

=====  
THIS IS THE OUTPUT FROM THE OPERA MODEL  
=====

THIS PROGRAM IS USED FOR FINDING OPTIMAL ENERGY  
RETROFITS IN MULTI-FAMILY BUILDINGS. AN INPUT DATA  
FILE MUST FIRST BE DESIGNED, BECAUSE THE PROGRAM  
WILL ASK FOR IT. THIS IS DONE, AND AN EXISTING FILE  
IS CHANGED, WITH AN ASCII EDITOR. ONE PREDESIGNED  
FILE EXISTS AT THE DISK AND IT IS NAMED HOUSE.DAT.  
IF THE SWEDISH SUBSIDY SYSTEM IS TO BE  
IMPLEMENTED, A SPECIAL PROGRAM CALLED SUB.EXE MUST  
FIRST BE RUN IN ORDER TO CHANGE THE INPUT FILE.  
THIS NEW FILE IS CALLED SUB.DAT BY THE PROGRAM.

A DURATION GRAPH, SHOWING THE SITUATION  
AFTER OPTIMAL RETROFITTING HAS OCCURRED, IS  
OBTAINED FROM A GRAPHICS PROGRAM THAT CAN BE  
RUN AFTER THE OPERA SESSION HAS COME TO ITS  
END. THE PROGRAM IS CALLED GRAPH.EXE AND USES  
A FILE DUR.DAT WHICH IS CREATED BY OPERA.

THERE IS A MANUAL FOR THE PROGRAM CALLED " THE  
OPERA MODEL. A COMPUTER MODEL FOR OPTIMAL ENERGY  
RETROFITS IN MULTI-FAMILY BUILDINGS, THE  
PC-VERSION ", BY STIG-INGE GUSTAFSSON, INSTITUTE  
OF TECHNOLOGY, ENERGY SYSTEMS, S581 83 LINK\PING  
SWEDEN. TEL:INT+46 13 281156, FAX:INT+46 13 281788

\*\*\*\*\*

1  
2  
3  
4  
5  
6  
7  
8

THE INPUT DATA FILE HAS BEEN READ WITHOUT PROBLEMS



\*\*\*\*\*

OBJECT NAME: S

=====

THE INPUT DATA BELOW SHOWS THE BASE CASE

\*\*\*\*\*

DATA ABOUT ECONOMY

=====

REAL DISCOUNT RATE	5.00 %
ANNUAL ENERGY PRICE ESCALATION	.00 %
PROJECT LIFE	50.00 YEARS

DATA ABOUT BUILDING GEOMETRY

=====

(Namnlös)

AREA ATTIC FLOOR		528.00 SQ.M
FLOOR		528.00 SQ.M
EXTERNAL WALL, WINDOWS EXCL.		1119.00 SQ.M
APARTMENTS, TOTAL VALUE		2086.00 SQ.M
ONE WINDOW ORIEN. TO THE NORTH		2.25 SQ.M
	EAST	2.72 SQ.M
	SOUTH	2.45 SQ.M
	WEST	2.67 SQ.M
NUMBER OF WINDOWS TO THE	NORTH	10 PCS
	EAST	45 PCS
	SOUTH	8 PCS
	WEST	51 PCS

REMAINING LIFE OF THE BUILDING ENVELOPE

=====

ATTIC FLOOR	20.00 YEARS
FLOOR	50.00 YEARS
EXTERNAL WALL	.00 YEARS
INSIDE OF THE EXTERNAL WALL	50.00 YEARS
WINDOWS	30.00 YEARS

DURABILITY FOR NEW BUILDING ASSETS

=====

ATTIC FLOOR	50.00 YEARS
FLOOR	50.00 YEARS

EXTERNAL WALL, FACADE	50.00 YEARS
INTERIOR	50.00 YEARS
WINDOWS	30.00 YEARS

COSTS FOR BUILDING ENVELOPE MEASURES

=====

	CONSTANT		
	C1	C2	C3
	-----		
ATTIC FLOOR	990.00	15.00	400.00
FLOOR	5000.00	5000.00	5000.00
EXTERNAL WALL	1000.00	25.00	400.00
, INS.	50.00	390.00	300.00
WINDOWS, 2-GLAZED	.00	1100.00	
3-GLAZED	.00	1300.00	
3-GL + GAS.	.00	1500.00	
3-GL+GAS+LE	100000.00	100000.00	

THERMAL PARAMETERS

=====

EXISTING U-VALUE ATTIC FLOOR	.27 W/SQ.M,K
FLOOR	.50 W/SQ.M,K
EXTERNAL WALL	.55 W/SQ.M,K

(Namnlös)

