

(No.3 2003年11月5日号目次)

特集:ロシアにおける新エネルギー開発 その3

今号では、ロシアにおける新エネルギー開発の最終回として太陽エネルギー開発について特集し、メタンハイドレート資源開発について付記いたします。

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・ロシアの太陽エネルギー開発について

太陽はクリーンかつ無尽蔵のエネルギー源として、世界で利用が始まっている。旧ソ連においても、太陽エネルギーの開発には大きな関心が払われていたが、その対象地域はトルクメニスタン、ウズベキスタン、グルジア、アルメニア、ウクライナといったソ連南部の共和国に偏っていた。その結果、ソ連邦が崩壊した後のロシアには太陽エネルギー施設はごく僅かしかなかった。やっとここ数年、太陽光および太陽熱利用施設も増え、新製品を開発したり、少ロットにも対応する企業が出てきた。

太陽エネルギー利用の難しさは、いかに効率よくその光を電力と熱に変換できるかにある。ロシアではアモルファスシリコンおよび単結晶シリコンによる太陽光パネルと太陽熱ヒーターが生産されている他、風力発電との組み合わせにより、現在の発電コスト 1W あたり 3ドルを 2～2.5ドルに下げる試みが行なわれており、向こう 10年で達成される見込みである。

今後の太陽エネルギー開発発展のカギは、いかに軍需部門を始めとする大型の研究機関を引き付けられるかにかかっている。例えば、ロシア原子力省は「太陽光発電プログラム」を策定して、新技術開発に努めている他、米国エネルギー省とこの分野における協力協定を締結している。合弁企業 Sovlaks は、スチールベルトに加水素アモルファスシリコンを載せた形の太陽光パネル（年間 2MW）を開発し、モスクワで生産を開始した。耐用年数が 10年と長いのが特徴で、今後の改良により、コストを現在の 1W 当り 4ドルから 2.5ドルに下げる余地がある。原子力省には、年間 20MW の太陽電池を大量に生産する計画もある。

今後の展開次第では、世界の太陽エネルギー施設市場でロシアがビッグプレイヤーとして最大 15%のシェアを獲得する可能性もないとは言えない。国内でももちろん、農村、海洋船舶、通信施設用電源、環境への配慮が特に必要な地域、過疎地等で大きな需要が見込まれる。

モスクワに隣接するポドリスクにはポドリスク化学金属工場があり、太陽光パネル用単結晶シリコンを 27t 生産しており、これは世界市場の 16%に相当する。今後、パネルまで自社生産する計画があり、これが実現すればロシアの存在感は大いに高まることになる。

太陽光発電発展に関する連邦プログラムもできており、2.36MW の設備を製造し 377 万 kW/h の電力生産を行なうことを目標としている。太陽熱施設は 70Gcal/h にまで能力を引き上げ、標準燃料 16,000 t に相当する 112Gcal のエネルギー生産が当面の目標である。

1 . 製造企業別太陽光発電システム

Krasnoe Znamya Design Office in association with the RUSANT-SOLAR Research and Production Company

○ FSM SOLAR MODULES

Solar modules FSM-10, FSM-25, FSM-30, FSM-33, FSM-35, FSM-40, FSM-45, FSM-50, FSM-55, and FSM-60 are intended for converting solar radiation into electric power as part of solar power systems, for autonomous or reserve feeding of electronic and electrochemical equipment located far from power grids, and as alternative sources of energy.

Ecology friendly solar modules serve for direct conversion of luminous energy into electric one. The efficiency factor of solar batteries exceeds 12%. Solar cells are sealed with high-strength glass and special protective layers. The module framing is made from anodized aluminum ensuring the structural strength and ease of assembling.

The design of the solar modules provides for the development and fabrication of small and medium power photovoltaic generators and power systems for various household and industrial applications, as follows:

- Electrification of houses in remote areas;
- Feed of TV sets, refrigerators etc.;
- Indicating lights in aviation;
- Telecommunications, telephone networks in rural areas, ground-based satellite communication systems, broadcasting systems;
- Power supply of hospitals, schools, public establishments;
- Water-raising machines, irrigation systems;
- Power supply of cottages;
- Water desalination systems;
- Charging devices.



Power characteristics of modules (at standards operating conditions: 1,000 W/m², 25°C, AM equal to 1.5)

Module type	Power, W, max.	Voltage, V			Max. power current, A	Short circuit current, A, max.	Mass, kg, max.	Dimensions, mm
		U _{max.}	U _{norm.}	U _{no load}				
FSM-10	10	17	12	21	0.61	0.82	1.8	340x340x21
FSM-15	15	17	12	21	0.88	1.0	2.3	400x400x21
FSM-25	25	17	12	21	1.6	2.0	5.0	1080x287x38
FSM-25	25	17	12	21	1.6	2.0	5.6	960x450x38
FSM-30	30	17	12	21	1.8	2.0	5.6	960x450x38
FSM-33	33	17	12	21	1.95	2.1	5.6	960x450x38
FSM-35	35	17	12	21	2.1	2.3	5.6	960x450x38
FSM-40	40	17	12	21	2.5	2.7	7.0	960x450x38
FSM-45	45	17	12	21	2.8	3.1	7.0	960x450x38
FSM-50	50	16.5	12	20.4	3.1	3.72	8.0	1180x463x38
FSM-55	55	16.5	12	20.4	3.4	4.02	8.0	1251x463x38
FSM-60	60	16.5	12	20.4	3.68	4.02	8.0	1251x463x38

Estimated cost of solar modules:

- FSM-30: \$180;
- FSM-40: \$190;
- FSM-50: \$270.

