Treball de Fi de Màster

Màster Universitari en Enginyeria de l'Energia

Anàlisi d'una comunitat energètica renovable en el campus Baix Llobregat de la UPC

ANNEXOS

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Convocatòria: Abril 2022

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Escola Tècnica Superior
d'Enginyeria Industrial de Barcelona

UPC

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1. Codi algoritme

```
clear all

clc

Dades=xlsread('Dades_totes_1');

Consum_PMT=xlsread('Consum_PMT');

nGen=3;

nConsum=6;


Gen_D4=Dades(:,1);

Gen_D7=Dades(:,2);

Gen_P=Dades(:,3);


for i=1:nGen

Gen(:,i)=Dades(:,i);

end

for i=1:nConsum


Consum(:,i)=Dades(:,i+nGen);

end

Consum_D4=Dades(:,4);

Consum_D7=Dades(:,5);
```

```
Edemanda_D4=Consum_D4-Gen_D4; % Demanda D4 desprÈs autoconsum
Edemanda_D7=Consum_D7-Gen_D7; % Demanda D7 desprÈs autoconsum

for i=1:length(Edemanda_D4)

    if Edemanda_D4(i)<0
        Edemanda_D4(i)=0;
    end
    if Edemanda_D7(i)<0
        Edemanda_D7(i)=0;
    end

end

Edisp_D4=Gen_D4-Consum_D4; % Energia disponible D4 despres autoconsum
Edisp_D7=Gen_D7-Consum_D7; % Energia disponible D7 despres autoconsum

for i=1:length(Consum_D4)

    if Edisp_D4(i)<0
        Edisp_D4(i)=0;
    end
        if Edisp_D7(i)<0
```

```
        Edisp_D7(i)=0;

    end


end


%% BalanÁ energËtic


Edisp=[];

Edisp=[Edisp_D4 Edisp_D7 Gen_P]; % Energia disponible despres autoconsum edificis D4, D7 i pergola

Edemanda=[Edemanda_D4 Edemanda_D7 Dades(:,6) Dades(:,7) Dades(:,8) Dades(:,9)]; % Demanda disponible despres autoconsum tots els edificis

Resultat={};

Coef_D4=[];

Consum_xarxa=[];


for d=1:8760;


if sum(Edisp(d,1:3))>sum(Edemanda(d,1:size(Edemanda,2))) % Si suma Energia disponible major que suma demanda

    1

    Cost=[0 800 200 400 300 500 1000 800 0 200 400 300 500 1000 800 800 300 350 300 350 1000]; % Matriu de cost amb coeficient exportar a xarxa


    A=zeros((nGen+nConsum),(nGen)*(1+nConsum));
```

```
A(1,1:nConsum+1)=1;

A(2,(nConsum+2):(nConsum+1)*2)=1;

A(3,(nConsum+1)*2+1:(nConsum+1)*3)=1;


ii=1;

jj=1;

for i=1:3

A(4,ii)=-1;

A(5,ii+1)=-1;

A(6,ii+2)=-1;

A(7,ii+3)=-1;

A(8,ii+4)=-1;

A(9,ii+5)=-1;



ii=1+((1+nConsum)*i);

jj=jj+1;

end


b=[Edisp(d,1)  Edisp(d,2)  Edisp(d,3)  -Edemanda(d,1)  -Edemanda(d,2)  -Edemanda(d,3)  -
Edemanda(d,4) -Edemanda(d,5) -Edemanda(d,6)  ]; % Prova amb fila d!!!!!
```

```
Aeq=[];

Aeq(1,7)=1; Aeq(1,14)=1;Aeq(1,21)=1;

beq=[ sum(Edisp(d,1:3))-sum(Edemanda(d,1:6)) ];


lb=zeros(1,(nGen)*(1+nConsum));

up=[];


f=ones(1,(nGen)*(nConsum+1));


f=f.*Cost;


[x fval]=linprog(f,A,b,Aeq,beq,lb,up);


X=reshape(x,(nConsum+1),nGen)';


Inj_xarxa(d,1:nGen)=[X(1:nGen,nConsum+1)];


elseif sum(Edisp(d,1:nGen))<sum(Edemanda(d,1:size(Edemanda,2))) % Si suma Energia disponible menor que suma demanda


Cost=[0 800 200 400 300 500 800 0 200 400 300 500  800 800 300 350 300 350 1000 1000 1000 1000 1000 1000];


A=[];
```

```
b=[];

Aeq=[];

beq=[];


A=zeros((nGen+nConsum),(nGen+1)*nConsum);


A(1,1:nConsum)=1;

A(2,(nConsum+1):(nConsum)*2)=1;

A(3,((nConsum*2)+1):(nConsum)*3)=1;


ii=1;

jj=1;

for i=1:4

A(4,ii)=-1;

A(5,ii+1)=-1;

A(6,ii+2)=-1;

A(7,ii+3)=-1;

A(8,ii+4)=-1;

A(9,ii+5)=-1;


ii=1+((nConsum)*i);

jj=jj+1;
```

```
    end

    b=[Edisp(d,1) Edisp(d,2) Edisp(d,3) -Edemanda(d,1) -Edemanda(d,2) -Edemanda(d,3) -
Edemanda(d,4) -Edemanda(d,5) -Edemanda(d,6) ]; % Prova amb fila d!!!!!

    Aeq=zeros(1,(nGen+1)*nConsum);
    Aeq(1,nConsum*nGen+1:nConsum*(nGen+1))=1;
    beq=[sum(Edemanda(d,1:nConsum))-sum(Edisp(d,1:nGen))];

    lb=zeros(1,(1+nGen)*nConsum);
    up=[];

    f=ones(1,(1+nGen)*nConsum);

    f=f.*Cost;

    [x fval]=linprog(f,A,b,Aeq,beq,lb,up);

    X=(reshape(x,nConsum,nGen+1))';

    Consum_xarxa(d,1:nConsum)=[X(nGen+1,:)];
end

    for k=1:nGen   % Energia consumida d'edifici n desde generaciÛ m (D4 D7 P)
```

```
    E_D4(d,k)=X(k,1);
    E_D4(d,1)=Gen_D4(d,1)-Edisp_D4(d,1);
    E_D7(d,k)=X(k,2);
    E_D7(d,2)=Gen_D7(d,1)-Edisp_D7(d,1);
    E_C1(d,k)=X(k,3);
    E_C3(d,k)=X(k,4);
    E_C4(d,k)=X(k,5);
    E_C4_2(d,k)=X(k,6);

   end

 Resultat(d,1)={[X]};

   for j=1:nConsum

   Coef_D4(d,j)=X(1,j)/Consum(d,j);
   Coef_D4(d,1)=(Gen_D4(d)-Edisp(d))/Consum(d);

   Coef_D7(d,j)=X(2,j)/Consum(d,j);
   Coef_D7(d,2)=(Gen_D7(d)-Edisp(d,2))/Consum(d,2);

   Coef_P(d,j)=X(3,j)/Consum(d,j);
```

```
    end

    Coef_rep=[Coef_D4 Coef_D7 Coef_P];
end

 %% Excedents totals

 Gen_total=sum(Gen,2);
 Consum_total=sum(Consum,2);

 Excedents_total=Gen_total-Consum_total;
 for ll=1:8760
 if Excedents_total(ll)<0
 Excedents_total(ll)=0;
 end
 end
 Ex_any=sum(Excedents_total);

 Total= [Consum_total Gen_total Excedents_total];
```

```
%% Excedents PMT


Excedents_PMT=Consum_PMT-Excedents_total;

k=0;

for k=1:8760

  if  Excedents_PMT(k)>0

      Excedents_PMT(k)=0;

  else

      Excedents_PMT(k)=Excedents_PMT(k)*(-1);

      k

  end

end




%% ExportaciÛ dades .txt


Dades_total=[Consum_total, Gen_total, Excedents_total];


writematrix(Dades_total,'Dades_total.txt');

type Dades_total.txt;


writematrix(E_D4,'En_D4.txt');

type En_D4.txt;
```

```
writematrix(E_D7,'En_D7.txt');

type En_D7.txt;


writematrix(E_C1,'En_C1.txt');

type En_C1.txt;


writematrix(E_C3,'En_C3.txt');

type En_C3.txt;


writematrix(E_C4,'En_C4.txt');

type En_C4.txt;


writematrix(E_C4_2,'En_C4_2.txt');

type En_C4_2.txt;


writematrix(Consum,'Consum.txt');

type Consum.txt;


%%


mesos=[744 672 744 720 744 720 744 744 720 744 720 744]' ;

k=1;
```

