

# 503 GROUP ENERGY

TECHNICAL AND FINANCIAL PROPOSAL FOR CONSTRUCTION OF 20, 25MW SOLAR PV PLANT, IRAQ

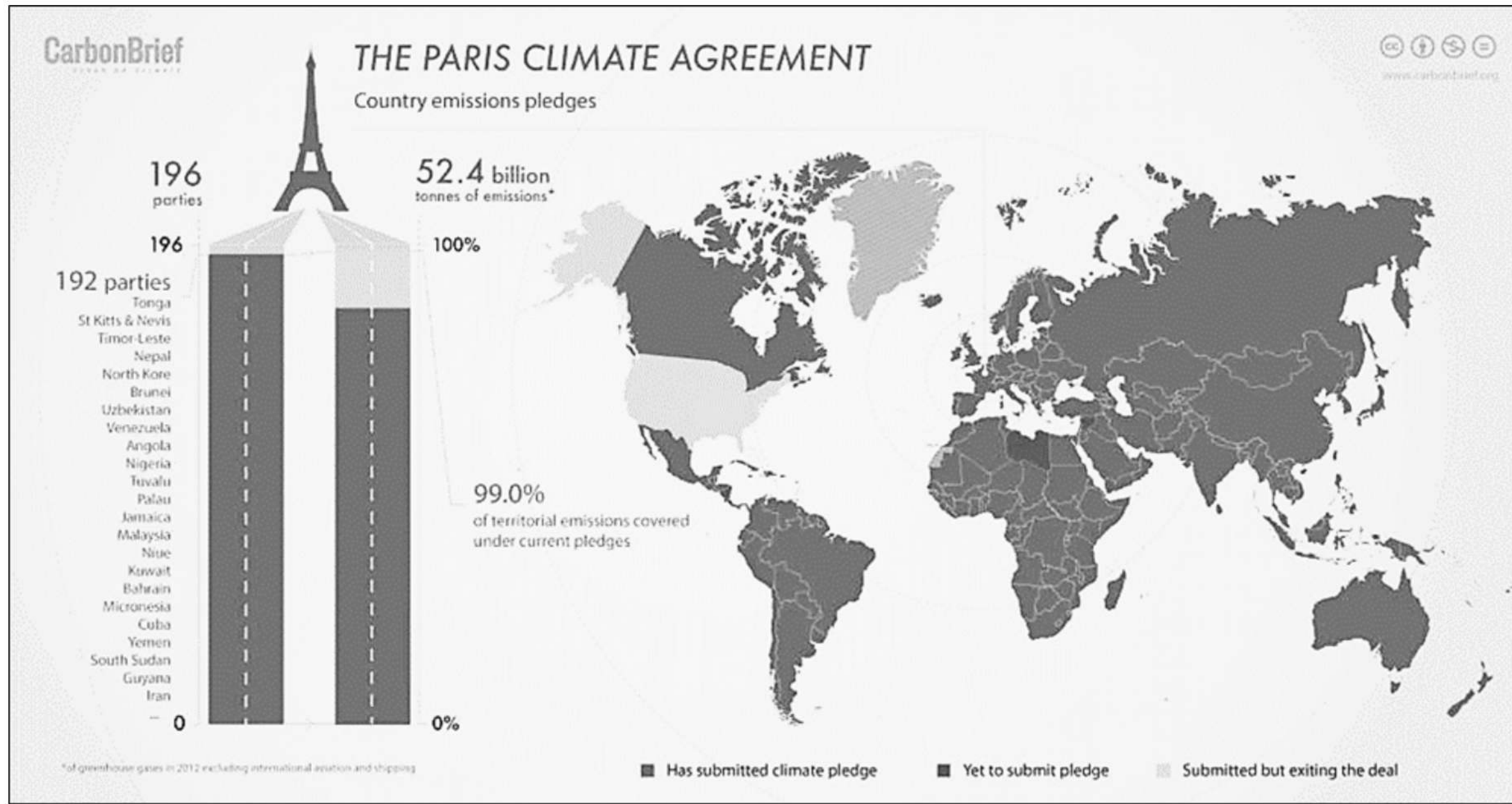
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# INTRODUCTION



## Environmental Benefits

Climate change is a global emergency that goes beyond national borders. It is an issue that requires international cooperation and coordinated solutions at all levels.

To tackle climate change and its negative impacts, world leaders at the UN Climate Change Conference (COP21) in Paris reached a breakthrough on 12 December 2015: the historic Paris Agreement.

