



Solar industry in Russia: achievements and potential

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Company Overview

HEVEL today



HEVEL GROUP, a joint venture founded in 2009 by Renova Group and Rusnano, is the biggest vertically integrated company in the field of solar energy in Russia and the only HJT manufacturer in Europe.

160_{MW/year*}

- PV cells production
- PV module supply

1 GW

SPP's pipeline

Hybrid and micro-generation

Export

- PV cells and modules
- EPC (+F)
- Innovative solutions: microgrid + off-grid
- IPP

HJT PV module power

over 300 W_p

SPP in operation by end 2017

174 MW

Cell efficiency

>22 %



Innovation technology

19 KG

• To upgrade up to 250 MW_T

Hevel activity



PRODUCTION

160 MW per year

Solar cells

Solar modules

Located in Novocheboksarsk (Chuvash Republic), 600 km from Moscow



ENGINEERING AND GENERATION

Engineering and construction of on- and off-grid solar power plants of any capacity.

Operation and Maintenance of solar power plants.



RESEARCH AND DEVELOPMENT ACTIVITY

Development of technological advantages and its implementation into production

Solar cell efficiency increase

Production cost reduction

Product line extension (e.g. flexible cells) and PV applications for different industries.

Hevel Milestones



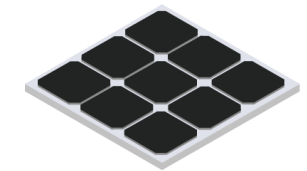
First commercial projects (off-grid)

Start of industrial solar power plant [SPP] development program in Russia.
First 5 MWp SPP in Altay Rep.

HJT program in progress
Program of facility production modernization to HJT technology by R&D center

HJT production upgrade to

250 MW p/year



2011

2014

2016

2018

2009-2010

2013

2015

2017

Hevel project start-up & foundation of the R&D center
Hevel facility construction in Novocheboksarsk

Start of Hevel hybrid diesel-solar system program in Russia.
First plant in Altay Rep.

Start of thin-film PV modules production.
Production over 90 MWp/year.

Start of HJT PV modules production
Production 160 MW p/year

SPP program under development.
174 MWp SPPs in operation. 1 GWp – pipeline to 2020.



– R&D



– management company



– construction



– SPPs

Saint Petersburg

Mytishchi,
Moscow region

Moscow

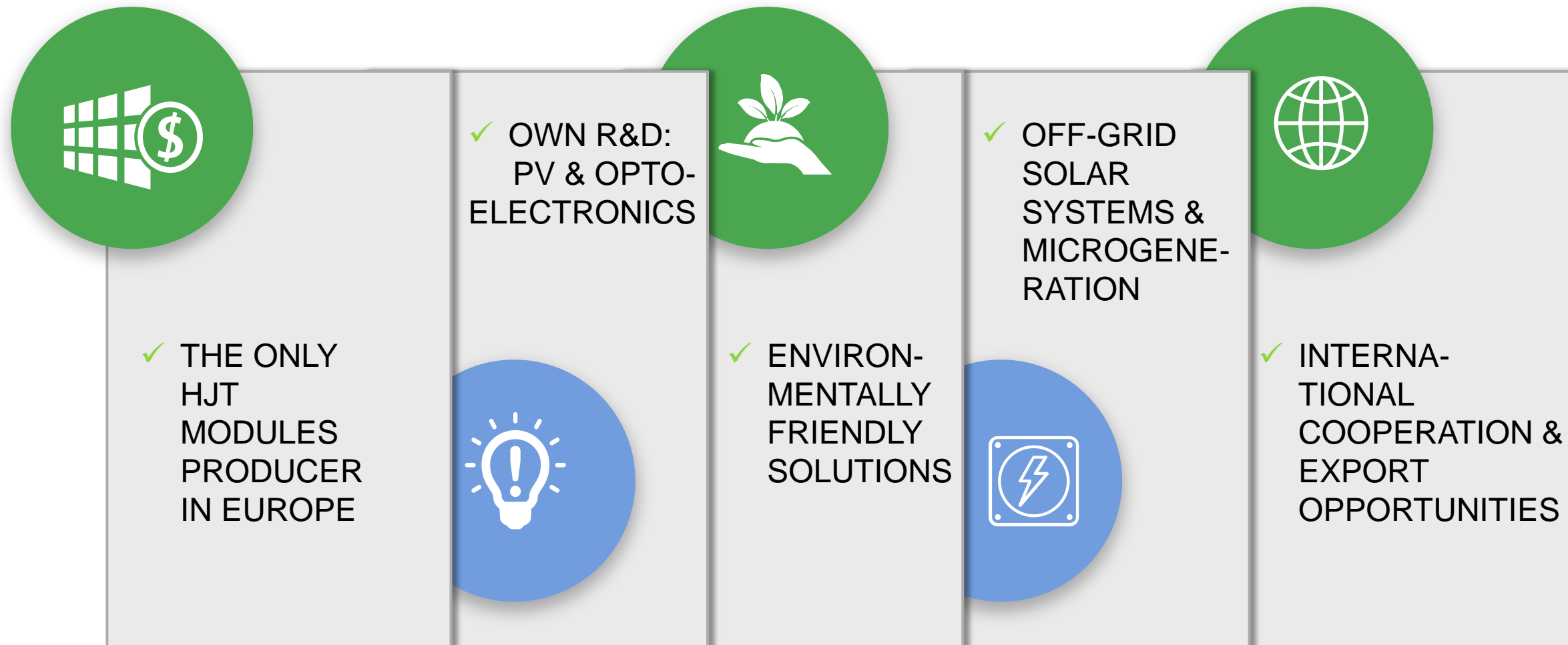
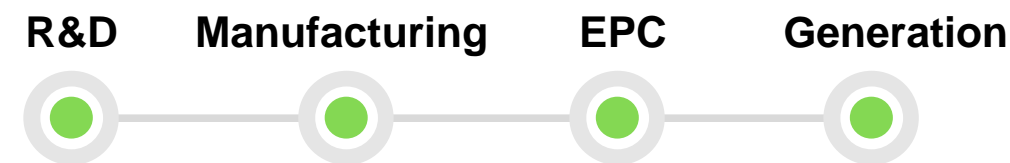
Saransk