○ **SOLAR BATTERIES OF THE SOLAR SERIES**

Ecology friendly solar batteries are intended for feeding:

- Small-sized portable radios;
- Tape recorders and players;
- Watches;
- E-games;
- Charging AA storage batteries and other devices.



Specifications:

- Solar-1-9: 9 V output voltage, 1 W power;
- Solar-1-6: 6 V output voltage, 1 W power;
- Solar-08-3/ 6/ 9: output voltage may be set by the 3-6-9 V switch, 0.8 W power.

Estimated cost of solar batteries:

- Solar-1-9: \$13;
- Solar-1-6: \$13;
- Solar-08-3/ 6/ 9: \$17;
- Solar-2-9: \$22.

Service life of solar batteries: five years.

○ **Solar 30 (Solar 60) AUTONOMOUS SOLAR BATTERIES**

Solar 30 (Solar 60) autonomous batteries are intended for feeding customers located far from central grids.

Solar battery peak power, W	Power consumed, W	Daily operation at solar radiation (Wh/m ² day) equal to:		
		2,000	3,000	4,000
30(60)	10 (20)	3.6 (7.2)	5.6 (11.2)	7.5 (15)
	20 (40)	1.9 (3.8)	2.8 (5.6)	3.7 (7.4)
	30 (60)	1.2 (2.4)	1.9 (3.8)	2.5 (5.0)

Estimated cost of solar batteries:

- Solar-30: \$350;
- Solar 60: \$420.

Organizations:

Manufacturer:

Krasnoe Znamya Design Office in association with the RUSANT-SOLAR Research and Production Company
 2A Shabulin Prosp., Ryazan 390043, Russia
 Тел: (0912) 53-84-03, 53-84-42, 53-85-39
 Fax: (0912) 98-38-11
 E-mail: rus@okb.ryazan.ru

KVANT Research & Production Association

○ SOLAR MODULES BSR-10, BSR-20, BSR-30, BSR-40, BSR-50, BSR-60, BSR-80, BSR-100

The modules intended for charging storage batteries or being connected to DC engines allow series and parallel commutation into a high-capacity solar battery. The modules meet the requirements for operation in hot climate.

Specifications are measured under the following conditions: 1,000 W/m² radiation power, AM equal to 1.5, 25°C cell temperature.

BSR-50 solar module



Specifications	Module type			
	BSR-10	BSR-20	BSR-30	BSR-40
Power W	11.0	22.0	33.0	44.0
No-load voltage, V	20.9	20.8	20.7	20.6
Short circuit current, A	0.72	1.44	2.16	2.88
Load voltage, V	16,5	16,5	16,5	16,5
Solar cells area, m ²	0,09	0,18	0,27	0,36
Dimensions, mm	360x340x28	668x336x28	1,000x336x28	1,328x336x38
Weight, kg	2.0	3.8	4.8	5.9

Specifications	Module type			
	BSR-50	BSR-60	BSR-80	BSR-100
Power W	50.0	66.0	88.0	110.0
No-load voltage, V	21.0	20.5	20.4	20.3
Short circuit current, A	3.4	4.32	5.76	7.2
Load voltage, V	17.0	16.5	16.5	16.5
Solar cells area, m ²	0.355	0.54	0.72	0.90
Dimensions, mm	970x440x38	1,000x668x38	1,328x668x38	1,665x668x38
Weight, kg	7.5	9.8	11.5	16.0

Estimated cost: \$4.50 per W

○ BSP-10 SWITCHED SOLAR BATTERY

The battery is intended for direct feed of autonomous consumers (10 W max. power); it also can act within power systems jointly with a floating battery.

The battery design enables generating a number of output voltages: 4.5, 6, 9, 10.5, and 12 V, of 6-10 W power. To this end, the battery is provided with a stabilization element and bypass diodes. The battery is made as a flat panel with a retractable prop for sun seeking. The required voltage is set by means of a switch mounted on the battery side surface. The battery back side houses closed connector boxes served for connecting power consumers.

Specifications (measured under the following conditions: 1,000 W/m² radiation power, AM equal to 1.5, 25°C cell temperature).

Output voltage, V	4.5	6	9	10.5	12
Power, W	10.0	10.0	6.0	7.5	10.5
Load current, A	1.95	1.32	0.66	0.66	0.66
Load voltage, V	5.4	8.2	11.0	13.6	16.5
Short circuit current, A	2.1	1.4	0.71	0.71	0.71
No-load voltage, V	6.8	10.5	13.8	17.5	20.9
Dimensions, mm	360x340x10				
Weight, kg	2				

Estimated cost: \$75

○ **SUN-SEEKING SOLAR BATTERY**

The battery is intended for feeding various consumers. For increasing power generation, the battery is provided with a special sun-seeking device.

The battery design enables the complete orientation of the panel's surface perpendicular to the radiant flux with the ± 10° accuracy. The orientation of panels in the meridian plane (manual, stepwise, each 20°) is performed monthly or bimonthly by means of the quick action fixing mechanism. Daily orientation is effected via the seeking system consisting of two thermal drives filled with liquid with a high thermal expansion coefficient, and a pinion drive. Orientation is made within the ±75° range.

Estimated cost: \$380



○ **SEFU-250 UNIVERSAL SOLAR POWER SUPPLY SYSTEM**

The SEFU-250 universal solar power system is intended for feeding a shepherd's house or sheep shear.

The system includes two solar batteries, 215 W power each, an inverter, an electrically driven shearer, a charge regulator, and connecting cables.