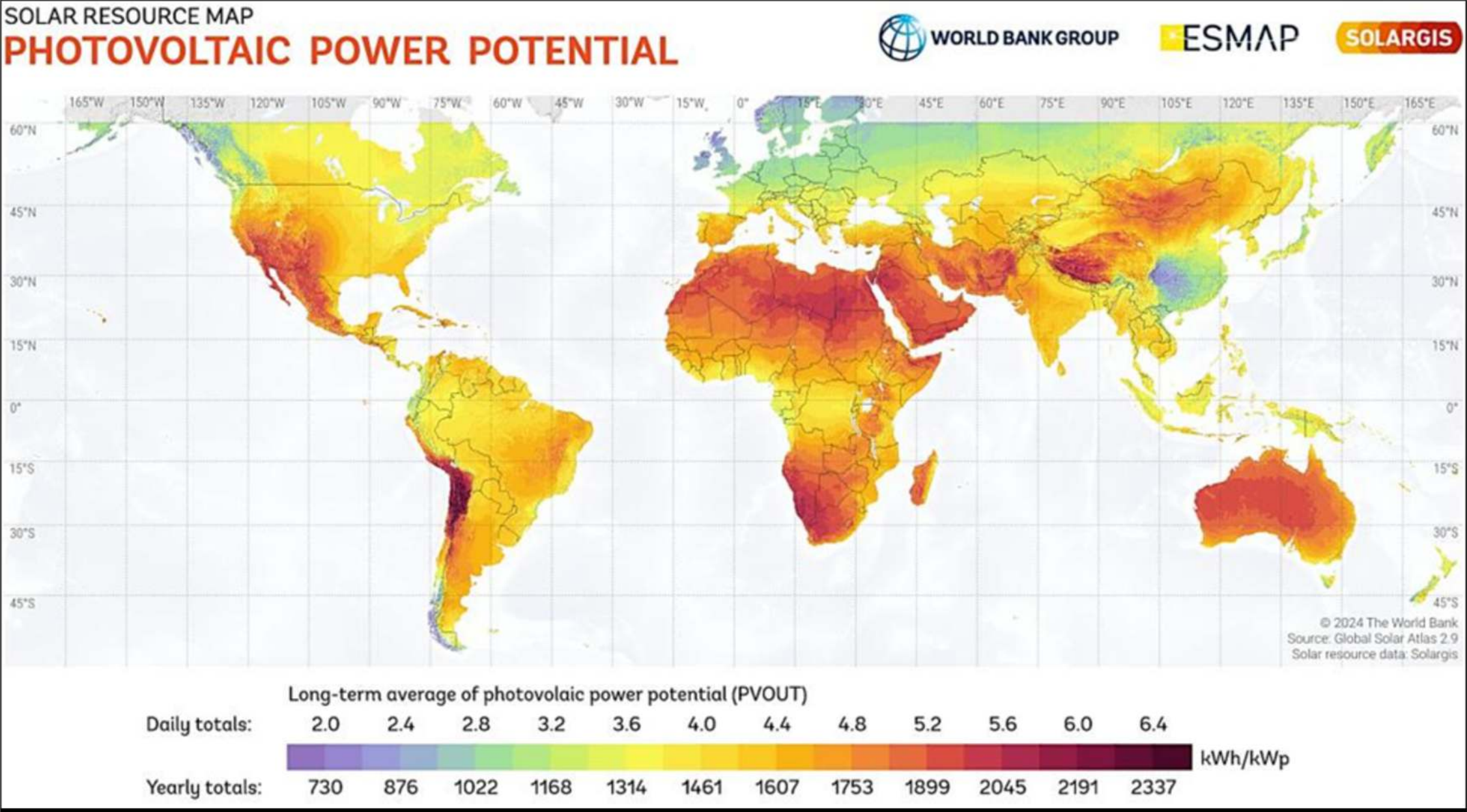
The Agreement includes commitments from all countries to reduce their emissions and work together to adapt to the impacts of climate change, and calls on countries to strengthen their commitments over time. The Agreement provides a pathway for developed nations to assist developing nations in their climate mitigation and adaptation efforts while creating a framework for the transparent monitoring and reporting of countries' climate goals.

Iraq aims to leverage international support to reduce its greenhouse gas emissions by 15 per cent by 2030, including by reducing methane emissions from its oil and gas, agriculture, and waste sectors. Iraq demonstrated its commitment for action by signing the Global Methane Pledge, a global effort to reduce methane emissions by at least 30 per cent from 2020 levels by 2030.

The detailed global data representing the solar resource and PV power output PVOUT calculated by SolarGIS[1], released via the Global Solar Atlas is provided by World Bank as a free service to support global scale-up of solar power. It makes it possible to evaluate or compare virtually the practical PV potential map or the power output achievable by a typical configuration of the utility scale PV system for any site, region, or country. Accordingly, Iraq with high average practical PV power potential, can be considered a country with one of the most generous conditions for PV.

