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**ADVANCED TECHNOLOGIES OF RES
UTILIZATION: AREAS OF POSSIBLE R&D
COLLABORATION BETWEEN EC AND RUSSIA**

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Министерство образования и
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Европейская Комиссия



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Государственный университет –
Высшая Школа Экономики



Инновационная образовательная
программа

INTRODUCTORY REMARKS

1. In this presentation nontraditional RES will be considered with exception of **Biomass** (separate presentation).
2. Some of RES utilization technologies have achieved a commercialization stage and don't need basic researches with support by the state. This presentation will deal mainly with rather new and promising technologies still need governmental financial contribution to accelerate their development - potential items for scientific collaboration between EC and Russia research teams.
3. Because of objective different situation with energy resources and different EC and Government of Russia attitude to RES implementation there is essential difference in practical utilization of RES in EC countries and Russia:
 - contribution of RES (without large HES) in the Russia energy balance is less than 0,5%;
 - relatively low prices and tariffs for fuel and energy till now ;
 - imperfection of legislation, stimulating RES technologies implementation;
 - inadequate financing of RD&D works by state budget during last years;
 - small amount of demonstration objects, illustrating the advantages and values of RES, etc.
4. Nevertheless scientific level of RES developments in Russia is still rather high, and there is a room for mutually useful scientific collaboration.

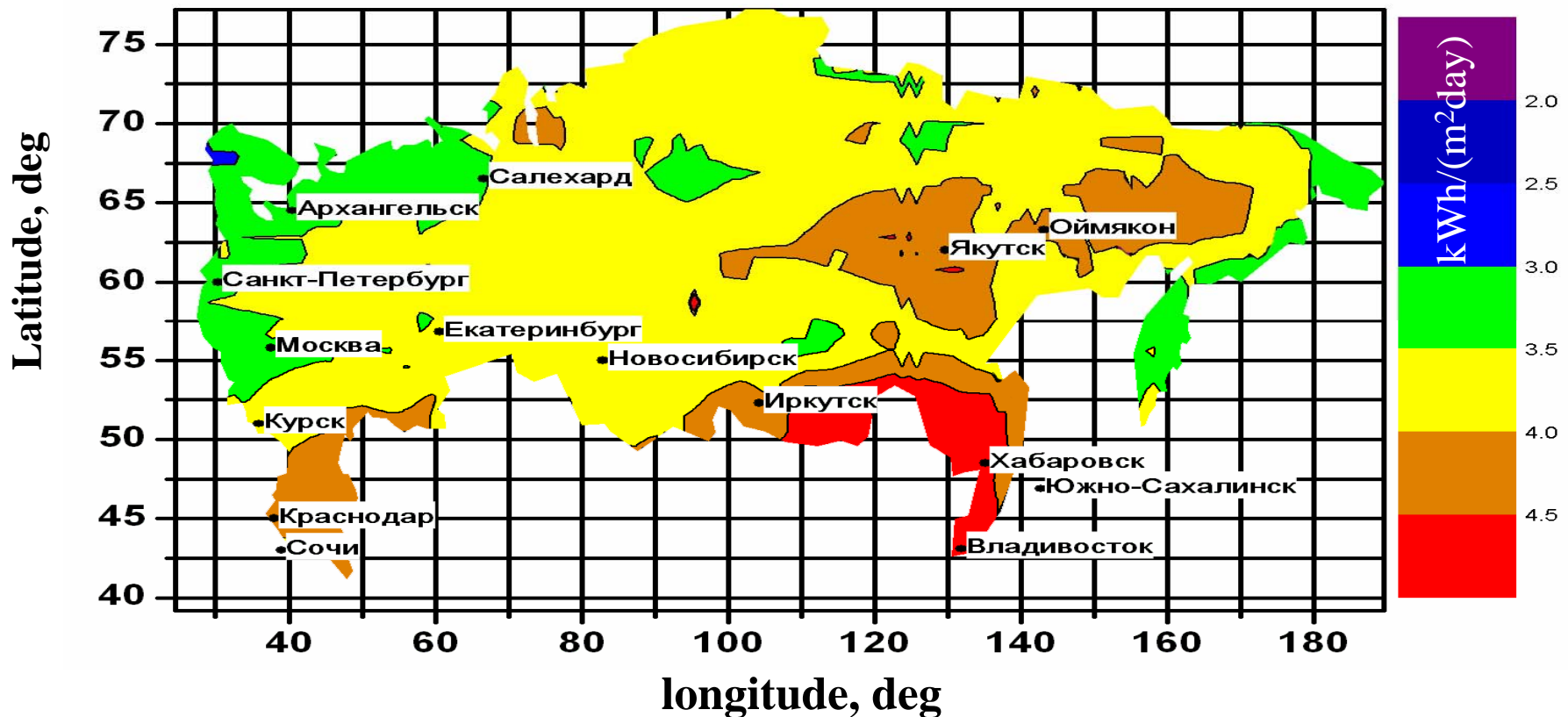
WHY RUSSIA IS INTERESTED IN ACCELERATED RES TECHNOLOGIES DEVELOPMENT?

- 1. Continuous and fast growth of prices and tariffs for fuel and energy;**
- 2. Centralized power systems cover less than 1/3 territory of Russia;**
- 3. About 50% of regions in Russia import energy resources;**
- 4. Only about 50% settlements are supplied with natural gas in Russia (in rural area - 31%, in towns – 59%);**
- 5. About 20 mln citizens are living in townships which are not connected to the centralized electricity and heat supply systems;**
- 6. There are objective opportunities to increase reliability of energy supply and to solve ecological problems by RES utilization for many consumers;**
- 7. Inexpensive natural resources of oil and gas are not unlimited. Energy sector is very inertial – 20-30 years period of transition is needed to be adopted to new energy technologies utilization.**

SOLAR ENERGY is most universal primary renewable energy source, which can be transformed into different useful forms: heat, electricity, cold, etc.

