Description of the specialization

I. MATERIALS AND TECHNOLOGIES

1. Materials of higher parameters, especially construction and insulation qualities, with elevated resistance to aging processes, vapour-permeable, low embedded energy, high flame resistance, low emission, thermo-reflexive and manufactured from plant raw materials and technologies for their production.
2. Materials and technologies applied for renovation of buildings, including historical objects.
3. Energy renovation materials and technologies to be applied on existing thermal insulation requiring improvement of insulation qualities.
4. Materials used to accumulate heat and cold and technologies for their production.
5. Materials and technologies for the production of coatings with increased parameters, hindering the development of fungi, bacteria and algae.
6. Materials with varied physical parameters regulated with external environment qualities and/or a system of thermal management in a building, including the material of changeable thermal, spectrum, moisture and other parameters, and technologies for their production.
7. Transparent materials and technologies for their production; windows, glazing systems with varied optical parameters for solar radiation.
8. Long-lasting roof coverings and other materials characterised with high resistance
   to degrading factors, protecting buildings against atmospheric conditions, including materials of varied absorption properties, as well as technologies for their production.
9. Materials and technologies protecting buildings against overheating and/or limiting heat losses.
10. Studies and technologies related to heat and moist transport processes in construction partitions,
    in relation to applied insulation materials and the technology of energy renovation.
11. Materials and technologies for daylight utilisation systems with high efficiency and controllability.
12. Materials and technologies for passive solar systems integrated with a building shell.
13. Materials and technologies forsolarheat energy(active)systemsintegrated with the buildingshell.
14. Materials and technologiesfor photovoltaic systemsintegrated with a buildingshell.

15. Materials and technologies forenergy interactivebuildings,multifunctional building shells forheating,cooling, ventilation, air conditioning, electricity production.
16. Energy-savinglighting,serviceablemodularluminairesofenergy-savinglightingwith minimized embodied energy, luminaires increasing the cooling efficiency and durability of theirelements, as well as materials and technologies for their production.

II. ENERGETIC SYSTEMS OF BUILDINGS

1. An integrated approach to building management systems.
2. Technologies and systems for a smart building, with special stress put on new algorithms that optimize utilisation of energy from renewable resources integrated with the building
   and local accumulation systems, advanced systems for forecasting producing and the need for energy.
3. Technologies and systems integrating sets of smart buildings with infrastructures of smart cities.
4. Systems allowing easy and full utilisation of smart buildings functions, including facilitated access and control (gesture and speech control), with the use of video camera, visual identification of threats (e.g. a fire or flood), user identification by a smart building.
5. Smart pre-payment systems for utilities supplied to a building.
6. Active façade systems protecting against overheating.
7. Systems of energy distribution in a building, regarding availability and momentary needs, preceded with development of a priority system for application of various energy sources
   in an integrated energy system of a building.
8. Smart lighting systems.
9. Development of algorithms and building management systems influencing users' awareness in terms of energy utilisation within the DSM (Demand-Side Management) system.

III. DEVELOPMENT OF MACHINES AND DEVICES

1. Waste-free / low-waste technologies and technological lines intended to reduce costs and/or improve effectiveness of the production of construction materials and products, as well as realisation of construction investments.
2. Technological lines, and corresponding machines and devices, which enable production (prefabrication) of modules of construction partitions with a high thermal resistance and low embedded energy.
3. Machines and devices reducing energy and labour consumption within a construction process and improving work safety.

4. Devices and systems for energy management, allowing automatic and fluent utilisation of numerous power supply sources in buildings.
5. Devices and systems for supplying building with direct current (DC).
6. BMS/HMS (Building/Home Management System) controllers installed permanently in household appliances/lightning, adjusted for cooperation with the BMS.
7. Devices and systems for conversion, storage and utilisation of renewable and waste energy.
8. Devices integrating systems for energy conversion and storage.
9. Micro or small scale devices with a high level of efficiency for transforming energy of the
   environment into electricity, heat, and cold for applications in construction.
10. Devices and systems of rationalisation of utilisation, obtaining, purification and treatment of water.

IV. DEVELOPMENT OF APPLICATIONS AND SOFTWARE ENVIRONMENT

1. Establishing an open Software Development Kit, which would enable creating higher-level applications in a graphic form, intended for control over operation of devices
   in smart buildings and interactions between particular devices in a network.
2. Integrated diagnostic applications for remote monitoring and inspection of BMS/HMS systems.
3. BMS/HMS applications/systems/interfaces improving safety, supporting buildings operations and increasing life quality of elderly persons with partial disability and disabled individuals (deaf, deafmutes, with motor disabilities).
4. Development of standards for communication and data exchange between active elements of smart buildings and local systems.
5. Designing, constructing and testing communication modules ensuring data exchange
   and management of active elements of smart buildings.
6. Designing, constructing and testing integrated energy management systems for autonomous local systems.
7. Designing, testing and introducing algorithms for optimisation of resources management for autonomous local systems.

V. INTEGRATED DESIGN

1. Development and standardisation of libraries supporting BIM
2. Design methods and tools leading to a Smart Design, including use of computer simulations techniques, BIM (Building Information Modelling), at all design stages (development of tools supporting the design, modelling and simulation processes for energy efficient buildings, both from the side of applied technologies and

simulation of an economic result, and outlays/time for return of investment).

VI. ENERGERIC AND ENVIRONMENTAL VERIFICATION

1. Programs supporting and automatising energetic audits for objects that undergo modernisation and monitoring of results.
2. Development of tools for energetic and environmental verifications in terms of embedded energy consumption and the application of the Life Cycle Assessment method.
3. Validation of integrated zero-energetic construction systems in real exploitation conditions (“a network of experimental buildings” in various systems).
4. Methods and tools for quality assessment of elements of buildings (existing or under construction), allowing to determine the real characteristics of the objects.
5. Research, technologies related to impact of buildings infrastructure systems on health and work efficiency.
6. Innovative system for polygonal control of parameters of construction products influencing
   the final energetic effectiveness of a building.

VII. MATERIALS PROCESSING AND RE-USE

1. Development of a technology for re-use of materials and constructional and insulation elements (recovery, including recycling) in the construction industry.
2. New technologies and technological lines for manufacturing materials and products for the construction industry,
   with use of accompanying raw material, by-products and waste.