ENERGY-EFFICIENT BUILDING MANAGEMENT VIA MODEL PREDICTIVE CONTROL

M. Rubagotti[1], V. Ten[2], A. Bermukhambetova[2*], A. Khakimova[2], D. Sharipova[2]

1) School of Science and Technology, Nazarbayev University, Astana, Kazakhstan; 2) NURIS, Nazarbayev University, Astana, Kazakhstan; *abermukhambetova@nu.edu.kz

Introduction. The growing world population and energy consumption, along with the depletion of fossil energy resources and increasing concern regarding the pollution of the environment, make the world-energy problem the largest challenge for technology in the forthcoming decades [1]. Distributed generation could play a major role in the technological changes of the new electricity service paradigm. The use of localized energy sources is only one of the faces of energy management in buildings. A large part of the produced energy is used for heating and cooling systems, in order to maintain acceptable levels of comfort for the occupants of the apartments (hereafter referred to as "users"). Therefore, at a local level, there is a need for the definition and the testing of intelligent algorithms that can automatically manage distributed energy sources, at the same time taking into account the management of heating/ cooling systems.

Materials and methods. Least squares method (LSM) technique was used for identifying a model of the dynamic system [2]. System identification was implemented in MATLAB. For system's energy management the Model Predictive Control (MPC) algorithm was employed. Optimisation and control action was performed using the Hybrid toolbox in MATLAB.

Results and discussion. The research team has successfully modeled thermodynamic and electrical generation/consumption models of the "smart" house. A great effort was put to model weather forecast, i.e. prediction of solar radiation according to cloud factor. Based on these results a preliminary control algorithm was constructed which simulates an optimum schedule for energy consumption/generation. The future activities include simulating MPC for various scenarios as well as applying and testing MPC algorithm in real conditions, i.e. the energy system in the smart house.

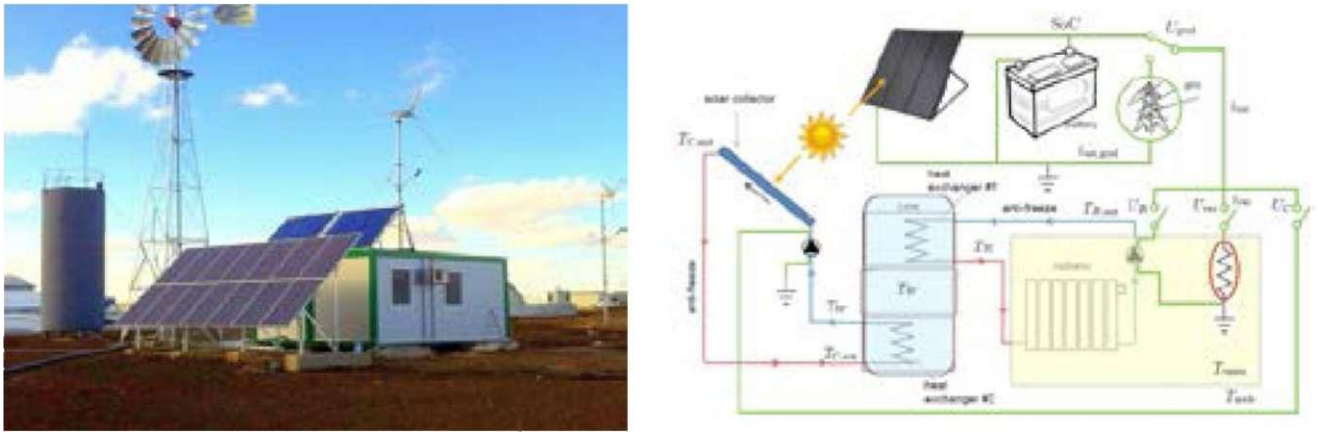

Figure 1. a) Smart house at Nazarbayev University; b) Energy system of the smart house.

Conclusions. The outcomes of the project show that the problem of efficient energy management in extreme weather conditions can be successfully managed by MPC controller.

References.

1. L. Perez-Lombard, J. Ortiz, and C. Pout, "A review on buildings energy consumption information," *Energy and Buildings,* 40 (3), pp. 394-398, 2008.
2. L. Ljung. 2008. *System Identification: Theory for the user,* 2nd edn, Prentice Hall PTR, Upper Saddle River.