Novocheboksarsk

Hevel today



The Hevel Group is a full-cycle vertical integrated company¹:

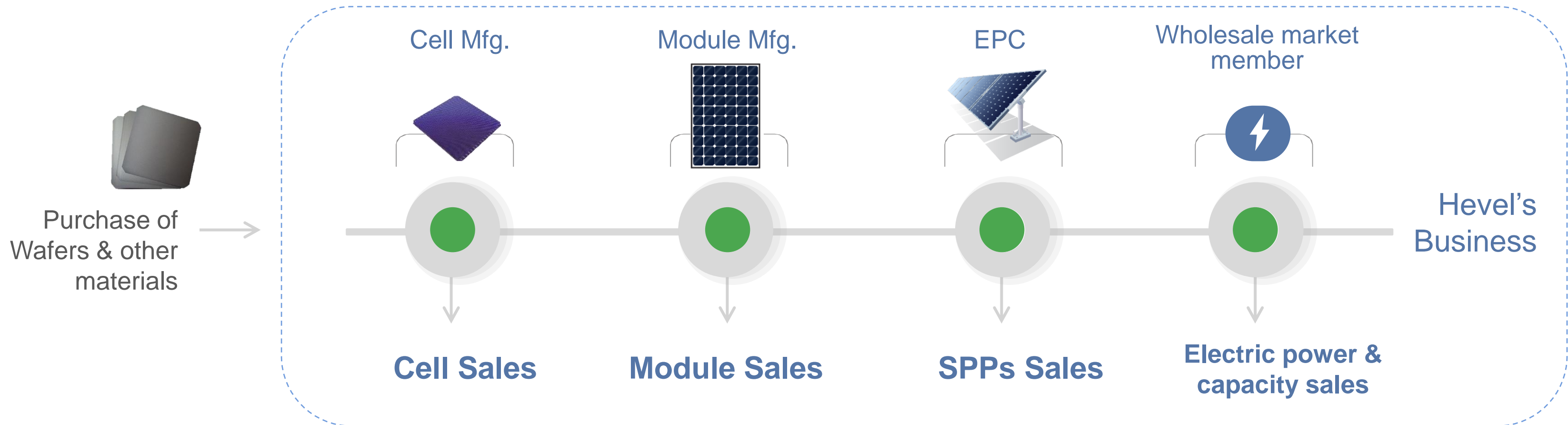


- i the only industrial HJT PV modules manufacturer in Europe among 3 HJT industrial manufacturers in the world.
- ii production of 160 MW p/year in 2017 with upgrade to **250 MW p/year** in 2018. European manufacturer with fast delivery anywhere in Europe.
- iii unique transfer Thin-film → HJT developed by R&D center in St. Petersburg led to production increase from 90 MW to **160 MW** of high-efficiency panels.
- iv **8 new patents** and researches for future transfers under permanent development.

Hevel's Business Model



Since its formation the Company expanded its business model beyond cell and module production developing its EPC capabilities to install utility scale solar projects



Hevel - Environmentally friendly company



✓ FULL-CYCLE VERTICAL INTEGRATED COMPANY

Significant experience in EPC and IPP in Russia

Own R&D: continuous improvement of unique high-efficient PV technology incl. cost reduction plan

Own cell and module Production facility: cost reduction plan in progress

Competitive in LCOE



✓ INNOVATIVE AND ENVIRONMENT FRIENDLY SOLUTIONS

- ✓ Low CO₂ footprint.
- ✓ Saving Water consumption
- ✓ Saving Electricity
- ✓ Saving fuel
- ✓ Saving money for end-users



INTERNATIONAL CERTIFICATION

✓ TÜV certified

Hevel HJT PV modules certified by IEC 61215: 2005, IEC 61730-1:2004+A1+A2, IEC 61730-2:2004 standards

✓ Certification for local foreign markets

Ready to certify HJT modules and cells for local foreign markets

RUSSIAN CERTIFICATION

- ✓ **Technical regulation of Customs Union** (TRCU 004/2011)
- ✓ **Green and nano- standards:** NANOSERTIFICA and GREEN NANOINDUSTRY
- ✓ **Quality management system** ISO 9001:2015
- ✓ **Environmental management system** ISO 14001:2016
- ✓ **Health and Safety management system** OHSAS 18001:2007



