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DECISION TREE METHOD IN ENERGY MANAGEMENT

Decision Tree Method is frequently used in Energy Management. It implies the energy project analysis in uncertainties. Decision tree analysis method connects present and future results and enables facilitates managers to make decision via grosser NPV. In the article is elaborated production and demand of transformers and generators, probabilities of demand (high or low) and cash flows for each combination. There is represented 2 year business- process decision tree, when a manager would choose the best result and make decision. Net present value of investment:

$$NPV= -Y_x + \sum_{x=1}^{r} NPVx * Px$$

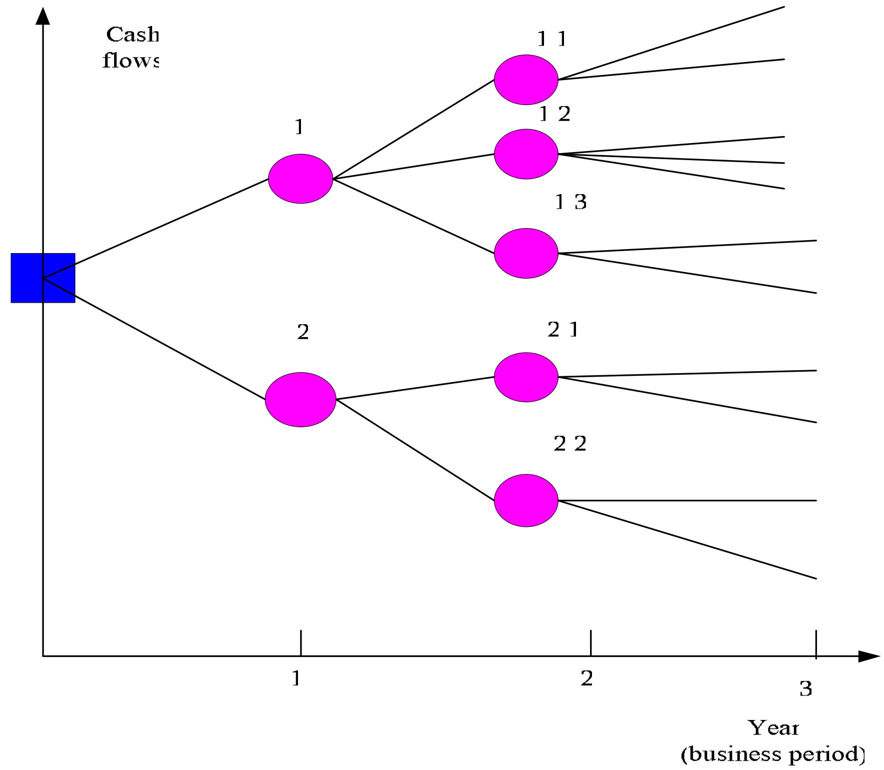
Y_x –Investment of each x period;
NPV_x- Net Present Value (NPV) of investment each x period;
P_x- Probability of demand each x period;
r- Series of cash flow.

A schematic tree-shaped diagram is used to determine a course of action or show a statistical probability. Each branch of the decision tree represents a possible decision or occurrence. The tree structure shows how one choice leads to the next, and the use of branches indicates that each option is mutually exclusive.

A decision tree can be used to clarify and find an answer to a complex problem. The structure allows users to take a problem with multiple possible solutions and display it in a simple, easy-to-understand format that shows the relationship between different events or decisions.

