

During an early planning stage for a new power plant, the question might arise, whether to use a cooling tower or an open cooling water cycle. The effects on performance are positive for the open cycle option (higher output and higher efficiency), but the construction costs are higher and the investment would increase by 5 mUSD.

Which option to chose? PG-ROI gives the answer by calculating the return on the additional investment.

Details Costs/Rev Off	Pay Off Time from NPV accumul  New Plant	ated 🚽	C	Open Cycle				Cooling T	ower	
Details Increase Off <b>Power</b> Electrical Net Power El. Full Load oper. Hours El. Net Efficiency	Without Heat Production	₩ h/a 	Value Min 722 8000 56,50%	% Max % Distr	91,3% NCF 6372 kJ/kWh	7	Value 720 8000 55,90%	Min % Max	:% Distr.	91,3% N 6440 kJ/ł
nvestment Volume	n	nill. USD	365				360			



PG-ROI shows the result of the additional investment in the delta analysis, i. e. the cash-flow obtained by subtracting the second cash-flow (Open Cycle) from the first cash-flow (Cooling Tower).

On one hand, there is the additional investment (blue negative columns) as well as the credit line and the credit payback correspond (blue striped columns).

The positive effect on revenues (positive green columns) and fuel costs (positive red columns = fuel savings) are very high, so that the Pay-Off Time is reached after 1.5 years.

The investor should chose the open cooling water cycle.

## Goal Seek 1: Minimun Output to achieve Pay Off Time < 3.0 years

Details Costs Pier DV V Nor Plast			ood oodk		
Death hereas: DV Villantika ) Power Beckhalliet Power Beckhalliet Power	Preduzsko 💌	Yatar 722	Value to be reached Net Present Value A: Open Cycle		Cancel
E. Net Efficiency		56,50X	Net Present Value B: Cooling Tower Net Present Palue 0-P Date	100	165,780 mil. L90 5 871 mil. USD
Operating Costs Personel Insurano Percolitationance Difer Costs A Difer Costs B Visible Maintenance	nii USDe nii USDe nii USDe nii USDe nii USDe USDMith	Value	Internet Robe of Roburn A: Open Cycle Internet Robe of Roburn A: Open Cycle Internet Robe of Roburn A: Debta Pay Off Time 3: Open Cycle Pay Off Time 3: Open Cycle Pay Off Time 3: Open Cycle Robert Off Time A: Blocks Electricity production costs & Open Cycle		34,21% 33,52% 82,21% 4,45 a 4,55 a 1,33 a 25,675 USD/NW
fuel Consumables	USD/NSJ USD/Mfwh	3	Electricity production costs 8: Cooling Tower Electricity production costs A-B: Delta	*	28,866 USD/NW -11,248 USD/M
Operating Revenues FredBwarws Electricy Dith Present D Dith Presents E Citer Presents E Version Best Without Exce	mit (SD), nit (SD), nit (SD), nit (SD), USD/Meh	¥əlae 30,90	Value to be changed Sheet Input; Row 13, Column 5 Start value Residoo	Goal	1,333
PROCAT found 2,999 with input	a solution with Delta value: 717,890	a <0.0001:	3 yrs POT are reached eveloped eveloped eveloped are reached eveloped at a second structure of the sec	ven if th Iow 718	ne 3 MW
	ОК				
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From the previous result, there might arise another question: How much lower could the output (MW) be so that the additional investment for the open cooling water cycle still reaches a three year Pay-Off Time?

PG-ROI quickly finds the solution with the goal-seek analysis: 717.89 MW.

Even if the output dropped with the open cycle compared to the cooling tower, the additional investment still would pay off within three years, due to the savings of fuel costs from higher efficiency.



A similar question with respect to the efficiency increase: What would be the minimum required efficiency increase, so that the additional investment for the open cycle reaches an Internal Rate of Return (IRR) of at least 20%?

PG-ROI gives the answer by its built-in sensitivity analysis. The graphic display of the results makes it easy to find out that a 20% IRR is reached when the efficiency increases at least 0.0022 (=0.22%) from 55.9 to 56.12%.

	Goal Seek 2: Check of result with goal seek
	Input the value from sensitivity analysis: Power Electrical Net Power El. Full Load oper. Hours El. Net Efficiency
	Result is not very exact: 18.3%         Net Present Value (10,0%) at 1.1.2002       mill. USD       0,903         Internal Rate of Return till 2012       % / a       15%         Internal Rate of Return till 2023       % / a       18,3%         Pay Off Time from 1.1.2004 (a)       11,9
	Goal seek finds 20.00% at       Microsoft Excel         56.134% efficiency:       Net Present Val         Internal Rate of       0,2000 with input value: 0,5613         0/2000 with input value: 0,5613       % / a         0/2000 with input value: 0,5613       10,800
9	© 2005 Spemann Consulting GmbH PG-ROI Example 3 mailto: office@spemann.com Tel: +49-172-8114335 6
D W of ai	ouble checking the result achieved by the sensitivity analysis proves it right: /hen the efficiency with the open cooling water cycle is set 56.12% (instead f 56.5% initially assumed), PG-ROI calculates the key investment figures nd comes to exactly 20% Internal Rate of Return.