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```
l=0;
for j=1:12

l=mesos(j)+l;

Consum_D4_mes(j)=sum(Consum_D4(k:l));
Consum_D7_mes(j)=sum(Consum_D7(k:l));
%%
Excedents_mes(j)=sum(Excedents_total(k:l));

for i=1:nConsum
Consum_mes(j,i)=sum(Consum(k:l,i));
end
Gen_D4_mes(j)=sum(Gen_D4(k:l));
Gen_D7_mes(j)=sum(Gen_D7(k:l));
Gen_P_mes(j)=sum(Gen_P(k:l));

Edisp_D4_mes(j)=sum(Edisp_D4(k:l));
Edisp_D7_mes(j)=sum(Edisp_D7(k:l));

E_D4_mes(j,:)=[sum(E_D4(k:l,1)); sum(E_D4(k:l,2)); sum(E_D4(k:l,3))];
E_D7_mes(j,:)=[sum(E_D7(k:l,1)); sum(E_D7(k:l,2)); sum(E_D7(k:l,3))];
E_C1_mes(j,:)=[sum(E_C1(k:l,1)); sum(E_C1(k:l,2)); sum(E_C1(k:l,3))];
```

```
E_C3_mes(j,:)=[sum(E_C3(k:l,1)); sum(E_C3(k:l,2)); sum(E_C3(k:l,3))];

E_C4_mes(j,:)=[sum(E_C4(k:l,1)); sum(E_C4(k:l,2)); sum(E_C4(k:l,3))];

E_C4_2_mes(j,:)=[sum(E_C4_2(k:l,1)); sum(E_C4_2(k:l,2)); sum(E_C4_2(k:l,3))];


   k=k+mesos(j);

end


% D4

Consum_D4_mes=Consum_D4_mes';

Gen_D4_mes=Gen_D4_mes';

Edisp_D4_mes=Edisp_D4_mes';


% D7

Consum_D7_mes=Consum_D7_mes';

Gen_D7_mes=Gen_D7_mes';

Edisp_D7_mes=Edisp_D7_mes';


% Pergola

Gen_P_mes=Gen_P_mes';


% Excedents

Excedents_mes=Excedents_mes';
```

```
%% D4_mes

D4_mes=[ Consum_D4_mes E_D4_mes(:,1) Edisp_D4_mes];

D7_mes=[ Consum_D7_mes E_D4_mes(:,1) Edisp_D7_mes];

%% Energia per gr‡fiques

E_D4_mes_plot=[ Consum_mes(:,1) E_D4_mes(:,1) E_D4_mes(:,2) E_D4_mes(:,3)];

E_D7_mes_plot=[ Consum_mes(:,2) E_D7_mes(:,1) E_D7_mes(:,2) E_D7_mes(:,3)];

E_C1_mes_plot=[ Consum_mes(:,3) E_C1_mes(:,1) E_C1_mes(:,2) E_C1_mes(:,3)];

E_C3_mes_plot=[ Consum_mes(:,4) E_C3_mes(:,1) E_C3_mes(:,2) E_C3_mes(:,3)];

E_C4_mes_plot=[ Consum_mes(:,5) E_C4_mes(:,1) E_C4_mes(:,2) E_C4_mes(:,3)];

E_C4_2_mes_plot=[ Consum_mes(:,6) E_C4_2_mes(:,1) E_C4_2_mes(:,2)
E_C4_2_mes(:,3)];


%% Gr‡fiques consum edificis

xmesos=['Gener', 'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre',
'Novembre','Desembre'];

edificis={' D4';' D7'; ' C1'; ' C3'; ' C4'; ' C4_2'};

tit='Consum edifici ';

for i=1:nConsum

figure

TITLE=strcat(tit, edificis{i})

plot(Consum(:,i), 'Color',[0.6350 0.0780 0.1840])

set(gca,'xtick',1:744:8760, 'xticklabel',{'Gener',
'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre',
'Novembre','Desembre'}); xtickangle (45);

ylabel('Energia [kWh]')
```

```
title(TITLE)

end

%% Gr‡fiques generaciÛ

xmesos=['Gener',     'Febrer','Mar√ß','Abril','Maig','Juny','Juliol','Agost','Setembre',     'Octubre',
'Novembre','Desembre'];

edificis={' D4';' D7'; ' PËrgola'};

tit='GeneraciÛ edifici ';

for i=1:nGen

figure

TITLE=strcat(tit, edificis{i})

plot(Gen(:,i))

set(gca,'xtick',1:744:8760,                          'xticklabel',{'Gener',
'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre',                 'Octubre',
'Novembre','Desembre'}); xtickangle (45);

ylabel('Energia [kWh]')

title(TITLE)
```

```
end

%% Gr‡fiques Excedents

figure
bar(Excedents_total, 'FaceColor',[0.9290 0.6940 0.1250]);
set(gca,'xtick',1:744:8760, 'xticklabel',{'Gener', 'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre', 'Novembre','Desembre'}); xtickangle (45);
ylabel('Energia [kWh]')
title('Excedents')
legend('Excedents')

figure
plot(Consum_total);
set(gca,'xtick',1:744:8760, 'xticklabel',{'Gener', 'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre', 'Novembre','Desembre'}); xtickangle (45);
ylabel('Energia [kWh]')
title('Consum total estudi')
legend('Consum')

bar(Excedents_mes/1000,0.2);
```

```
set(gca,'xtick',1:12, 'xticklabel',{'Gener', 'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre', 'Novembre','Desembre'});xtickangle (45)

title('Excedents mensual')

legend('Excedents')

ylabel('Energia [MWh]')




%% Gr‡fiques Excedents PMT


figure

plot(Consum_PMT);

set(gca,'xtick',1:744:8760, 'xticklabel',{'Gener', 'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre', 'Novembre','Desembre'}); xtickangle (45);

ylabel('Energia [kWh]')

title('Consum comptador fiscal PMT')

legend('Consum PMT')


figure

bar(Excedents_PMT,10, 'FaceColor',[0.9290 0.6940 0.1250]);

set(gca,'xtick',1:744:8760, 'xticklabel',{'Gener', 'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre', 'Novembre','Desembre'}); xtickangle (45);
```

```
ylabel('Energia [kWh]')

title('Excedents PMT')

legend('Excedents')




%% BalanÁ energËtic edifici D4 i D7

figure

bar(D4_mes/1000);

set(gca,'xtick',1:12, 'xticklabel',{'Gener', 'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre', 'Novembre','Desembre'});xtickangle (45)

title('Consum, autoconsum,  i excedents Edifici D4')

legend('Consum','Autoconsum','Excedents')

ylabel('Energia [MWh]')


figure

bar(D7_mes/1000);

title('Consum, autoconsum i excedents Edifici D7')

legend('Consum','Autoconsum','Excedents')

ylabel('Energia [MWh]')

set(gca,'xtick',1:12,'xticklabel',{'Gener', 'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre', 'Novembre','Desembre'});xtickangle (45)


%% Gr‡fiques BalanÁ energËtic mensual
```

```
figure

bar(E_D4_mes_plot/1000)

set(gca,'xtick',1:12, 'xticklabel',{'Gener',
'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre',
'Novembre','Desembre'});xtickangle (45)

title('Energia consumida edifici D4 des dels diferents punts de generaciÛ del campus ')

legend('Consum','Autoconsum Edifici D4','Autoconsum Edifici D7','Autoconsum PËrgola')

ylabel('Energia [MWh]')


figure

bar(E_D7_mes_plot/1000)

set(gca,'xtick',1:12, 'xticklabel',{'Gener',
'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre',
'Novembre','Desembre'});xtickangle (45)

title('Energia consumida edifici D7 des dels diferents punts de generaciÛ del campus ')

legend('Consum','Autoconsum Edifici D4','Autoconsum Edifici D7','Autoconsum PËrgola')

ylabel('Energia [MWh]')


figure

bar(E_C1_mes_plot/1000)

set(gca,'xtick',1:12, 'xticklabel',{'Gener',
'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre', 'Octubre',
'Novembre','Desembre'});xtickangle (45)

title('Energia consumida edifici C1 des dels diferents punts de generaciÛ del campus ')

legend('Consum','Autoconsum Edifici D4','Autoconsum Edifici D7','Autoconsum PËrgola')