Opinion that Russia is not enough sunny country for effective solar energy utilization is not correct. There are regions where solar energy income is the same as in most solar European countries.

**Daily average annual sums of solar radiation,
(optimally oriented surface)**



1. TECHNOLOGY STUDIES DIRECTED ON ADVANCED SOLAR COLLECTORS MADE OF NEW GENERATION OF PLASTICS PRODUCTION

This theme corresponds to the WP Topic 5.4.1.1: Collector design and components

Main idea: Current materials used in the collectors could be replaced by new ones as e.g. by substituting glass and metals by new generations of plastics. The use of high performing plastics would decrease total cost of the equipment and would favour a more suitable mass production operation. Future developments need also to be ensured on cost effective optical coatings (reflect, transmit, absorb the light in more effective way), self cleaning and glazing materials.



Targets:

Price - < € 70/m²

Weight - < 10 kg/m²

Solar collectors made of thermal and UV resistant plastics (JIHT RAS)

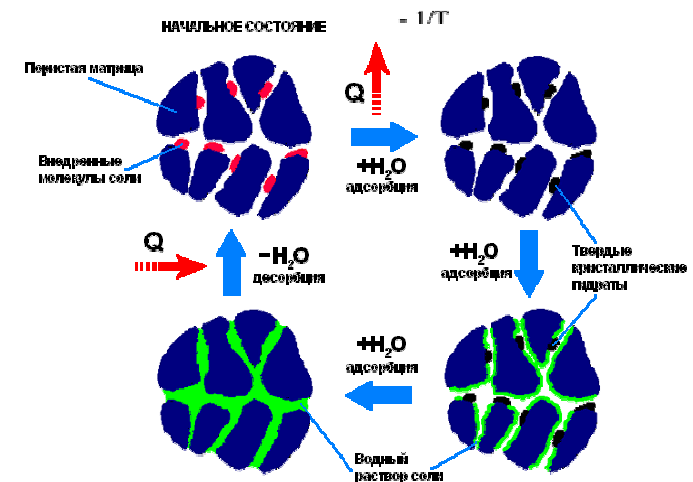
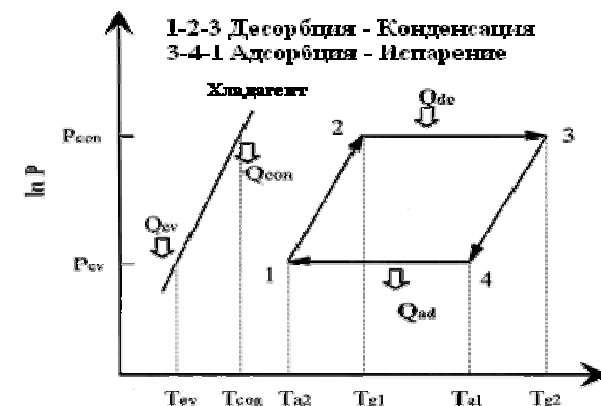
2. DEVELOPMENT OF NEW TYPE THERMAL SOLAR REFRIGERATORS BASED ON NEW SORPTION MATERIALS

This theme corresponds to the WP Topic 5.4.1.2: Small scale thermal cooling units

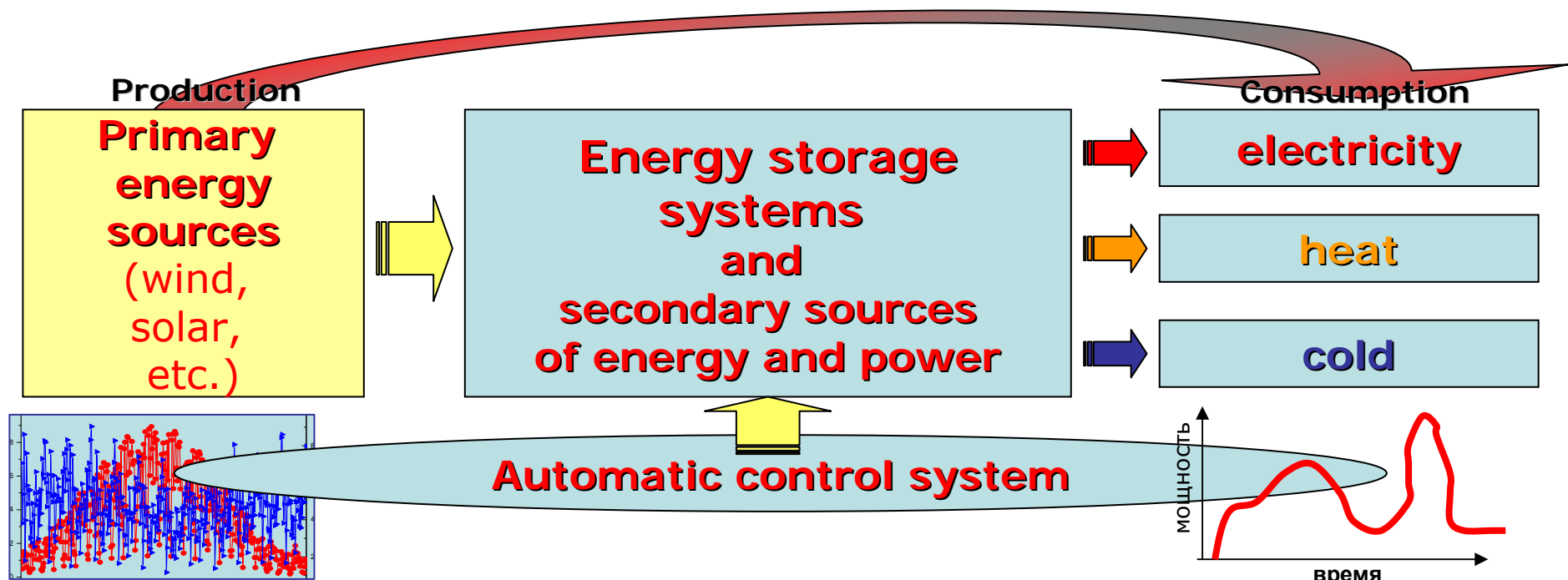
Main idea: To develop and demonstrate new type solar thermal refrigerators of cooling capacity 0,1 – 10 kW competitive with traditional electric cooling devices for different consumers in hot climate (medical and agricultural products storage, air conditioning, beverage foods cooling, etc.).

