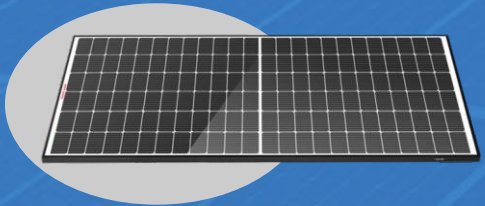
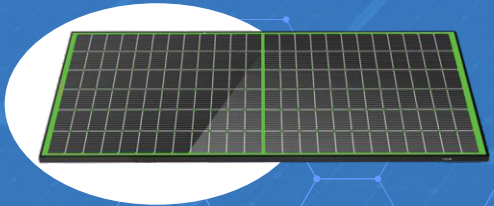
We bring efficiency

FreeVolt™
ENERGY EFFICIENCY COMPANY

The Megawatt that produces more



Classical Tech
1MW
~10,000m2
~1,100MWh/year



FreeVolt PVGraf
1MW
~10,000m2
~1,450MWh/year

**The productivity is an arythmetical mean between different sunshine areas in Romania.*

**The calculations are done based on sunshine data available in Romania and on PV Graf exports from Poland.*

What is graphene?

Graphene is a new type of semiconductor that is much faster and efficient than silicone. It's discovery has been awarded the Nobel Prize in 2010, to the two scientists who discovered it back in 2004 at the University of Manchester.

Electron mobility in SI – 2,300 cm2/(Vs)

Electron mobility in graphene – 100,000 – 200,000 cm2/(Vs)

Degradation rate of SI panels - 85% conversion power in 20 years

Degradation rate of PV Graph panels - 91% conversion power in 30 years

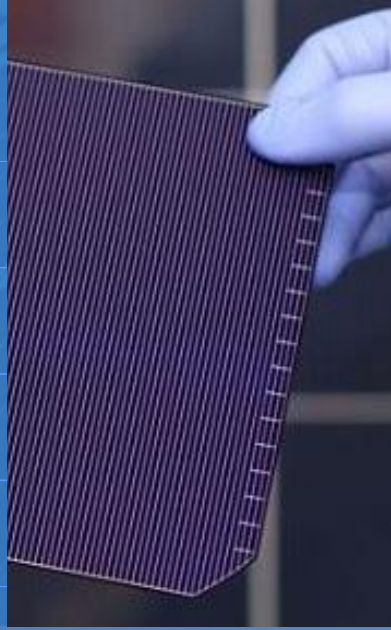
CERTIFIED

Click on logos

Our Graphene Solar Cell

Ordinary, silicone based, PV Panels have problems with absorbing the full light spectrum and have significant system losses.

The FreeVolt graphene based patented solar cell, PV Graf, manages to absorb 100% of the light and significantly mitigates system losses, increasing system production by 25-30%.



Key Benefits

+ 30 year product & performance warranty
+ 25-30% more productivity per m2
+ Linear degradation rate of ≤0.3% per year
+ NO Microcracks & Hot-spots
+ 0% PID & LID losses
+ System maintenance reduced by -90%
+ Less impact of shading

Graphene Shielding

The use of graphene in the hybrid silicone-graphene cell, makes the panel immune to system losses even, if damaged, because of its millions of connection points.

Below, you can see a witness of video of nearly 0 productivity loss after a PV Graf panel is shot several times.

YouTube

Click on logo

RESISTANT AGAINST

- Hail
- Ammonia
- Saline mists
- Abrupt temperature changes
- Overheating
- Sand damage

Technical Datasheet

PVGraf™

High Efficiency Graphene Module — 435 WP

SPECIFICATIONS

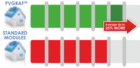
- More power per 1 sq. ft.
- Less impact on shading
- No microcrack effect

DIMENSIONS

Length	82.76 inch
Width	40.94 inch
Height	1.37 inch
Frame	anodized aluminum
Weight	50.71 lbs