[1]<https://solargis.com/resources/free-maps-and-gis-data?locality=world>





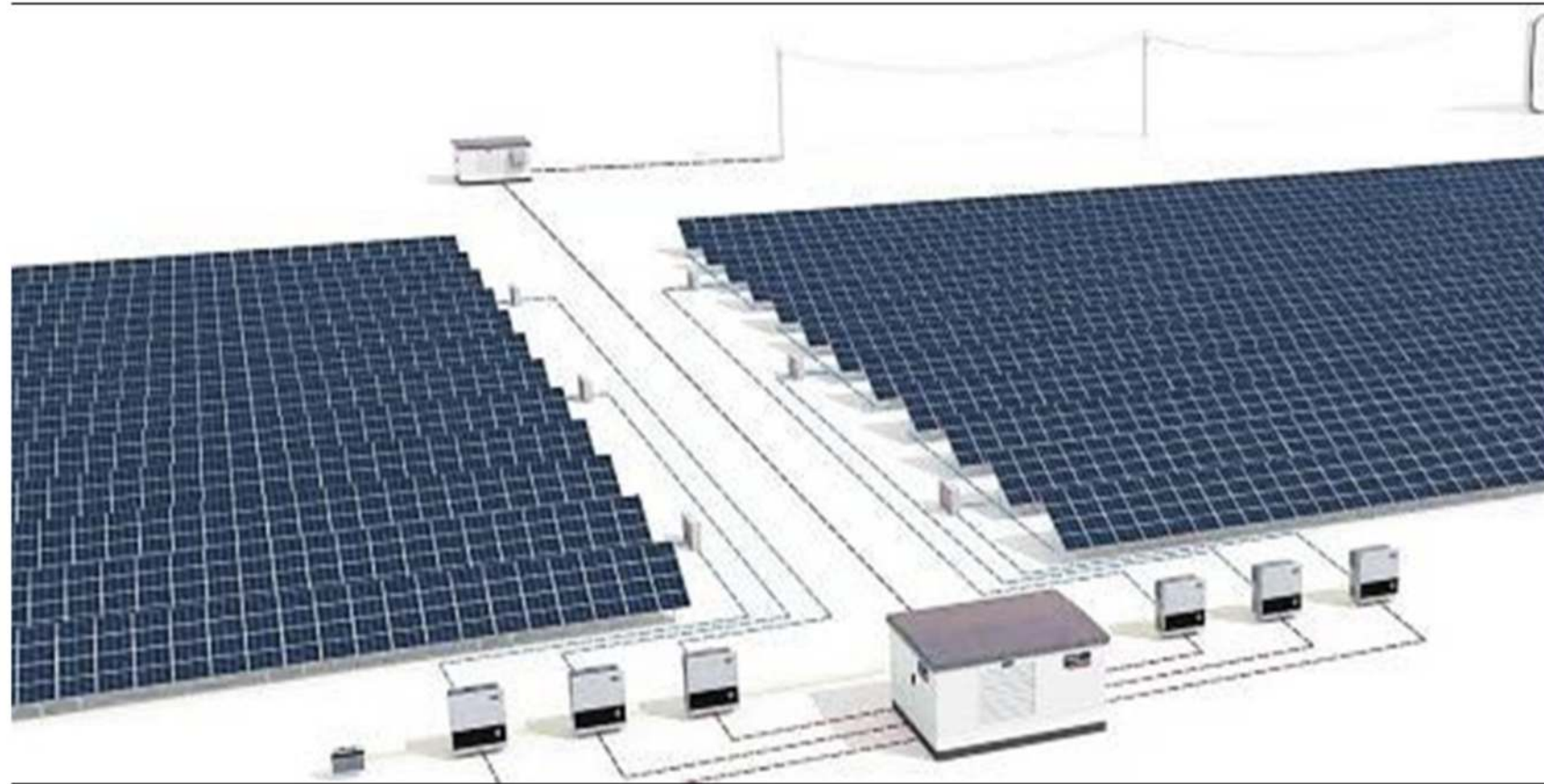
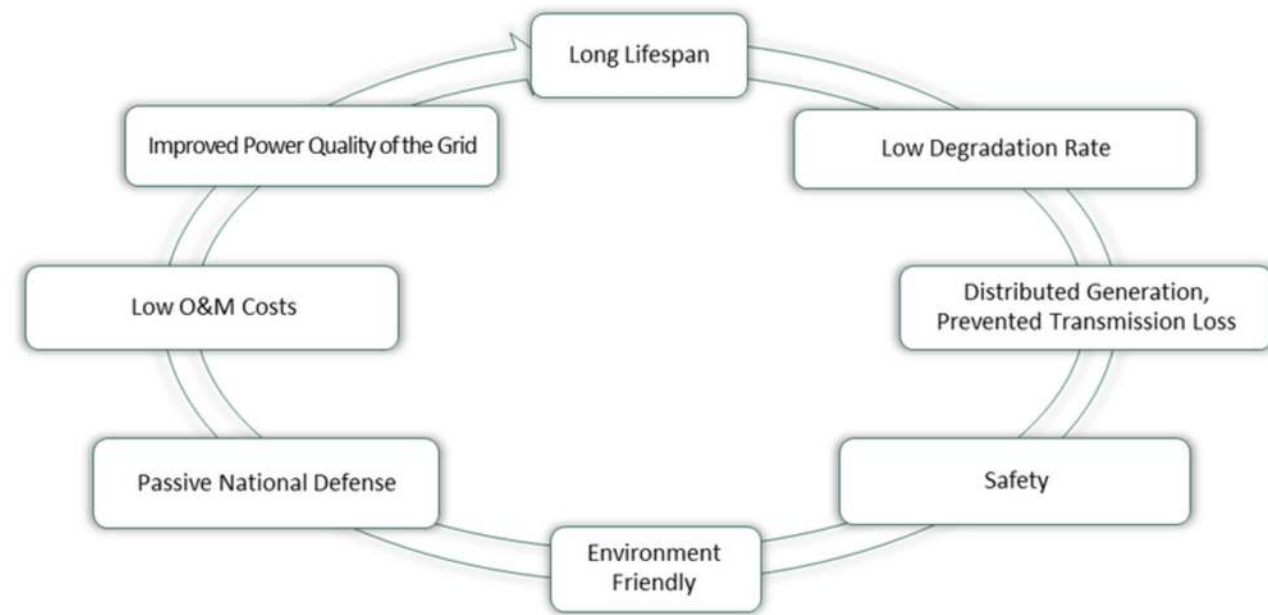
Based on PVSyst[1] simulations of PV plant Performance, the estimated annual energy generation of 25MW solar PV plant in Iraq is 44,529,706kWh and is 35,646,136kWh for 20MW plant. By which, according to instructions of US Environmental Protection Agency[2], the estimated annual emission of 17,525 metric tons of CO2 equivalent can be mitigated by the 25MW plant.

**Grid-Connected Solar PV Plant**

Today, most of solar PV systems are of Grid-connected type. Battery is not required in Grid-connected systems, because in the absence of solar insolation, the consumer's required energy is provided by the Grid. In the same time, the surplus energy generated by the PV plant is not wasted, being fed back into the Grid. On-Grid systems can produce electricity for a long time, without having to have too much O&M expenses. The use of PV systems as one of the distributed energy generation sources started in the 1990s. Utility-scale power plants are developed in large (megawatt) scale and therefore have lower levelized cost of electricity LCOE compared to distributed power generators. The photovoltaic power plant converts the solar energy into electricity. This conversion takes place in solar panels. The output voltage of the solar panels is of DC type which is converted into AC power by MPPT converter in inverter. The generated electricity is injected into the Grid by transformers. Some of main advantages of solar PV plants are as follows:

[1]<https://www.pvsyst.com>  
[1]<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>





#### Utility scale solar PV plant construction considerations:

- solar insolation
- Land requirements
- Distance to Access Points
- Distance to Transmission Line
- Site topography
- Geotechnical specifications
- climatic fluctuations
- Land availability for future expansion plans