The most promising is utilization of advanced thermo-chemical cycles with new pairs of sorption materials.

In frame of **INTAS Project: INTAS/2003/51/6260** basic and some applied studies have been carried out, new composite materials called "selective water sorbents" (SWS) with advanced sorption properties have been developed by Boreskov Institute of Catalysis (BIC), which are expected to be very promising for multiple practical applications. SWS material is a two-phase system which consists of a porous host matrix and a hygroscopic substance impregnated into its pores. Close and fruitful scientific collaboration between CNR-ITAE (Italy), RWTH-Aachen (Germany), BIC SB RAS, JIHT RAS, MSU (Russia) and ITTF NASU (Ukraine) has been established.



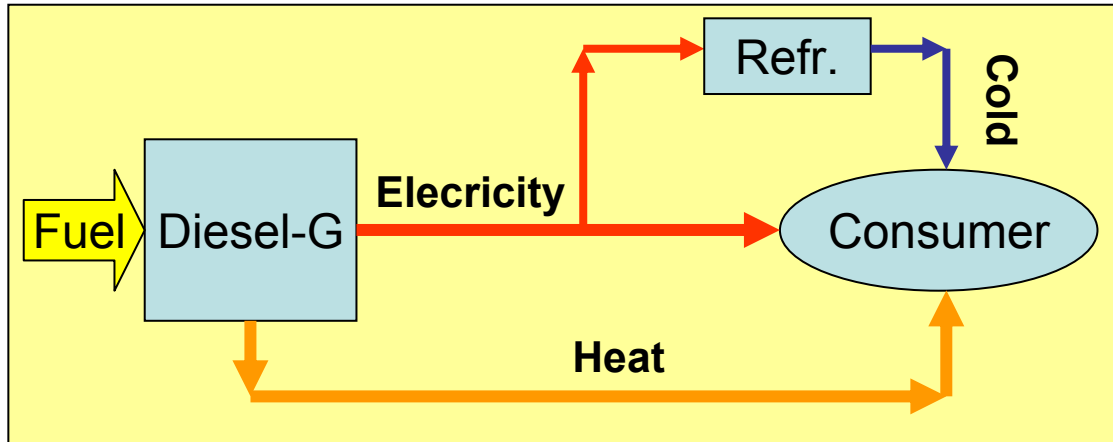
3. DEVELOPMENT OF FULLY AUTONOMOUS ENERGY SYSTEMS BASED ON RES WITH ADVANCED ENERGY STORAGE DEVICES FOR RELIABLE COMBINED ELECTRICITY, HEAT AND COLD SUPPLY FOR AUTONOMOUS CONSUMERS



Target:

- optimal concordance of energy generation, storage and consumption:
 - Optimal system configuration !
 - Optimal energy conversion processes management!
 - **Minimal system cost !**

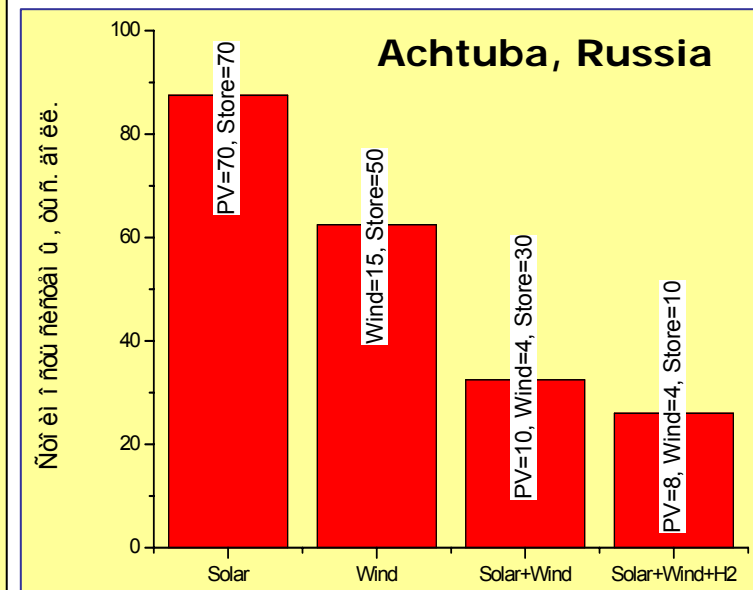
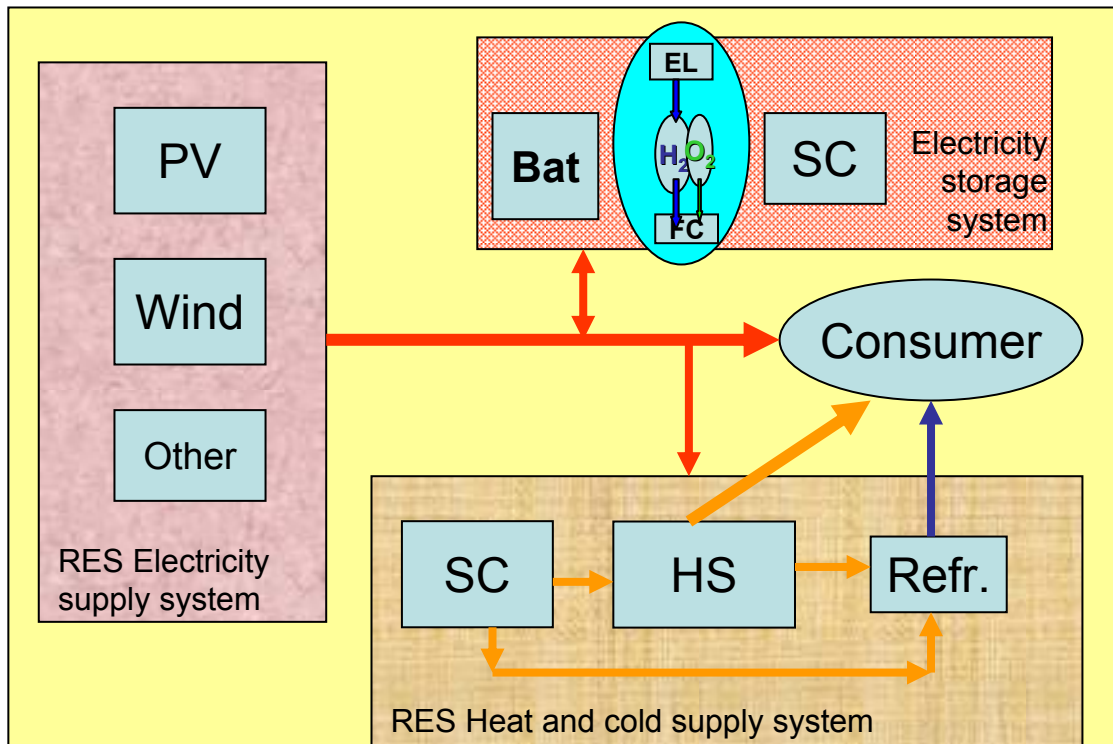
Traditional energy supply scheme