ylabel('Energia [MWh]')
```

```
figure

bar(E_C3_mes_plot/1000)

set(gca,'xtick',1:12,                                    'xticklabel',{'Gener',
'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre',                 'Octubre',
'Novembre','Desembre'});xtickangle (45)

title('Energia consumida edifici C3 des dels diferents punts de generaciÛ del campus ')

legend('Consum','Autoconsum Edifici D4','Autoconsum Edifici D7','Autoconsum PËrgola')

ylabel('Energia [MWh]')


figure

bar(E_C4_mes_plot/1000)

set(gca,'xtick',1:12,                                    'xticklabel',{'Gener',
'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre',                 'Octubre',
'Novembre','Desembre'});xtickangle (45)

title('Energia consumida edifici C4 des dels diferents punts de generaciÛ del campus ')

legend('Consum','Autoconsum Edifici D4','Autoconsum Edifici D7','Autoconsum PËrgola')

ylabel('Energia [MWh]')


figure

bar(E_C4_2_mes_plot/1000)

set(gca,'xtick',1:12,                                    'xticklabel',{'Gener',
'Febrer','MarÁ','Abril','Maig','Juny','Juliol','Agost','Setembre',                 'Octubre',
'Novembre','Desembre'});xtickangle (45)

title('Energia consumida edifici C4.2 des dels diferents punts de generaciÛ del campus ')

legend('Consum','Autoconsum Edifici D4','Autoconsum Edifici D7','Autoconsum PËrgola')
```