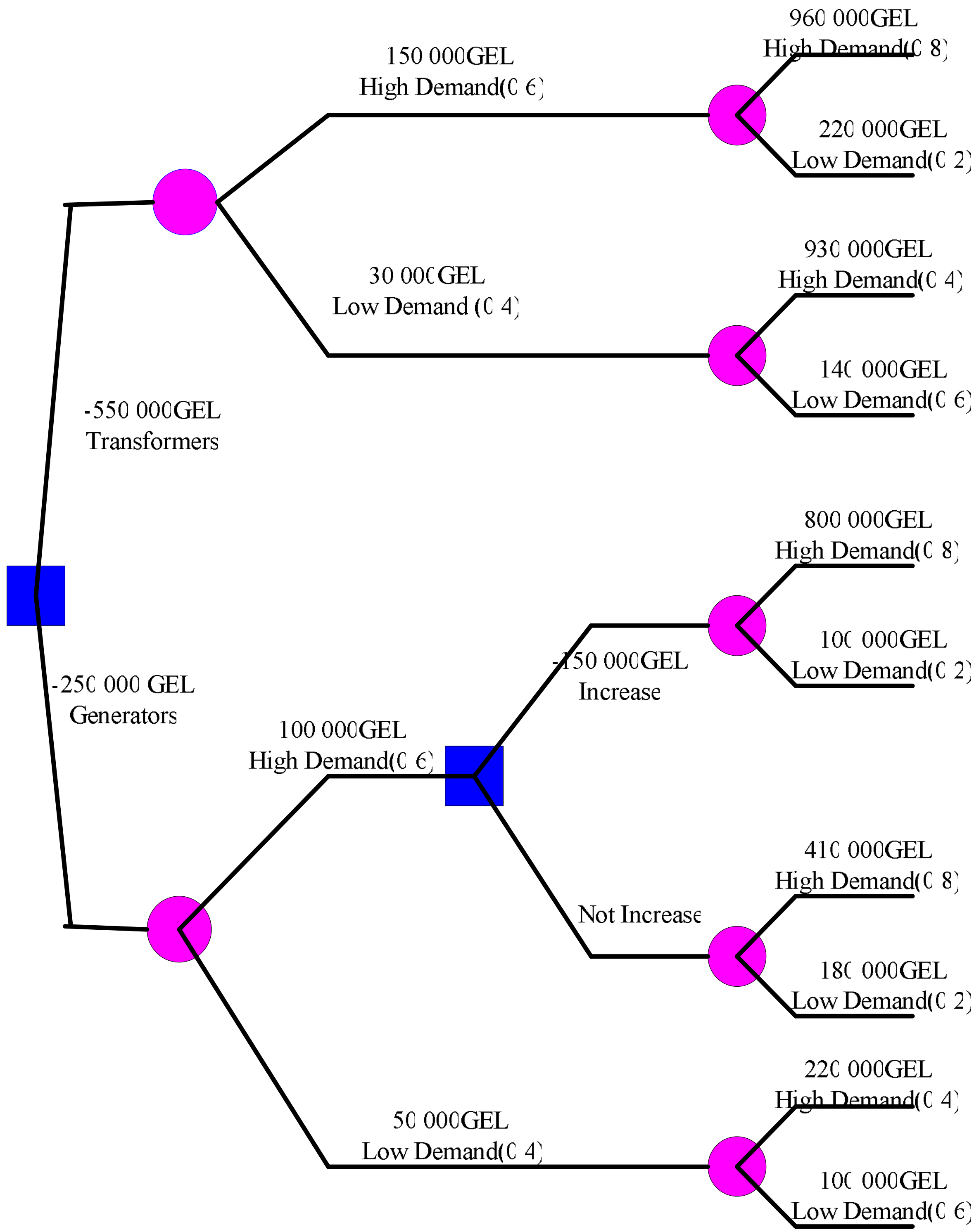
The furthest branches on the tree represent possible end results. A decision tree is a diagram of nodes and connecting branches. Nodes indicate decision points, chance events, or branch terminals. Branches correspond to each decision alternative or event outcome emerging from a node. The root node represents the first set of decision alternatives. For each decision alternative draws a line, or branch, extending to the right from the root node.

Some branches may split into additional decision alternatives or outcomes. Let us label each branch with the decision and its associated investment cost. The root node is the small square at the left. Branch lines emerge from the root towards the right. Each branch represents one decision alternative.