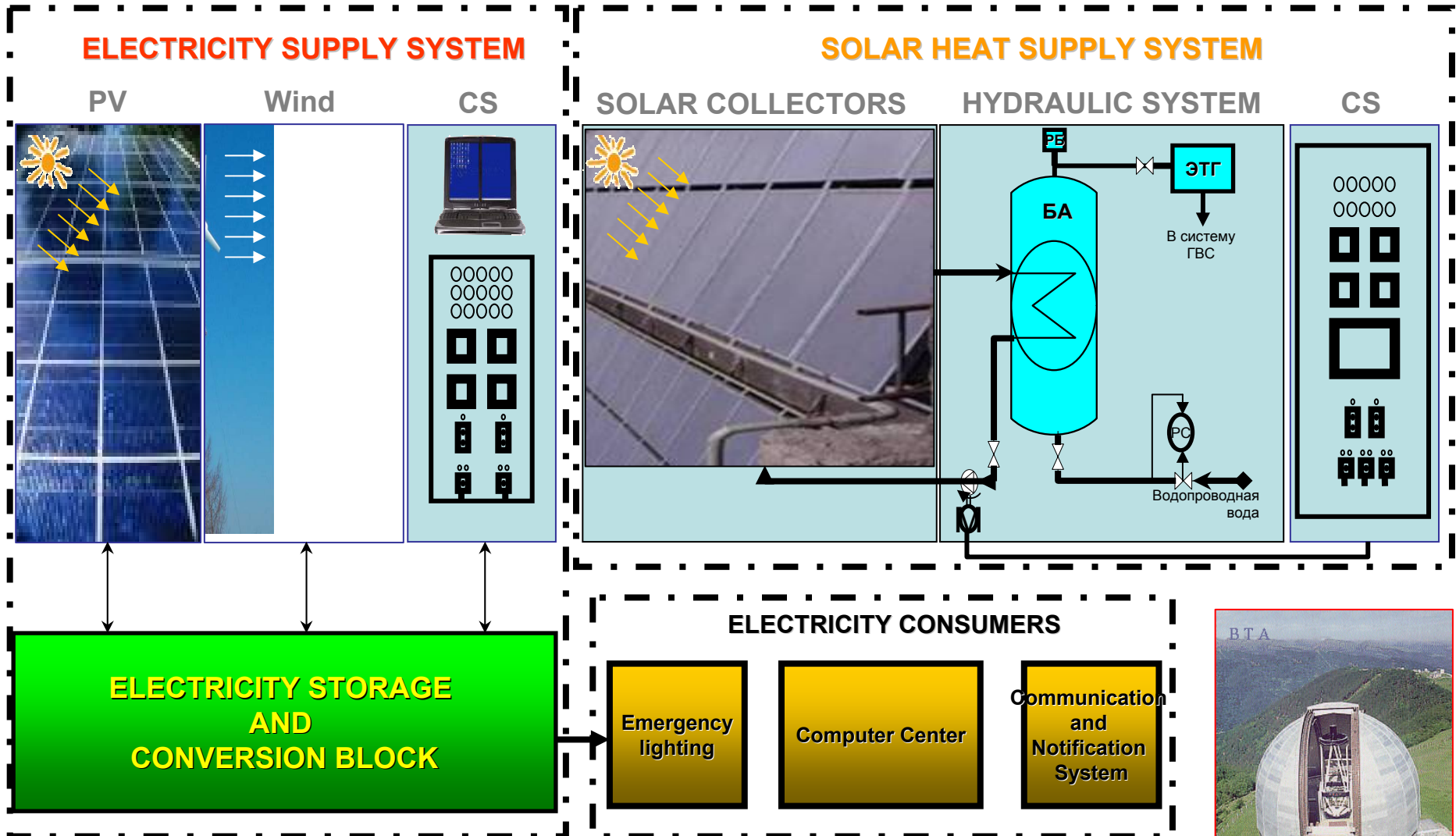
Problems:

- Fuel delivery;
- Low efficiency;
- High cost of fuel and servicing;
- Pollution of the environment

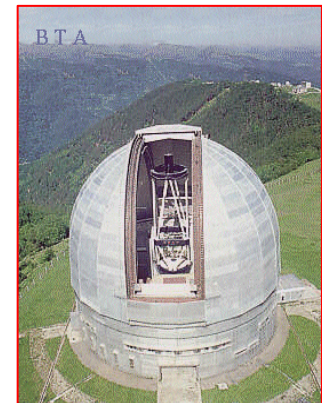
Energy supply scheme based on RES



STRUCTURAL SCHEME OF AUTONOMOUS ENERGY SUPPLY SYSTEM ON SOLAR AND WIND ENERGY



Implementation object: Building of the Big Optical Telescope of SAO RAS (Western Caucasus)

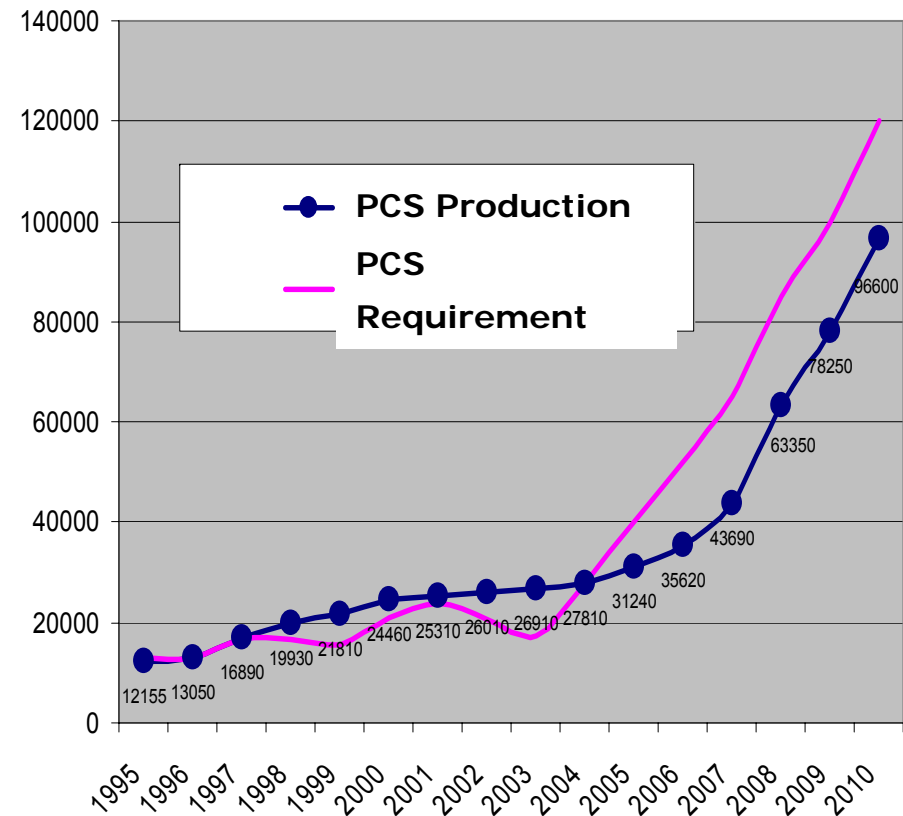


4. DEVELOPMENT OF ECOLOGICALLY FRIENDLY CHLORINE-FREE TECHNOLOGY OF SOLAR SILICON MASS PRODUCTION FOR PV CELLS

According to Russian experts estimations based on carried out R&D studies the new chlorine-free technologies could provide many advantages in comparison with now used «Siemens» and «Union Carbide» technologies of polycrystalline silicon (PCS) production:

- higher quality of PCS,
- 20-30% lower cost,
- usage of less expensive construction materials due to absence of chlorine compounds,
- more ecologically friendly production processes.

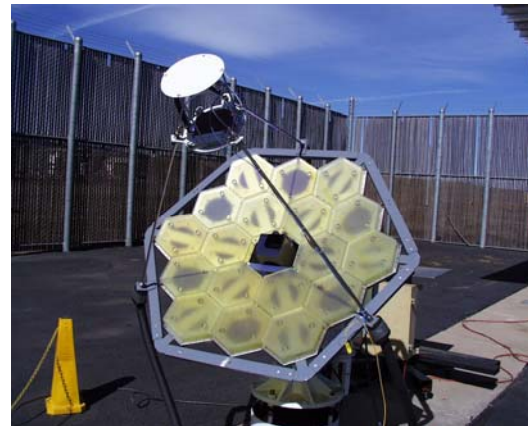
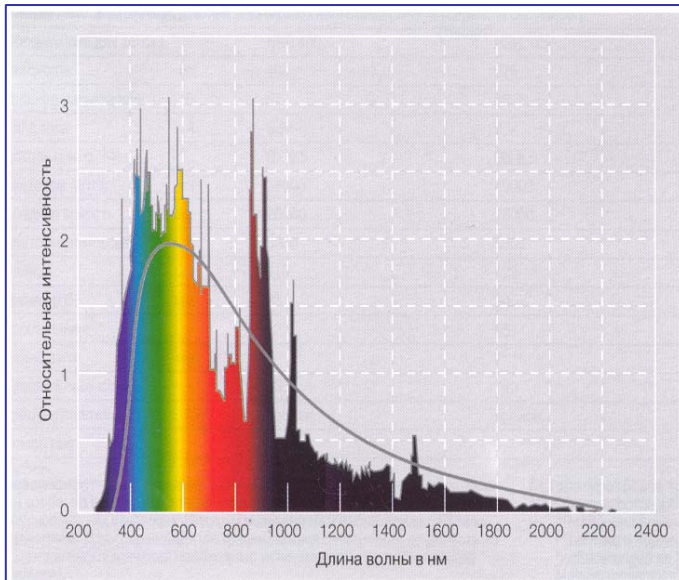
There are several research teams in Russia actively working in this area, expressed interest to international collaboration.