Our focus is green energy

Hevel group is the biggest integrated company in the field of solar energy in Russia. The main target is to make Russian energy market more “green”, environmentally friendly and attractive for investors and green bonds

The key effect is the reduction of CO₂ emissions:

174MWp – SPP’s in operation since 2014

1 GWp – pipeline to 2022

Over 134 000 MWh – current total electricity output

94 000 tons – current reduction of CO₂ emissions into atmosphere

~ 900 000 tons / year – target to reduce CO₂ emissions by 2022

Regions of presence

Regions with implemented infrastructural projects

HEVEL
SOLAR

1 GW

Pipeline till 2022

174 MW

SPP In operation
to end 2017

40 MW

Pipeline off-grid hybrid solar
systems till 2022

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Production & Technology

Hevel HJT Technology

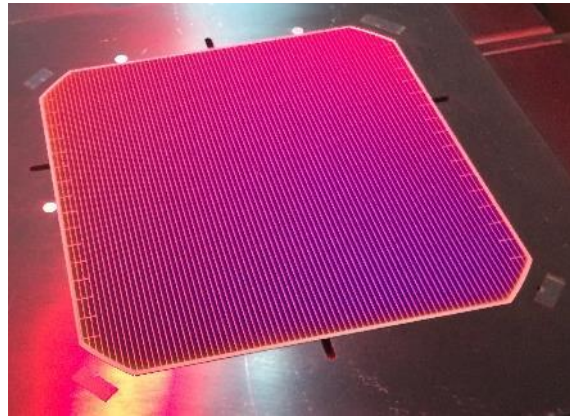
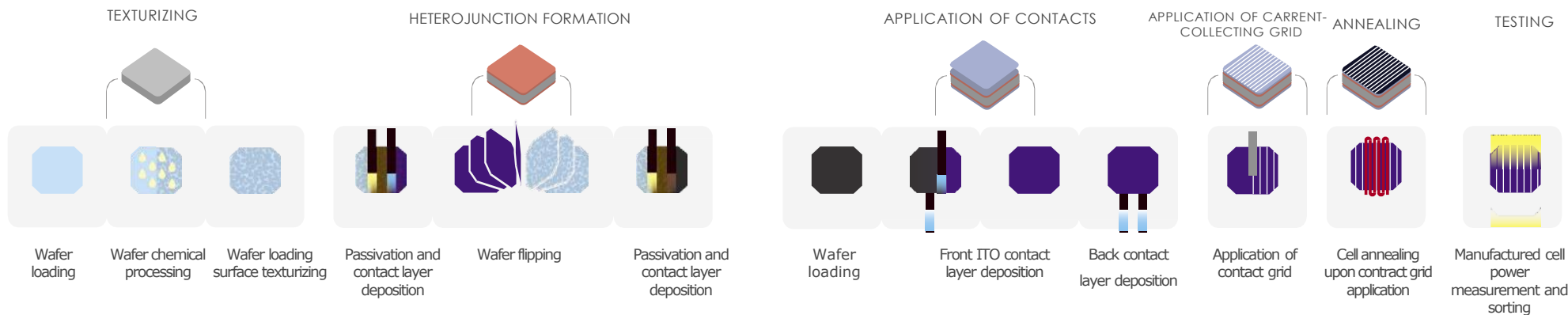


PRODUCTION FACILITY

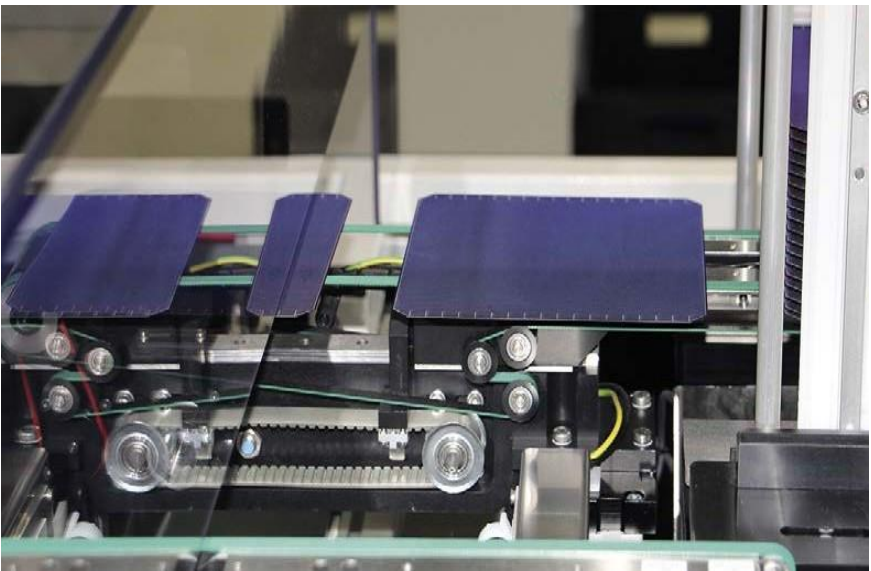
Hevel heterojunction technology combines the advantages of the classical silicon technologies (thin-film and crystalline silicon), which makes it possible to secure efficient solar module performance at high and low temperatures, as well as in diffused light.