The system can operate in two modes: charging a storage battery (200 W power, 20.5 V no-load voltage, 16.5 V at the maximum power) and feeding the sheep shearer (250 V, 50 V no-load voltage, 41 V inverter output voltage, 40 Hz, 6.1 A current).



Estimated cost: \$2,500

Organizations:

Manufacturer:

KVANT Research & Production Association
16, 3rd Mytishchinskaya St., Moscow 129626, Russia
Tel: (095) 287-98-28, 287-97-42
Fax: (095) 287-18-71
E-mail: kvanteko@mail.cnt.ru

SOVLAX Company

○ PORTABLE FOLDABLE SOLAR BATTERY BASED ON AMORPHOUS SILICON (P Series)

The battery is intended for direct (or jointly with galvanic batteries) feed of power consumers (TV sets, radios, lighting etc.), as well as for charging storage batteries with up to 12.5 V rated voltage, including starter batteries.

The thin-filmed portable foldable solar battery is fabricated by depositing nine-layer (three-cascade) structures of amorphous silicon on a stainless steel strip. The battery is laminated with polymers. It does not contain fragile components such as glass and crystal silicon.



Owing to bypass diodes, the battery can operate even at partial shading. The battery design enables feeding at the rated voltage within 3-12.5 V. To this end, it is necessary to hide several cells from the sun radiation by using a special retracting mechanism. Batteries can be connected in parallel or in series. Batteries providing for charging 6, 9, 12, and 24 V accumulators of various capacity can be supplied at the Customer's request,

Specifications

Electrical specifications were measured at standard conditions: 1,000 W/m² radiation power, AM equal to 1.5, 25°C cell temperature.

	P-65	P-13	P-26
Rated power, W, minimum	6.5	13	26
Voltage at the maximal power, V, minimum	19	19	19
Current at the maximal power, A, minimum	0.33	0.65	1.3
No-load voltage, V, minimum	25	25	25
Short circuit voltage, A, minimum	0.45	0.9	1.8
Dimensions, cm:			
- unfolded	164x23x0.3	164x39.5x0.3	252x39.5x0.3
- folded	13.5x39.5x3.5	13.5x39.5x3.5	18x39.5x4
Weight, kg	0.5	0.9	2.2

○ RIGID (FRAMED) SOLAR MODULES BASED ON AMORPHOUS SILICON (R Series)

The modules serve for charging storage batteries used for power supply of houses, means of communication, street lightning, water raising, agricultural machinery etc. Solar power plants of the required capacity can be set up by connecting the corresponding amount of modules.

Rigid (framed) thin-filmed modules are fabricated by depositing nine-layer (three-cascade) structures of amorphous silicon in the gas phase. Amorphous layers with different properties are deposited one on top another on the stainless steel substrate.



The module is laminated with a long-lived durable material. It does not contain fragile components such as glass and crystal silicon. The module design ensures reliable operation while illuminating only a part of its surface.

Specifications

Electrical specifications ($\pm 10\%$) were measured at standard conditions: 1,000 W/m² radiation power, AM equal to 1.5, 25°C cell temperature.

	R-125	R-20
Rated power, W, minimum	12.5	20
Voltage at the maximal power, V, minimum	17.5	19
Current at the maximal power, A, minimum	0.7	1.05
No-load voltage, V, minimum	24	26
Short circuit voltage, A, minimum	0.9	1.5
Dimensions, cm:	78.5x34.5x3.75	127x36x3.75
Weight, kg	3.1	4.8

Organizations:

Manufacturer:

SOVLAX Company
15 Kulakov Lane, Moscow 129626, Russia
Tel: (095) 287-97-58,
Fax: (095) 286-35-67

POZIT EXPERIMENTAL PLANT

o SOLAR MODULES AND BATTERIES

Solar modules and batteries are compact and in many cases irreplaceable DC sources. The design features and mechanisms ensure reliable operation of batteries in outer space at temperatures ranging from -100 to 75°C, which is confirmed with their many-year functioning. At the temperature of 65°C, the battery specific power reaches 140 W/m² (AM equal 0).

Ground-based solar batteries (0.5 to 40 W power) can be used for feeding radios, tape recorders, TV sets, broadcasting stations, lighting appliances, as well as for charging storage batteries.

Their reliable operation under severe conditions is confirmed by the members of the Arctic expedition.

Solar batteries produced at the POZIT experimental plant are exported to the USA, Pakistan, Australia, Mexico, Germany, and India.



Specifications:

1. Frameless solar batteries (photoconverters laminated on glass)

Dimensions, mm	Cell dimensions, mm	Number of elements	Operating voltage, V	Power, W	Weight, kg
326x326x5	50x50	36	16.0	10	1.0
326x326x5	50x50	36	16.0	9	1.0
326x326x5	50x50	36	16.0	8	1.0
326x174x5	50x25	36	16.0	5	0.6
326x174x5	50x25	36	16.0	4.5	0.6
326x174x5	50x50	18	8.0	5	0.6
326x326x5	50x50	36	8.0	8	1.0

2. Solar batteries with aluminum extrusion frame

Dimensions, mm	Cell dimensions, mm	Number of elements	Operating voltage, V	Power, W	Weight, kg
338x368x15	50x50	36	16.0	10	1.6
338x368x15	50x50	36	16.0	9	1.6
338x368x15	50x50	36	16.0	8	1.6
338x216x15	50x25	36	16.0	5	1.2
338x216x5	50x25	36	16.0	4.5	1.2
338x216x5	50x50	18	8.0	5	1.2
338x368x15	50x50	36	8.0	8	1.6