World PCS production and requirements

5. DEVELOPMENT OF NEW TYPES OF CONCENTRATORS SELECTIVELY CONCENTRATING LIGHT FROM DIFFERENT PARTS OF SOLAR RADIATION SPECTRUM FOR VARIOUS PRACTICAL APPLICATIONS

Idea: to concentrate only the active (for technology under consideration) part of solar spectrum to prevent overheating by the passive part.



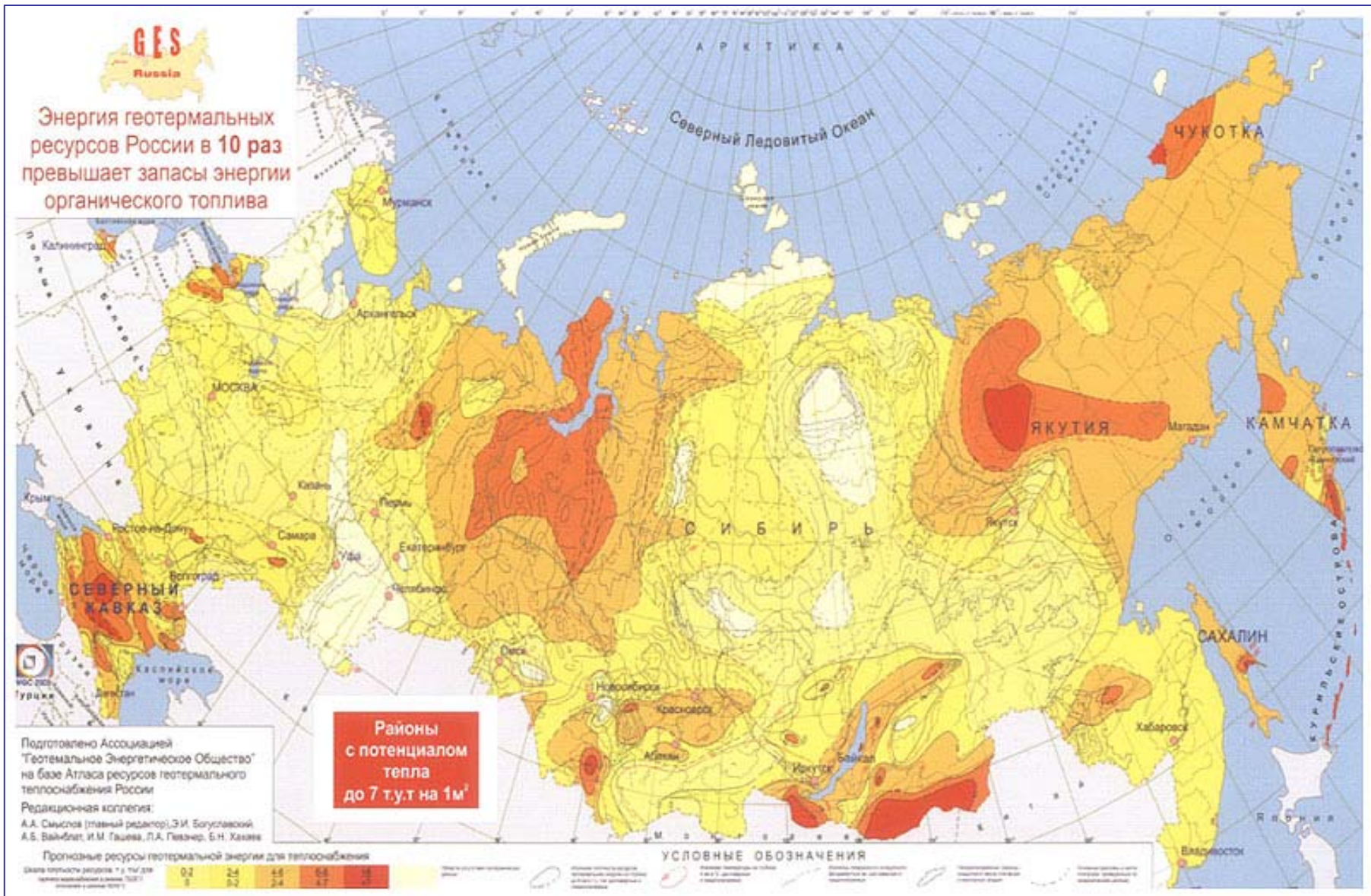
Examples of application:

1. Accelerated testing of aging effects for different materials under UV radiation,
2. PV with concentrators,
3. Photochemistry processes,
4. Solar pumped lasers, etc.

