## 10-31-2013-energy-cost-calculator-generic-power-only

Input are highlighted in green

### Capital Cost

CapitalCost=70000000

### Electrical and Fuel--base year

GrossElectricalCapacity=28000

NetPlantCapacity=25000

ParasiticLoad =GrossElectricalCapacity-NetElectricalCapacity

CapacityFactor=85

AnnualHours=CapacityFactor/100\*8760

NetStationEfficiency=20

FuelHeatingValue=18608

FuelConsumptionRate=NetPlantCapacity/(NetStationEfficiency/100)\*3600/FuelHeatingValue/1000

FuelPower =FuelConsumptionRate\*1000\*FuelHeatingValue/3600

GrossStationElectricalEfficiency =GrossElectricalCapacity/FuelPower\*100

FuelAshConcentration=5

CapitalCostNEC=CapitalCost/NetPlantCapacity

AnnualFuelConsumption=FuelConsumptionRate\*AnnualHours

AnnualAshDisposal=AnnualFuelConsumption\*FuelAshConcentration/100

### Expenses--base year

FuelCost=22.05

LaborCost=2000000

MaintenanceCost=1500000

InsurancePropertyTax=1400000

Utilities=200000

AshDisposal=100000

Management=200000

OtherOperatingExpenses=400000

TotalNonFuelExpenses=LaborCost+MaintenanceCost+InsurancePropertyTax+Utilities+AshDisposal+Management+OtherOperatingExpenses

TotalExpensesIncludingFuel=FuelCost\*AnnualFuelConsumption+TotalNonFuelExpenses

FuelCostKwh=AnnualFuelConsumption\*FuelCost/AnnualGeneration

LaborCostKwh=LaborCost/AnnualGeneration

MaintenanceCostKwh=MaintenanceCost/AnnualGeneration

InsurancePropertyTaxKwh=InsurancePropertyTax/AnnualGeneration

UtilitiesKwh=Utilities/AnnualGeneration

AshDisposalKwh=AshDisposal/AnnualGeneration

ManagementKwh=Management/AnnualGeneration

OtherOperatingExpensesKwh=OtherOperatingExpenses/AnnualGeneration

TotalNonFuelExpensesKwh=LaborCostKwh+MaintenanceCostKwh+InsurancePropertyTaxKwh+UtilitiesKwh+AshDisposalKwh+ManagementKwh+OtherOperatingExpensesKwh

TotalExpensesIncludingFuelKwh=FuelCostKwh+TotalNonFuelExpensesKwh

### Taxes

FederalTaxRate=34

StateTaxRate=9.6

ProductionTaxCredit=0.009

CombinedTaxRate=StateTaxRate+FederalTaxRate\*(1-StateTaxRate/100)

### Financing

DebtRatio=75

EquityRatio =100-DebtRatio

InterestRateOnDebt=5

EconomicLife=20

CostOfEquity=15

CostOfMoney =DebtRatio/100\*InterestRateOnDebt+EquityRatio/100\*CostOfEquity

TotalCostOfPlant =CapitalCost

TotalEquityCost =TotalCostOfPlant\*EquityRatio/100

TotalDebtCost =TotalCostOfPlant\*DebtRatio/100

CapitalRecoveryFactorEquity =CostOfEquity/100\*(1+CostOfEquity/100)^EconomicLife/((1+CostOfEquity/100)^EconomicLife-1)

CapitalRecoveryFactorDebt=InterestRateOnDebt/100\*(1+InterestRateOnDebt/100)^EconomicLife/((1+InterestRateOnDebt/100)^EconomicLife-1)

AnnualEquityRecovery =CapitalRecoveryFactorEquity\*TotalEquityCost

AnnualDebtPayment =TotalDebtCost\* CapitalRecoveryFactorDebt

DebtReserve =AnnualDebtPayment

### Income other than energy

CapacityPayment=166

InterestRateonDebtReserve=5

AnnualCapacityPayment=CapacityPayment\*NetPlantCapacity

AnnualDebtReserveInterest=DebtReserve\*InterestRateonDebtReserve/100

### Escalation/Inflation

GeneralInflation=2.1

EscalationFuel=2.1

EscalationForProductionTaxCredit=2.1

EscalationOther=2.1

### Depreciation Schedule

DepreciationFraction =1/EconomicLife

### Tax Credit Schedule

"TaxCreditFrac": [1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]