3. Solar batteries with accumulators (SBA)

SBA type	Operating voltage, V	Operating current, mA, min.	Dimensions, mm	Accumulator capacity, Ah	Weight, g
Electronica-M1	9	56	250x149x21	0.26	500
Electronica-M2	6	40	130x85x18	0.26	185

4. Solar batteries

SBA type	Operating voltage, V	Operating current, mA, min.	Dimensions, mm	Weight, g
BS-0.5-9P	9	56	155x98x10	140
BS-0.5-6P	6	80	155x98x10	140

Organizations:

Manufacturer:

POZIT Experimental Plant of Current Sources
8 Fabrichnaya St., Pravdinsky 141290, Moscow Region, Russia
Tel: (095) 584-62-52, 584-34-02,
Fax: (095) 584-32-82

SATURN Company

○ SATURN BS-10/10 MODULE

The modules are composed by electrically connected photoconverters protected against the environmental impact by two layers of the Butvel film, 3-mm glass (front side), lavsan film (back side), and fixed in the frame made from painted anodized aluminum. Modules are provided with external mains connectors.

Module characteristics:

Dimensions, mm	593x283x35
Weight, kg	2.5
Electrical characteristics	
Peak power, W	10
Optimal voltage, V	17
No-load voltage, V	21
Short circuit current, A	0.9
Number of solar cells	36
Series connection length	36
Solar cell type	60x60 pseudo-square
Temperature coefficients	
Short circuit current, mA/deg	1.3
No-load voltage, V/deg	-0.0075
Optimal voltage, v/deg	-0.0079
Peak power, W/deg	-0.0065

Estimated cost: \$66

○ SATURN BS-25/25, BS-50/55 MODULES

Characteristics:

	BS-25/25	BS-50/55
Physical characteristics		
Dimensions, mm		
L	790	1,100
H	410	562
A	490	680
B	390	522
Weight, kg	6	10
Electrical characteristics		
Peak power, W	25	55
Optimal voltage, V	16.1	16.7
No-load voltage, V	20.2	21.35
Short circuit current, A	1.91	3.5
Number of solar cells	72	72
Series connection length	36	36
Solar cell type	60x60 pseudo-square	85x85
Temperature coefficients		
Short circuit current, mA/deg	2.56	4.6
No-load voltage, V/deg	-0.075	-0.075
Optimal voltage, V/deg	-0.079	-0.079
Peak power, W/deg	-0.09	-0.2

Estimated cost:

- BS-25/25 \$130
- BS-50/55 \$240

The total amount of Saturn BS-50/55 modules produced is about 1,500 pcs. The said modules are exported to CIS countries, Germany, Israel, South-East Asia etc.

○ **UNIVERSAL SOLAR PLANT**

The universal solar plant is composed by solar modules mounted on support structures, storage batteries (lead-acid, alkali, or nickel-hydrogen), a controller (photodischarge module), and a set of connecting cables

The modular principle enables producing 110 versions with DC output voltages equal to 1.5, 12, 24, 36, 48, 60, 110, and 220 V. The installed (peak) power of solar modules may lie within the 0.06 - 10 kW range.

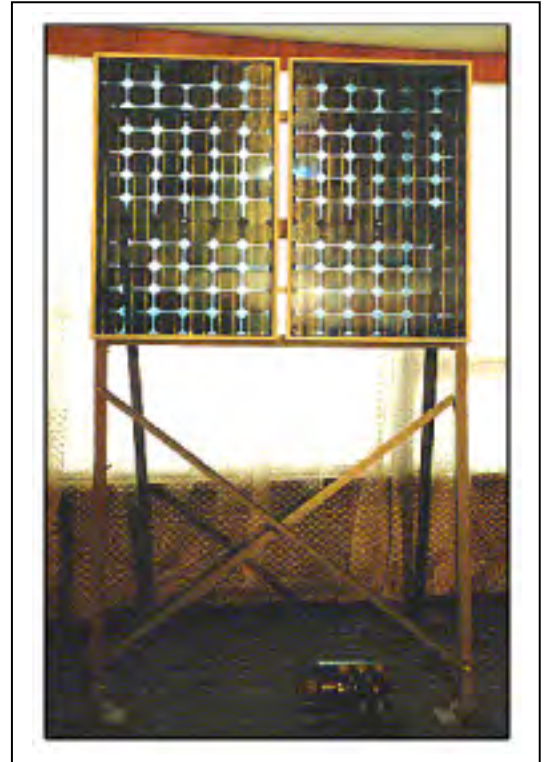
At the Customer's request, the plant may be provided with a DC/AC inverter for generating 220 V output voltage, 50 (60) Hz. The storage battery capacity ranges from 0.6 to 1.0 kWh.

Unattended period of operation: one year.
Service life: 20 years.

Estimated cost: \$10 per W

Organizations:

Manufacturer:
SATURN Company
6 Solnechnaya St., Krasnodar 350072, Russia
Tel: (8612) 54-47-64, 57-85-33
Fax: (8612) 54-35-92



Ryazan Factory of Metal-Ceramic Instruments

The Ryazan Factory of Metal-Ceramic Instruments develops and manufactures the following types of solar power equipment:

- Miniature solar modules of 3.5-5 W power;
- Solar modules based on monocrystalline silicon, 8 to 100 W power;
- Photovoltaic DC systems;
- Photovoltaic AC systems;
- Photovoltaic torches;
- Photovoltaic lights for public gardens.

○ SMALL-SIZED SOLAR MODULES OF THE MSM Series

Small-sized MSM solar modules based on monocrystalline silicon are intended for converting direct solar radiation into DC current. Silicon plates are located between two glasses of 1.5 mm thickness.

