SMALL IS BEAUTIFUL

Even in power generation – small can mean a lot

OSSBERGER

Your question is well justified: Why report on a mini hydropower station of less than 50 kW, even though OSSBERGER installed several plants with a capacity in the order of 1 MW in the past few months alone?

For example there is the Schluchsee Hydro station, which is one of the largest pumped storage plants in Germany with a 942 kW turbine located at the downstream basin.

Presently one OSSBERGER-Turbine is in the manufacturing process, coping with a flow rate of 10 m³/s at 22,2 m head, with a guaranteed output of 1 828 kW. This unit is intended for installation in the Capital of Chile.

Why then report on a mini hydro station and not on one of these much larger projects?

Reasons for this are many and after I have detailed all aspects, you may concur with me.

Fig. 1: Schluchsee, H = 37,6 m; Q =4,68 m³/s; N = 1 442 kW; n = 214,3 r.p.m.

Fig. 2: The proud owner at his intake

Let us consider the Sunny Brook Hydro story.

Bruce Sloat – remember this name – started to look for alternative energy, after the Energy Crisis hit in 1978. He owns a farm with 280 acres in New England, U.S.A., which is situated on a mountain slope with hilly terrain, through which a small creek flows. Some 24 years ago, he built a small power station with an OSSBERGER™ Turbine.

This was our company's first export of hydro equipment to the U.S.A. Knowing for how long OSSBERGER has been in hydro business, it makes one wonder, why it took such a long time until our turbine system, which proved so successful throughout the whole world, finally reached the shores of the Unites States. There are, however, good reasons for this. Even today there are still people trying to copy our turbine system. In 1945 it was a US Soldier who had taken the design drawings from the factory. Using this documentation many efforts were tried to imitate the OSSBERGER™ Turbine concept in the US. But the outcome was mostly unsuccessful and the good reputation of this unique turbine system was seriously damaged. Nowadays we continue to experience the same problem with numerous new imitators, even in Central Europe.

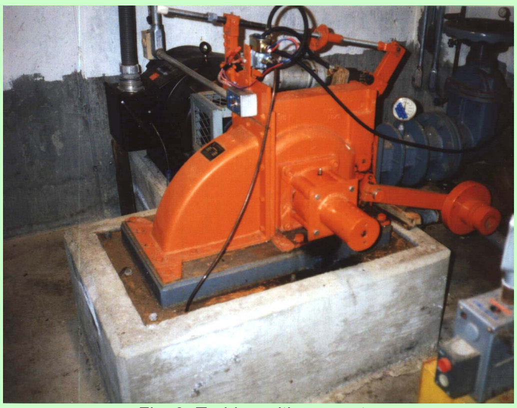


Fig. 3: Turbine with generator

Bruce Sloat's early vision to build his own small hydropower station on his farm took shape. The following year, an extraordinarily hard winter had hit New England, proved Sloat right and he had sufficient energy to get electric power for his estate and for the heating of his house. This created much sensation at that time, since downed power lines in large parts of the state seriously affected power supply.

Subsequently a flood of inquiries was received for similar projects. One newspaper heading read: „Sunny Brook Hydro: One man's answer to the energy crisis". Bruce Sloat is an interesting character, who knows how to inspire others. To understand his behaviour I need to cite a statement made by our former U.S. Representative: "He gets people excited".

Sloat's small hydro station was the corner stone which launched the installation of 40 more hydro plants ranging from 5 kW to 1.2 MW and this is one of the reasons why this first unit has made such an impact. Even more interesting is to learn about this plant's economic success, which is directly linked to my story.

As you all know, since as of January 1st of this year, the European States have been united by one common currency. I have converted all monetary amounts from Dollars to EURO and you will certainly agree, this conversion will make it easier for all of us.

Fig. 4:
Bruce Sloat builds his own glacier, every winter. The turbine house is visible in the right background

Plant Data:

Net head	**=**	**114 m**
Flow rate	**=**	**52 liters/sec.**
Turbine speed	**=**	**1 200 r.p.m.**
Generator speed	**=**	**1 200 r.p.m. (60 Hz)**
Nominal output	**=**	**45,3 kW**
Penstock	**=**	**3 100 feet = 945 m**
		Ø 10 inch = 254 mm

Plant Costs:

a) Penstock	EUR 13,360
b) Civil contractor	EUR 7,430
c) Bulldozer	EUR 1,860
d) Transformer	EUR 720
e) Concrete work	EUR 550
f) Transport, customs duties	EUR 1,280
g) Turbine	EUR 12,420
External supplies total	EUR 37,620
Own supplies	EUR 13,190
Total investment	EUR 50,810
Government Subsidies 21 %	EUR 10,670
Net cost	EUR 40,140