THERMAL PARAMETERS

TK U_{oc}	-0,353%/K
	0,056%/K
Working temperature range	-40°F do +185°F



CERTIFICATES AND WARRANTY

Certificate	IEC 61215
Warranty	30 years
PID and LID	100% free
Performance guarantee	10 years at 97% nominal power
	30 years at 91% nominal power

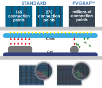
KEY BENEFITS

- Increased durability
- 30 years at 91% of nominal power
- Maximum power reduction ≤0.3% per year

- Significantly shorter return on investment
- Increased energy production compare to standard BusBar technology
- Enhanced diffused solar irradiation

- Eliminated negative impact of microcracks on power module
- Less impact on shading
- Lower operating costs

DIFFERENCES IN TECHNOLOGY



FreeVolt™

PATENT US # 0358498 | EU # 421831
EC 61730 IEC 61215 UL 1703 IEC 62716 IEC 60068-2-68 IEC 61701

FreeVolt EU & FreeVolt USA

Official distributor of FreeVolt:
FreeVolt Romania

PVGraf™ High Efficiency Graphene Module — 435 WP

NEW TECHNOLOGY

Photovoltaic Graphene Matrix Technology or PVGraf™ shatters the mold of traditional BusBar PV technology and will soon become the go-to technology for Solar Power Installations.
PVGraf™ utilizes a hybrid cell technology – combining thin film tech with crystalline silicon tech – to produce 25% higher efficiency modules that last longer, are less prone to micro-damage, and even when damaged, still work with almost zero loss of productivity.

UNIQUE FEATURES OF GRAPHENE

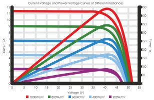
- Almost transparent (absorbs 2.3% of light)
- Very strong (100-200 times more than steel)
- Flexible (it can extend by 20%)
- Very good heat conductive – around 5000 W / mK
- Very low electrical resistance
- Very high electron mobility (200,000 cm²/Vs)
- Huge flow speed electron – (1/300) c

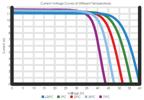
MECHANICAL CHARACTERISTICS

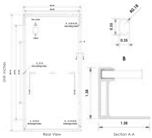
Cell type	monocrystalline PERC 166*83 mm
Number of cells	144 (6 × 24)
Module dimensions	82.76 × 40.94 × 1.37 inches
Weight	50.71 lbs
Front cover	0.13 inches tempered glass with AR coating
Frame	anodized aluminum alloy
Junction Box	IP68, 3 diodes
Cable	0.006 inches²; length: portrait - 11.81 inches, landscape - 55.12 inches
Connector	MC4 or MC4 compatible

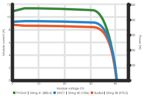
ELECTRICAL DATA

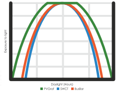
MPP Voltage Vmpp	[V]	41.2 - 42.4 +
MPP Current Impp	[A]	10.56 - 10.97 +
Open Circuit Voltage Voc	[V]	49.6 - 50.8 +
Short Circuit Current Isc	[A]	11.11 - 11.46 +
Power Pmax	[W]	435 - 465 +











We bring efficiency

FreeVolt™
ENERGY EFFICIENCY COMPANY

Fronius Inverters

Besides being direct distributors and partners of FreeVolt, Fronius also constiute the ideal technical solution for PVGraf system given their high-voltage operational parameters.

The monitoring system together with the Fronius Smart Meters will ensure that the system will function in peak parameters.

Fronius Technical Datasheet

TECHNICAL DATA FRONIUS SYMO (10.0-3-M, 12.5-3-M, 15.0-3-M, 17.5-3-M, 20.0-3-M)