20MW PV plant constructed in Razavi Khorasan Province, Iran



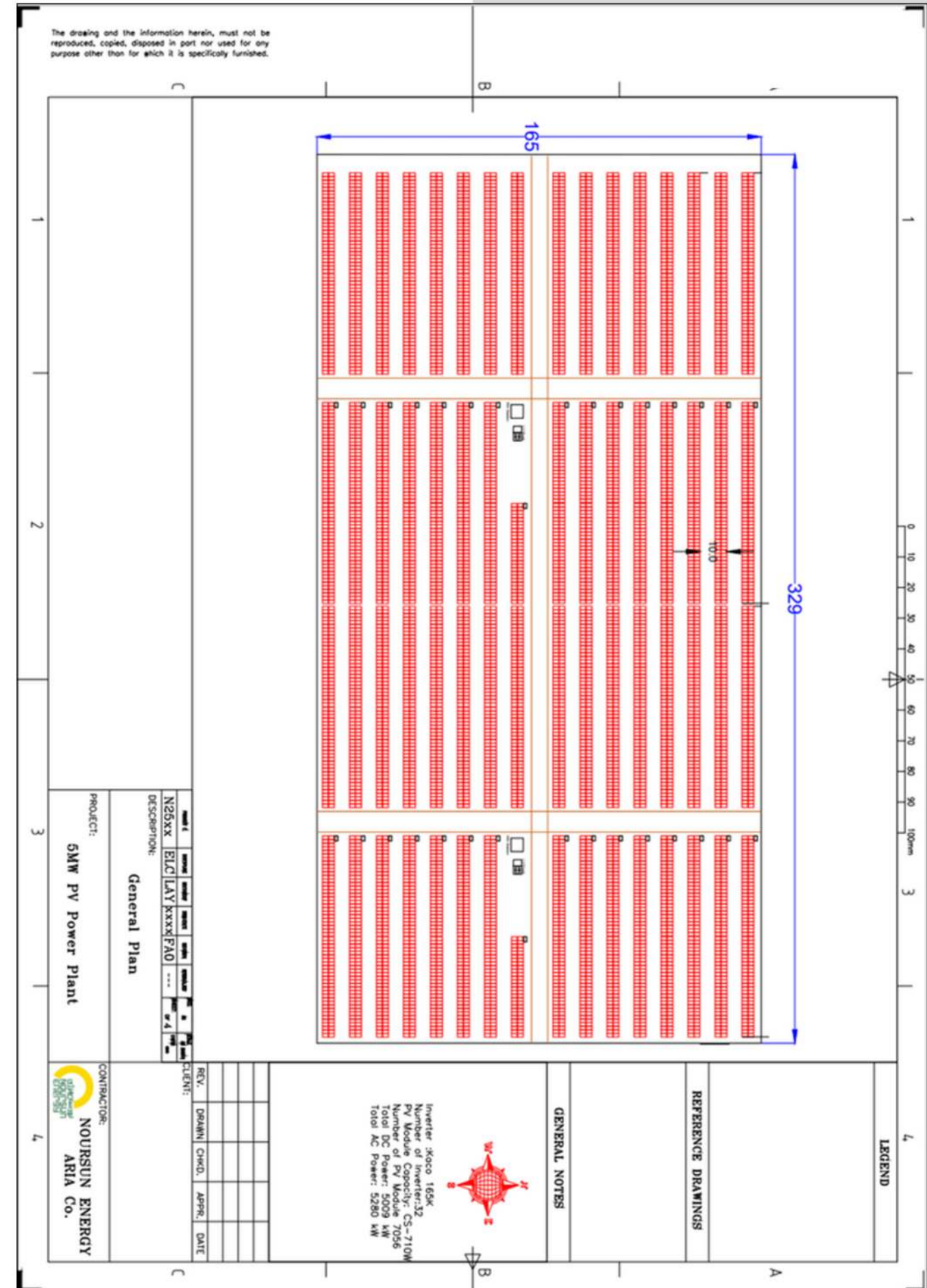
10MW PV plant constructed in Kerman Province, Iran



## Project: 20, 25MW Solar PV plant

## Site specifications

Construction site is supposed to be located in 32.38N. 44.186E geographical coordinates. The plants' capacity is 20MW and 25MW equipped with fixed 25° tilted mounting structure. PV plants are designed as integration of 5MW blocks of 54300 m<sup>2</sup> area. Plot plan is as follows.



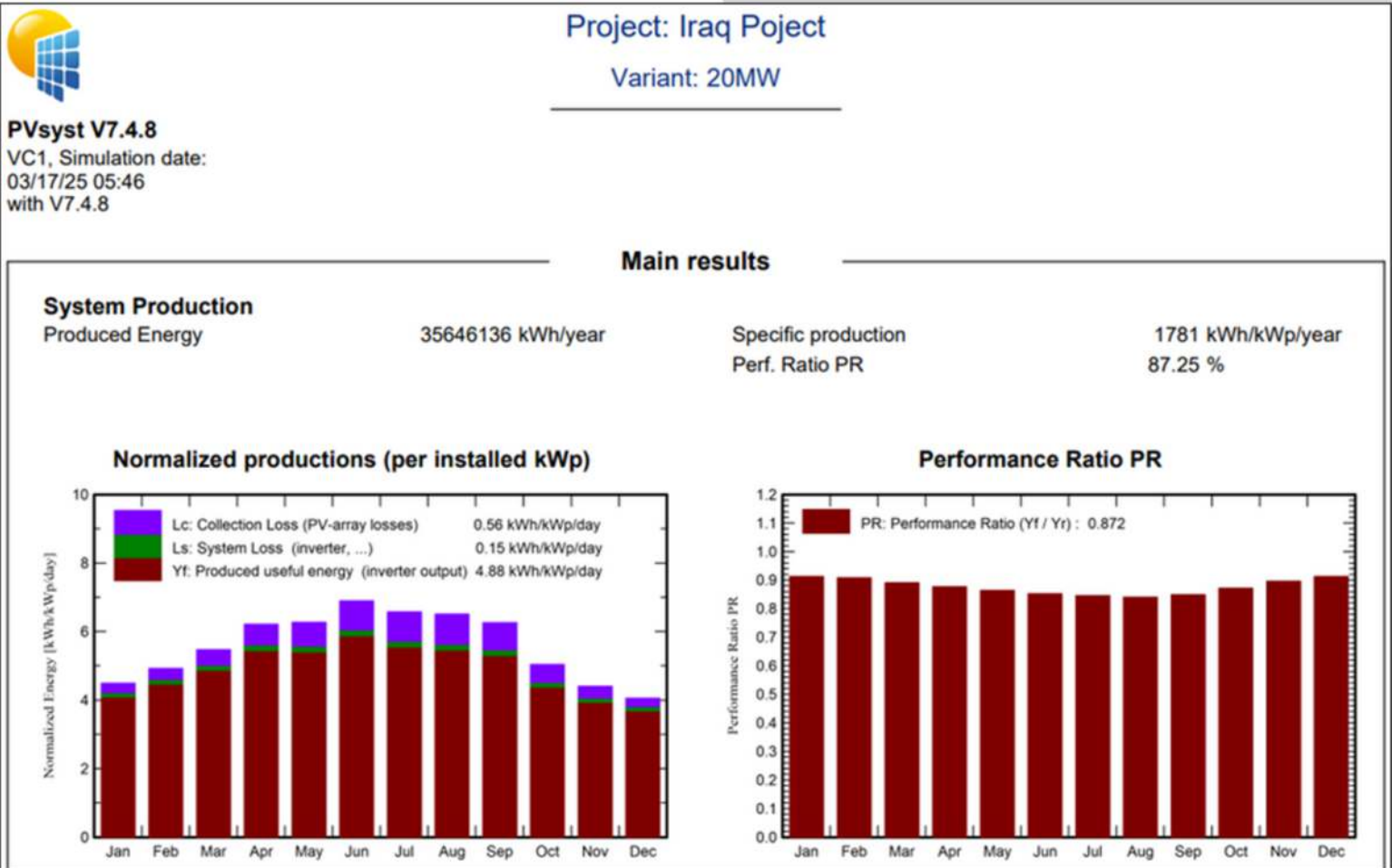
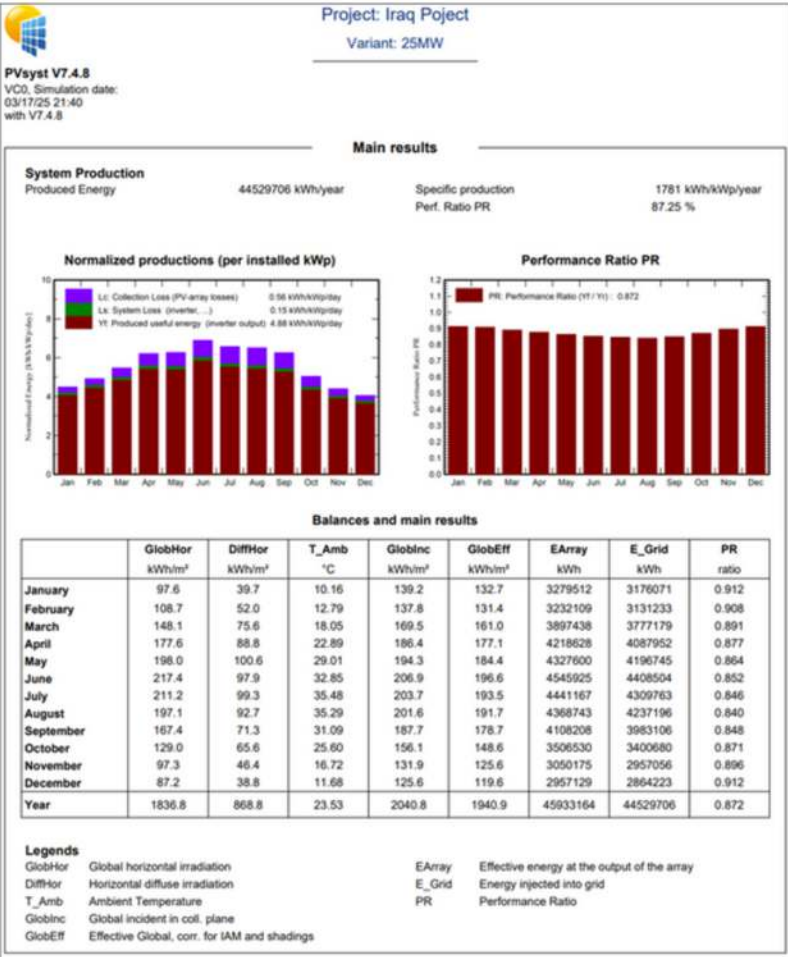