### Annual Cash Flows

Common vars in each year are highlighted in yellow

#### Year1

EquityRecovery =AnnualEquityRecovery

EquityInterest1 =CostOfEquity/100\*TotalEquityCost

EquityPrincipalPaid1 =EquityRecovery-EquityInterest1

EquityPrincipalRemaining1 =TotalEquityCost-EquityPrincipalPaid1

DebtRecovery =AnnualDebtPayment

DebtInterest1 =InterestRateOnDebt/100\*TotalDebtCost

DebtPrincipalPaid1 =DebtRecovery-DebtInterest1

DebtPrincipalRemaining1 =TotalDebtCost-DebtPrincipalPaid1

FuelCost1 =AnnualFuelConsumption\*FuelCost

NonFuelExpenses1 =TotalNonFuelExpenses

DebtReserve1 =DebtReserve

Depreciation =TotalCostOfPlant\*DepreciationFraction

CapacityIncome =AnnualCapacityPayment

InterestOnDebtReserve =AnnualDebtReserveInterest

TaxesWoCredit1 =((CombinedTaxRate/100)/(1-CombinedTaxRate/100))\*(EquityPrincipalPaid1+DebtPrincipalPaid1+EquityInterest1-Depreciation+DebtReserve1)

TaxCredit1 =AnnualGeneration\*ProductionTaxCredit\*TaxCreditFrac1

Taxes1 =((CombinedTaxRate/100)/(1-CombinedTaxRate/100))\*(EquityPrincipalPaid1+DebtPrincipalPaid1+EquityInterest1-Depreciation+DebtReserve1-TaxCredit1)

EnergyRevenueRequired1 =EquityRecovery+DebtRecovery+FuelCost1+NonFuelExpenses1+Taxes1+DebtReserve1-CapacityIncome-InterestOnDebtReserve

#### Year2

EquityInterest2 =CostOfEquity/100\*EquityPrincipalRemaining1

EquityPrincipalPaid2 =EquityRecovery-EquityInterest2

EquityPrincipalRemaining2 =EquityPrincipalRemaining1-EquityPrincipalPaid2

DebtInterest2 =InterestRateOnDebt/100\*DebtPrincipalRemaining1

DebtPrincipalPaid2 =DebtRecovery-DebtInterest2

DebtPrincipalRemaining2 =DebtPrincipalRemaining1-DebtPrincipalPaid2

FuelCost2 =FuelCost1\*(1+EscalationFuel/100)^(Year-1)

NonFuelExpenses2 =NonFuelExpenses1\*(1+EscalationOther/100)^(Year-1)

DebtReserve2=0

TaxesWoCredit2 =((CombinedTaxRate/100)/(1-CombinedTaxRate/100))\*(EquityPrincipalPaid2+DebtPrincipalPaid2+EquityInterest2-Depreciation+DebtReserve2)

TaxCredit2 =AnnualGeneration\*ProductionTaxCredit\*((1+EscalationForProductionTaxCredit/100)^(Year-1))\*TaxCreditFrac2

Taxes2 =((CombinedTaxRate/100)/(1-CombinedTaxRate/100))\*(EquityPrincipalPaid2+DebtPrincipalPaid2+EquityInterest2-Depreciation+DebtReserve2-TaxCredit2)

EnergyRevenueRequired2 =EquityRecovery+DebtRecovery+FuelCost2+NonFuelExpenses2+Taxes2+DebtReserve2-CapacityIncome-InterestOnDebtReserve

The others follow the same pattern as Year2

#### Year20

DebtReserve = - DebtReserve1

### Current $ Level Annual Cost (LAC)

PresentWorth1=EnergyRevenueRequired1\*(1+CostOfEquity/100)^-B130

TotalPresentWorth=SUM(PresentWorth1: PresentWorth20)

CapitalRecoveryFactorCurrent= CapitalRecoveryFactorEquity

CurrentLevelAnnualRevenueRequirements =TotalPresentWorth\*CapitalRecoveryFactorCurrent

CurrentLACofEnergy =CurrentLevelAnnualRevenueRequirements/AnnualGeneration

RealCostOfMoney =(1+CostOfEquity/100)/(1+GeneralInflation/100)-1

CapitalRecoveryFactorConstant=CapitalRecoveryFactor(RealCostOfMoney\*100, EconomicLife)