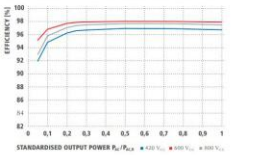
INPUT DATA	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
Number MPP trackers	2				
Max. input current ($I_{dc\ max\ 1}$ / $I_{dc\ max\ 2}$)	27.0 A / 16.5 A [1]			33.0 A / 27.0 A	
Max. usable input current total ($I_{dc\ max\ 1} + I_{dc\ max\ 2}$)	43.5 A			51.0 A	
Max. array short circuit current (MPP / MPP 2)	40.5 A / 24.8 A			49.5 A / 40.5 A	
DC input voltage range ($U_{dc\ min}$ - $U_{dc\ max}$)	200 - 1000 V				
Feed-in start voltage ($U_{dc\ start}$)	200 V				
Usable MPP voltage range	200 - 800 V				
Number of DC connections	3+3				
Max. PV generator output ($P_{dc\ max}$)	15.0 kW_{peak}	18.8 kW_{peak}	22.5 kW_{peak}	26.3 kW_{peak}	30.0 kW_{peak}

OUTPUT DATA	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
AC nominal output ($P_{ac,n}$)	10,000 W	12,500 W	15,000 W	17,500 W	20,000 W
Max. output power / rated apparent power	10,000 VA	12,500 VA	15,000 VA	17,500 VA	20,000 VA
AC output current ($I_{ac,nom}$)	14.4 A	18.0 A	21.7 A	25.3 A	28.9 A
Grid connection (voltage range)	3-NPE 400 V / 230 V or 3~NPE 380 V / 220 V (+20 % / -30 %)				
Frequency (Frequency range)	50 Hz / 60 Hz (45 - 65 Hz)				
Total harmonic distortion	1.8 %	2.0 %	1.5 %	1.5 %	1.3 %
Power factor ($cos\ \varphi_{ac,r}$)	0 - 1 ind. / cap.				

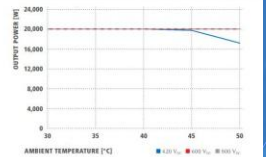
GENERAL DATA	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
Dimensions (height x width x depth)	725 x 510 x 225 mm				
Weight	34.0 kg			43.4 kg	
Degree of protection	IP 66				
Protection class	1				
Overvoltage category (DC / AC) [2]	2 / 3				
Night time consumption	< 1 W				
Inverter design	Transformerless				
Cooling	Regulated air cooling				
Installation (DIN rail)	Indoor and outdoor installation (158 x 90 x 66 mm)				
Ambient temperature range	-40 - +60 °C				
Permitted humidity	0 - 100 %				
Max. altitude	2,000 m / 3,400 m (unrestricted / restricted voltage range)				
DC connection technology	6x DC+ and 6x DC- screw terminals 2.5 - 16 mm^2				
AC connection technology	5-pole AC screw terminals 2.5 - 16 mm^2				
Certificates and compliance with standards	ÖVE / ÖNORM E 8001-4-712, DIN V VDE 0126-1-1A1, VDE AR N 4105, IEC 62109-1/-2, IEC 62116, IEC 61727, AS 3100, AS 4777-2, AS 4777-3, CEIR 06-190, G83/2, UNE 206007-1, SI 4777, CEI 0-16, CEI 0-21, NRS 097				
Country of manufacture	Austria				

[1] 14.0 A for voltages < 420 V.
[2] According to IEC 62109-1. DIN rail for optional type 1 + 2 or type 2 surge protection device available.
Further information regarding the availability of the inverters in your country can be found at www.fronius.com.

FRONIUS SYMO 20.0-3-M EFFICIENCY CURVE



FRONIUS SYMO 20.0-3-M TEMPERATURE DERATING



TECHNICAL DATA FRONIUS SYMO (10.0-3-M, 12.5-3-M, 15.0-3-M, 17.5-3-M, 20.0-3-M)

EFFICIENCY	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
Max. efficiency	98.0 %			98.1 %	
European efficiency (ηEU)	97.4 %	97.6 %	97.8 %	97.8 %	97.9 %
MPP adaptation efficiency	> 99.9 %				

PROTECTIVE DEVICES	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
DC insulation measurement	Yes				
Overload behaviour	Operating point shift, power limitation				
DC disconnector	Yes				
Reverse polarity protection	Yes				
RCMU	Yes				