Technical Spec

Main material requirement and the power plant specifications are short-listed as follows:

Annual Energy Generation

The estimated specific production of PV plants, according to PVSyst simulation results (see figure below), is 1,781kWh/kWp. This corresponds to annual power generation capacity of 35,646,136kWh/Year for 20MW plant and 44,529,706kWh/Year for 25MW plant.



NO.	Item	unit	Qty.	
			20MW	25MW
1	Solar module – Canadian solar CS7N-710TB-AG 1500V or any other brand from tier 1 as per request	pcs	28,196	35,224
2	Solar inverter – KACO blueplanet 165 TL3 - INT	units	126	157
3	Annual Energy generated per kW of installed capacity	kWh/kWp	1,781	
4	Annual Energy generated per total installed capacity	kWh	35,646,136	44,529,706
5	Minimum Land requirement per 5MW block	m2	54300	



# Financial Analysis

## Investment

No	Item Description	Category	USD	
			20MW	25MW
PV Plant				
1	Solar Modules	Procurement	2,240,000	2,800,000
2	KACO 165kW Inverter & LV Station (LV panel, Fire and Electrical Protection Device, DC/AC UPS, Battery, Internal Monitoring system ,...)	Procurement	650,000	812,000
4	Structure	Procurement	2,000,000	2,500,000
5	Electrical Components	Procurement	2,720,000	3,400,000
6	Electrical Installation (up to Yard Entrance)	Construction	600,000	750,000
7	Mechanical Installation	Construction	600,000	750,000
8	Engineering, Test & Commissioning	Engineering	400,000	500,000
TOTAL price (without Transformer & Grid Connection)* USD			9,210,000	11,512,000

\*Price includes land preparation based on normal maximum 50cm land leveling.  
\*Fencing price is included if concrete wall is required by customer the price will change.



## Annual O&M Expenses (20MW)

1st 5-year	Item
0	PV Module
0	Inverter
0	PV Structure
27,200	Transformer, Switchgear and cabling
38,600	Insurance
1,300	Utility and Cleaning**
71,700	Site Operators (HR)
138,800	Total USD

\*PV modules have 10-years and inverters have 5-years guarantee period  
\*\* water consumption of 15 liter/kW is assumed for PV plant cleaning

## Human Resource Expenses

.NO	Position	Qty	Monthly payment	Annual payment
1	Accountant	1	800	9600
2	Electrical Technician	1	800	9600
3	Electrical Engineer	1	1200	14400
4	Unskilled Labor	3	600	21600
5	Security Guard	9	600	64800
Total USD				1200000

[1]Greenhouse Gas Equivalencies Calculator, United States Environmental Protection Agency (EPA.gov)

## Annual O&M Expenses (25MW)

1st 5-year	Item
0	PV Module
0	Inverter
0	PV Structure
34,000	Transformer, Switchgear and cabling
48,300	Insurance
1,600	Utility and Cleaning**
71,700	Site Operators (HR)
155,600	Total USD

\*PV modules have 10-years and inverters have 5-years guarantee period  
\*\* water consumption of 15 liter/kW is assumed for PV plant cleaning

## Environmental Benefits

The offered 25MW PV plant, based on instructions of US Environmental Protection Agency for CO2 equivalent calculation, has environmental benefits as follows:

- Annual CO2 emission reduction of 17,525 metric tons
- 9,730 tons of coal saved
- 289,755 tree seedlings grown for 10 years
- 700 garbage trucks of waste recycled instead of landfilled



## Construction Timeline

### Monthly Gantt chart of construction period

Description				1	2	3	4	5	6	7	8	9
Site mobilization (land preparation, access road ...)												
Plant construction	procurement	purchase	Invoice and contract									
			Order registration, pre-payment									
			Acceptance tests in supplier site									
		Transport and customs										
		Construction site initiation										
	installation	Civil works (foundations, post, trenching , ...)										
		Structures and cabling										
		PV modules										
		inverters										
		Construction/correction of PCC and transition line										
Grid connection	Monitoring system deployment											
	PCC and transmission line commissioning											
	Monitoring system commissioning											
	Inverter commissioning											
	Meter seal											







# Technical Spec - Inverter



## blueplanet 155 + 165 TL3

String inverters for utility-scale solar power plants  
up to multi-megawatt solar parks.