RESEARCH AND DEVELOPMENT
Own R&D center provided fast and smooth transition from micromorph thin-film technology into advanced HJ technology increasing the PV product capacity from 9 % to 22% .

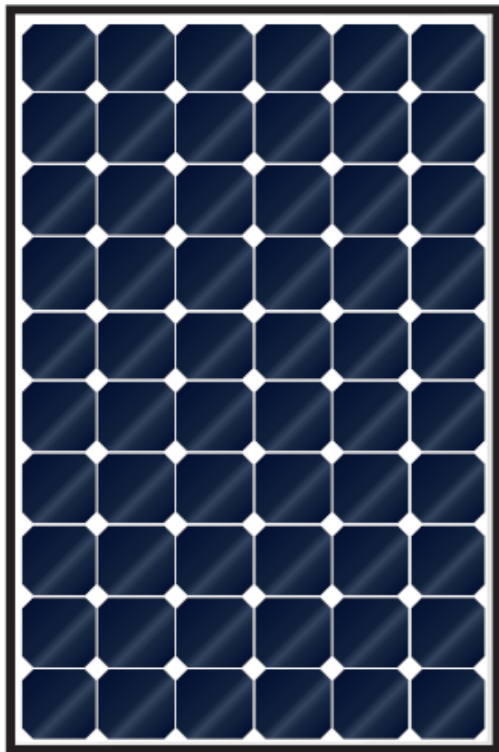
Production process



Mass production of heterojunction solar modules (HJT) started at Hevel fab in 2017.



PRODUCT

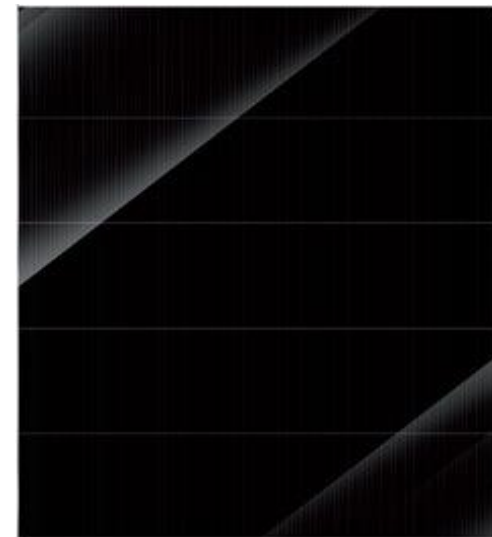


Technology:
HJT
60 cells
Cell efficiency:
Above 22%
Power:
300 -310Wp

Warranty

25 years
Low temperature ratio
0,3%/°C
Operating temperatures
from -40°C to +85°C

Continuous technology upgrade¹



Technology:
Thin-film
micromorph®

156 sections

Efficiency:
9%

Power:
125 Wp



Technology:
HJT

60 cells

Cell efficiency:
22.5%

Power:
300-310 Wp

✓ Better temperature coefficient -
Better output at high temperatures



Technology:
HJT
bifacial / mono

72 cells

Cell efficiency:
23%

Power:
400 Wp +

✓ **+15% output to current HJT technology**

2015

Thin-film micromorph®
glass-glass technology
125W module
with 9% efficiency

2017

Heterojunction (HJT)
technology
60 cell 300-310W module
with 22.5% cell efficiency

end of
2018

HJT technology upgrade to
72 cell bifacial / mono glass-glass
400W module
with 23% cell efficiency

HJT better performance – reduction of CO₂ emissions



HEVEL HJT MODULES ARE MOST EFFICIENT FOR APPLICATIONS IN REGIONS WITH RELATIVELY HIGH TEMPERATURE

300W HJT MODULE IS EQUIVALENT TO CONVENTIONAL Si CRYSTALLINE MODULE WITH 315 W POWER

FIELD TESTS

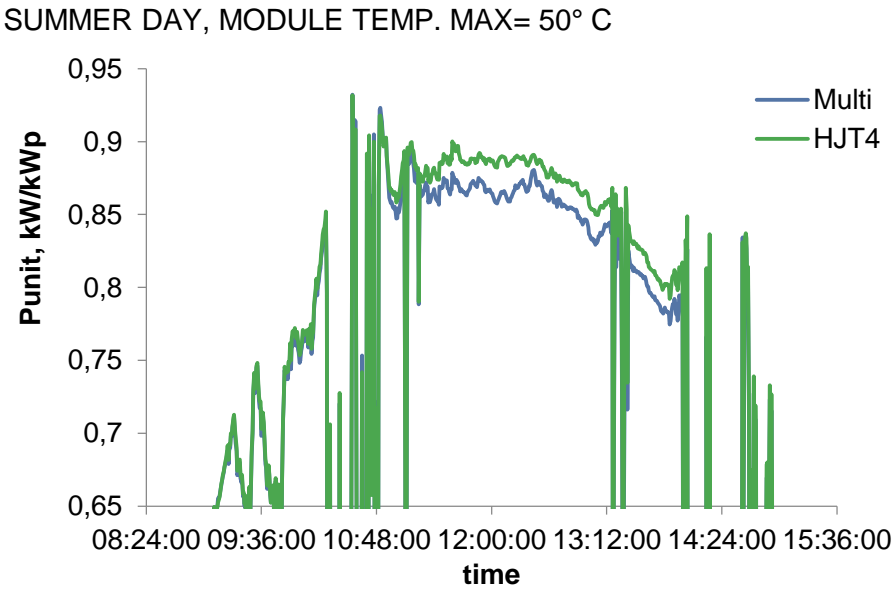
- Location** Hevel facility in Novocheboksarsk city
- Insolation** Equivalent to North Germany (Berlin)
- Results**
- ✓ Low temperature coefficient of HJT modules leads to **5%** increase in output during the operation of modules under optimal conditions (summer cloudless day).
 - ✓ Full-scale tests confirm a higher unit output of HJT modules compared to multicrystalline modules.
 - ✓ HJT modules output will increase when used at lower latitude with an increased average temperature