```
ylabel('Energia [MWh]')
```

2. Fitxes tècniques

3. Simulació plantes fotovoltaiques PVSyst

Version 7.2.5

PVsyst - Simulation report

Grid-Connected System

Project: CBL - UPC

Variant: D4 15º - REC365W SMA 75 kW

Sheds on ground

System power: 84.3 kWp

Castelldefels (CBL UPC) - Spain

Author

Project summary

Geographical Site	Situation		Project settings	
Castelldefels (CBL UPC)	Latitude	41.28 °N	Albedo	0.20
Spain	Longitude	1.99 °E		
	Altitude	10 m		
	Time zone	UTC+1		

Meteo data
Castelldefels (CBL UPC)
PVGIS api TMY

System summary

Grid-Connected System — **Sheds on ground**

PV Field Orientation		Near Shadings	User's needs
Fixed plane		Linear shadings	Unlimited load (grid)
Tilt/Azimuth	15 / -18 °		

System information

PV Array		**Inverters**	
Nb. of modules	231 units	Nb. of units	1 Unit
Pnom total	84.3 kWp	Pnom total	75.0 kWac
		Pnom ratio	1.124

Results summary

Produced Energy	135.3 MWh/year	Specific production	1605 kWh/kWp/year	Perf. Ratio PR	85.62 %

Table of contents

General parameters

Grid-Connected System

Sheds on ground

PV Field Orientation

Orientation
Fixed plane
Tilt/Azimuth 15 / -18 °

Sheds configuration
Nb. of sheds 6 units
Sizes
Sheds spacing 1.77 m
Collector width 1.04 m
Ground Cov. Ratio (GCR) 58.8 %
Shading limit angle
Limit profile angle 19.6 °

Models used
Transposition Perez
Diffuse Imported
Circumsolar separate

Horizon
Free Horizon

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

PV Array Characteristics

PV module
Manufacturer Generic
Model REC 365TP4
(Original PVsyst database)
Unit Nom. Power 365 Wp
Number of PV modules 231 units
Nominal (STC) 84.3 kWp
Modules 11 Strings x 21 In series
At operating cond. (50°C)
Pmpp 77.2 kWp
U mpp 652 V
I mpp 119 A

Inverter
Manufacturer Generic
Model Sunny Highpower-SHP 75-10
(Original PVsyst database)
Unit Nom. Power 75.0 kWac
Number of inverters 1 unit
Total power 75.0 kWac
Operating voltage 570-800 V
Pnom ratio (DC:AC) 1.12

Total PV power
Nominal (STC) 84 kWp
Total 231 modules
Module area 422 m²

Total inverter power
Total power 75 kWac
Nb. of inverters 1 Unit
Pnom ratio 1.12

Array losses

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 20.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

DC wiring losses
Global array res. 90 mΩ
Loss Fraction 1.5 % at STC

Module Quality Loss