ConstantLevelAnnualRevenueRequirements =TotalPresentWorth\*CapitalRecoveryFactorConstant

ConstantLACofEnergy =ConstantLevelAnnualRevenueRequirements/AnnualGeneration

function CapitalRecoveryFactor(i: number, N: number) {

const A = i / 100 \* Math.pow((1 + i / 100), N) / (Math.pow((1 + i / 100), N) - 1);

return A;

}

## 10-31-2013-energy-cost-calculator-gasification-power-generation-model

Input are highlighted in green

### Capital Cost

### Electrical and Fuel--base year

### Heat--base year

### Expenses--base year

### Taxes

### Income other than energy

### Escalation/Inflation

### Financing

### Depreciation Schedule

DepreciationFraction =1/EconomicLife

### Tax Credit Schedule

"TaxCreditFrac": [1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]

### Annual Cash Flows

### Current $ Level Annual Cost (LAC)

## 10-31-2013-energy-cost-calculator-generic-combined-heat-power-model

Input are highlighted in green

### Capital Cost

CapitalCost=70000000

### Electrical and Fuel--base year

GrossElectricalCapacity=28000

NetElectricalCapacity=25000

ParasiticLoad =GrossElectricalCapacity-NetElectricalCapacity

CapacityFactor=85

AnnualHours=CapacityFactor/100\*8760

NetStationEfficiency=20

FuelHeatingValue=18608

FuelConsumptionRate=NetPlantCapacity/(NetStationEfficiency/100)\*3600/FuelHeatingValue/1000

FuelPower =FuelConsumptionRate\*1000\*FuelHeatingValue/3600

GrossStationElectricalEfficiency =GrossElectricalCapacity/FuelPower\*100

AnnualNetGeneration=NetElectricalCapacity\*8760\*CapacityFactor/100

AnnualFuelConsumption=FuelConsumptionRate\*AnnualHours

CapitalCostNEC=CapitalCost/NetElectricalCapacity

FuelAshConcentration=5

AnnualAshDisposal=AnnualFuelConsumption\*FuelAshConcentration/100

### Heat-base year

TotalHeatProductionRate=FuelPower-GrossElectricalCapacity

AggregateFractionOfHeatRecovered=60

RecoveredHeat=TotalHeatProductionRate\*AggregateFractionOfHeatRecovered/100

AnnualHeatSales=RecoveredHeat\*AnnualHours

AggregateSalesPriceForHeat=0.0102

TotalIncomeFromHeatSales=AnnualHeatSales\*AggregateSalesPriceForHeat

HeatIncomePerUnitNEE=TotalIncomeFromHeatSales/AnnualNetGeneration

OverallCHPefficiencyGross=(GrossElectricalCapacity\*AnnualHours+AnnualHeatSales)/(FuelPower\*AnnualHours)\*100

OverallCHPefficiencyNet=(AnnualNetGeneration+AnnualHeatSales)/(FuelPower\*AnnualHours)\*100

### Expenses--base year

FuelCost=22.05

LaborCost=2000000

MaintenanceCost=1500000

InsurancePropertyTax=1400000

Utilities=200000

AshDisposal=100000

Management=200000

OtherOperatingExpenses=400000

TotalNonFuelExpenses=LaborCost+MaintenanceCost+InsurancePropertyTax+Utilities+AshDisposal+Management+OtherOperatingExpenses

TotalExpensesIncludingFuel=FuelCost\*AnnualFuelConsumption+TotalNonFuelExpenses

FuelCostKwh=AnnualFuelConsumption\*FuelCost/AnnualGeneration

LaborCostKwh=LaborCost/AnnualGeneration

MaintenanceCostKwh=MaintenanceCost/AnnualGeneration

InsurancePropertyTaxKwh=InsurancePropertyTax/AnnualGeneration

UtilitiesKwh=Utilities/AnnualGeneration

AshDisposalKwh=AshDisposal/AnnualGeneration

ManagementKwh=Management/AnnualGeneration

OtherOperatingExpensesKwh=OtherOperatingExpenses/AnnualGeneration

TotalNonFuelExpensesKwh=LaborCostKwh+MaintenanceCostKwh+InsurancePropertyTaxKwh+UtilitiesKwh+AshDisposalKwh+ManagementKwh+OtherOperatingExpensesKwh