Proceeds:

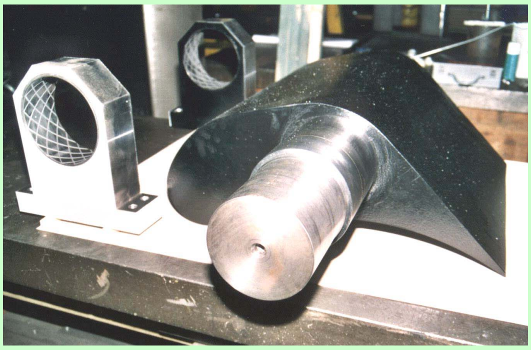


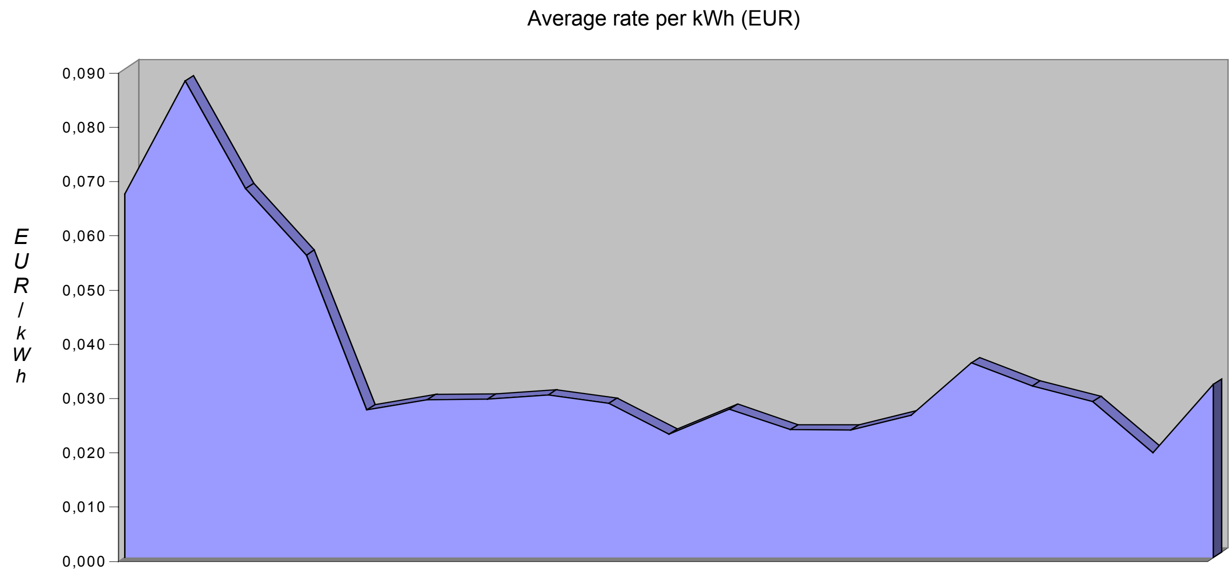
Fig. 5: maintenance-free guide vane bearings