Loss Fraction -0.3 %

Module mismatch losses
Loss Fraction 2.0 % at MPP

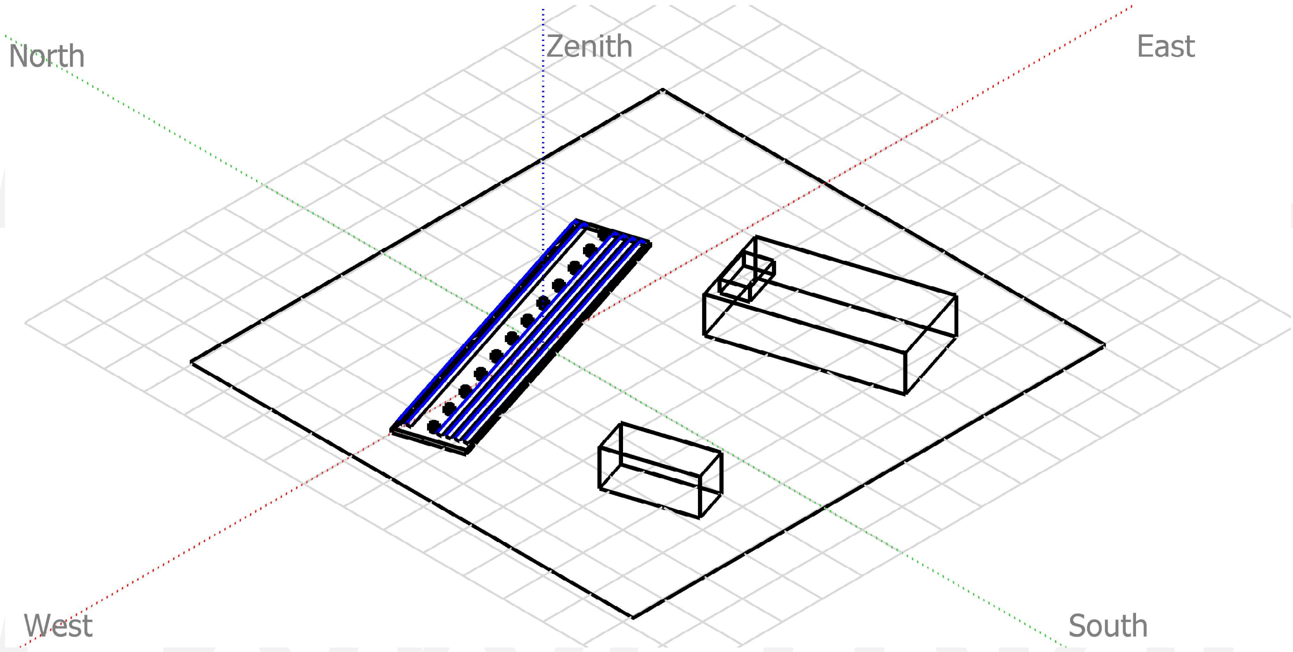
Strings Mismatch loss
Loss Fraction 0.1 %

IAM loss factor
Incidence effect (IAM): User defined profile

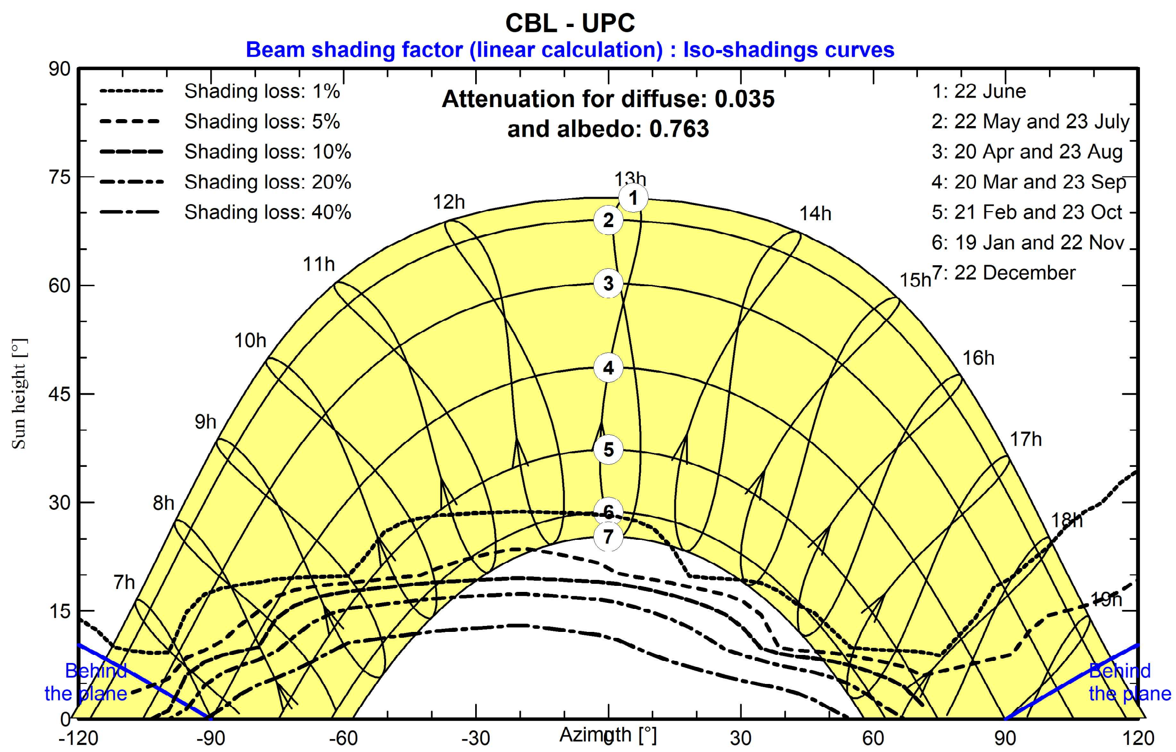
0°	30°	45°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	0.974	0.907	0.832	0.688	0.445	0.000

Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

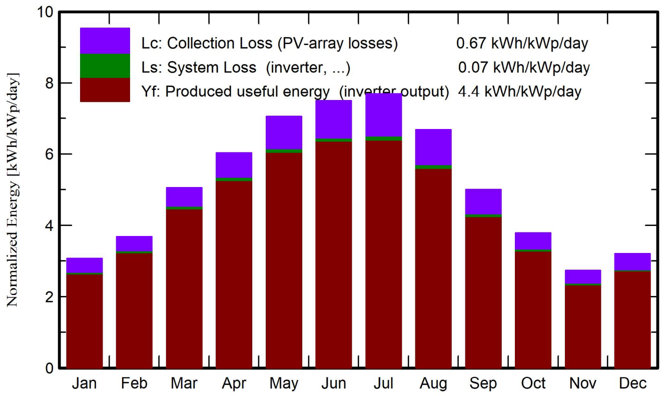


Main results

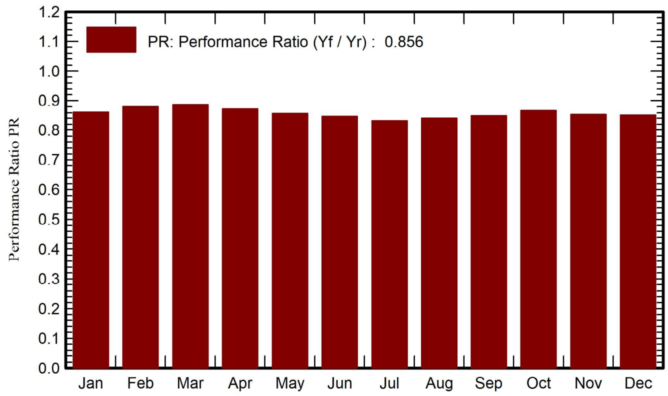
System Production

Produced Energy	135.3 MWh/year	Specific production	1605 kWh/kWp/year
		Performance Ratio PR	85.62 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

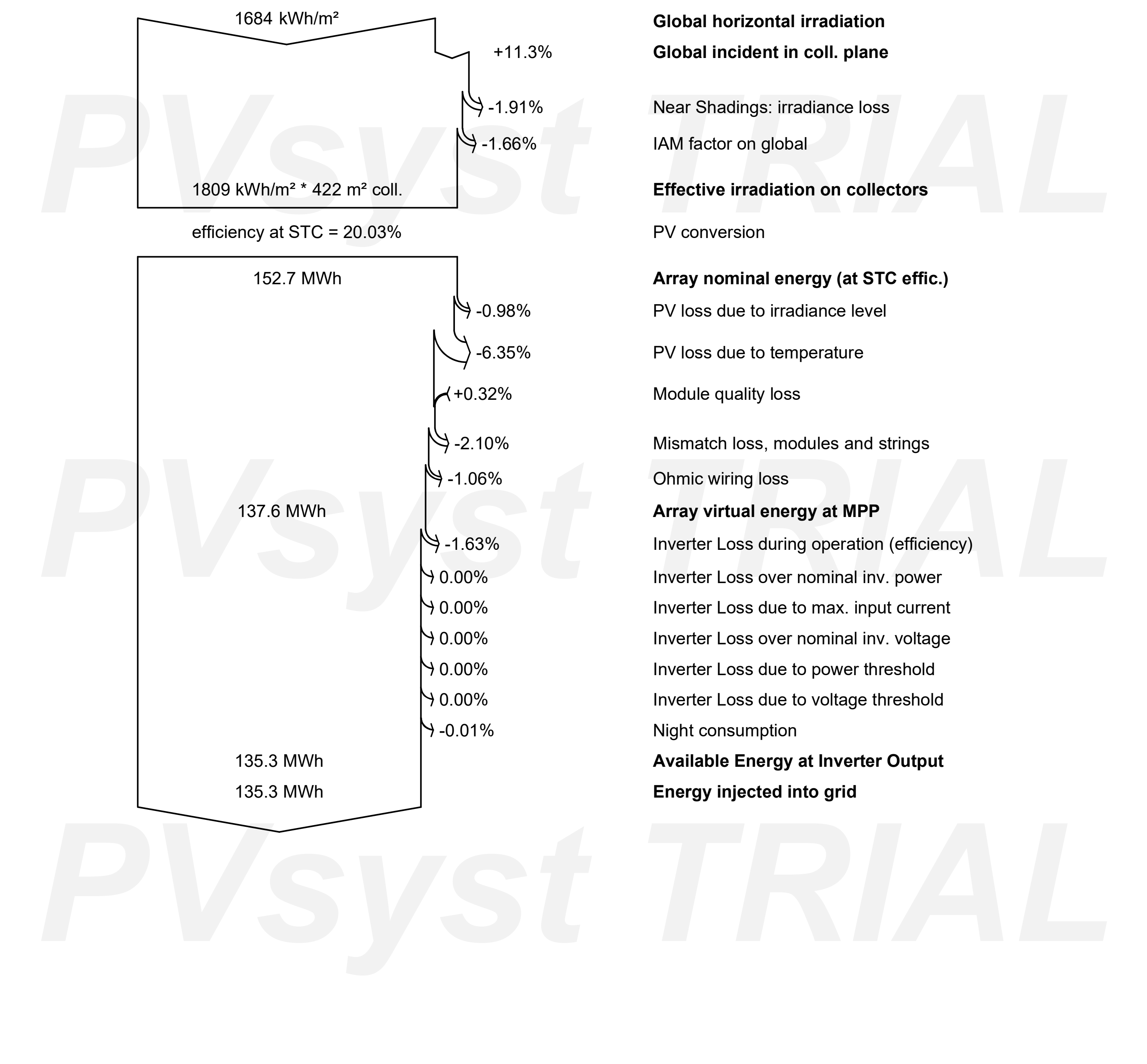
	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR ratio
January	69.0	25.49	6.95	95.4	87.8	7.05	6.93	0.861
February	82.1	33.37	9.13	103.2	98.4	7.79	7.66	0.880
March	135.7	46.65	8.71	156.6	152.0	11.91	11.71	0.887
April	167.9	57.92	11.95	180.9	176.3	13.54	13.31	0.873
May	213.5	71.26	16.15	219.0	213.7	16.10	15.83	0.858
June	222.8	76.12	19.55	225.2	219.7	16.35	16.09	0.848
July	234.6	64.23	24.09	238.9	233.6	17.03	16.76	0.832
August	195.1	59.58	22.46	206.7	202.0	14.89	14.65	0.841
September	134.7	53.26	19.79	150.1	145.8	10.94	10.76	0.850
October	97.4	39.50	14.93	117.4	113.2	8.73	8.59	0.867
November	62.7	29.65	11.89	82.2	76.1	6.03	5.92	0.854
December	68.4	22.77	7.74	99.4	90.0	7.25	7.14	0.852
Year	1684.0	579.80	14.47	1874.9	1808.6	137.60	135.35	0.856

Legends

GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		

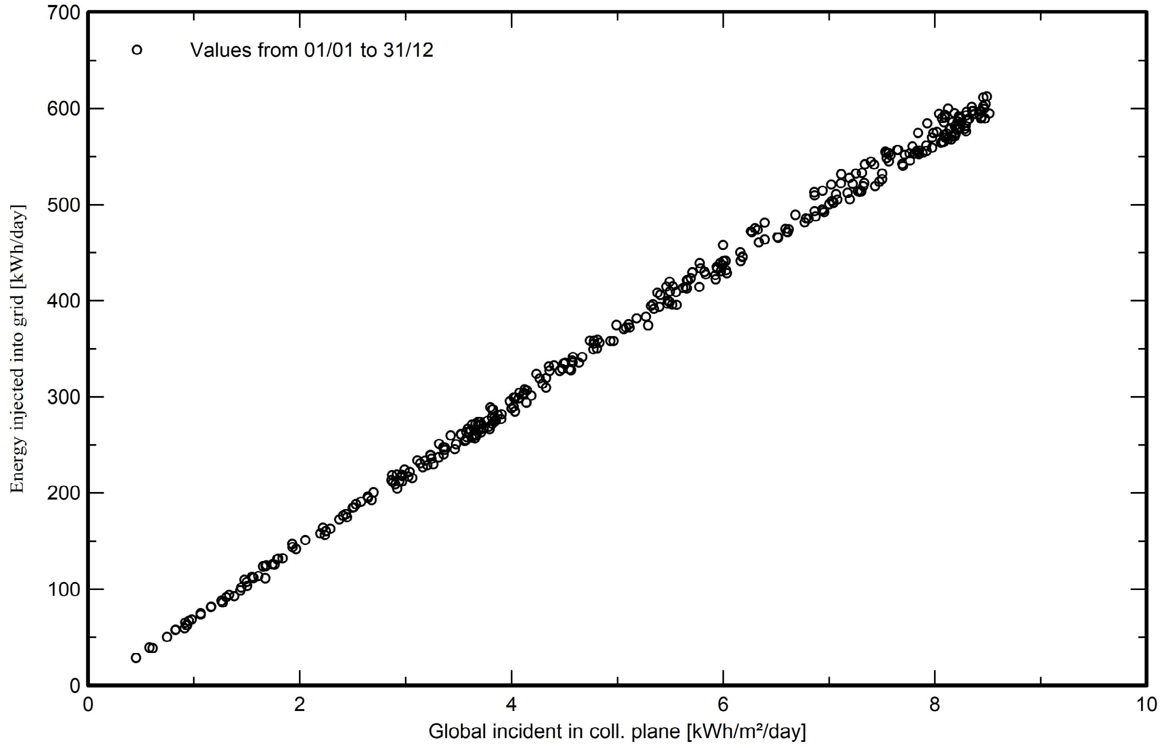
PVsyst V7.2.5
VC7, Simulation date:
11/09/21 16:59
with v7.2.5

Loss diagram

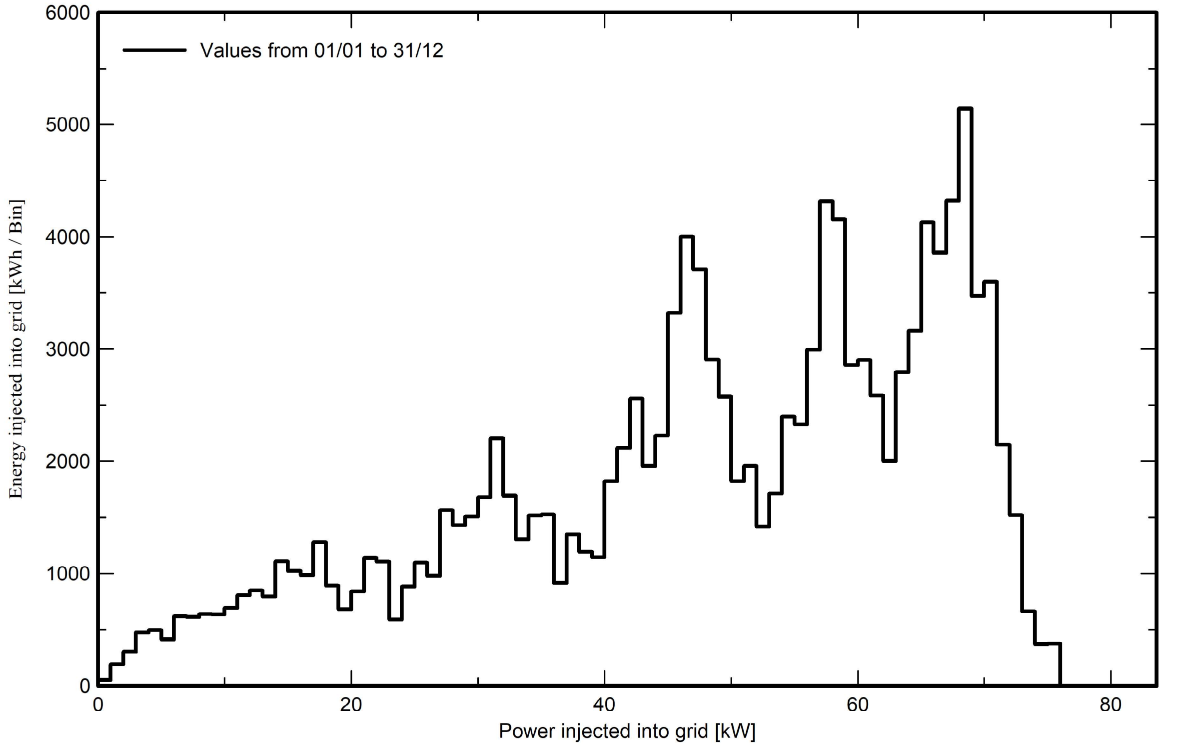


Special graphs

Daily Input/Output diagram



System Output Power Distribution



PVsyst - Simulation report

Grid-Connected System

Project: CBL - UPC

Variant: D7 15º - REC365W SMA 75 kW

No 3D scene defined, no shadings

System power: 84.3 kWp

Castelldefels (CBL UPC) - Spain

Author

Project summary

Geographical Site
Castelldefels (CBL UPC)
Spain

Situation

Latitude	41.28 °N
Longitude	1.99 °E
Altitude	10 m
Time zone	UTC+1

Project settings
Albedo 0.20

Meteo data
Castelldefels (CBL UPC)
PVGIS api TMY

System summary

Grid-Connected System

No 3D scene defined, no shadings

PV Field Orientation
Fixed plane