Advantages:

- Lightweight airtight design;
- Resistance: to 40- mm hail and 15 m/s hail velocity;
- Working temperature range: from -40 to 70 °C;
- Permissible air humidity: 100%;
- Power-saving assembling technology.

Application: universal power source for:

- Small fans;
- Sensors;
- Mobile telephones;
- Portable communication equipment;
- Miniature NiCd, Li-ion, Me-H or other types of storage batteries used for feeding electronic equipment



○ SOLAR MODULES OF THE PSM AND RSM Series

Ecology friendly solar modules based on monocrystalline silicon are intended for converting direct solar radiation into DC current.

Pseudo-square (PSM) or round (RSM) silicon plates connected to form a battery are sealed between the substrate from polyethylene terephthalate film and special shockproof 4 mm-glass. The said structure is placed into an aluminum frame.

Advantages:

- Lightweight airtight design;
- Resistance to 40-mm hail and 15 m/s hail velocity
- Range of working temperatures: from -40 to 90 °C;
- Permissible air humidity: 100%;
- Power-saving assembling technology.



Application. The modules can be used as the basic or auxiliary power source for:

- Cottages and summer houses
- Objects located far from power grids;

- Objects with intermittent power supply;
- Radio equipment, TV and radio communications;
- Safeguard systems, car storage batteries;
- Street lighting;
- Illumination of advertising panels;
- Water supply and desalination systems;
- Agricultural objects;
- Filling stations;
- Cathodic protection of objects.

○ **PV-500, PV-1000, PV-2000 INVERTERS**

Inverters are served for converting DC current of a solar battery or lead-acid accumulators into industrial frequency AC current.

Each inverter is provided with a controller ensuring normal operation of the storage battery within the solar power plant.

Advantages:

- Fine mass-dimensional characteristics (up to 600 W per dm³) owing to using modern energy conversion methods, original magnetic materials, and a modern element base;
- Good waveform of the output signal;
- High efficiency factor
- Admissibility of short-term overloads (up to 30%) and long-term reduction of consumed power;
- Protection against short circuits and long-term overloads.

Organizations:

Manufacturer:

Ryazan Factory of Metal-Ceramic Instruments

51 "V" Novaya St., Ryazan 390027, Russia

Tel: (0912) 44-19-70, 44-94-35

Fax: (0912) 44-19-70

E-mail: marketing@rmcip.ru

Website: www.rmcip.ru

National Research Institute of Agriculture Electrification

○ FSM-30-12 SOLAR MODULE

The solar module converting solar energy into DC current is used for feeding autonomous consumers (e.g. in agriculture) remote from power grids.

○ **Specifications**

- Power: from 27 to 33 W
- Dimensions: 960x400x28 mm
- Voltage: 17.5 to 19.5 V
- Weight: 4.8 kg
- Short circuit current: from 2.0 to 2.2 A
- Load current: from 1.8 to 2.0 A
- Blocking diode: KD 213A or KD 202D
- Guarantee period: one year
- Service life: 10 years



Solar modules can be used for feeding power consumers located far from power grids (1-5 km) or act as supplementary power sources when the main amount of power is generated by gasoline aggregates, ensuring besides liquid fuel savings.

As part of solar plants, solar modules can supply power to the following objects: relay radio communication systems; cathode protection of metal structures; navigation marks in water reservoirs and on seacoasts; street lights; amplifiers-retransmitters in telephone, TV, and broadcasting lines; radio telephones and other household devices.

Estimated cost: \$4.50 per W

Organizations:

Manufacturer:

National Research Institute of Agriculture Electrification
2 Pervy Veshniakovsky Passage, Moscow 109456, Russia
Tel: (095) 171-19-20, 171-02-10, 171-02-74
Fax: (095)170-51-01
E-mail: viesh@dol.ru

2 . 製造企業別太陽熱施設

Kovrov Engineering Plant

○ PLANE HYDRAULIC COLLECTOR AND AIR COLLECTOR

The collectors make use of solar energy for heating up a heat carrier circulating through the system.

The collectors are used for supplying heat and hot water to industrial, municipal, household, and agricultural objects.

The collectors can be applied both in single- and double-circuit systems with natural or forced circulation of a heat carrier.

The collectors using both direct and diffused solar energy are installed as stationary facilities and do not require sun-seeking devices.



Design features of the plane hydraulic collector:

- Heat carrier: water or antifreeze;
- Daily capacity: 70 l of warm water (50 - 60°C);
- Register: brass pipes;
- Solar receiver: metal sheet;
- Body: sheet steel;
- Transparent insulation: 3-mm glass with the minimal content of iron;
- Mating: elastic couplings with fully overlapping steel clamps;
- Attachment to the plant: steel brackets for M6 bolts;
- Dimensions: 1,000x1,000x115 mm;
- Weight: 27 kg.

Design features of the air collector:

- Heat carrier: air;
- Capacity: 60 m³/h m²;
- Power: 0.7 kW/m²;
- Solar receiver: multi-channel stamped & welded structure;
- Transparent insulation: 3-mm glass with the minimal content of iron;
- Mating: M6 bolts via flange and rubber gaskets;
- Dimensions: 1000x1000x220 mm;
- Weight: 30 kg.

○ MOBILE SOLAR HEAT SUPPLY PLANT

The plant is intended for individual houses, farms, pastures, recreational and social objects. The plant operates in field conditions without connection to a water supply system because it can be filled from any water source. In case of being connected to the water conduit, water feed to the plant is made automatically via a special valve.

The plant can be transferred into a unit measured 1,000x1,000x1,000 mm convenient for transportation. After delivery to the workplace, the plant can be brought into the working position within 15-20 minutes.