TotalExpensesIncludingFuelKwh=FuelCostKwh+TotalNonFuelExpensesKwh

### Taxes

FederalTaxRate=34

StateTaxRate=9.6

ProductionTaxCredit=0.009

CombinedTaxRate=StateTaxRate+FederalTaxRate\*(1-StateTaxRate/100)

### Financing

DebtRatio=75

EquityRatio =100-DebtRatio

InterestRateOnDebt=5

EconomicLife=20

CostOfEquity=15

CostOfMoney =DebtRatio/100\*InterestRateOnDebt+EquityRatio/100\*CostOfEquity

TotalCostOfPlant =CapitalCost

TotalEquityCost =TotalCostOfPlant\*EquityRatio/100

TotalDebtCost =TotalCostOfPlant\*DebtRatio/100

CapitalRecoveryFactorEquity =CostOfEquity/100\*(1+CostOfEquity/100)^EconomicLife/((1+CostOfEquity/100)^EconomicLife-1)

CapitalRecoveryFactorDebt=InterestRateOnDebt/100\*(1+InterestRateOnDebt/100)^EconomicLife/((1+InterestRateOnDebt/100)^EconomicLife-1)

AnnualEquityRecovery =CapitalRecoveryFactorEquity\*TotalEquityCost

AnnualDebtPayment =TotalDebtCost\* CapitalRecoveryFactorDebt

DebtReserve =AnnualDebtPayment

### Income other than energy

CapacityPayment=166

InterestRateonDebtReserve=5

AnnualCapacityPayment=CapacityPayment\*NetPlantCapacity

AnnualDebtReserveInterest=DebtReserve\*InterestRateonDebtReserve/100

### Escalation/Inflation

GeneralInflation=2.1

EscalationFuel=2.1

EscalationForProductionTaxCredit=2.1

EscalationOther=2.1

### Depreciation Schedule

DepreciationFraction =1/EconomicLife

### Tax Credit Schedule

"TaxCreditFrac": [1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]

### Annual Cash Flows

Common vars in each year are highlighted in yellow

#### Year1

EquityRecovery =AnnualEquityRecovery

EquityInterest1 =CostOfEquity/100\*TotalEquityCost

EquityPrincipalPaid1 =EquityRecovery-EquityInterest1

EquityPrincipalRemaining1 =TotalEquityCost-EquityPrincipalPaid1

DebtRecovery =AnnualDebtPayment

DebtInterest1 =InterestRateOnDebt/100\*TotalDebtCost

DebtPrincipalPaid1 =DebtRecovery-DebtInterest1

DebtPrincipalRemaining1 =TotalDebtCost-DebtPrincipalPaid1

FuelCost1 =AnnualFuelConsumption\*FuelCost

NonFuelExpenses1 =TotalNonFuelExpenses

DebtReserve1 =DebtReserve

Depreciation =TotalCostOfPlant\*DepreciationFraction

CapacityIncome =AnnualCapacityPayment

HeatSalesIncome = TotalIncomeFromHeatSales

InterestOnDebtReserve =AnnualDebtReserveInterest

TaxesWoCredit1 =((CombinedTaxRate/100)/(1-CombinedTaxRate/100))\*(EquityPrincipalPaid1+DebtPrincipalPaid1+EquityInterest1-Depreciation+DebtReserve1)

TaxCredit1 =AnnualGeneration\*ProductionTaxCredit\*TaxCreditFrac1

Taxes1 =((CombinedTaxRate/100)/(1-CombinedTaxRate/100))\*(EquityPrincipalPaid1+DebtPrincipalPaid1+EquityInterest1-Depreciation+DebtReserve1-TaxCredit1)

EnergyRevenueRequired1 =EquityRecovery+DebtRecovery+FuelCost1+NonFuelExpenses1+Taxes1+DebtReserve1-CapacityIncome-InterestOnDebtReserve - HeatSalesIncome;