Tilt/Azimuth 15 / -18 °

Near Shadings
No Shadings

User's needs
Unlimited load (grid)

System information

PV Array

Nb. of modules	231 units
Pnom total	84.3 kWp

Inverters

Nb. of units	1 Unit
Pnom total	75.0 kWac
Pnom ratio	1.124

Results summary

Produced Energy	137.8 MWh/year	Specific production	1635 kWh/kWp/year	Perf. Ratio PR	87.18 %

Table of contents

General parameters

Grid-Connected System | **No 3D scene defined, no shadings**

PV Field Orientation

Orientation
Fixed plane
Tilt/Azimuth 15 / -18 °

Sheds configuration
No 3D scene defined

Models used

Transposition	Perez
Diffuse	Imported
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
No Shadings

User's needs
Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer	Generic
Model	REC 365TP4
(Original PVsyst database)	
Unit Nom. Power	365 Wp
Number of PV modules	231 units
Nominal (STC)	84.3 kWp
Modules	11 Strings x 21 In series
At operating cond. (50°C)	
Pmpp	77.2 kWp
U mpp	652 V
I mpp	119 A

Inverter

Manufacturer	Generic
Model	Sunny Highpower-SHP 75-10
(Original PVsyst database)	
Unit Nom. Power	75.0 kWac
Number of inverters	1 unit
Total power	75.0 kWac
Operating voltage	570-800 V
Pnom ratio (DC:AC)	1.12

Total PV power

Nominal (STC)	84 kWp
Total	231 modules
Module area	422 m²

Total inverter power

Total power	75 kWac
Nb. of inverters	1 Unit
Pnom ratio	1.12

Array losses

Thermal Loss factor

Module temperature according to irradiance
Uc (const) 20.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

DC wiring losses

Global array res. 90 mΩ
Loss Fraction 1.5 % at STC

Module Quality Loss

Loss Fraction -0.3 %

Module mismatch losses

Loss Fraction 2.0 % at MPP

Strings Mismatch loss

Loss Fraction 0.1 %

IAM loss factor

Incidence effect (IAM): User defined profile

0°	30°	45°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	0.974	0.907	0.832	0.688	0.445	0.000

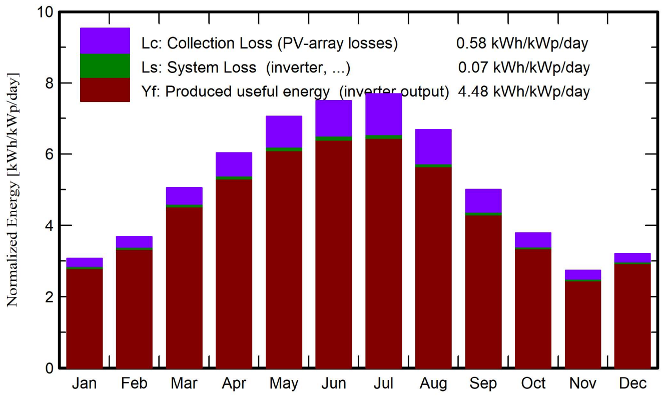
PVsyst V7.2.5
VC5, Simulation date:
12/09/21 12:19
with v7.2.5

Main results

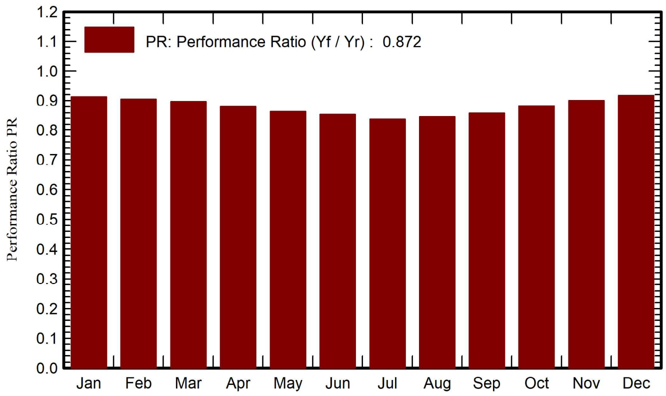
System Production

Produced Energy	137.8 MWh/year	Specific production	1635 kWh/kWp/year
		Performance Ratio PR	87.18 %

Normalized productions (per installed kWp)



Performance Ratio PR



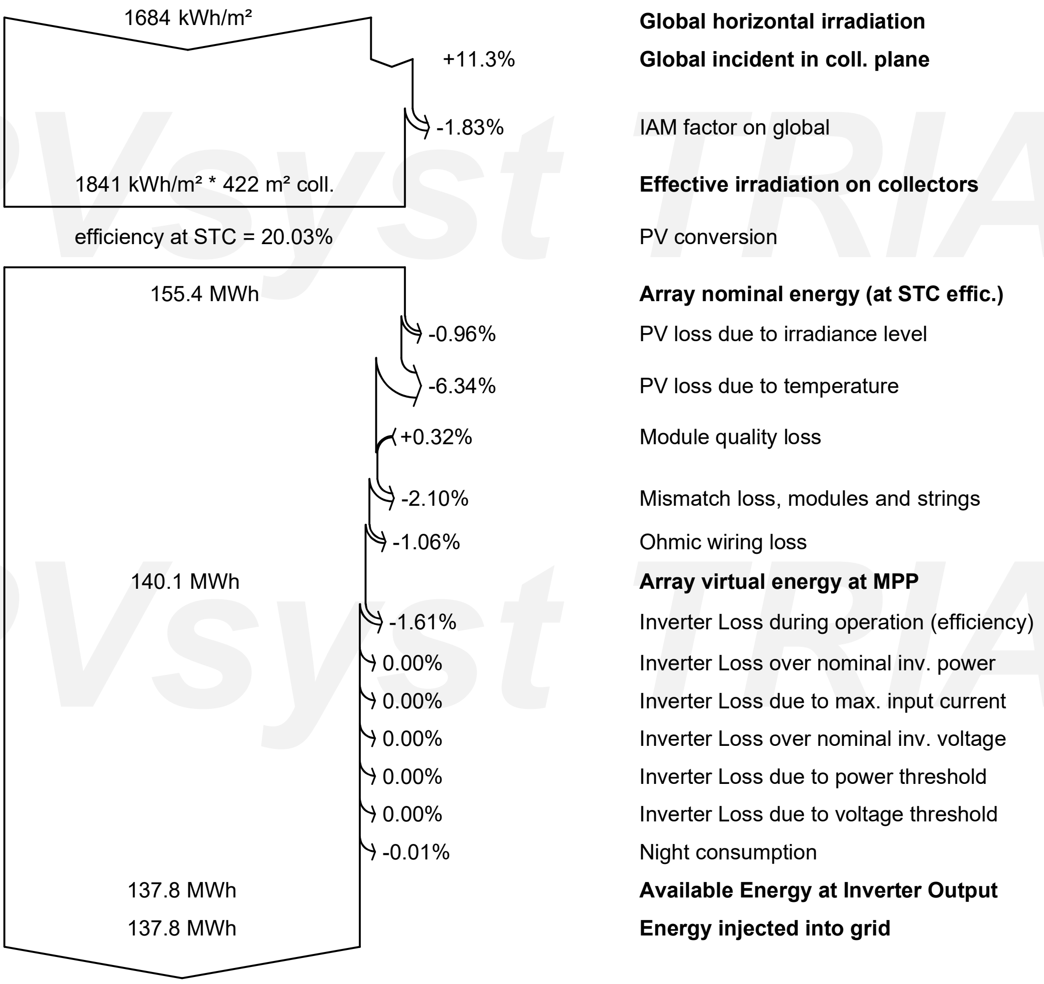
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR ratio