Technical parameters of UV solar concentrator by SPA "Astrophysica", Moscow

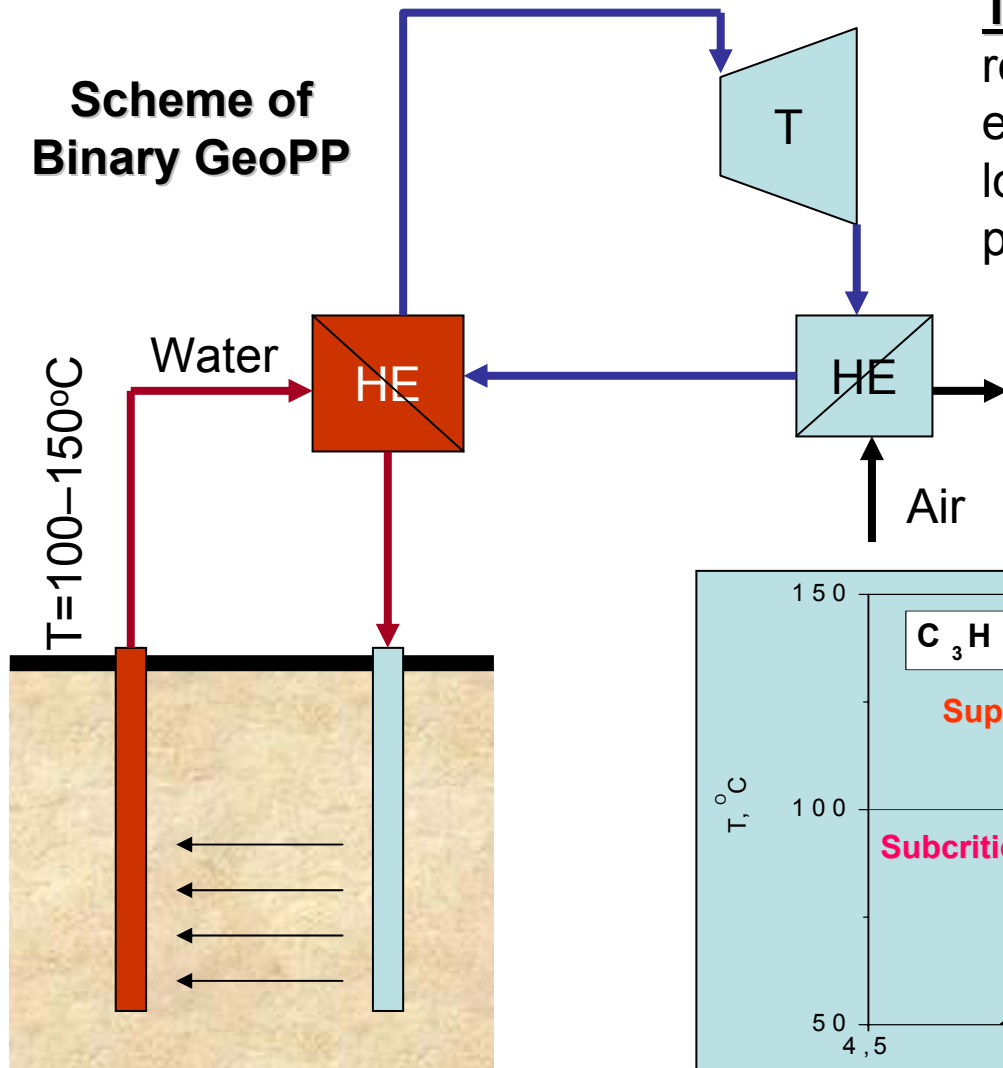
1. Concentration coefficient – 100
2. Mirror diameter – 1,3; 2,0 m
3. Mirror spectral reflection
($\lambda = 290 - 450 \text{ nm}$) $\geq 0,90$; ($\lambda \geq 600 \text{ nm}$) $\leq 0,05$
4. Uniformity of light intensity in target area
 $>95\%$

GEOHERMAL ENERGY



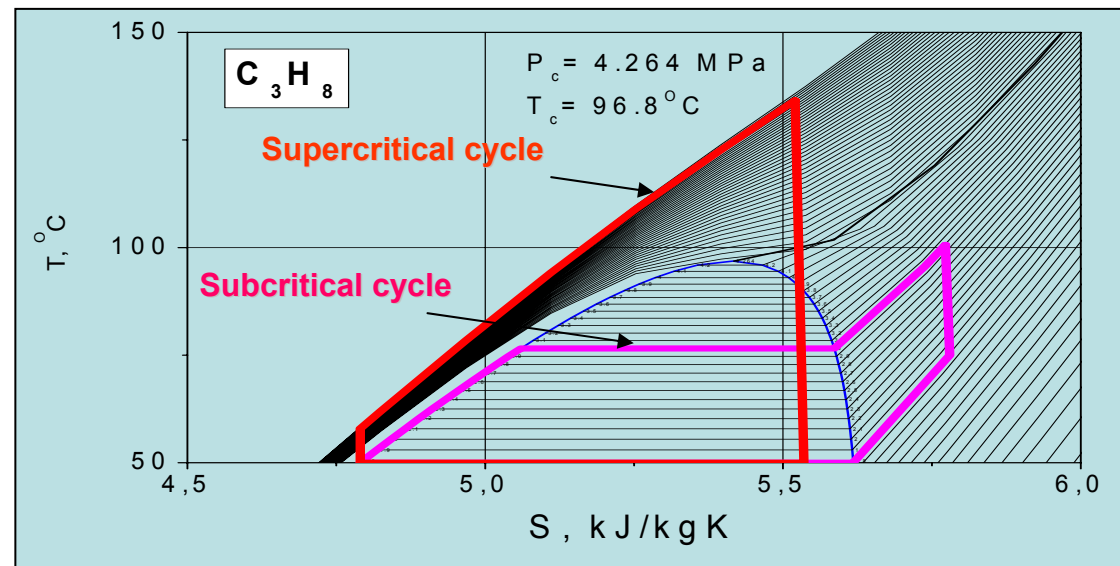
6. NEW TECHNOLOGIES OF ELECTRICITY PRODUCTION BASED ON ADVANCED CYCLES OF MEDIUM POTENTIAL HEAT CONVERSION DEVELOPMENT