### Pushing the limits.

Superior efficiencies and  
overload capacity through silicon  
carbide technology

Outstanding power density for  
easy logistics and installation

Decentralised design or 'Virtual  
Central' concept possible

Overvoltage protection AC/  
DC and for communication  
interfaces available

Lean commissioning and updates  
via remote services



[www.kaco-newenergy.com](http://www.kaco-newenergy.com)

### Technical Data

DC input data	155 TL3	165 TL3
Max. recommended PV generator power	232 500 W	247 500 W
MPP range	875 - 1 300 V	960 - 1 300 V
Operating range	875 - 1 450 V	960 - 1 450 V
Rated DC voltage / start voltage	900 V / 1 000 V	1000 V / 1 100 V
Max. no-load voltage	1 500 V	1 500 V
Max. input current	183 A	183 A
Max. short circuit current $I_{sc,max}$	300 A	300 A
Number of MPP tracker	1	1
Connection per tracker	1 - 2	1 - 2
AC output data		
Rated output	155 000 VA	165 000 VA
Max. power	155 000 VA	165 000 VA
Line voltage	600 V (3P+PE)	660 V (3P+PE)
Voltage range (Ph-Ph)	480 - 690 V	480 - 760 V
Rated frequency (range)	50 Hz / 60 Hz (45 - 65 Hz)	50 Hz / 60 Hz (45 - 65 Hz)
Rated current	3 x 149.5 A	3 x 144.5 A
Max. current	3 x 152.0 A	3 x 152.0 A
Reactive power / cos phi	0 - 100 % Snom / 0.30 ind. - 0.30 cap.	
Max. total harmonic distortion (THD)	≤ 3 %	≤ 3 %
Number of grid phases	3	3
General data		
Max. efficiency	99.1 %	99.1 %
Europ. efficiency	98.9 %	99.0 %
CEC efficiency	98.9 %	99.0 %
Standby consumption	< 10 W	< 10 W
Circuitry topology	transformerless	transformerless
Mechanical data		
Display	LEDs	LEDs
Control units	webserver, supports mobile devices	webserver, supports mobile devices
Interfaces	Ethernet (Modbus TCP, Sunspec), RS485 (KACO-protocol), USB, optional: 4-DI	
Fault signalling relay	potential-free NOC max. 30 V / 1 A	potential-free NOC max. 30 V / 1 A
DC connection	cable lug, max. 240 mm <sup>2</sup> (0.372 in <sup>2</sup> ) Cu or Al	
AC connection	cable lug, max. 240 mm <sup>2</sup> (0.372 in <sup>2</sup> ) Cu or Al	
Ambient temperature	-25 °C - +60 °C <sup>1)</sup>	-25 °C - +60 °C <sup>1)</sup>
Humidity	0 - 100 %	0 - 100 %
Max. installation elevation (above MSL)	3 000 m	3 000 m
Min. distance from coast	500 m	500 m
Cooling	temperature controlled fan	temperature controlled fan
Protection class	IP66 / NEMA 4X	IP66 / NEMA 4X
Noise emission	59.2 db (A)	59.2 db (A)
H x W x D	719 x 699 x 460 mm	719 x 699 x 460 mm
Weight	78.2 kg	78.2 kg
Certifications	IEC 62109-1/-2, EN 61000-6-1/-2/-4, EN 61000-3-11/-12, EN 55011 group 1, class A, EN 62920 Emission class A / Immunity class A, UL62109-1, UL1741, CSA-C22.2 No.107.1, CSA-C22.2 No.62109-1, CSA-C22.2 No.62109-2	
Safety	overview see homepage / download area	

<sup>1)</sup> Power derating at high ambient temperatures

Versions	S	XL
Number of DC inputs	1 - 2	1 - 2
DC switch	-	✓
DC SPD	Type 1 + 2	Type 1 + 2
AC SPD	○	○
RS485 interface SPD	○	○
Ethernet interface SPD	○	○
PID Set	○	○

standard = ✓ upgradeable = ○



KACO new energy GmbH | Werner-von-Siemens-Allee 1 | 74172 Neckarsulm | Germany



## ▼ Project Reference

Capacity: 20+20 MW

Location: Jovein, Sabzevar, Iran

Solar Panels: Canadian Solar 660W

Inverters: Solis 250kW

Status: 20MW Connected to the Grid- 20MW under Construction



## ▲ Project Reference

Capacity: 100 MW

Location: Yazd, Iran

Solar Panels: Trina Solar 665W

Inverters: Kaco 165 kW

Status: under Construction





## ▼ Project Reference

Capacity: 10+2.5 MW  
Location: Momtazan Cement, Kerman, Iran  
Solar Panels: Canadian Solar 660W  
Inverters: Solis 110 kW  
Status: Connected to the Grid



## ▲ Project Reference

Capacity: 5/3MW  
Location: Delijan Cement, Isfahan, Iran  
Solar Panels: Canadian Solar  
Inverters: Solis  
Status: Under Construction



## ▼ Project Reference

Capacity: 1.2 MW  
Location: Mashhad, Iran  
Solar Panels: Canadian Solar 660W monofacial  
Inverters: Solis 110kW  
Status: Connected to the Grid, April 2024



## ▲ Project Reference

Capacity: 10 MW  
Location: Esfandqeh, Kerman, Iran  
Solar Panels: Longi Solar 455W  
Inverters: Solis 110kW  
Status: Connected to the Grid



## ▼ Project Reference

Capacity: 2 MW  
Location: Khormoj, Bushehr, Iran  
Solar Panels: SHARP 330W  
Inverters: Sungrow 60kW  
Status: Connected to the Grid