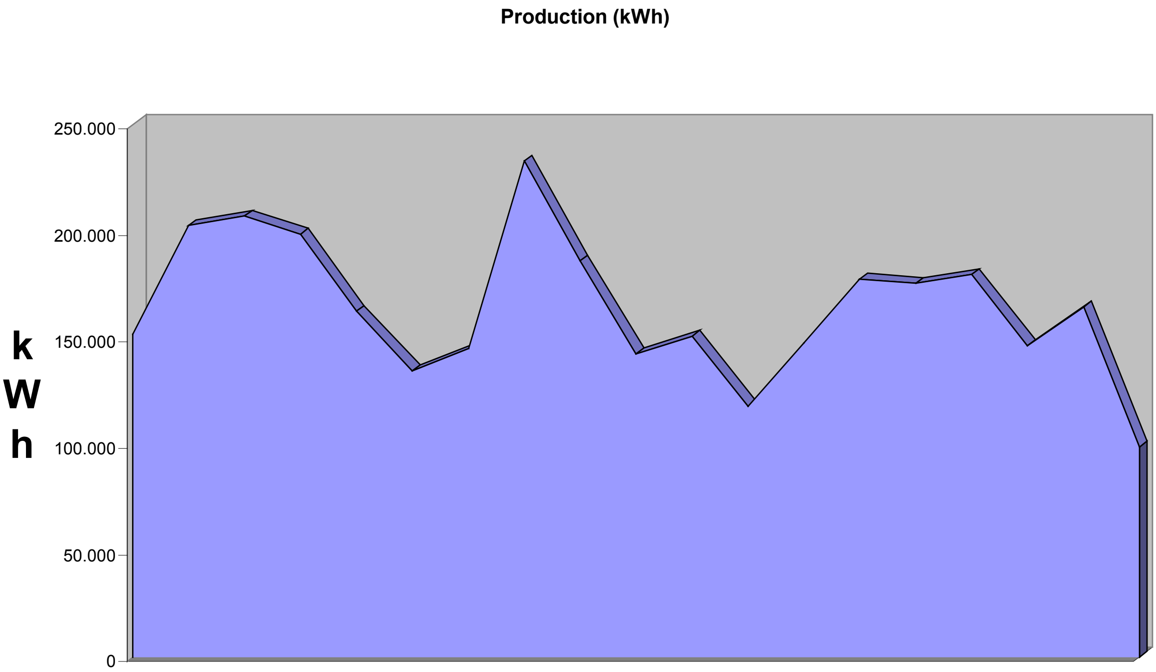
At the time of the investment and during the following years, the average purchase power rate the local Utility paid, was as high as € 0,089/kWh. The investment couldn't have been made at a better time. Later on, the rate decreased to a value of only € 0,022/kWh.

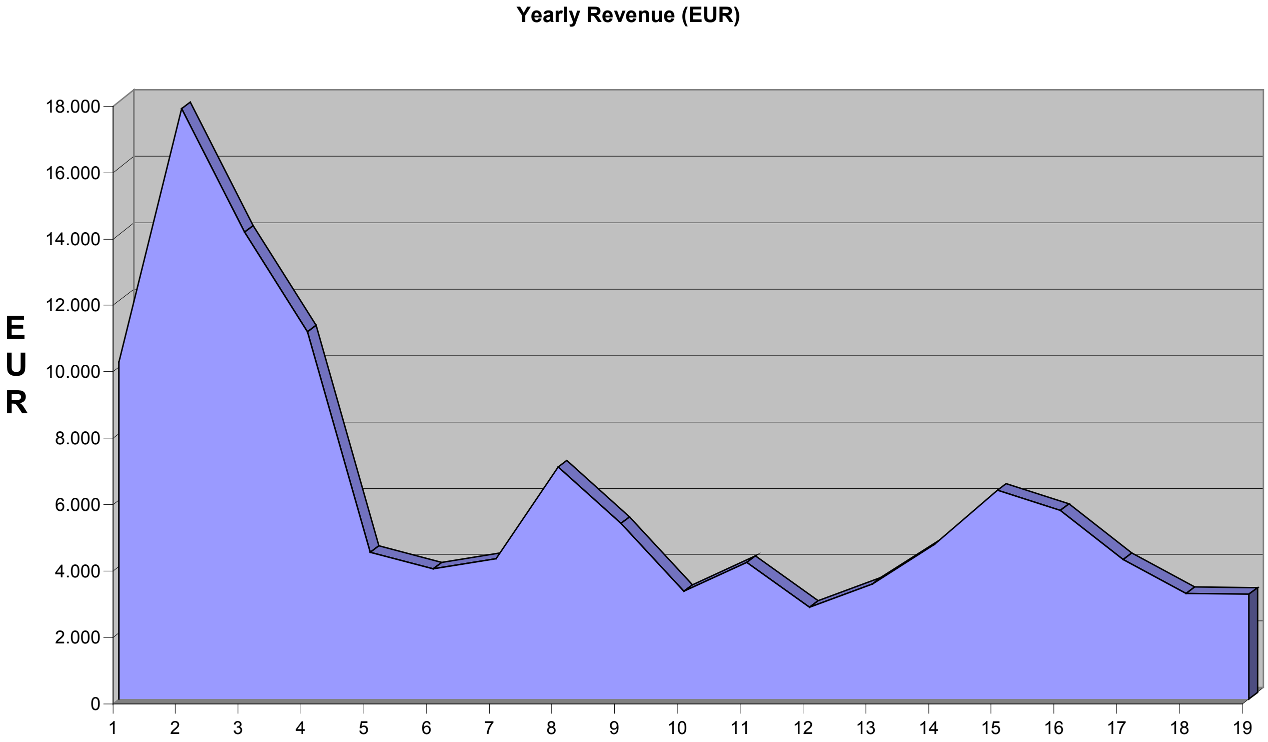
Presently the rates are on an increase again, depending on the "Independent System Operator (ISO) rates". The Electric Utility performs daily readings of the power meter, using a modem installed in the powerhouse. Throughout the day the rate varies continuously. There are even times, when no compensation is made at all, but strangely enough, during a heat wave in the summer of 2001 the power rate exploded to € 1.11/kWh!, which lasted for a few hours. Unfortunately little water was available at this short period, but these few hours rendered half the monthly income. Presently you may assume an average rate of € 0.444/kWh.