Scheme of Binary GeoPP



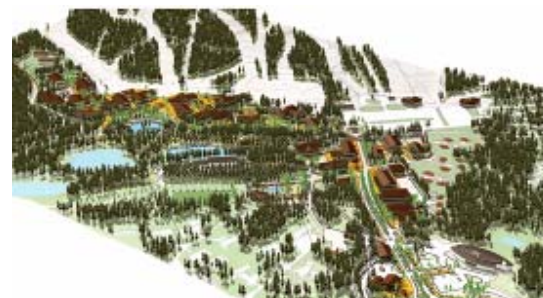
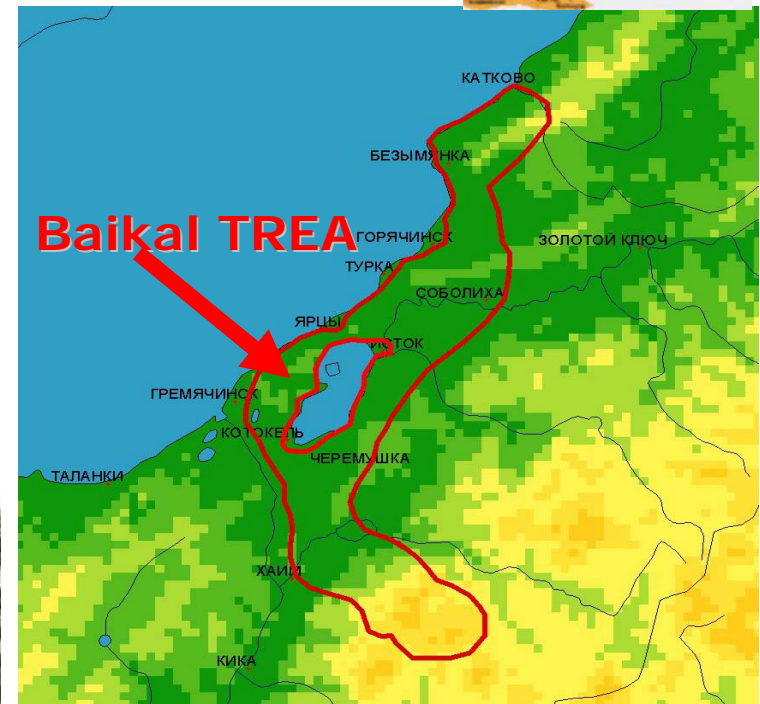
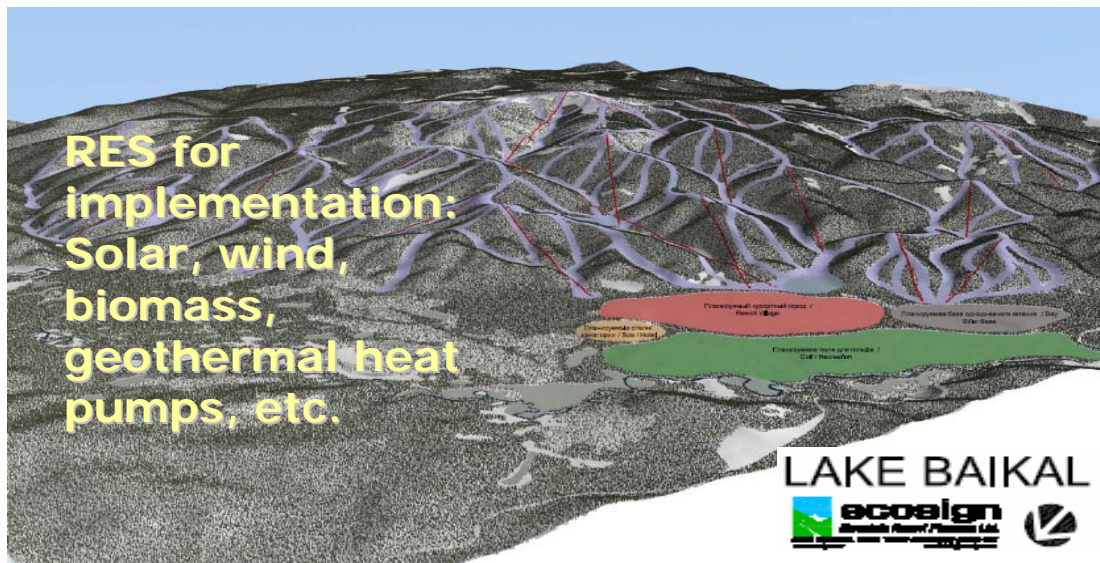
The idea: There are thermodynamic reserve to significantly increase efficiency of binary GeoPP by using low boiling working media with optimal properties and thermodynamic cycles

Perspectives: broadening of spheres and regions of economically efficient utilization of geothermal and industrial waste heat for electricity production



7. JOINT DEMONSTRATION PROJECTS OF COMPLEX RES UTILIZATION IN RUSSIAN TOURISTIC RECREATION ZONES WITH SPECIAL ECONOMIC STATUS

Example: BAIKAL TOURIST-RECREATION ECONOMIC AREA (Mountain-skiing lodge, more than 30 hotels for 3000 visitors, aquatics centers, etc.) is planned to be constructed in 2007-2011 with wide RES implementation



CONCLUDING REMARKS

1. Only a few ideas of joint EC-Russia RES projects have been formulated in this presentation. There are potential and opportunities for R,D&D collaboration in many other areas of RES utilization (wind, tidal, wave, etc.)
2. There is experience of Russian research centers participation in the projects of EC6 and other EC programs. Unfortunately most projects deal mainly with information exchange (“coordination actions”)
3. It could be useful to extend frames of collaboration on real technologies development and implementation
4. Very important favorable factor is acceptance by the Federal Agency of Science and Innovations a number of research and business initiated RES projects which will be financially supported by state budget (tender procedure is on-going)