NEW U-VALUE WINDOWS, 2-GLAZED	3.00 W/SQ.M,K
3-GLAZED	2.00 W/SQ.M,K
3-GL.+GAS FILL	1.50 W/SQ.M,K
3-GL+GAS+LOW E	1.20 W/SQ.M,K
K-VALUE AT NEW ATTIC FLOOR	.04 W/M,K
FLOOR	.05 W/M,K
EXTERNAL WALL	.04 W/M,K
, INSIDE	.05 W/M,K

MISCELLANEOUS

=====

HEIGHT OF ONE APARTMENT	2.45 M
TENANTS RENT FOR THE APARTMENT	450.00 SEK/SQM, YEAR
HOT WATER ENERGY DEMAND	87040.00 KWH/YEAR
NUMBER OF APARTMENTS	28 PCS
DESIRED INDOOR TEMPERATURE	21.00 C
DIMENSIONING OUTDOOR TEMPERATURE	-20.00 C

EXISTING HEATING SYSTEM

=====

EXISTING BOILER TYPE	DISDIFF
EFFICIENCY OR COP	.96
INSTALLED THERMAL POWER	140.00 KW
REMAINING LIFE OF BOILER	50.00 YEARS

EXISTING SYSTEM FOR VENTILATION

=====

TYPE	NATURAL
NUMBER OF AIR RENEWALS	.88 REN/HOUR

INSTALLATION COSTS ETC, NEW HEATING EQUIPMENT

=====

E	TYPE	CONSTANT				
		C1	C2	C3	L1	L2
	-----					
.8	OIL-BOILER	80000.0	380.0	1800.0	20.0	30.0
.9	EL.-BOILER	30000.0	200.0	250.0	30.0	15.0
1.0	DISTR. HE.	75000.0	225.0	250.0	30.0	15.0
2.0	HEAT P. 1	75000.0	7000.0	1800.0	15.0	30.0
.8	NAT. GAS	80000.0	380.0	1800.0	20.0	30.0
	HEAT P. 2	75000.0	8000.0	300.0	15.0	30.0
	FIRST COP COEFFICIENT HEAT PUMP 2				66.43	
	SECOND COP COEFFICIENT HEAT PUMP 2				20.54	
	REINVESTMENT RATE HEAT PUMP 2				.10	
	REINVESTMENT OCCURS EACH				7.00 YEARS	

WEATHERSTRIPPING

=====

NUMBER OF ITEMS	114	PCS
COST FOR EACH ITEM	93.00	SEK
REDUCTION OF VENT. RENEWAL RATE	.05	REN/H
REINVESTMENT EACH	7.00	YEARS

EXHAUST AIR HEAT PUMP

=====

INLET AIR TEMPERATURE	20.00	C
OUTLET AIR TEMPERATURE	10.00	C
INSTALLATION COST C1	10000.00	SEK
C2	4500.00	SEK/KW
REINVESTMENT EACH	10.00	YEARS
COEFFICIENT OF PERFORMANCE	2.00	
PIPING INSTALLATION COST	10000.00	SEK/AP.

FREE ENERGY GAINS FROM APPL., PERSONS AND THE SUN

=====

MONTH NR	APPL. AND PERSONS	SOLAR/SQ.M			
		NORTH	EAST	SOUTH	WEST
1	12649.5	.8	2.7	17.2	2.7
2	12291.2	2.2	8.7	31.2	8.7
3	11932.7	7.0	27.7	59.1	27.7
4	11335.3	11.7	44.0	59.7	44.0

(Namnlös)

5	10618.7	19.1	68.0	73.8	68.0
6	10260.2	20.2	69.1	71.6	69.1
7	10499.3	19.3	66.3	69.7	66.3
8	10857.6	14.9	54.0	64.9	54.0
9	11215.9	9.7	37.5	64.8	37.5
10	11574.4	4.2	16.5	47.0	16.5
11	12171.8	1.1	4.1	20.6	4.1
12	12649.5	.4	1.2	10.1	1.2

ENERGY RATES AND TARIFFS

=====

FIXED PRICE FOR OIL	.29 SEK/KWH
ELECTRICITY	.39 SEK/KWH
DISTRICT HEATING	.41 SEK/KWH
NATURAL GAS	.28 SEK/KWH
CONNECTION FEE, DISTRICT HEATING	300.00 SEK/KW
NATURAL GAS	210.00 SEK/KW
FIXED FEE ELECTRICITY DEMAND RATE	6000.00 SEK/YEAR
FIXED FEE 1 FOR DISTRICT HEATING	19926.00 SEK/YEAR
FIXED FEE 2 FOR DISTRICT HEATING	.00 SEK/YEAR
SUBSC FEE, ELECTRICITY DEMAND RATE	55.00 SEK/KW, YEAR
POWER FEE FOR DISTRICT HEATING	386.00 SEK/YEAR, KW
POWER FEE, ELECTRICITY DEMAND RATE	245.00 SEK/YEAR, KW



REDUCTION COEFFICIENT DISTRICT H.