The plant includes as follows: two hydraulic collectors, a tank from stainless steel of 160-liter capacity with a level indicator, a demountable support with connecting fittings, and a reserve heating facility in case of cloudy and cold weather. The plant weight is 150 kg.

Plant advantages:

- Automatic keeping of the preset temperature in any weather by means of the control unit;
- Additional water heating is made with the aid of modern film heaters not contacting with water, which greatly enhances their survivability;
- Triple blocking system ensures the plant reliability and operational safety.

○ **SOLAR POWER PLANTS**

Solar power plants comprise hydraulic or air collectors, as well as heat accumulators, accessories and connecting cables, pumps, ventilators, refrigerators, automatics etc.

The Manufacturer ensures the development of plants for each particular object, supply of all units and parts, assembly, adjustment, commissioning, and maintenance operations.



○ **SOLAR COOLING PLANT**

The plant is intended for cooling dwellings, industrial premises, swimming pools etc.

A cooling unit acting as a two-component sorption machine operates on a heat carrier (40 to 60°C temperature) delivered from the collectors.

Plant advantages

- High refrigerating capacity;
- Power savings;
- Environmental purity;
- Noiseless operation.

Organizations:

Manufacturer:

Kovrov Engineering Plant

26 Sotsialisticheskaya St., Kovrov 601909, Vladimir Region, Russia

Тел:(09232) 9-42-86, 9-42-01

Fax: (09232) 3-47-54, 3-09-12

E-mail: kmz@kovrov.ru

KONKURENT Research & Production Enterprise

○ **RADUGA-M SOLAR COLLECTOR**

The Raduga-M plane solar collector is used for transmitting solar energy to a heat carrier circulating in the system. These collectors are the principal element of any solar thermal system of industrial or domestic application for feeding hot water to dwellings, industrial premises, and various objects (municipal, residential, agricultural etc.)

Besides water, the Raduga-M solar collector can be used for heating up other liquid heat carriers compatible with the material of the collector's absorbing panel and applied in the heating, conditioning, and cooling systems, as well as in manufacturing processes.

The absorbing panel – the collector's basic element – is made as two sheets of stainless steel, 0.3 and 0.5 mm thickness. The panel outer surface has a selective coating enhancing heating efficiency by 25-30%.

The lower heat insulation has two layers: basalt fiber wrapped into reflecting aluminum foil, and a plate from rigid foamed polyurethane. The total insulation width is 50 mm.

The side heat insulation is composed by 15-mm layer of foamed polyurethane faced with foil.

The collector body is made from specially designed pressed profiles from the AD31 aluminum alloy coated with long-lived powder enamels. The body features bolted connection to mounting supports at any point of the wall, as well as the glass compression with the aid of clamps with built-in locks.

Specifications

- Collector dimensions (without branch pipes): 1,830x630x104 mm.
- Overall area: 1.15 m².
- Absorbing panel area: 1.0 m².
- Collector weight: 27 kg.
- Volume of the absorbing panel channels: 1.3 liter.
- Panel coating absorbing factor: 0.92 to 0.94.
- Panel coating blackness degree: 0.11 to 0.14.
- Heat carrier working pressure: 400 kPa.
- Estimate service life: 15 years (minimum).

Over 1,000 Raduga-M collectors have been fabricated.

Estimated cost of 1 m² collector: \$240

○ **RADUGA-2M SOLAR WATER HEATING PLANT**

The Raduga-2M solar water heating plant (SWHP) makes use of solar energy for heating up water and keeping its temperature until the demand for such water arises. The SWHP -converted solar energy is sufficient for ensuring only seasonal supply of hot water.

SWHP accumulates heated water because the volume of solar radiation is limited by daylight hours whereas water supply shall be uninterrupted. In cloudy days, water is heated by a tubular electric heater built into the accumulator tank.

For enhancing the reliability and ease of operation, SWHP has two circuits, and non-toxic antifreeze is used in the primary circuit. The said scheme eliminates the threat of a heat carrier freezing and destruction of SWHP elements at subzero temperatures.

For ensuring a long service life of SWHP, its main elements coming in contact with the primary circuit heat carrier or warm water are made from stainless steel.

About 150 plants have been manufactured.

Estimated cost of the plant: \$1,000 per 1 m².

Organizations:

Manufacturer:

KONKURENT Research & Production Enterprise
44 Chkalov St., Zhukovsky 140160, Moscow Region
Tel: (095) 556-38-98, 556-40-09
Fax: (095) 556-40-38

Mashinostroenie Research & Production Association

○ SOLAR COLLECTORS FROM STAINLESS STEEL

The solar collector uses solar energy for water heating. It is applied in heat and hot water supply systems of household and industrial application. The collector is made as an absorbing panel with specially selected coating.

Coating is made by the plasma-chemical technique. Such a panel features a high absorbing capacity in the solar spectrum.

At the same time, the coating parameters are selected for ensuring the minimal radiant emittance in the spectrum region corresponding to heat self-radiation.



The combination of selective coating parameters results in the panel heat carrier's maximal receipt of solar heat without losses.

The following modern materials have been used in the collector design: the absorbing panel from stainless steel by the stamping and welding technique; heat insulation ensured by foamed polyethylation ensured by foamed polyethyl, transparent insulation from hardened glass.

Specifications:

	IELU 065147.001 Version 1	IELU 065147.002 Version 2
Absorbing panel material	Stainless steel 12H18N10T	
Absorbing panel thickness, mm	0.8	
Selective coating absorbing factor	0.92 - 0.96	
Selective coating blackness degree	0.04 - 0.06	
Maximal working pressure, MPa	0.4	
Service life, years, minimum	15	
Dimensions, mm	1,350x700x85	1,610x800x85
Collector working area, m ²	0.9	1.27
Collector weight, kg	27	34

The solar collector produces 90 liters of water with the temperature of 60-70 C from one square meter of the absorbing panel surface.