January	69.0	25.49	6.95	95.4	92.9	7.46	7.34	0.912
February	82.1	33.37	9.13	103.2	101.0	8.00	7.87	0.905
March	135.7	46.65	8.71	156.6	153.7	12.04	11.85	0.897
April	167.9	57.92	11.95	180.9	177.9	13.65	13.43	0.880
May	213.5	71.26	16.15	219.0	215.5	16.22	15.96	0.864
June	222.8	76.12	19.55	225.2	221.4	16.48	16.22	0.854
July	234.6	64.23	24.09	238.9	235.1	17.14	16.87	0.837
August	195.1	59.58	22.46	206.7	203.5	15.00	14.76	0.847
September	134.7	53.26	19.79	150.1	147.4	11.06	10.87	0.859
October	97.4	39.50	14.93	117.4	115.3	8.90	8.75	0.884
November	62.7	29.65	11.89	82.2	80.1	6.35	6.24	0.900
December	68.4	22.77	7.74	99.4	96.8	7.79	7.68	0.917
Year	1684.0	579.80	14.47	1874.9	1840.7	140.09	137.82	0.872

Legends

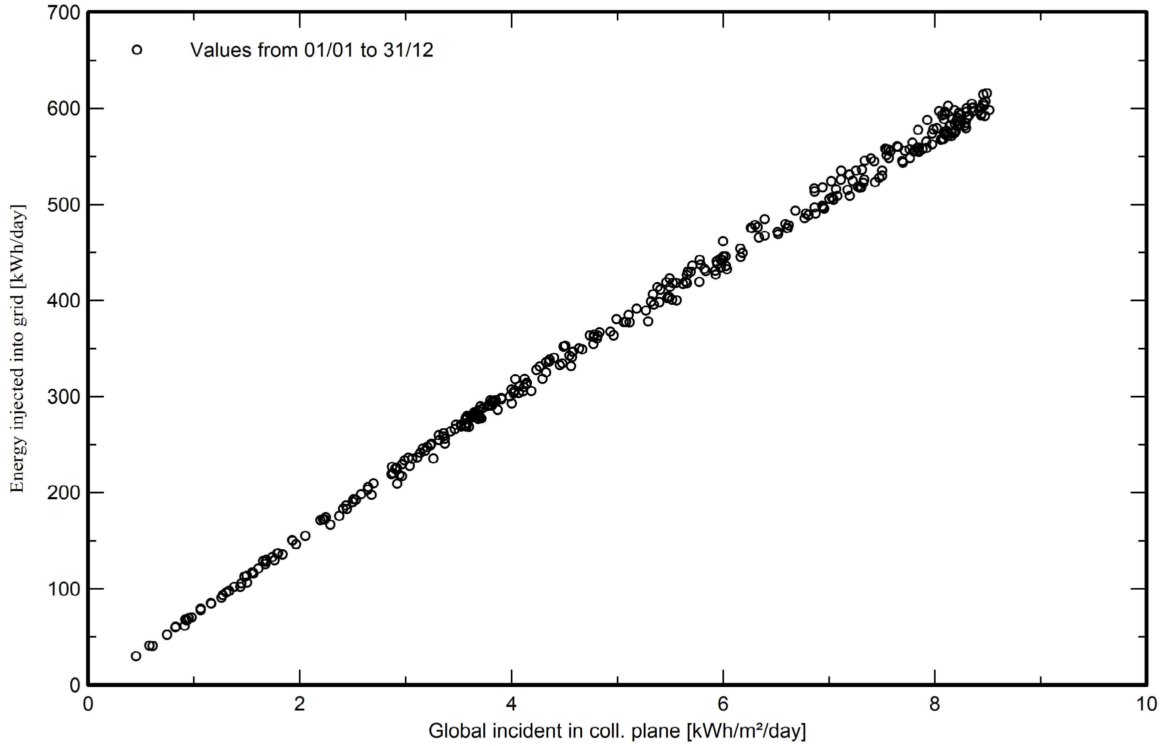
GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		

Loss diagram

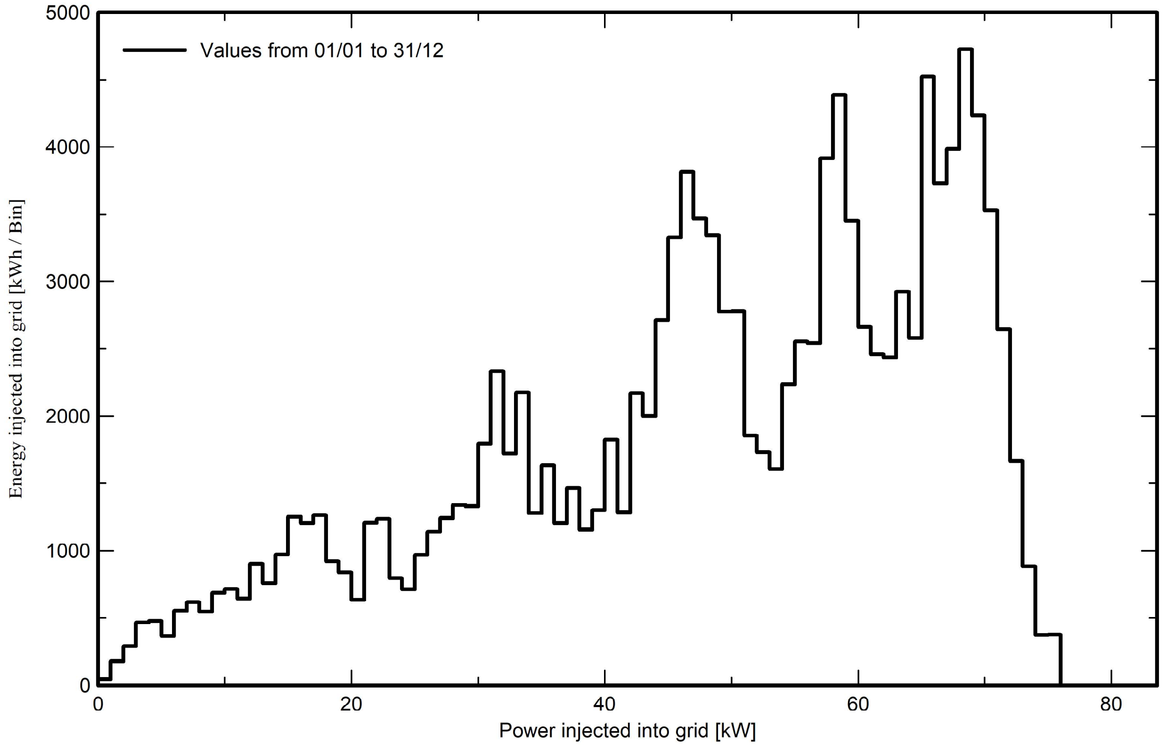


Special graphs

Daily Input/Output diagram



System Output Power Distribution



Version 7.2.5

PVsyst - Simulation report

Grid-Connected System

Project: CBL - UPC

Variant: Parking

No 3D scene defined, no shadings

System power: 467 kWp

Castelldefels (CBL UPC) - Spain

Author

Project summary

Geographical Site	Situation		Project settings	
Castelldefels (CBL UPC)	Latitude	41.28 °N	Albedo	0.20
Spain	Longitude	1.99 °E		
	Altitude	10 m		
	Time zone	UTC+1		

Meteo data
Castelldefels (CBL UPC)
PVGIS api TMY

System summary

Grid-Connected System — **No 3D scene defined, no shadings**

PV Field Orientation		Near Shadings	User's needs
Fixed plane		No Shadings	Unlimited load (grid)
Tilt/Azimuth	12 / -18 °		

System information

PV Array		Inverters	
Nb. of modules	1280 units	Nb. of units	8 units
Pnom total	467 kWp	Pnom total	400 kWac
		Pnom ratio	1.168

Results summary

Produced Energy	744.4 MWh/year	Specific production	1593 kWh/kWp/year	Perf. Ratio PR	86.38 %

Table of contents

General parameters

Grid-Connected System

No 3D scene defined, no shadings

PV Field Orientation

Orientation
Fixed plane
Tilt/Azimuth 12 / -18 °

Sheds configuration
No 3D scene defined

Models used

Transposition	Perez
Diffuse	Imported
Circumsolar	separate

Horizon
Free Horizon

Near Shadings
No Shadings

User's needs
Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer	Generic
Model	REC 365TP4
(Original PVsyst database)	
Unit Nom. Power	365 Wp