HJT ADVANTAGES IN REAL CONDITIONS

Factors / Type	Si-poly	HJT Hevel	HJT Hevel (bifacial)
Light degradation	2-3% per first week	No	No
Temp. power coefficient	-0,45%/K	-0,25%/K	-0,25%/K
Backside sensitivity	No	No	Yes
Scattered light sensitivity	Standard	Standard	High
Nominal power	240W	300W	300W
Average daily power output, kWh	1,16	1,5	1,68
Average daily yield (P/P _{nominal})	4,85	5,00	5,59

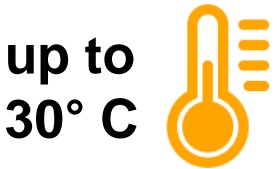
HEVEL R&D TESTS RESULTS: BETTER PERFORMANCE FOR SOUTHERN REGIONS

COMPARING THE DAILY PERFORMANCE OF HJT AND MULTI-CRYSTALLINE



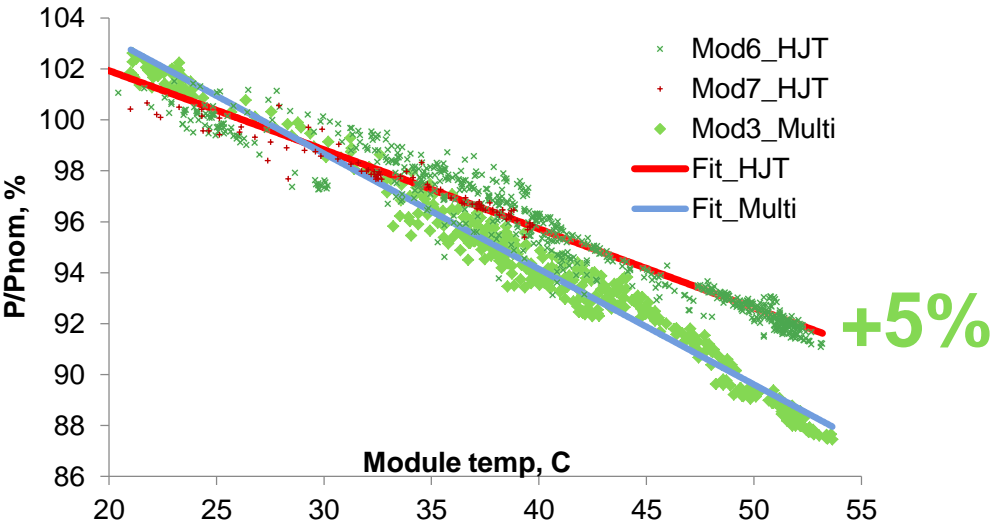
HEVEL HJT MODULES PROVIDES*:

+5% BETTER DAILY OUTPUT
IN COMPARISON WITH CRYSTALLINE
MODULES ON A SUMMER DAY*



* in climate condition of Northern Europe

DEPENDENCE OF MODULE POWER ON TEMPERATURE



LOWER TEMPERATURE COEFFICIENT PROVIDES

UP TO 15%
BETTER YEAR OUTPUT
IN SOUTH REGIONS



Continuous technology upgrade

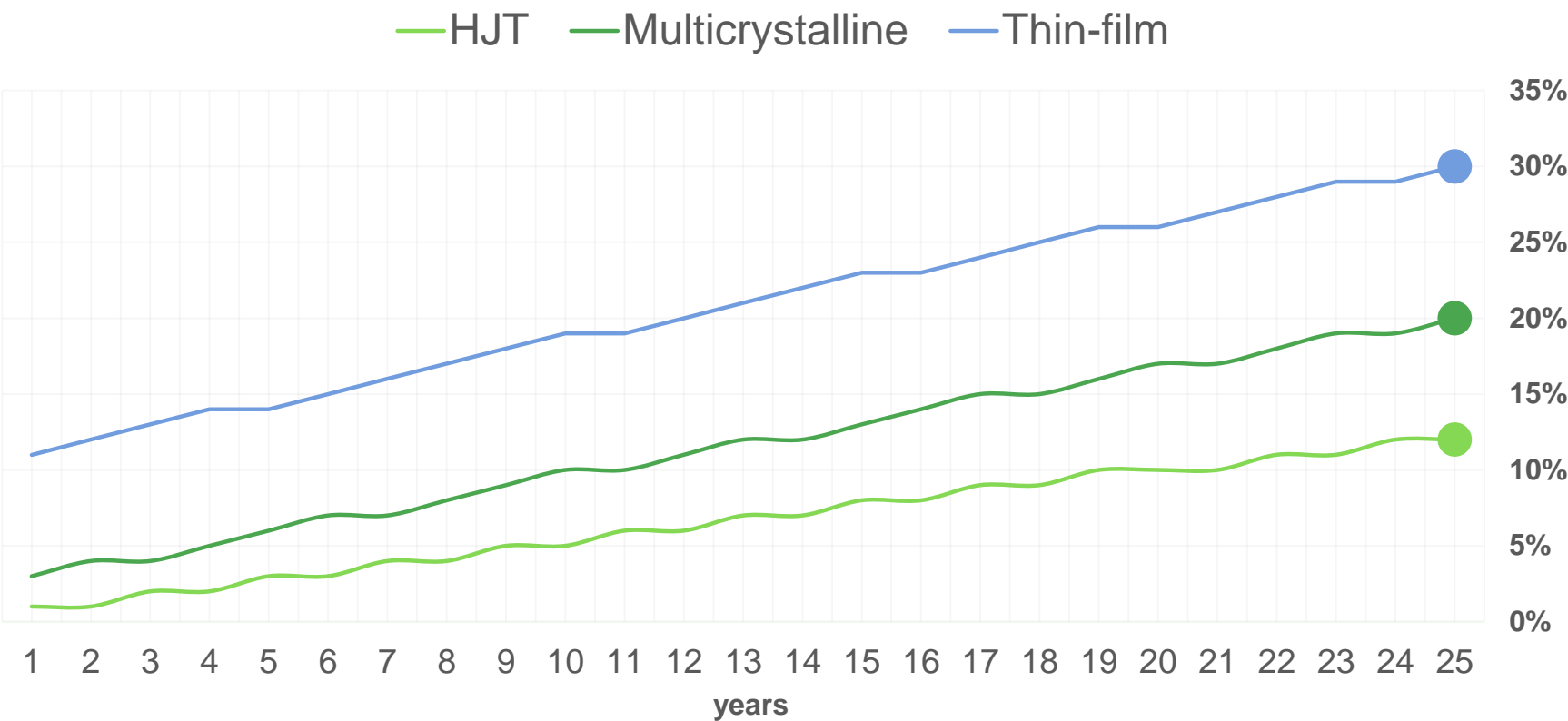
First year degradation, %:



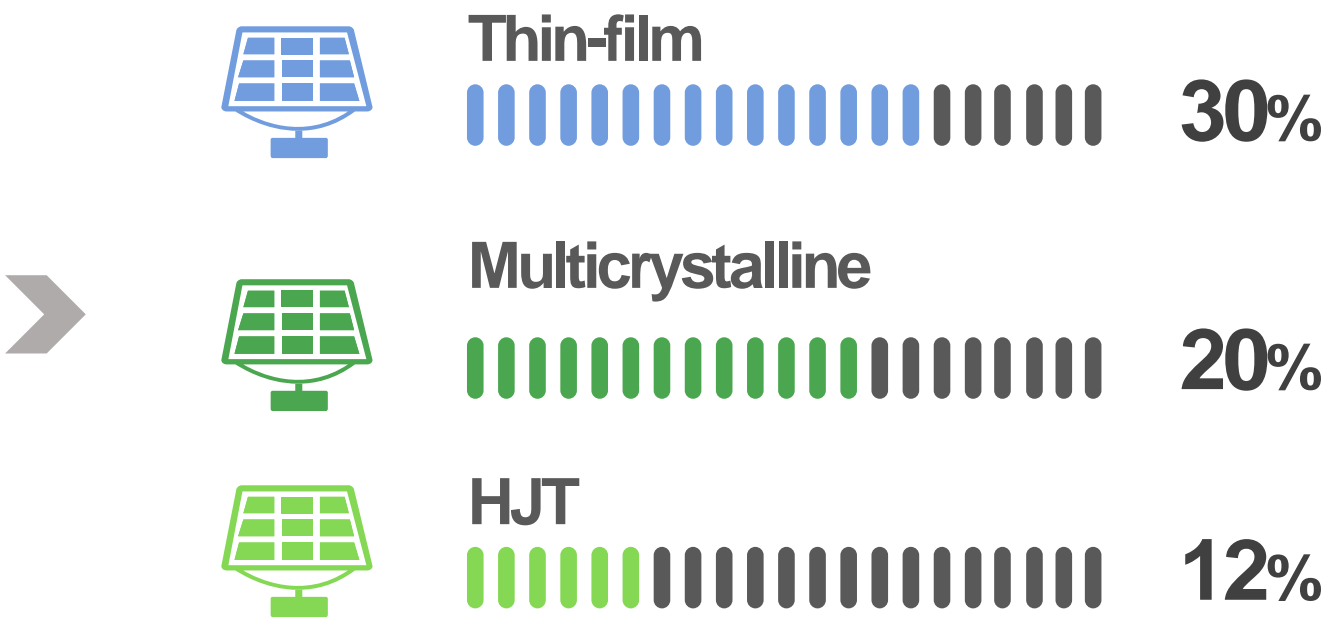
The degradation rate of the HJT modules is:

- 0.5% p/year
- 12% in 25 years
- 25 years linear performance warranty

Degradation ratio, %:



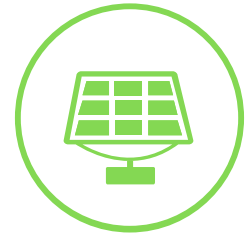
Degradation in 25 years:



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Export Opportunities

Export: key factors



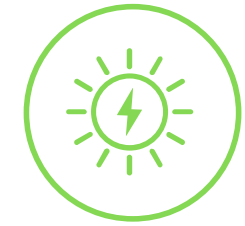
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Own cell and module Production facility

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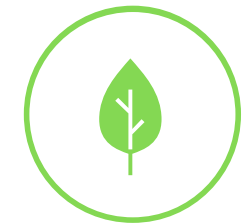
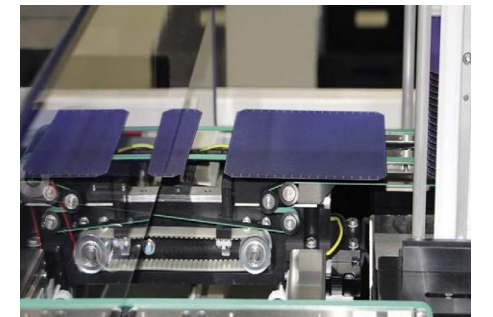


✓ THE ONLY HJT CELL and MODULE PRODUCER IN EU

Hevel is **the only industrial HJT PV cell and module manufacturer** in Europe and among 3 HJT industrial manufacturers in the world.

Possibilities of OEM in Europe based on Hevel HJT cells

High demand for high efficiency cells in Europe



✓ TÜV CERTIFIED

TÜV certified. Co-license for OEM in Poland in progress.



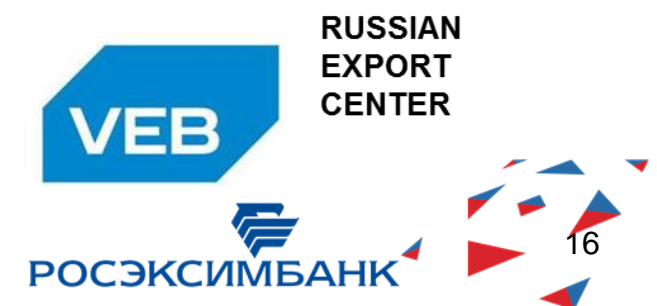
✓ INNOVATIVE AND ENVIRONMENT FRIENDLY SOLUTIONS

- ✓ Low CO₂ footprint.
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- ✓ Saving Electricity
- ✓ Saving money for end-users



✓ EXPORT FINANCING

Possibilities of Russian export financing up to 85% of EPC cost from leading Russian financial institutions: Vneshekonombank (VEB), ROSEKSIMBANK, Russian Export Agency



Export business models and HJT advantages



MODEL	PROJECTS and STRATEGY
1. HJT cells + OEM in EU	Projects: EPC/IPP, hybrid, off-grid
2. SMART INNOVATIVE AND ENVIRONMENT FRIENDLY SOLUTIONS	<ul style="list-style-type: none"> ➤ Smart energy-efficient solutions for agriculture ➤ Microgrid, off-grid, hybrid
3. OPPORTUNITY MARKETS	<ul style="list-style-type: none"> ➤ Available Russian Export financing ➤ EPC +F/IPP ➤ High tariffs + High efficiency modules (increased output) → higher IRR

HEVEL ADVANTAGES IN EPC BASED ON HJT

KEY FACTORS	ADVANTAGES
➤ Shortage of land/ High land cost	up + 20% of installed capacity and power output up to 16% less space for the same installed capacity
➤ High temperature regions	up to 15% better yield in hot climate
➤ High technological requirements	25 year – warranty 100 % PID Free Technology – avoiding the Potential Induced degradation that can lead to losses in performance of more than 20% even from the first months.
➤ Lack of financing	Availability of Russian Export Financing up to 85% of EPC cost

SOLUTIONS



TARGET AREAS OF COOPERATION IN FOREIGN PV MARKETS:

Innovative High-tech PV solutions:

Smart energy-efficient solutions for agriculture to solve the key challenges of the agro-industrial complex in the conditions of resources shortage (electricity, water), high fuel and operation costs.

Integration with all existing technologies and solutions for agricultural market.

Application of grid and hybrid generation in conjunction with solutions in the field of production and storage of water



Hybrid solutions
Capacity: over 10 kW
Lifetime: over 25 years

- Ensuring long-term tariffs and guarantees of return of investment
- Electrification of distant and rural areas



EPC(F) – Solar Power Plants, on-grid and off-grid, IPP

- Turn-key SPP solution with export financing up to 85%
- Complex solution: HJT modules + EPC+F

Cooperation with international partners in joint projects based on HJT cells/modules

Available Russian Export Financing: VEB, ROSEKSIMBANK




HJT cells and modules export

Possibility of OEM based on HEVEL HJT cells




Microgrid (retail market)

Benefits from HJT modules key advantages for rooftop and facade solutions



Ground solutions (SPP)