The best power generation year yielded € 17,789, but tariffs were most favourable then and Bruce's home was not yet connected to the hydro at this time, so all energy production could be sold. Up to now, the year 2001 has been the most disappointing one regarding income, due to small energy production and low tariff rates.

	kWh	€	€/kWh
1983	151.440	10.150	0,067
1984	202.600	17.790	0,088
1985	207.000	14.071	0,068
1986	198.520	11.059	0,056
1987	162.280	4.413	0,027
1988	134.480	3.911	0,029
1989	144.720	4.216	0,029
1990	232.960	6.980	0,030
1991	185.920	5.278	0,028
1992	142.400	3.234	0,023
1993	150.720	4.113	0,027
1994	117.840	2.771	0,024
1995	147.280	3.458	0,023
1996	177.520	4.658	0,026
1997	175.360	6.292	0,036
1998	179.520	5.674	0,032
1999	146.160	4.198	0,029
2000	164.400	3.168	0,019
2001	98.706	3.152	0,032
	3.119.826	118.583	0,038


Average rate per kWh (EUR)
0,090
0,080
0,070
0,060
0,050
0,040
0,030
0,020
0,010
0,000
EUR/kWh


Production (kWh)
250.000
200.000
150.000
100.000
50.000
0
kWh



Proceeds of € 118,583 appear most encouraging, when considering an investment of only € 40,140. However, Sloat reports on some further windfall. First, the write-off must be mentioned, which helps to reduce the tax payments and second, saving on his own power consumption. Mr. Sloat arrived at the following interesting calculation:

The farm's electric consumption for cooling, lighting and hot water boiler amounts to 1500 kWh/month. Applying the relative low US average energy tariff of € 0,111/kWh during a period of 19 years therefore amounts to

€ 38,000

An average consumption of between 5 and 8 kW must be assumed for heating and air conditioning. Since electric energy is now also available for this purpose and less costly than oil fuel, since the conversion, which was made some 10 years ago, further savings could be achieved in the order of

€ 17,000

In order to spend the saved amount totaling

€ 55,000

a pre-tax amount of

€ 72,000

would have to be earned.

Based on the numbers provided by Sloat an impressive result is obvious:

Period: 19 years	
Energy sold:	*3,119,826 kWh*
Own use:	*490,000 kWh*
Production total:	*3,609,826 kWh*
Power generation income:	*€ 118.583*
Own use:	*€ 72,000*
Total income:	*€ 190,583*
Appreciation:	*€ 70,000*
Total:	*€ 260,583*

Considering an initial investment amount of € 40,000 in the year 1983, arriving at € 260,000 until the end of 2001 would require a rate of return in the order of 11%.

Operation and Maintenance:

Apart from income taxes – at a special low tax rate – Sloat reported of required routine maintenance work, which are minimal and the daily rake cleaning work in autumn. Even during his absence of six months, no problems were reported. During this time, his neighbour, who also owns and operates an OSSBERGER turbine, kept an eye on his plant. To further automate his plant, Sloat hooked-up a telephone dialler, accessible by modem, which permits him to listen to various pertinent plant parameters, such as output, voltage, etc., from any phone around the world.

Once per year a "large" inspection is necessary. This comprises cleaning of electric relays and exchange of bearing grease. This task may take around 6 hours. Throughout the past few years one of the turbine bearings had to be exchanged after being in constant operation for ten years. Since this bearing is a standard design, a local dealer could obtain it from stock. During 19 years of permanent operation the total costs of consumption material and spare parts amounted to approximately € 30,000. This amount would have to be deducted from the total listed above.

Fig. 6: Test stand of the OSSBERGER™ Turbine

Summary:

Irrespective of the project size, investment in hydropower is mostly rewarding.

Essential factors for a good success rate are:

Analysis of energy production

Quality of equipment

As we can see from Sloat's cost figures, his investment plan was timed perfectly. Keeping in mind the present energy politics in Europe - similar developments should be expected for the years to come.

