A system powered solely by a 100 MW nuclear power plant was suplemented with 20 MW of photovoltaics. Provide the unit cost of the system "before" and "after."

100 MW nuclear 20 MW photovoltaics - correct calculation of system costs.

Pa=100 MW, Pp=166,66 MW, cfa=600 zł/MWh, cfp=250 zł/MWh,
LFa=0,91, LFp=0,12, cva=50 zł/MWh, Pma=80 MW, Pmp=20 MW
KSE - national power system

(1) LCOE.KSE = (Ca + Cp) / S (1a) LCOE.KSE = (513 336 000 + 43 800 000) / 876 000 = 636 zł/MWh

LCOE.KSE - unit energy costs from the system [zł/MWh]
Ca - annual nuclear costs [zł]
Cp - annual costs of photovoltaics [zł]
S - annual sales from the system [MWh]

(2) LCOE.KSE = (Cfa + Cva+ Cfp + Cvp) / S (2a) LCOE.KSE = (478 296 000 + 35 040 000+ 43 800 000 + 0) / 876 000

Cfa - annual fixed costs of the atom [zł]
Cva - annual variable costs of the atom [zł]
Cfp - annual fixed costs of photovoltaics [zł]
Cvp - solar fuel cost = 0

(3.1.a) Cfa=Pa*cfa*8760*LFa (3.1.b) Cfa=100 MW * 600 zł/MWh * 8760 h * 0,91=478 296 000 zł

Pa - installed nuclear power capacity [MW]
cfa - unit fixed atom costs for LFa [zł/MWh]
LFa - design indicator of the use of installed nuclear power capacity [-]

(3.2.a) Cfp=Pp*cfp*8760*LFp (3.2.b) Cfp=166,66 MW * 250 zł/MWh * 8760 h * 0,12=43 800 000 zł

Pp - installed photovoltaic power [MW]
cfp - unit fixed costs of photovoltaics for LFp` [zł/MWh]
LFp - design indicator of the use of installed photovoltaic capacity [-]

(3.3.a) Cva=Pma*8760*cva (3.3.b) Cva=80 MW * 50 zł/MWh * 8760 h =35 040 000 zł

Pma - average nuclear power on sale [MW]
cva - unit costs of nuclear fuel [zł/MWh]

(4.a) S=8760*(Pma+Pmp) (4.b) S= 8760 h * (80+20) MW = 876 000 MWh

Pmp - average power of photovoltaics on sale [MW]

$$(5)\ LCOE.KSE = \frac{Pa*cfa*8760*LFa+Pp*cfp*8760*LFp+ Pma*8760*cva}{8760 * (Pma+Pmp)}$$

$$(6.a)\ LCOE.KSE = \frac{Pa*cfa*LFa+Pp*cfp*LFp+ Pma*cva}{Pma+Pmp} \qquad (6.b)\ LCOE.KSE = \frac{100*600*0,91+167*250*0,12+ 80*50}{80+20}$$

(6.c) LCOE.KSE = 600*0,91 +($\frac{20}{100}$)*250 +($\frac{80}{100}$)*50 zł/MWh = 636 zł/MWh

(7.1.) LCOE.KSE = 600*0,91 +($\frac{0}{100}$)*250 +($\frac{100}{100}$)*50 zł/MWh = 596 zł/MWh *100% nuclear power without maintenance downtime*
(7.2.) LCOE.KSE = 600*0,91 +($\frac{9}{100}$)*250 +($\frac{91}{100}$)*50 zł/MWh = 614 zł/MWh
(7.3) LCOE.KSE = 600*0,91 +($\frac{20}{100}$)*250 +($\frac{80}{100}$)*50 zł/MWh = 636 zł/MWh
(7.4.) LCOE.KSE = 600*0,91 +($\frac{50}{100}$)*250 +($\frac{50}{100}$)*50 zł/MWh = 696 zł/MWh
(7.5.) LCOE.KSE = 600*0,91 +($\frac{91}{100}$)*250 +($\frac{9}{100}$)*50 zł/MWh = 778 zł/MWh

$$(8)\ LCOE.KSE = \frac{100*600*0,91+ 70*50}{70} = 830 zł/MWh$$ *not fully used atom*

(9.1.) LCOE.a = Ca/(Pma*8760)
(9.2.) LCOE.a = Ca/(100*8760)=596 zł/MWh *100% nuclear power without maintenance downtime*
(9.3.) LCOE.a = Ca/(91*8760)=**650 zł/MWh** *design load*
(9.4.) LCOE.a = Ca/(80*8760)=733 zł/MWh
(9.5.) LCOE.a = Ca/(50*8760)=1142 zł/MWh
(9.5.) LCOE.a = Ca/(9*8760)=6117 zł/MWh

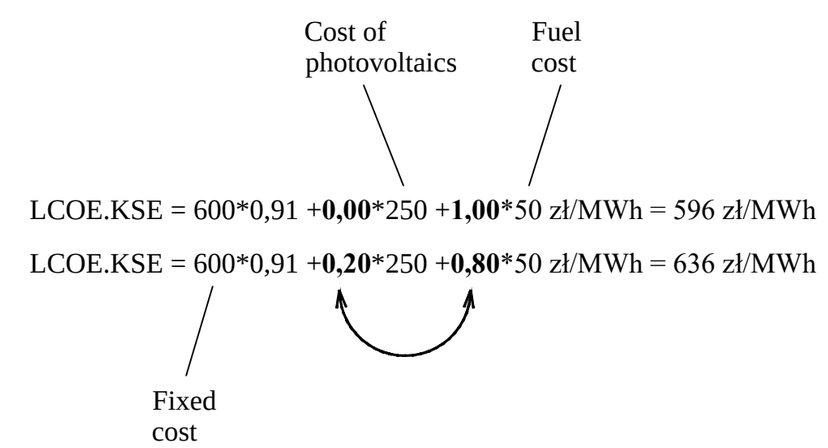
100 MW nuclear 20 MW photovoltaics - incorrect calculation of system costs.

Pa=100 MW, Pp=20 MW,
LCOE.atom=650 zł/MWh, LCOE.photo=250 zł/MWh

(10) LCOE.KSE = LCOE.atom*share.atom + LCOE.photo*share.photo.

(11.1.) LCOE.KSE = 650*$\frac{100}{100}$ + 250*$\frac{0}{100}$ = 650 zł/MWh

(11.2.) LCOE.KSE = 650*$\frac{80}{100}$ + 250*$\frac{20}{100}$ = 570 zł/MWh *wrong result!*



LCOE.KSE = 600*0,91 +**0,00***250 +**1,00***50 zł/MWh = 596 zł/MWh
LCOE.KSE = 600*0,91 +**0,20***250 +**0,80***50 zł/MWh = 636 zł/MWh

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