Estimated cost:

- Version 1: \$190
- Version 2: \$250

○ SOLAR COLLECTOR FROM CORROSION-PROOF ALUMINUM ALLOY

Specifications:

Absorbing panel material	Corrosion-proof aluminum alloy
Transparent insulation	Glass, 3-4 mm thickness
Heat insulation	Mineral fiber, 50 mm thickness, 25-mm side insulation
Selective coating absorbing factor	0.92 - 0.96
Selective coating blackness degree	0.03 - 0.08

Working pressure, MPa	1
Embedding pressure, MPa	1.5
Guarantee period, years	5
Service life, years	25
Absorbing panel area/full area, m ²	1.84/2.02
Heat carrier (liquid)	Water, antifreeze
Liquid volume, l	2.15
Union size, inch	³ / ₄
Dimensions, mm	2,007x1,007x100
Weight, kg	45

Estimated cost: 190 \$

○ **OASIS SOLAR DISTILLERS**

The solar distillers are intended for getting potable water from seawater and contaminated water.

The Oasis and Oasis-1 distillers are small-sized plants.

The Oasis-1000 desalinator serves for supplying distilled (potable) water to settlements, hotels, restaurants etc. The distiller also effects water purification from harmful admixtures and pathogenic microorganisms and saturation with all required microelements with the aid of the conditioning units thus ensuring water conformity to the WHO hygienic standards.



Water desalination is effected by its evaporation with the subsequent condensation. The distiller design provides for easy transportation. The distiller daily output of purified water makes up 7-8 liters from the 0.85 m² of evaporation area. At the Customer's request, specialists can mount a desalination system of the total area of 4, 8 и 12 m² with the daily output of 28, 56 and 84 liters of potable water, respectively.

The Oasis-1000 distiller has a modular design; the table below gives the data for a single module. The number of modules used is determined by the Customer depending on the amount of potable water consumption.

	Oasis	Oasis -1	Oasis -1000
Effective area, m ²	0.85	1.5	250
Daily amount of potable water, liters	7-8	12-14	1,000-1,500
Weight, kg	40	60	
Dimensions (operating state), mm	1,530x740x750	1,750x1,000x850	
Dimensions (packed), mm	1,580x815x275	1,800x110x110	Standard 20-foot container
Service life, years	10	10	10

At the Customer's request, the delivery set may include a filter for additional purification of condensate produced, as well as a device for its saturation with microelements in conformity with the sanitary and hygienic standards for potable water.

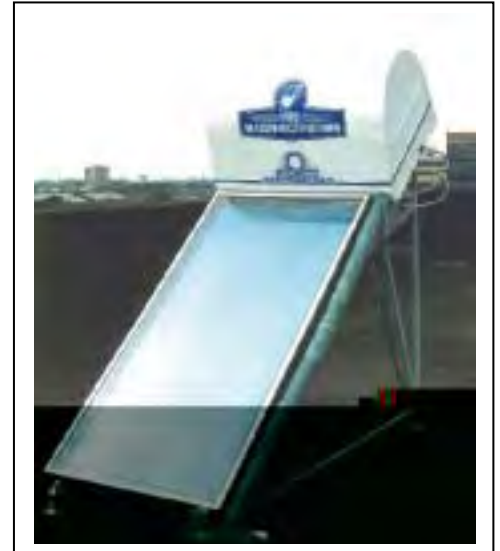
Estimated cost:

- Oasis: \$280;
- Oasis 1: \$320;
- Oasis 1000: \$25,000

○ **SOLAR WATER HEATING PLANT**

The solar water heating plant serves for feeding hot water to consumers without using any traditional energy sources such as gas, electric energy, coal etc. Such plants can be used in summer houses and cottages as well as on farms. The plants mounted on roofs or horizontal planes or vertical walls are connected to water supply mains. The delivery set incorporates one or two collectors and one accumulating tank of 80- or 120-liter capacity. The daily output of each collector is up to 100 liters of water with the temperature not below 40°C.

Water is heated due to heat transfer from the collector's solar panel. The plant has natural circulation. Heated water is fed to the consumer from the upper part of the accumulator tank due to its displacement by cold water from the water pipeline being delivered to the lower part.



The plant's high efficiency is achieved by applying selective coating in collectors and ensuring the proper heat insulation of the accumulator tank and circulation water pipelines.

Organizations:

Manufacturer:

Mashinostroenie Research & Production Association
33 Gagarin St., Reutov 143952, Moscow Region