Pict.1. Tree-shaped diagram business- process

In the Picture 1 is represented a schematic tree-shaped diagram of 2 year business- process of production and demand transformers and generators. Production of transformers requires 1st year investment costs - 550 000 GEL. Production of generators requires 1st year investment costs -250 000 GEL and for the second year – additional investment costs - 150 000 GEL.



Pict.2. Tree-shaped diagram business- process of production and demand transformers and generators

A schematic tree-shaped diagram shows production and demand of transformers and generators, probabilities of demand (high or low) and cash flows for each combination. Based on discount rate 10%, cash flows will be (see Table 1, 2):

Table 1.

I year	Cash flow	Probability	Demand
Transformers	150 000 GEL	0,6	High
Transformers	30 000 GEL	0,4	Low
Generators	100 000 GEL	0,6	High
Generators	50 000 GEL	0,4	Low

Table 2.

II year	Cash flow	Probability	Demand
Transformers	960 000 GEL	0,8	High
Transformers	220 000 GEL	0,2	Low
Transformers	930 000 GEL	0,6	High
Transformers	100 000 GEL	0,4	Low
Generators	410 000 GEL	0,8	High
Generators	180 000 GEL	0,2	Low
Generators	220 000 GEL	0,4	High
Generators	100 000 GEL	0,6	Low

Payoff calculates as: (probability high demand * payoff with high demand) + (probability low demand * payoff with low demand). We calculate expected cash flows and discount:

$$NPV_{transf} = -550000 + \frac{(0,6*150000)+(0,4*30000)}{1,10} +$$

$$+\frac{0,6*[(0,8*960000)+(0,2*220000)]+0,4*[(0,4*930000)+(0,6*140000)]}{(1,10)^2} =$$

$$= \_550000 + \frac{102000}{1,10} + \frac{670000}{(1,10)^2} = 96000 \text{ GEL}$$

$$NPV_{generat} = \_250000 + \frac{(0,6*100000)+(0,4*50000)}{1,10} +$$

$$+ \frac{0,6*[(0,8*410000)+(0,2*180000)]+0,4*[(0,4*220000)+(0,6*100000)]}{(1,10)^2} = 52000 \text{ GEL}$$

NPV comparative analysis shows:

NPV_{transf} = <u>96 000 GEL</u>

$NPV_{generat}$ = 52 000 GEL P

Conclusion: investment for transformer production via grosser NPV is more attractive then investment for generator production. If we expand and invest additionally 150 000 GEL, choice would be different, because investment for generator production and its further expansion will bring more net present value (NPV) of investment.

Investment for generator production according to high demand (80%) would guarantee cash flow 800 000 GEL, or 100 000 GEL according to low demand (20%). In this case cash flow would be:

(0,8*800 000) + (0,2*100 000)=660 000 GEL

Present value of expanding:

$$NPV_{generat} = -150\,000 + \frac{660000}{1,10} = 450\,000 \text{ GEL}$$

If we choose investment for generator production we expect to receive cash worth 550 000 GEL in year 1 if demand is high:

550 000 GEL (100 000 cash flow+450 000 NPV)

And cash worth 185 000 GEL if it is low:

$$NPV_{generat} = \frac{(0,4*220000)+(0,6*100000)}{1,10} = 135\,000 \text{ GEL}$$

185 000 GEL (50 000 cash flow+135 000 NPV)

The present value of investment in the generator production is:

$$NPV_{generat}=-250000+\frac{(0,6*550000)+(0,4*185000)}{1,10}=117000 \text{ GEL}$$

A schematic tree-shaped diagram business-process of production and demand transformers and generators, probabilities of demand (high or low) and cash flows for each combination, gives opportunity to choose the best result and make the decision: investment for generator production and its expansion is more attractive via the net present value (NPV) of investment.

References

1. Brealey R. A., Myers S.C. 2000. *Principles of Corporate Finance.* London.
2. Turrner E.C. 2002. *Energy Management.* Handbook. Published by Fiarmont Press.