#### Year2

EquityInterest2 =CostOfEquity/100\*EquityPrincipalRemaining1

EquityPrincipalPaid2 =EquityRecovery-EquityInterest2

EquityPrincipalRemaining2 =EquityPrincipalRemaining1-EquityPrincipalPaid2

DebtInterest2 =InterestRateOnDebt/100\*DebtPrincipalRemaining1

DebtPrincipalPaid2 =DebtRecovery-DebtInterest2

DebtPrincipalRemaining2 =DebtPrincipalRemaining1-DebtPrincipalPaid2

FuelCost2 =FuelCost1\*(1+EscalationFuel/100)^(Year-1)

NonFuelExpenses2 =NonFuelExpenses1\*(1+EscalationOther/100)^(Year-1)

DebtReserve2=0

HeatSalesIncome = TotalIncomeFromHeatSales \* Math.pow((1 + EscalationHeatSales / 100), (Year - 1));

TaxesWoCredit2 =((CombinedTaxRate/100)/(1-CombinedTaxRate/100))\*(EquityPrincipalPaid2+DebtPrincipalPaid2+EquityInterest2-Depreciation+DebtReserve2)

TaxCredit2 =AnnualGeneration\*ProductionTaxCredit\*((1+EscalationForProductionTaxCredit/100)^(Year-1))\*TaxCreditFrac2

Taxes2 =((CombinedTaxRate/100)/(1-CombinedTaxRate/100))\*(EquityPrincipalPaid2+DebtPrincipalPaid2+EquityInterest2-Depreciation+DebtReserve2-TaxCredit2)

EnergyRevenueRequired2 =EquityRecovery+DebtRecovery+FuelCost2+NonFuelExpenses2+Taxes2+DebtReserve2-CapacityIncome-InterestOnDebtReserve - HeatSalesIncome;

The others follow the same pattern as Year2

#### Year20

DebtReserve = - DebtReserve1

### Current $ Level Annual Cost (LAC)

PresentWorth1=EnergyRevenueRequired1\*(1+CostOfEquity/100)^-B130

TotalPresentWorth=SUM(PresentWorth1: PresentWorth20)

CapitalRecoveryFactorCurrent= CapitalRecoveryFactorEquity

CurrentLevelAnnualRevenueRequirements =TotalPresentWorth\*CapitalRecoveryFactorCurrent

CurrentLACofEnergy =CurrentLevelAnnualRevenueRequirements/AnnualGeneration

RealCostOfMoney =(1+CostOfEquity/100)/(1+GeneralInflation/100)-1

CapitalRecoveryFactorConstant=CapitalRecoveryFactor(RealCostOfMoney\*100, EconomicLife)

ConstantLevelAnnualRevenueRequirements =TotalPresentWorth\*CapitalRecoveryFactorConstant

ConstantLACofEnergy =ConstantLevelAnnualRevenueRequirements/AnnualGeneration

function CapitalRecoveryFactor(i: number, N: number) {

const A = i / 100 \* Math.pow((1 + i / 100), N) / (Math.pow((1 + i / 100), N) - 1);

return A;

}

## 10-31-2013-energy-cost-calculator-hydrogen-model

### Hydrogen Generation

GrossDesignHydrogenCapacity=158366.518706405

HydrogenHHV=141.93

HydrogenLHV=119.98

Feedstock=19.3498437209302

HydrogenEnergy=GrossDesignHydrogenCapacity\*HydrogenHHV

DesignHydrogenProductionRateMW=HydrogenEnergy/24/3600

DesignHydrogenProductionRateMg=GrossDesignHydrogenCapacity/24/1000

OverallProductionEfficiency=60.5

FeedstockInput=DesignHydrogenProductionRateMW/(OverallProductionEfficiency/100)

FeedstockSupply=FeedstockInput/Feedstock\*3600/1000

CapacityFactor=91.324200913242

AnnualHours=8760\*CapacityFactor/100

AnnualFeedstockSupply=FeedstockSupply\*AnnualHours

AnnualFeedstockEnergyInput=AnnualFeedstockSupply\*1000\*Feedstock/1000000000

AnnualHydrogenProductionMg=DesignHydrogenProductionRateMg\*AnnualHours

AnnualHydrogenProductionKg=AnnualHydrogenProductionMg\*1000

AnnualHydrogenEnergy=AnnualHydrogenProductionMg\*1000\*HydrogenHHV/1000

### Capital Cost

### Expenses--base year

### Other Revenues or Cost Savings

### Taxes and Tax credit

### Escalation/Inflation

### Financing