Tel: (095) 528-30-54

Fax: (095) 302-20-01

E-mail: fnpc@npomash.ru

3 . その他の主要太陽光発電システム・太陽熱施設製造企業

No.	Name of enterprise	Range of products	Enterprise address
1	Solnechny Veter (Solar wind) Company	Household photovoltaic facilities, 3 to 200 W power	69 Bazovskaya St., Krasnodar 350000, Russia Tel/fax: (8612) 55-22-86 E-mail: solwind@krasnodar.ru Website: http://www.solar.tnn.ru
2	Ioffe Physics & Technics Institute's Center	Solar cells based on gallium arsenide	26 Polytekhnicheskaya St., St. Petersburg 194021, Russia
3	Sun Energy Research & Production Enterprise	Eight kinds of photovoltaic facilities	16 bldg. 60, Third Mytishchinskaya St., Moscow 129626, Moscow Tel: (095)287-96-36, 287-98-40 Fax: (095)287-67-97
4	TELECOM-STV Company	Solar modules of 20, 22, 25, 30, 33, 35, 40, 45, 50, and 53 W power	1 Solnechnaya Alley, Moscow 103527 (Zelenograd), Russia Tel: (095) 531-83-51, 532-90-36 Fax: (095) 531-83-54
5	Research Institute of Semiconductor Devices	Solar modules, 0.3 to 200 W power	99a Krasnoarmeiskaya St., Tomsk 634034, Russia Tel:(382-2) 48-81-59,48-82-12 Fax: (382-2) 55-50-89 E-mail: opt@niipp.tomsk.ru
6	Research & Planning Institute of Agriculture Electrification	Solar plants	14 Lenin St., Zernograd 347720, Rostov Region, Russia Tel: (863-59) 32-4-98
7	Vetrotok Scientific & Production Company	Solar water heating plants	Yekaterinburg 620151, P.O.B 54 Tel: (3432) 39-98-19
8	Moscow Power Institute, Chair of hydraulic and renewable energy	Water raising plant fed by solar batteries	14 Krasnokazarmennaya St., Moscow 105385, Russia Tel:(095) 362-75-74, 362-72-51 Fax: (095) 362-75-74

・メタンハイドレート資源開発

現在、人類は、原子力利用の一方で、環境問題と石油ガス資源の枯渇という問題に直面している。近い将来これらの問題を解決するためのひとつの方法として、メタンハイドレート堆積層からメタンガスを採取する技術の開発が進められている。メタンハイドレートにおけるガスの総埋蔵量は天然ガス田の確認埋蔵量の 100 倍という試算が出ている。

メタンハイドレートは水と炭化水素（大半がメタン）の安定した化合物であり、大陸沿岸の水深数百メートルの海底下や北極圏・南極圏の永久凍土地帯に広く分布しているが、メタンハイドレートからガスを大量に採取する合理的技法はまだ開発されていない。

ロシア領内メタンハイドレート層のガス埋蔵量は 1,400 兆 m^3 と試算されており、これは天然ガス田の確認埋蔵量の 50 倍である。

日本では国の主導でメタンハイドレートの開発が進められており、日本周辺海域でガス採取実験が開始されている（見積埋蔵量 7.4 兆 m^3 ）。日本は海底からメタンハイドレート結晶の大規模採取を 2011 年までに開始する予定であり、4 年以内に準備作業を始める計画である。

ロシアにおいても効率的なガス採取技術の開発が進められており、GTL Company（旧 Methanol Company）はメタンガスの熱化学採取技術を開発し特許を受けた。ガスプロム、ロシア科学アカデミー他の研究所の専門家からなるワーキング・グループがガスの採取・貯蔵・輸送に関する 2004 年から 2010 年までのプログラムの作成を予定している。

○ Technology for thermochemical extraction of methane-containing gas from gas hydrate

The GTL Company was given a proposal to elaborate a profitable technique for methane-containing gas extraction from Indian gas hydrate deposits. Solving the said problem for India means the provision of its billion-worth population with power resources for centuries. In this connection, GTL is carrying out R&D work under the Company-patented technology.

For recovering methane-containing gas from gas hydrates, use is made of the newly designed thermochemical plant. At the temperature of 540-640°C, a methanol-containing gas-steam mixture going out from the plant reactor is delivered via heat-insulating pipes through wells to a gas hydrate deposit where heat power contained in the said mixture decomposes solid gas hydrates liberating methane-containing gas. Methanol from the gas-steam mixture gets into gas hydrates and acts as an inhibitor, which results in an increased volume of gas liberated.

Deposits can be developed by using both vertical (under different angles) and horizontal wells. Injection wells deliver a gas-steam mixture from reactors inside gas hydrate deposits. After cooling, the injected gas-steam mixture is released from steam, methanol, and together with methane-containing gas formed from gas hydrates is returned through outlet wells to the entrance of the first reactor setting up a circulating system feeding reactors with methane-containing gas required for their operation.

Thus, the circulation mode of operation of homogeneous oxidation reactors ensured by passing a gas-steam mixture through gas hydrate strata leads to an increased gas volume owing to the decomposition of gas hydrates and formation of methane-containing gas. The said gas may be fully used for chemical reprocessing in homogeneous oxidation reactors. In addition, it can be withdrawn from the circulation gas cycle for other industrial or domestic purposes with the sufficient amount left in the circulation system.

For enhancing the efficiency of gas hydrate deposits development use can be made of generally acknowledged techniques for cutting large-sized strata, making splits and micro splits (wave actions, micro explosions etc.)

The most efficient operation of the thermochemical plant is attained at the steam-gas mixture pressure from 55 to 300 atm and the gas mixture temperature from 540 to 1700°C, though high value parameters increase the plant cost. Serial homogeneous oxidation reactors are rated for operation at the pressure ranging from 75 to 100 atm and the temperature within 540-640°C. Plants with other pressure and temperatures values can be manufactured individually after surveying a gas hydrate deposit and drafting the project of its development with due account of operating conditions, natural climatic factors, volume of a gas hydrate deposit, its depth, and other geophysical conditions.

Thermochemical plants manufactured as production modules enabling their transportation by helicopters can be used both at continental and shelf deposits. Apart from that, plants provided with remote control systems and intended for gas recovery on the Arctic shelf or in ice-covered areas may be mounted underwater.

Organizations:

Designer

GTL Company

1 bldg 1, Kaluzhskaya Sq., Moscow, Russia

Tel: (095) 238-1203