

# How the IRR\* drives bias in energy investment decisions



**Tanja Groth**

Department of Economics and Business, Aarhus University

\* IRR: Internal rate of return, a project evaluation tool used to summarize returns to investment in a simple percentage figure, taking into account the time value of money.

## Introduction

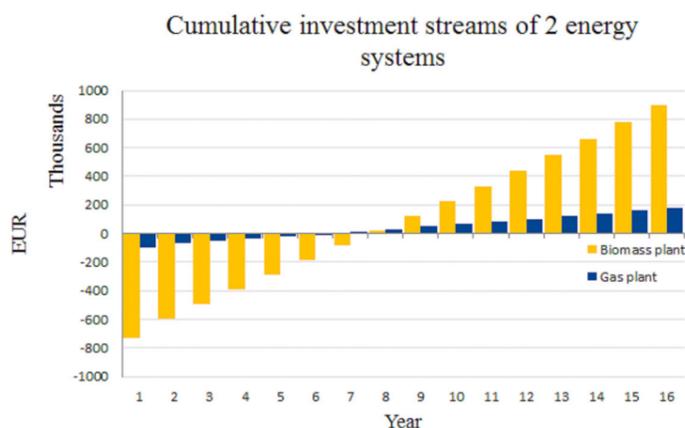
The IRR was introduced in the 1930's, but by the late 1970's it had been discredited in academic literature. Perversely, it has since become one of the 2 most popular project evaluation tools used in business. The IRR has multiple issues, each of which creates bias in project evaluation

### Bias # 1

**You cannot use IRR to directly compare 2 mutually exclusive investments**

Using IRR to compare projects with different initial investment costs will provide inconsistent ranking.

If you compare the cumulative investment streams of the 2 energy systems:

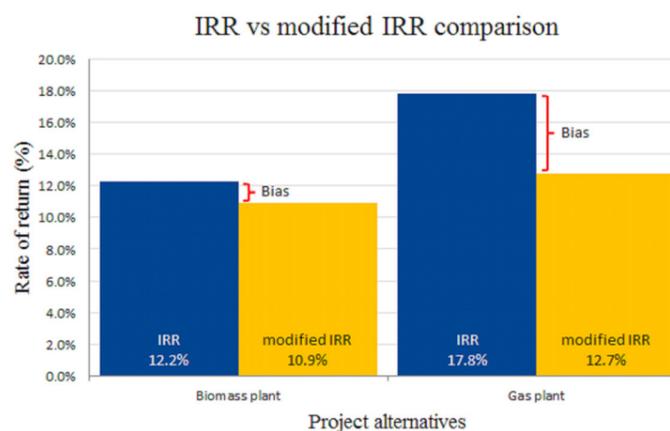


calculations. This poster quantifies the magnitude of such bias using real investment cases for 2 energy solutions, a biomass-fuelled energy plant and a natural-gas fuelled energy plant. Only 2 forms of bias from the IRR are considered here due to space constraints.

### Bias # 2

**The greater the difference between your desired profit and the IRR, the greater the bias**

Let's assume you have a desired profit rate of 10%. This means that you invest in projects which earn at least 10%. The modified IRR takes income earned during the project and reinvests it in projects earning 10%.



Direct comparison	Investment (€)	IRR (%)	Net present value (€)
Biomass plant	733,333	12.2	94,984
Gas plant	100,000	17.8	44,710

The net present value is a second project evaluation tool which uses a discount rate to account for the time value of money, here 10%. Both projects are profitable, indicated by a net present value greater than 0.

The higher IRR from the gas plant suggests greater profit. However, what is relevant when comparing two investments with different initial costs is whether the **additional** cost of the larger investment is worthwhile.

In order to determine this, you simply subtract the smaller investment from the larger one. This will provide you with a single investment stream:

Correct comparison	Investment (€)	IRR (%)	Net present value (€)
Incremental investment	633,333	11.4	50,274

The biomass plant not only returns the profit of the gas plant but also generates profit from the additional investment. Unless the additional investment can provide greater profit elsewhere, the biomass plant is the most profitable option, despite its lower IRR value.

Bias comparison	Biomass plant	Gas plant
IRR (%)	12.2	17.8
Modified IRR (%)	10.9	12.7
Bias	1.3	5.1

An energy plant will earn income each year of its lifetime. What happens with this income during the project lifetime influences the size of the bias from the IRR. The standard IRR will reinvest income in other projects with the same project profit rate but a shorter lifetime. The larger the difference between the project IRR and the desired profit rate, the larger the bias. This explains why the bias from the gas plant is greater.

For the example illustrated in Bias #1, the income from year 14 from the gas plant would be reinvested in a project with an expected profit rate of 17.8% and a lifetime of 2 years. This is clearly unrealistic; if projects such as this were common, the desired profit rate would be greater than 10%.

The project profit rate generated by the gas plant is much lower once the bias from reinvestment has been accounted for. The difference in profit rates between the 2 projects reduces from 5.6% to 1.8% just by correcting for one type of bias.

## Summary

Decision-makers who use the IRR to evaluate investment options are probably not aware of how biased the calculations may be.

1. The first case shows that the IRR is not sufficient for ranking 2 mutually exclusive options. Preference for the gas plant based on it's IRR would result in the wrong choice.

2. The second case shows that the IRR will be biased when the desired profit rate is not taken into account. IRR values greater than the desired profit rate will bias upwards and vice versa.

**Caution is therefore strongly advised when using IRR**