INTERFACES	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
WLAN / Ethernet LAN	Fronius Solar web, Modbus TCP SunSpec, Fronius Solar API (JSON)				
4 inputs and 4 digital inputs/outputs	Interface to ripple control receiver				
USB (A socket) [1]	Datalogging, inverter update via USB flash drive				
2x RS422 (RJ45 socket) [1]	Fronius Solar Net				
Signalling output [1]	Energy management (potential-free relay output)				
Datalogger and Webserver	Included				
External input [1]	S0-Meter interface / input for overvoltage protection				
RS485	Modbus RTU SunSpec or meter connection				

[1] Also available in the light version.
Further information and technical data can be found at www.fronius.com.

K2 Mounting Systems

By using the K2 systems we get access to an extensive array of planning and project tools that make the job much easier and guarantee ease of implementation and precise bill of materials

Using PVGis

PVGis is the E.U. standard for simulating the productivity of PV systems across Europe.

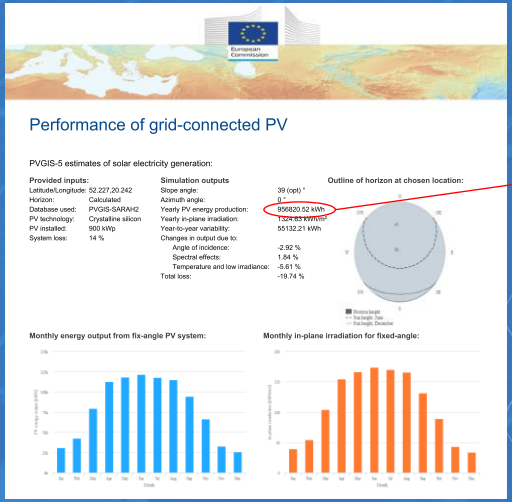
PVGis simulations are required when it comes to applying with PV projects for E.U. funding.

PVGIS Photovoltaic Geographical Information System

PVGIS provides information about solar radiation and photovoltaic (PV) system performance for any location in Europe and Africa, as well as a large part of Asia and America. It is available in English, French, Italian, Spanish and German.

Source: https://joint-research-centre.ec.europa.eu/pvgis-photovoltaic-geographical-information-system_en

PVGis vs FreeVolt installation in Poland



Performance of grid-connected PV

PVGIS-5 estimates of solar electricity generation:

Provided inputs:		Simulation outputs	
Latitude/Longitude:	52.227,20.242	Slope angle:	39 (opt) °
Horizon:	Calculated	Azimuth angle:	0 °
Database used:	PVGIS-SARAH2	Yearly PV energy production:	956820.52 kWh
PV technology:	Crystalline silicon	Yearly in-plane irradiation:	1304.83 kWh/m²
PV installed:	900 kWp	Year-to-year variability:	55132.21 kWh
System loss:	14 %	Changes in output due to:	
		Angle of incidence:	-2.92 %
		Spectral effects:	1.84 %
		Temperature and low irradiance:	-5.61 %
		Total loss:	-19.74 %

Outline of horizon at chosen location:

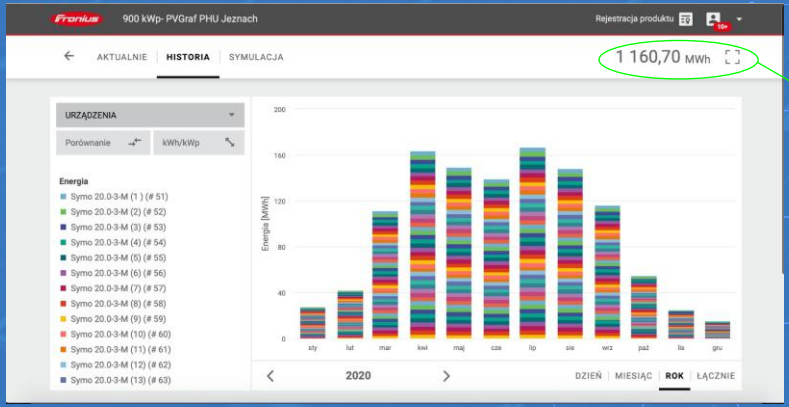
Monthly energy output from fix-angle PV system:

Monthly in-plane irradiation for fixed-angle:

956820.52 kWh = 956 MWh

The comparison is between a normal 900 kW installation in Poland, and a 900 kW PV Graf installation in the same geographical conditions.

