Croatian Science Foundation

HRZZ Research Projects
(IP-11-2013)
Work plan[1] for second year

Project proposal's title:	Flexible energy nodes in low carbon smart grid
Principal Investigator:	Prof. Igor Kuzle
Starting date:	01/10/2014
Finishing date:	30/09/2018

Objectives	Activities	Outputs – Milestones (M) and/or Deliverables (D)	Team members	Duration of activity (from-to, in months)
O1. Establishment and maintenance of project web sites	A1.1. Server and website setup	D1.1. Project description, work packages, team and project goals	Ninoslav Holjevac	October 2014 - December 2014 (3 months)
	A1.2. Web site maintenance	D1.2. Presentation of project activities, workshop calls, publications, planned project results, reports and disseminations, etc.	Igor Kuzle Ninoslav Holjevac	October 2014 – October 2018 (48 months)
O2. Employment of Posdoc researcher	A2.1. Public advertisement for a post doctorate position	D2.1. Selection and recruitment of the best candidate	Igor Kuzle Marko Delimar Željko Tomšić	August 2014 - October 2014 (3 months)
O3. Power Node (RES, DG, PHEV, energy storage) and network infrastructure data aquisition	A3.1. Determining the essential static and dynamic parameters of various Power Nodes	D3.1. Table with the relevant input parameters needed for the Croatian power system model (which will be developed in the later stages of the project) M3.2. Description of the obtained parameters. Reports on this will be	Miljenko Brezovec Tomislav Capuder Juraj Havelka Ninoslav Holjevac Igor Kuzle Hrvoje Pandžić Davor Škrlec	December 2014 – February 2015 (3 months)

[1] Instructions for completing Work plan can be found in the Guide for Applicants for the Research Projects *IP-11-2013* Call.

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		available with respect to privacy policy of the national utility company - the activity is not conditioned by results of any previously or parallel activity	Anamari Nakić	
	A3.2. Detailed analysis of potentials for EV integration into Croatian power system	D3.3. Detailed, publicly available report on electric vehicles, trends in the world and Croatia, forecasts for adaptation of EV in Croatia	Tomislav Capuder Ninoslav Holjevac Igor Kuzle Davor Škrlec	February 2014 - April 2015 (3 months)
	A3.3. Detailed analysis of potentials for RES and other DG integration into Croatian power system	D3.4. Detailed, publicly available report on DG and RES in Croatia and forecasts for future integration - The report will capture potential obstacles and bottlenecks for larger integration of RES and DG into the system - The report will also capture the potential for district heating as well as other multi-energy options in Croatia	Tomislav Capuder Hrvoje Pandžić Davor Škrlec Anamari Nakić	May 2015 - June 2015 (2 months)
	A3.4. Determining relevant network parameters	M3.5. Input parameters for the model which will be developed in the later stage of the project M3.6. Initial test network models - the activity is not conditioned by results of any previously or parallel activity	Marko Delimar Igor Kuzle Tomislav Plavšić Sejid Tešnjak Željko Tomšić Anamari Nakić	July 2015 – August 2015 (2 months)
	A3.5. Selection of Power Nodes and power system	M3.7. Relevant power system connection schemes - the activity is partially conditioned	Miljenko Brezovec Tomislav Capuder Igor Kuzle	September 2015 – November 2015 (3 months)

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	connection schemes	by results of activity "*Selection, connection design, procurement and installation equipments in Power Systems Laboratory*"	Hrvoje Pandžić Anamari Nakić	
	A3.6. Defining the models of specific Power Nodes plants in the power system	M3.8. Each Power Node modeled with relevant technical attributes - the activity is partially conditioned by results of activity "*Selection, connection design, procurement and installation equipments in Power Systems Laboratory*" and the completing previous activities in "*Power Node (RES, DG, PHEV, energy storage) and network infrastructure data acquisition*"	Tomislav Capuder Marko Delimar Tomislav Plavšić Anamari Nakić	June 2015 – October 2015 (5 months)
O4. Selection, connection design, procurement and installation equipments in Power Systems Laboratory	A4.1. Selection of energy storage system and public procurement process (if needed)	D4.1. Detailed, publicly available report on different energy storage technologies, technical capabilities and constraints supported with investment costs for each of the technologies.	Tomislav Capuder Ninoslav Holjevac Hrvoje Pandžić Anamari Nakić	November 2014 – January 2015 (3 months)
	A4.2. Selection of smart metering equipment, defining its parameters, public procurement process	D4.2. Detailed, publicly available report on different smart metering equipment, pilot project, capabilities and capacities for demand response provision and economic evaluation of those services.	Juraj Havelka Igor Kuzle Željko Tomšić Anamari Nakić	February 2015 – April 2015 (3 months)
	A4.3. Selection of ICT equipment and public procurement process (if needed)	M4.3. Detecting usable existing equipment and communication protocols, equipment upgrading if necessary.	Tomislav Capuder Ninoslav Holjevac Juraj Havelka Anamari Nakić	May 2015 – June 2015 (2 months)