## ▲ Project Reference

Capacity: 1.5 MW  
Location: Shahrekord, Charmahal va Bakhtiari, Iran  
Solar Panels: SHARP 315W  
Inverters: Fronius 20kW  
Status: Connected to the Grid





## ► Project Reference

Capacity: 10 MW  
Location: Lamerd, Fars, Iran  
Solar Panels: SHARP poly-c 320W  
Inverters: Fronius 25kW  
Status: Connected to the Grid



## ► Project Reference

Capacity: 2 MW  
Location: Qale Ganj, Kerman, Iran  
Solar Panels: SHARP 330W  
Inverters: Fronius 20kW  
Status: Connected to the Grid





## ► Project Reference

Capacity: 1 MW  
Location: Bardsir, Kerman, Iran  
Solar Panels: LG 330W  
Inverters: Fronius 27kW  
Status: Connected to the Grid



## ► Project Reference

Capacity: 10 MW  
Location: Khusf, Khorasan, Iran  
Solar Panels: SunTech 325W  
Inverters: Huawei 55kW  
Status: Connected to the Grid





## ► Project Reference

Capacity: 200kW  
Location: Tehran, Iran  
Solar Panels: Longi 455W  
Inverters: Solis 110kW  
Status: Connected to the Grid



## ► Project Reference

Capacity: 120 kW  
Location: Khoramdareh, Zanjan, Iran  
Solar Panels: Longi 455W  
Inverters: Kaco 105kW  
Status: Connected to the Grid





## ► Project Reference

Capacity: 100 kW  
Location: Parand, Iran  
Solar Panels: Longi 455W  
Inverters: Kaco 50kW  
Status: Connected to the Grid



## ► Project Reference

Capacity: 150 KW  
Location: Sirjan, Iran  
Solar Panels: Longi 455W  
Inverters: Kaco 50kW  
Status: Connected to the Grid





## ▼ Project Reference

Capacity: 200 kW  
Location: Zanjan, Iran  
Solar Panels: SHARP 320W  
Inverters: Fronius 25kW  
Status: Connected to the Grid



## ▲ Project Reference

Capacity: 100 kW  
Location: Birjand, Iran  
Solar Panels: SHARP 320W  
Inverters: Fronius 25kW  
Status: Connected to the Grid





## ▼ Project Reference

Capacity: 100 kW  
Location: Yazd, Iran  
Solar Panels: SHARP 320W  
Inverters: Fronius 25kW  
Status: Connected to the Grid



## ▲ Project Reference

Capacity: 200 kW  
Location: Hamedan, Iran  
Solar Panels: SHARP 330W  
Inverters: Fronius 25kW  
Status: Connected to the Grid





## ▼ Project Reference

Capacity: 20 kW  
Location: Tehran, Iran  
Solar Panels: SHARP 360W  
Inverters: Fronius 20kW  
Status: Connected to the Grid



## ▲ Project Reference

Capacity: 30 kW  
Location: Jam, Bushehr, Iran  
Solar Panels: Talesun 270W  
Inverters: Fronius 27kW  
Status: Connected to the Grid





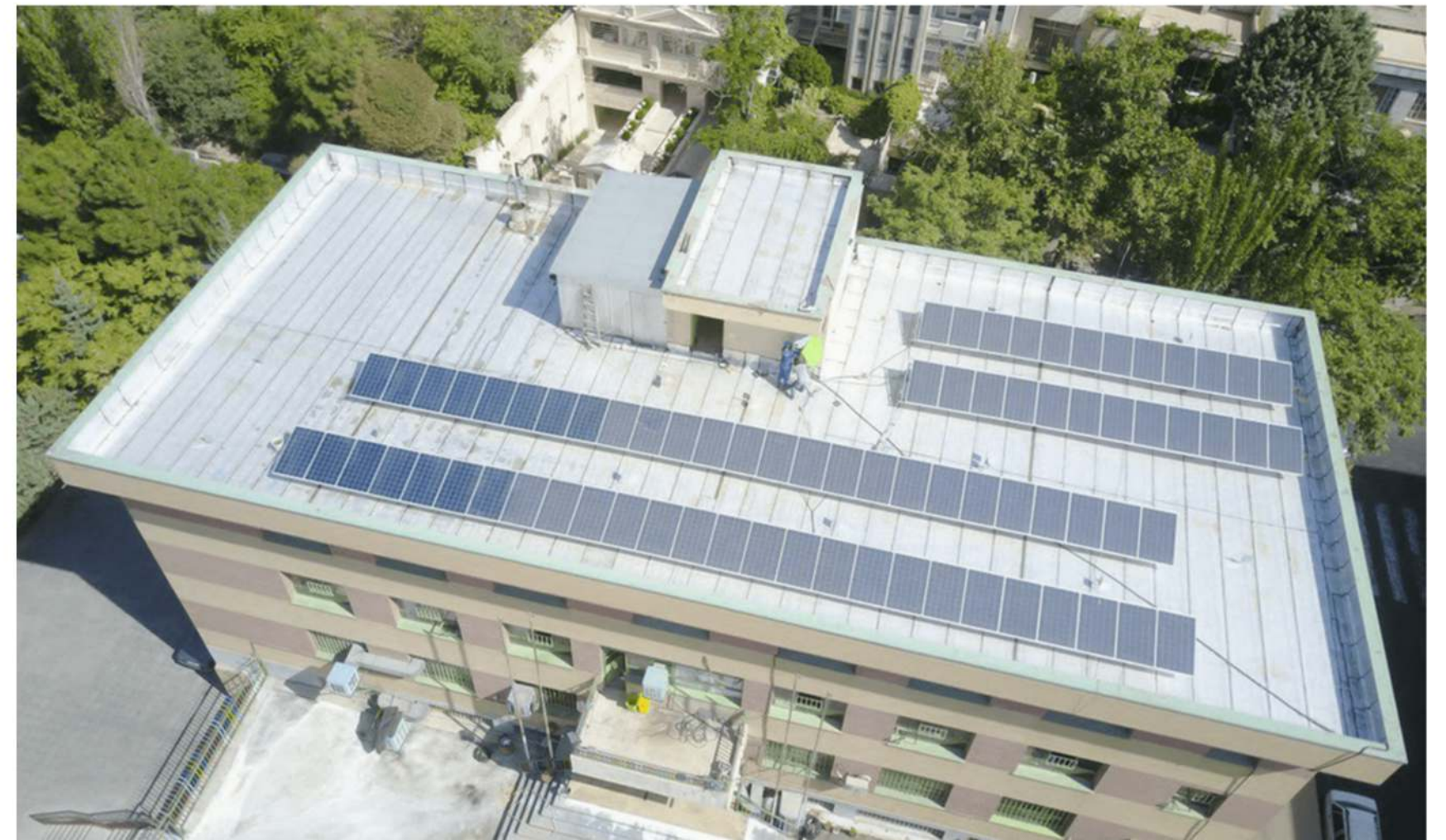
## ► Project Reference

Capacity: 10 kW  
Location: Tehran, Iran  
Solar Panels: SHARP 330W  
Inverters: Fronius 5kW  
Status: Connected to the Grid