Regarding the quality of the machinery to be implemented in your project, please be referred to the paper named "Aspen Revisited". This paper can be obtained from Ossberger Turbines. If you decide in favour of the original OSSBERGER™ Turbine you have the guarantee of:

- Low-maintenance operation for decades
- Guaranteed efficiency values

Fig. 7: Runner power station of 1 MW operating at high head

which are pre-requisites for a profitable return of your investment.

Fig. 8: Runner power station operating at low head

To achieve such low-maintenance operation, the original OSSBERGER™ Turbine is equipped with maintenance-free guide vane bearings. Efficiency tests were conducted at many stations owned by large Utility companies, which verified that our stated efficiency claims were not only achieved but in some cases even exceeded. You are probably familiar with complaints and efficiency short falls of other Cross-Flow Turbine Imitators, which must not be overlooked. Stick with the Original. Pertaining to the same subject you will find further information in the paper dealing with the Aspen power station.

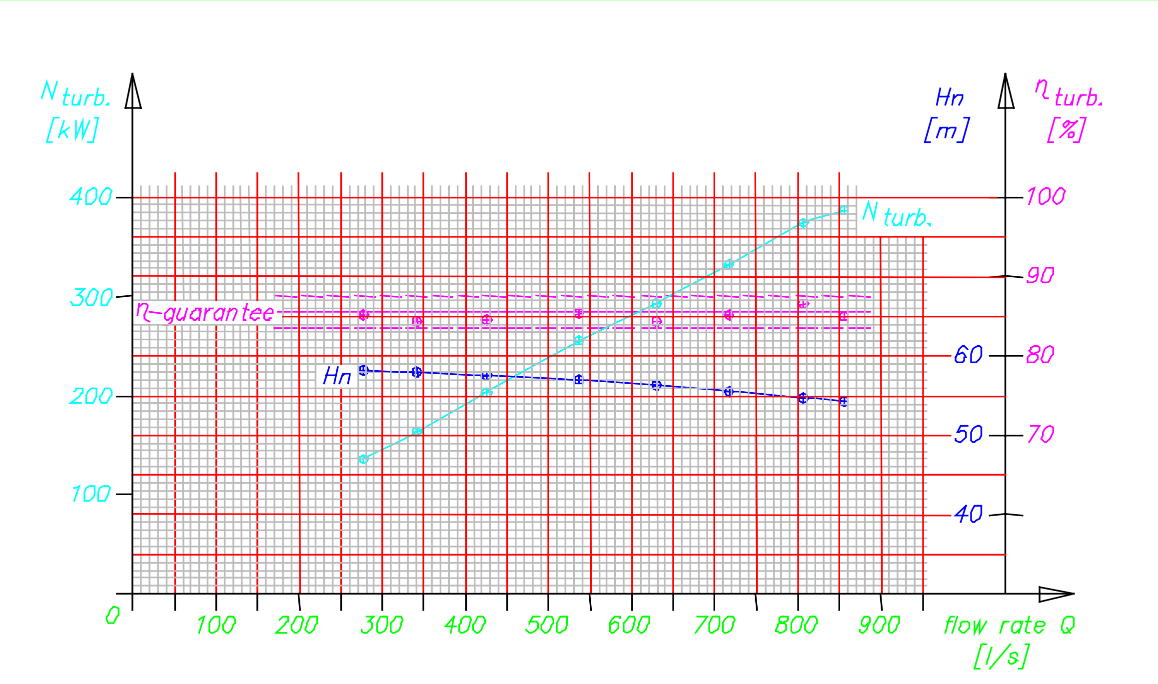


Fig. 9:Efficiency measurement at Alsjö hydro station – all test points are within the guaranteed efficiency band.

Our concept of turbine and governor works for the small Sunny Brook Hydro Station; it works just the same for medium- and larger-sized power plants. Differences in size should be irrelevant for the investor. An investor with a 20 kW unit desires the same rentability than owners of larger OSSBERGER power stations. Of course, I could have reported of power plants with 1000 kW output, which are running at a mere 40 kW during the low-flow season. But I'm sure, you know such facts which seem to be expected from our turbines.

Irrespective of installed capacity and invested amount each project should be approached with the same diligence, care of details and the high demand for a modest technical concept. These are my main reasons for presenting you Sunny Brook Hydro instead of a new 2 MW turbine. What has been achieved for mini hydro can be realised for larger plants at even lower specific costs.

Thank you for your kind attention and I shall gladly be at your disposal for further explanations.

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