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O5. Educational activities	A5.1. Research visit to University of Manchester	D5.1. Report on conducted research with University of Manchester on the topic of multi-energy systems D5.2. potential publication relevant to cooperation and education at University of Manchester	Tomislav Capuder	November 2014 – January 2015 (3 months)
O6. Publication activities	A6.3. 1-2 conference paper(s) - 1 journal paper submitted	D6.1. Publication in 9th Conference on Sustainable Development of Energy, Water and Environment Systems D6.2. submitting a journal paper on power system modeling	Tomislav Capuder Ninoslav Holjevac Igor Kuzle Hrvoje Pandžić	October 2014 - January 2015 (4 months)
Descriptive and financial **annual** report				
O7. Preparation of Smart Power Node Laboratory for simulations	A7.1. Designing electrical and IT schemes of future Smart Power Node lab setting. Definitions of AC and DC grid layout in the laboratory.	M7.1. Determining and selecting the parameters of the main equipment with regard to the power system requirements and economic benefits M7.2. Electrical and IT schemes of the Smart Power Node lab	Igor Kuzle Juraj Havelka Ninoslav Holjevac Kristina Jurković	December 2015 – February 2016 (3 months)
O8. First test stage of the Smart Power Node Laboratory	A8.1. Connecting the equipment installed in the previous activities ("Equipment installation"), testing the equipment and comparing the parameters of the equipment to the specifications defined	M8.1. Initial testing, synchronization of the DC microgrid - Connection and testing of the EV charging stations, initial measurement results - adjusting Power Node models with the parameters of the tested equipment	Juraj Havelka Kristina Jurković Igor Kuzle	February 2016 – May 2016 (3 months)

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	in the previous activities			
O9. Workshop at Faculty of electrical engineering and computing	A9.1. Presentation of Smart Lab possibilities	D9.1. Presentation of the New Lab concept and design	Tomislav Capuder Marko Delimar Juraj Havelka Ninoslav Holjevac Igor Kuzle Željko Tomšić Matija Zidar Anamari Nakić	June 2016
O10. Interaction between electric vehicles and power system	A10.1. Defining and quantifying power system services that can be provided by electric vehicles, defining the additional flexibility needs in case of transport electrification	M10.1. Defining the impact of fast charging of electric vehicles on the power system M10.2. Quantifying additional flexibility/reserve requirements as a result of large integration of fast charging EV/stations M10.3. Modelling interactions of EV and power systems and defining role of storage systems in fast charging of EV	Kristina Jurković Igor Kuzle Ivan Pavić Anamari Nakić	May 2016 – July 2016 (3 months)
O11. The role of multi-energy nodes in decarbonizing future power system	A11.1. Specifying the relevant criteria of interactions between the multi-energy nodes and the power system	M11.1. Defining interaction between the Energy/Power nodes and the power systems with regard to the power system dynamics and control M11.2. Techno-economic assessment of integrating multi-energy districts in the future smart city D11.3. Conference papers, aiming at publishing at EEEIC 2016	Juraj Havelka Ninoslav Holjevac Igor Kuzle Kristina Jurković Željko Tomšić Anamari Nakić	May 2016 – July 2016 (3 months)

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Objectives	Activities	Outputs – Milestones (M) and/or Deliverables (D)	Team members	Duration of activity (from-to, in months)
O12. Impact of electric vehicles on distribution system	A12.1. Analyzing the impact of connecting EV to the distribution network, defining the technical and economic requirements of distribution network for provisions of fast charging service to EV	M12.1. Creating a mathematical convex model for distribution network analyses capable of assessing the impact of EV on different voltage levels M12.2. techno-economic assessment of integration storage to mitigate the negative impact of EV on the distribution network operation based on mathematical design D12.3. Conference paper, aiming at publishing at 2016 IEEE PES. D12.4. Presentation of obtained theoretical results at mathematical combinatorial conference.	Ninoslav Holjevac Igor Kuzle Anamari Nakić	May 2016 – August 2016 (4 months)
O13. Modeling of the Croatian transmission power system	A13.1. Definition of supplementary simulation models	M13.1. Prerequisite for the analysis of Croatian EPS with selection of Energy/Power nodes in the system M13.2. Integration of models developed separately into a system level model capable of simulation and quantifying operation of future low carbon energy system	Miljenko Brezovec Tomislav Capuder Juraj Havelka Ninoslav Holjevac Igor Kuzle Sejid Tešnjak Matija Zidar Kristina Jurković	January 2015 – January 2016 (12 months)
	A13.2. Modeling generation dispatch through unit commitment models based on mixed integer linear programming techniques	M13.3. AC model of Croatian transmission network with all lines, power plants and energy storage units M13.4. New tools and models to integrate widespread RES and DG into operational assessments and dispatching	Miljenko Brezovec Marko Delimar Ninoslav Holjevac Igor Kuzle Tomislav Plavšić Željko Tomšić Matija Zidar Kristina Jurković	February 2016 – March 2016 (2 months)