PVGis vs FreeVolt installation in Poland



The productivity of the FreeVolt PV Graf system outshines classical technology by ~ 204 Mwh in the same conditions.

Financial outcome

Selling and buying energy will increase by a factor of at least +20% throughout 2023;

ROI with a PV Graf system will be +20% faster vs. classical systems;

The +30% increased productivity of PVGraf™ will impact heavily on EPC savings;

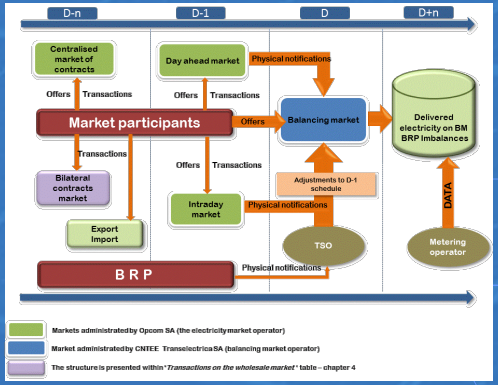
How the energy market is shaping up

		ROPEX_DAM_H											Piata pentru ziua urmatoare - Ziua de livrare 14/6/2022 [lei/MWh]
		1	2	3	4	5	6	7	8	9	10	11	12
ROPEX_DAM_Base	1.028,45	836,76	793,59	771,26	804,83	806,94	910,35	1.063,87	1.126,45	1.079,96	1.068,16	997,96	887,20
ROPEX_DAM_Peak	1.056,43	13	14	15	16	17	18	19	20	21	22	23	24
ROPEX_DAM_Off_Peak	1.000,47	947,36	1.031,74	1.065,32	971,43	1.041,57	1.010,49	1.141,75	1.434,24	1.460,00	1.222,85	1.161,18	1.047,56

		ROPEX_FM_M											Piete la termen 2021-2023 [lei/MWh]
		ian	feb	mar	apr	mai	iun	iul	aug	sep	oct	nov	dec
ROPEX_FM_2021	279,92	257,73	254,62	247,59	243,00	247,53	256,35	281,49	286,01	288,95	300,73	349,50	362,62
ROPEX_FM_2022	544,21	592,01	600,23	584,35	549,06	511,25	533,74	533,50	526,44	526,36	514,15	516,93	516,67
ROPEX_FM_2023	640,18	658,62	658,61	658,59	637,03	636,99	637,00	631,51	631,51	631,51	631,51	631,51	631,51

		ROPEX_GC_M											Certificate Verzi (PCSCV) 2021-2022 [lei/CV]
		ian	feb	mar	apr	mai	iun	iul	aug	sep	oct	nov	dec
ROPEX_GC_2021	142,22	142,22	142,22	142,22	142,22	142,22	142,22	142,22	142,22	142,22	142,22	142,22	142,22
ROPEX_GC_2022	144,66	144,66	144,66	144,66	144,66	144,66	144,66	-	-	-	-	-	-

The Romanian energy market at a glance

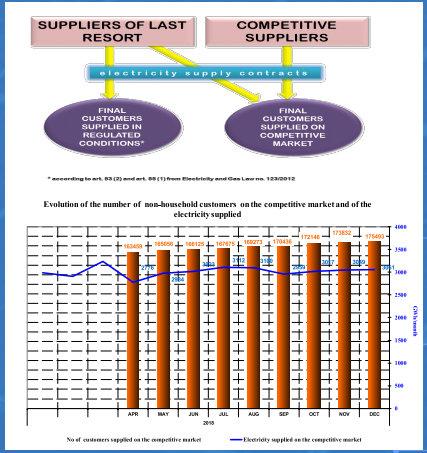


Source: ANRE report for 2019

Wholesales electricity market overview

- 100% liberalised market, including: centralized market of bilateral contracts, forward contracts, day ahead, intra day, balancing and green certificates
- 230 participants (dispatching generators, active suppliers, traders, distributors, operators)
- 62 TWh overall market volume (data for 2019)
- independent TSO being balancing market operator, listed on the Bucharest stock exchange