Number of PV modules	1280 units
Nominal (STC)	467 kWp
Modules	64 Strings x 20 In series
At operating cond. (50°C)	
Pmpp	428 kWp
U mpp	620 V
I mpp	690 A

Inverter

Manufacturer	Generic
Model	Sunny Tripower STP50-41-Core1
(Original PVsyst database)	
Unit Nom. Power	50.0 kWac
Number of inverters	8 units
Total power	400 kWac
Operating voltage	188-800 V
Pnom ratio (DC:AC)	1.17

Total PV power

Nominal (STC)	467 kWp
Total	1280 modules
Module area	2336 m²

Total inverter power

Total power	400 kWac
Nb. of inverters	8 units
Pnom ratio	1.17

Array losses

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 20.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

DC wiring losses
Global array res. 15 mΩ
Loss Fraction 1.5 % at STC

Module Quality Loss
Loss Fraction -0.3 %

Module mismatch losses
Loss Fraction 2.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

IAM loss factor
Incidence effect (IAM): User defined profile

0°	30°	45°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	0.974	0.907	0.832	0.688	0.445	0.000

Main results

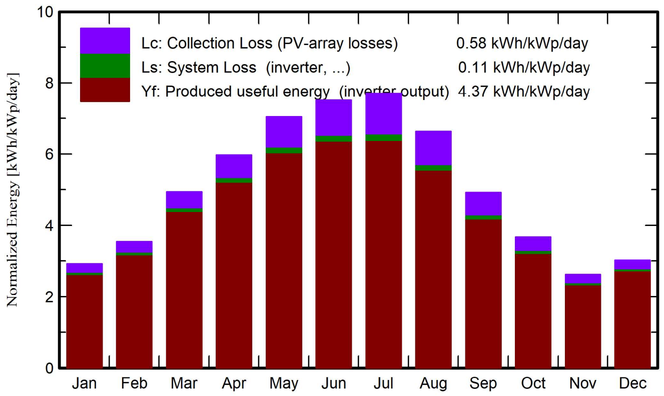
System Production

Produced Energy 744.4 MWh/year

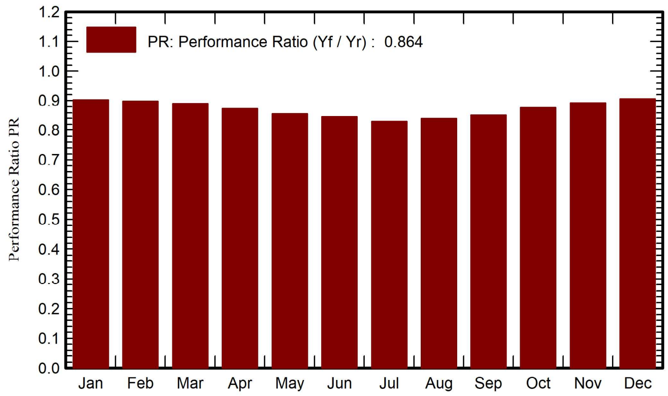
Specific production 1593 kWh/kWp/year

Performance Ratio PR 86.38 %

Normalized productions (per installed kWp)



Performance Ratio PR



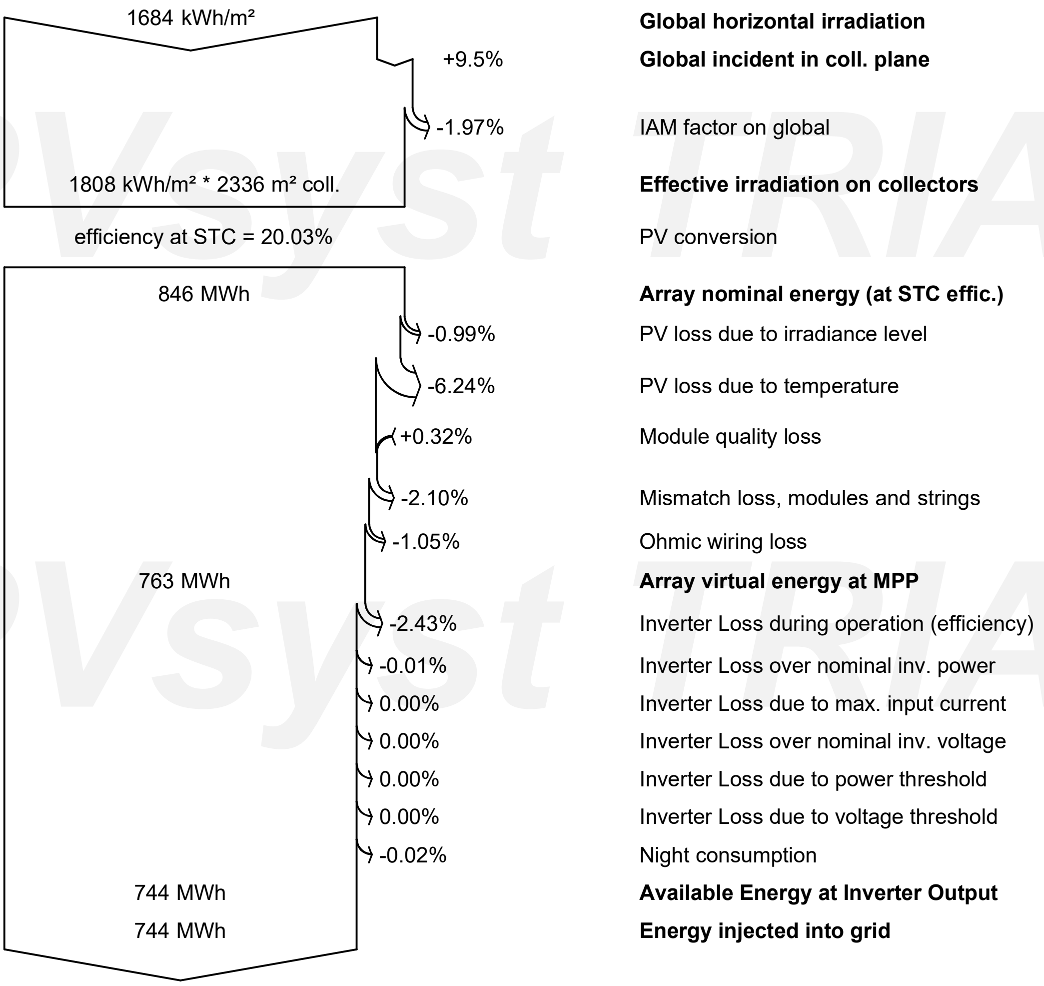
Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR ratio
January	69.0	25.49	6.95	90.5	87.6	39.06	38.20	0.903
February	82.1	33.37	9.13	99.4	97.0	42.66	41.69	0.898
March	135.7	46.65	8.71	153.1	150.1	65.27	63.72	0.891
April	167.9	57.92	11.95	179.0	176.0	74.92	73.06	0.874
May	213.5	71.26	16.15	218.8	215.2	89.84	87.55	0.857
June	222.8	76.12	19.55	225.7	221.9	91.57	89.23	0.846
July	234.6	64.23	24.09	239.1	235.3	95.13	92.64	0.829
August	195.1	59.58	22.46	205.3	202.0	82.60	80.48	0.839
September	134.7	53.26	19.79	147.7	144.8	60.33	58.82	0.853
October	97.4	39.50	14.93	113.9	111.6	47.82	46.68	0.877
November	62.7	29.65	11.89	78.6	76.2	33.55	32.77	0.892
December	68.4	22.77	7.74	93.6	90.5	40.45	39.60	0.906
Year	1684.0	579.80	14.47	1844.6	1808.2	763.21	744.44	0.864

Legends

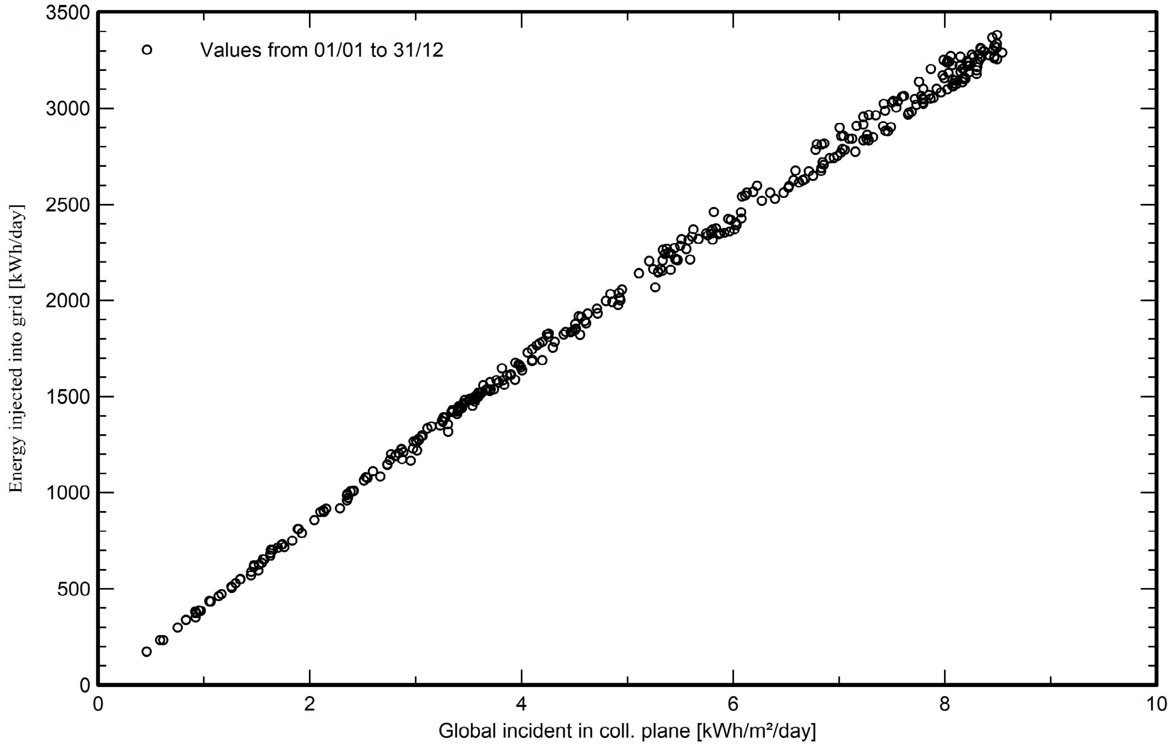
GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		

Loss diagram



Special graphs

Daily Input/Output diagram



System Output Power Distribution