Rooftop and BIPV

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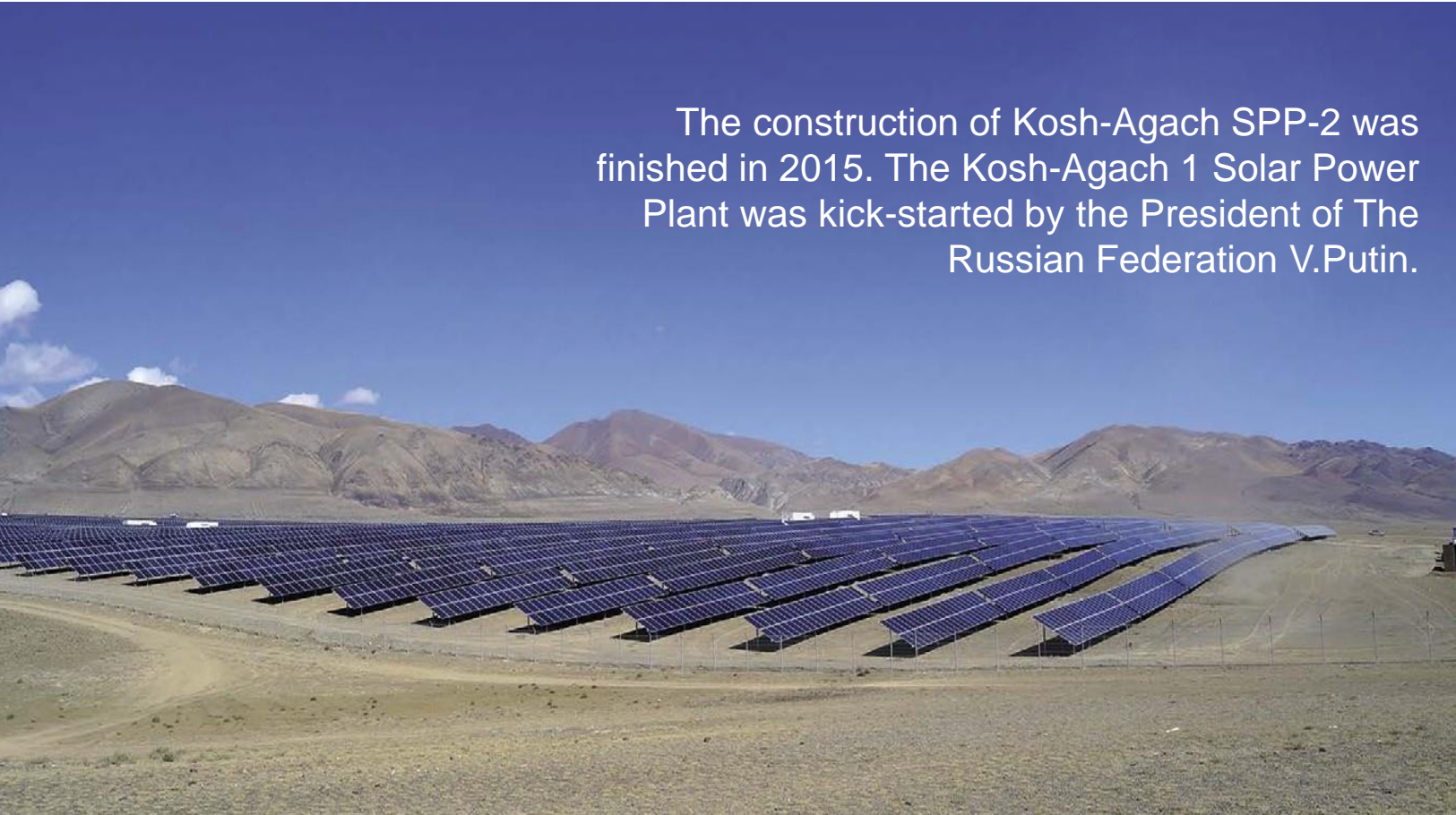
Implemented projects

Implemented projects



ON-GRID PROJECTS

REPUBLIC OF ALTAY



The construction of Kosh-Agach SPP-2 was finished in 2015. The Kosh-Agach 1 Solar Power Plant was kick-started by the President of The Russian Federation V.Putin.

- 10MW Kosh-Agach SPP
- 5MW Ust-Kan SPP
- 20MW Maima SPP
- 5 MW Onguday SPP



Maima SPP 20MW – first SPP designed on Hevel HJT modules

ORENBERG REGION



- 10MW Perevolotsk SPP
- 5MW Pleshanovskaya SPP
- 25MW Sol-Iletskaya SPP
- 10MW Grachevskaya SPP

BASHKORTOSTAN REGION

- 9MW Ysangulovo SPP
- 15MW Bugulchan SPP
- 20MW Buribay SPP
- 10MW Grachevsk SPP

SARATOV REGION

- 15MW Pugachev SPP
- 5MW Orlov-Gai SPP

VOLGOGRAD REGION

- 10MW Volgograd SPP

THE REPUBLIC OF BURYATIA

- 10MW Bichura SPP

Implemented projects

OFF-GRID and COMMERCIAL PROJECTS



100 kW Republic of
Altai
Yaylyu

400 kW Baikal
region
Menza



200 kW Rooftop for railway
stations,
Krasnodarsky Kray

50 kW Façade solutions,
Krasnodarsky Kray and
SKOLKOVO

> 500 kW Commercial implemented
projects in Russia
(rooftop, ground mount)



Thank you for your attention!



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