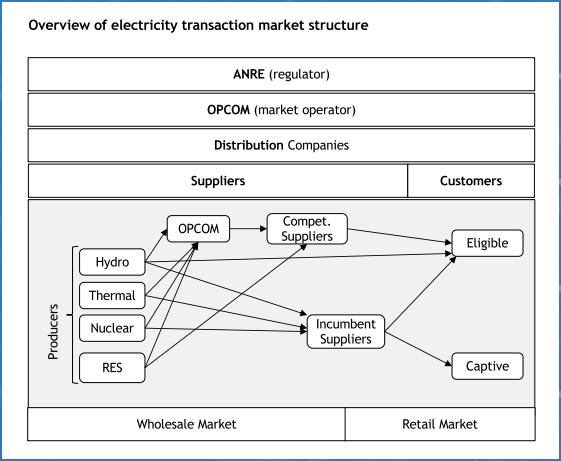
The players in the Romanian energy market



Source: ANRE report for 2019

- 57 active suppliers
- 49,50 TWh, divided between:
  - competitive market: 40,10 TWh
  - incumbent market: 9,40 TWh
- 8 incumbent suppliers (former distribution companies, 5 privatised - ENEL, CEZ and E.ON, 3 still stated owned)
- permanent increase of customers joining competitive market
- renewable producers trying to enter in the supply market (vertical integrated model seen as an advantage)

Stakeholder network of the Romanian energy market



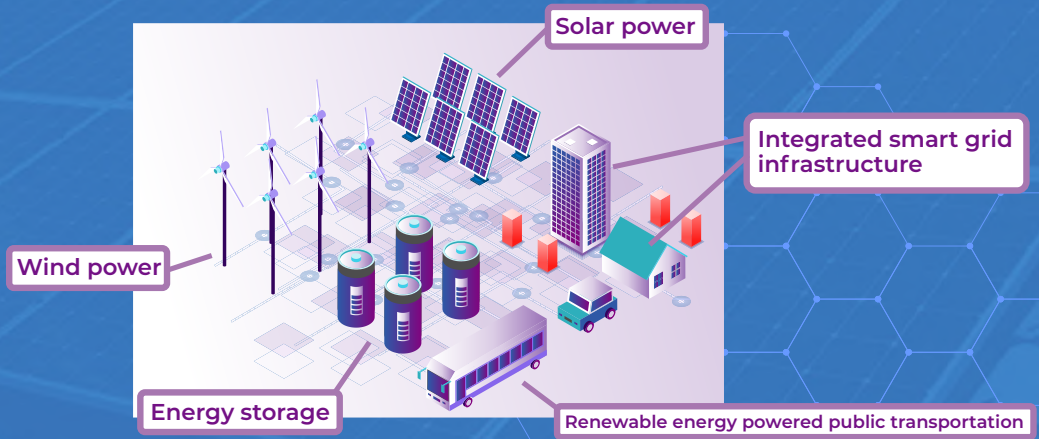
Participants

- 125 licensed dispatching generators
- 57 licensed active suppliers
- 172146 eligible non households consumers
- TSO ▫ Transelectrica
- OPCOM - Market operator
- 8 distribution operators (E.ON, CEZ, ENEL and Electrica subsidiaries)

Wholesale market segments

- Electricity Exchange
  - Centralized bilateral contact market (PCCB-LE)
  - Forward (PCCB-NC)
  - Romanian Commodities Exchange (OTC)
  - DAM (Day Ahead Market)
  - Intra Day market
- Regulated contract market

Integrating renewable energy with smart city & grid applications



Our partners