1.00

## TIME-OF-USE RATES, TARIFF ELEMENTS

LIMIT AMPERE	SUBSCR. FEE	MONTH NR	DISTR. HEAT.	EL TIME HIGH	ELEMENTS LOW
16.0	1023.0	1	.268	352	392
20.0	1395.0	2	.268	320	352
25.0	1860.0	3	.268	368	376
35.0	2790.0	4	.268	320	400
50.0	4185.0	5	.268	368	376
63.0	5394.0	6	.268	352	368
80.0	6975.0	7	.268	336	408
100.0	8835.0	8	.268	368	376
125.0	11160.0	9	.268	336	384
160.0	14415.0	10	.268	352	392
200.0	15375.0	11	.268	352	368
250.0	17000.0	12	.268	336	408

## ENERGY PRICES:

FUSE RATE, HIGH PRICE .51 SEK/KWH  
 LOW PRICE .25 SEK/KWH

DEMAND RATE, ELEMENT NO 1 .58 SEK/KWH  
 2 .37 SEK/KWH  
 3 .33 SEK/KWH  
 4 .33 SEK/KWH

THIS IS THE END OF THE INPUT DATA FILE

\*\*\*\*\*  
\*\*\*\*\*

THE CALCULATIONS HAVE NOW STARTED



ENERGY BALANCE

=====

MONTH NO	DEG.- HOURS	ENERGY- TRANSM	HOT - WATER	FREE ENERGY	SOLAR HEAT	UTILIZ. FREE	FROM BOILER	INSUL OPTIM
1.	19418.	66181.	7253.	12650.	1058.	13708.	59727.	6618
2.	17560.	59848.	7253.	12291.	2913.	15204.	51898.	5984
3.	17261.	58828.	7253.	11933.	8477.	20410.	45671.	5882
4.	12744.	43434.	7253.	11335.	12819.	24154.	26533.	4343
5.	9151.	31189.	7253.	10619.	19465.	30084.	8358.	3118
6.	5184.	17668.	7253.	10260.	19735.	17668.	7253.	
7.	3274.	11157.	7253.	10499.	18935.	11157.	7253.	
8.	4241.	14453.	7253.	10858.	15563.	14453.	7253.	
9.	7416.	25275.	7253.	11216.	11178.	22394.	10134.	2527
10.	11681.	39810.	7253.	11574.	5270.	16845.	30219.	3981
11.	14472.	49323.	7253.	12172.	1478.	13650.	42926.	4932

(Namnlös)

12.	17186.	58574.	7253.	12650.	520.	13169.	52658.	5857
4.								
-----								
TOTAL.	139588.	475740.	87040.	138056.	117411.	212895.	349885.	432462

TRANSMISSION COEFFICIENT = . 1924.02

VENTILATION COEFFICIENT = . 1484.15

NORMALIZED DIST HEATING PRICE = .41 SEK/KWH

NORMALIZED ELECTRICITY PRICE = .39 SEK/KWH

NORMALIZED DIST HEATING PRICE = .41 SEK/KWH

NORMALIZED ELECTRICITY PRICE = .39 SEK/KWH

CALCULATIONS PART 1 COMPLETED

-----

THE BEST HEATING SYSTEM IS THE DISDIFF

=====

TABLE	LOAD	TRANS	ENERGY	RETROFIT	INEVI
(KSEK)	(KW)	(W/K)	(MWH/YEAR)	COST (KSEK)	COST
NO RETROFITS	139.7	3408.2	349.9	.0	1364
.7					
EXT. WALL INS. .22 M	120.7	2944.8	294.8	127.2	1364
.7					
WEATHERSTRIPPING	117.3	2860.5	285.5	160.6	1364
.7					

DIFFERENT PARTS OF THE LCC IN SEK:

-----

(Namnlös)

SALVATION VALUE EXISTING BOILER	=	0.
INEVITABLE BUILDING RETROFIT COST	=	1364686.
NEW BOILERS COST, PIPING EXCLUDED	=	0.
PIPING COST	=	0.
ENERGY COST	=	2305496.
BUILDING RETROFIT COST	=	160627.
CONNECTION FEE	=	0.
		-----
THE LOWEST COMBINATION LCC	=	3830809.
INCREMENTAL LCC	=	3823689.
		-----
DIFFERENCE BETWEEN INC. AND COMB.		-7120.

CALCULATIONS PART 2 COMPLETED

-----

## **Del 2 Förändringar i OPERA**