## ► Project Reference

Capacity: 20 kW  
Location: Tehran, Iran  
Solar Panels: SHARP 330W  
Inverters: Fronius 20kW  
Status: Connected to the Grid





## ► Project Reference

Capacity: 10 kW  
Location: Damavand, Iran  
Solar Panels: SHARP 270W  
Inverters: Fronius 10kW  
Status: Connected to the Grid



## ► Project Reference

Capacity: 20 kW  
Location: Khoramdasht, Tehran, Iran  
Solar Panels: SHARP 250W  
Inverters: Fronius 20kW  
Status: Connected to the Grid





## ► Project Reference

Capacity: 145 kW  
Location: Shiraz, Iran  
Solar Panels: CSUN 250W  
Inverters: Eltek 5kW  
Status: Connected to Diesel



## ► Project Reference

Capacity: 8 kW  
Location: Ahvaz, Iran  
Solar Panels: CSUN 250W  
Inverters: SMA 8kW  
Status: Connected to Diesel





## ► Project Reference

Capacity: 1 kW  
Location: Parand, Tehran, Iran  
Solar Panels: CSUN 250W  
Inverters: Studer 1kW  
Status: Connected to CCTV

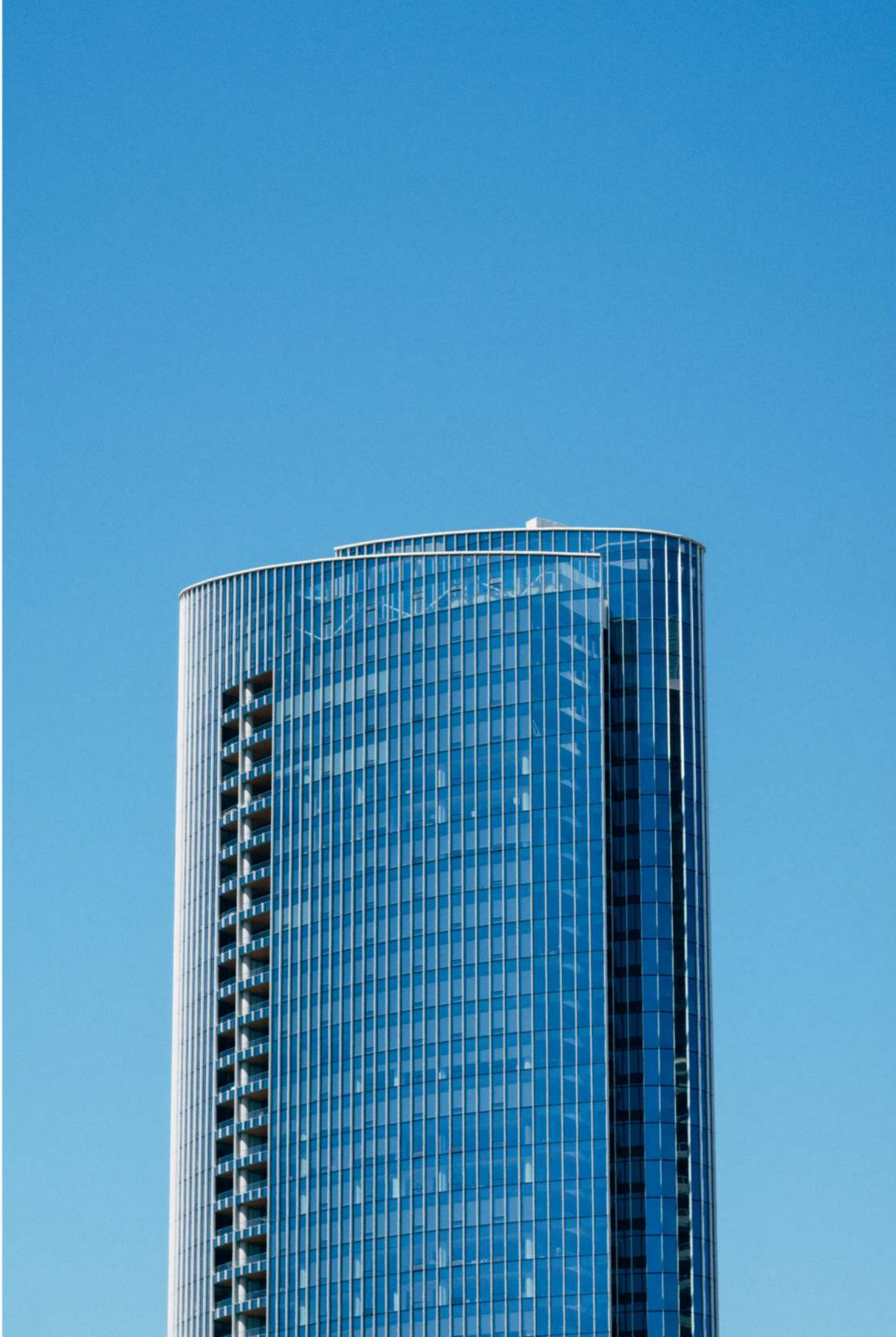


## ► Project Reference

Capacity: 7 kW  
Location: Jandaq, Semnan, Iran  
Solar Panels: CSUN 250W  
Inverters: Studer 3kW  
Status: Connected to BTS







# Contact Us

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+123-456-7890



[www.reallygreatsite.com](http://www.reallygreatsite.com)



[hello@reallygreatsite.com](mailto:hello@reallygreatsite.com)



123 Anywhere ST., Any City, ST 12345



**THANK YOU**