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			Anamari Nakić	
	A13.3. Unit commitment analysis	M13.5. Upgraded model of the Croatian power system which includes all current and potentially relevant RES, output active and reactive power of RES	Miljenko Brezovec Marko Delimar Ninoslav Holjevac Igor Kuzle Tomislav Plavšić Željko Tomšić Matija Zidar Anamari Nakić	April 2016 – July 2016 (3 months)
	A13.4. Flexibility assessment through developed unit commitment models	M13.6. Analyzing different types of feeding modes for power electronic converters M13.7. Quantifying the flexibility requirements as multiple ancillary services in scenarios of large RES integration	Miljenko Brezovec Kristina Jurković Igor Kuzle Tomislav Plavšić Matija Zidar Željko Tomšić	April 2016 - June 2016 (3 months)
	A13.5. Uncertainty definitions and quantifications, modifying the outcomes of models from previous tasks	M13.8. Creating a robust model capable of capturing relevant uncertainty parameters of large integration of RES M13.9. re-assessing the outcomes from previous models D13.10. Journal paper	Miljenko Brezovec Kristina Jurković Igor Kuzle Tomislav Plavšić Željko Tomšić Matija Zidar Anamari Nakić	July 2016 – September 2016 (3 months)
O14. Modeling of the part of the Croatian distribution system	A14.1. Definition of supplementary simulation models	M14.1. Analysis of the demonstrative part of the Croatian distribution system with selection of power nodes in the system D14.2. Conference paper, presented to the national energy industry stakeholders (HR CIRED 2016)	Tomislav Capuder Igor Kuzle Davor Škrlec Željko Tomšić Matija Zidar Anamari Nakić Kristina Jurković	January 2016 – April 2016 (3 months)

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Objectives	Activities	Outputs – Milestones (M) and/or Deliverables (D)	Team members	Duration of activity (from-to, in months)
	A14.2. Generation dispatching and unit commitment analysis	M14.3. AC model of representative Croatian distribution network with all lines, power plants and energy storage units M14.4. New tools to integrate widespread RES and DG into operational assessments	Miljenko Brezovec Tomislav Capuder Ninoslav Holjevac Igor Kuzle Davor Škrlec Željko Tomšić Matija Zidar Anamari Nakić Kristina Jurković	May 2016 – June 2016 (2 months)
	A14.3. Steady state analysis	M14.5. Upgraded model of the part of the Croatian distribution network which includes all current and potential RES and DG, active and reactive power, in combination with different types of feeding modes for power electronic converters	Ninoslav Holjevac Davor Škrlec Matija Zidar Anamari Nakić Kristina Jurković	June 2016 – September 2016 (3 months)
Descriptive and financial **annual** report				
O15. Presentation of the project	A15.1. Organization of special session at international conference (proposal is ISGT 2016)	D15.1. The dissemination session of the project at international conference ISGT 2016.	Marko Delimar Igor Kuzle Željko Tomšić Ninoslav Holjevac	September 2016
O16. Process information flows	A16.1. Analyzing and improving the structure of the process information flows in the power system control in Croatia	M16.1. Advanced structure of the process information flows in the power system control in Croatia, while taking into account two basic requirements: development of modern information and communication technologies and more complex power network with a power nodes	Miljenko Brezovec Ninoslav Holjevac Igor Kuzle Davor Škrlec Željko Tomšić Matija Zidar Anamari Nakić	September 2016 – March 2017 (7 months)

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Objectives	Activities	Outputs – Milestones (M) and/or Deliverables (D)	Team members	Duration of activity (from-to, in months)
O17. Energy storage system commissioning	A17.1. Finishing of energy storage system installation and commissioning	M17.1. Testing of installed equipment	Juraj Havelka Ninoslav Holjevac	March 2017 - April 2017 (2 months)
O18. Formation of power node in the Power System Lab	A18.1. Research of influences of different plants and corresponding connection point on stability of the Lab power system	M18.1. Testing Lab power system in various power plants, RES, DG and energy storage production and connection points in the Lab power systems	Juraj Havelka Ninoslav Holjevac Igor Kuzle Davor Škrlec Matija Zidar Stjepan Tusun	May 2017 – August 2017 (3 months)
Descriptive and financial **annual** report				
O19. Presentation of the Lab	A19.1. Organization of workshop at Faculty of Electrical Engineering and Computing	D19.1. The dissemination session of the project with presentation new Smart Grids Lab possibilities	Juraj Havelka Ninoslav Holjevac Igor Kuzle Davor Škrlec Matija Zidar Stjepan Tusun	September 2017
O20. Verification of developed simulation models	A20.1. Comparison between simulated results and measured responses in the Smart Grid Laboratory	D20.1. Journal papers	All team members	October 2017. – February 2018 (4 months)
O21. Establishing of the model	A21.1. Establishing an Smart Grid model of the electric power system that will allow a more advanced power system control, with a possible solution to information	**D21.1. Applied information model of the electric power system that will allow a more advanced power system control**	All team members	March 2018 – September 2018 (7 months)

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	congestions in the control centers, developing a methodology to adapt existing control systems in the power plants due to the introduction of new technologies (RES) consistent with the new norms and standards			
Descriptive and financial **final** report with financial audit				