-belly	(x)	1.9000	2 500

Costs for freight trains excluding track charges including tax factor I. 1999 prices.

Type of train	*Per tonne*				*Per train*			
	El		*Diesel*		*El*		*Diesel*	
	SEK/ km	*SEK/ hour*	*SEK/ km*	*SEK/ hour*	*SEK/ km*	*SEK/ hour*	*SEK/ km*	*SEK /hour*
j (wagon load)	0.113	5.50	0.132	5.768	39.6	1924	46.1	2019
y (system)	0.078	2.82	0	0	58.7	2113	0	0
k (combi)	0.104	4.40	0	0	46.6	1982	0	0

3 How are values determined in social economic estimates?

To be able to make social economic estimates, we have to know the value placed by individuals on different effects at. This is not a problem in the case of goods as there are functioning markets. According to economic theory, price corresponds exactly to value on so-called perfect markets. Consumers are said to have expressed their values or “preferences” in action by valuing goods and services according to their willingness to pay for them.

The problem is considerably bigger when we do not have perfect markets. It is recommended in these situations that an attempt is made to resemble the market by using individuals’ own values to the greatest possible extent as a basis. There are different methods for finding out people’s willingness to pay for different “goods” or effects.

The following methods are used to try to quantify individuals’ values:

a) To study how people choose between alternatives in *real* situations where the studied good is also the good we are interested in. An example of this is to study how individuals choose between a fast, expensive mode of travel and a slow, cheap one.

b) To study how people choose between different alternatives in *real* situations but where the studied good is another good than the one we are really interested in. An example of this is to study how individuals choose between houses situated in areas with different degrees of noise. This can give an *indirect* valuation of noise.

c) To study how people choose between different alternatives in *experimental* situations. An example of this is to study how individuals in a controlled experiment choose between a fast, expensive mode of travel on the one hand and a slow, cheap mode of travel on the other.

d) To study how people choose between different alternatives in hypothetical situations. An example of this is to study how much individuals in a survey state that are willing to pay to improve traffic safety.

Capturing individual values is often difficult and there are a lot of uncertainties about the methods used. If it is not possible to obtain values in this way, there is the alternative of using values derived from the balances struck when politicians make decisions in different issues.

The following two methods are based on values derived form political decisions:

e) Using the *cost of the measure* as a value which can be derived from political decisions, for instance decisions on maximum levels for various emissions. An example is the cost of installing catalysers in all cars which was previously the basis for valuation of nitrous oxides

f) Using a *tax rate* as a basis. An example of this is the tax on carbon dioxide which was previously used as the basis for valuation of carbon dioxide. This tax rate is viewed as a minimum valuation of the effect.

Which approach is adopted in particular cases of valuation of different effects is shown in SIKA Report 1999:6 *Review of principles for social economic estimates and estimates in the transport sector* (in Swedish).