ANNEX A

PUBLIC SELECTION BASED ON QUALIFICATIONS AND INTERVIEW FOR THE AWARDING OF NO. 1 EARLY STAGE GRANT LASTING 12 MONTHS FOR CONDUCTING RESEARCH PURSUANT TO ART. 22 OF LAW NO. 240/2010 AT THE DEPARTMENT OF MANAGEMENT, INFORMATION AND PRODUCTION ENGINEERING (SC 01/A6 – OPERATIONS RESEARCH - SSD MAT/09 - OPERATIONS RESEARCH) TYPE B
PICA CODE: 20AR011

announced with decree of the Chancellor Rep. no. 86/2020 of 11.02.2020 and posted on the official registry of the University on 20.02.2020

RESEARCH PROJECT
"Mathematical models for analyzing decarbonization scenarios in the Italian energy system"

Research structure: Department of Management, information and production engineering
Duration of the grant: 12 months
Scientific Area: 01 – Mathematics and informatics
Academic recruitment field: 01/A6 – Operations research
Academic discipline: MAT/09 – Operations research
Scientific Director: Prof. Maria Teresa Vespucci

The project aim is to develop mathematical models for simulating and analysing energy scenarios in the framework of the Italian National Integrated Energy and Climate Plan (PNIEC) 2030 for the transition from conventional to Renewable Energy Sources (RES) in order to reduce CO2 emissions. The currently available mathematical simulation models allow analyzing energy systems in which the load is mainly satisfied by generation from conventional sources (hydroelectric and thermoelectric), with only marginal contributions from non-programmable RES generation and energy storage. New simulation models are therefore needed to study the evolution towards increasing integration of RES generation. Indeed, if the installed RES power generation capacity is above the peak load, an excess production will occur in the peak hours of RES power production. Part of the energy produced in the seasons (spring and summer) with the highest RES power production will have to be stored for use in the winter period. As no seasonal electricity storage systems are available, a possible solution will be to use the surplus to produce synthetic fuel (H2, CH4) using Power-to-Gas (P2G) systems. In fact, transforming electricity into fuel will make it possible to exploit the greater storage and transit capacities that characterize the gas system. The new simulation models will analyze strongly decarbonized systems with very close interactions between the electrical system and the gas system, taking into account the gas network constraints, such as the transport capacity of the produced gas, the network storing possibility in case of a reduction in gas consumption, the consumption/production capacity of P2G systems. The mathematical models will also take into account direct and indirect effects of interventions of the regulatory authorities, in order to evaluate their effectiveness in supporting the transition. In fact, the effects of rules introduced to support some technologies may be diminished by the market reactions of non-supported technologies: if this reaction is not taken into account, scenario studies may overestimate the effects of regulatory policies.
The complexity of the electrical system (in the Italian energy sector there are about one hundred operators) requires developing mathematical simulation tools by considering increasing degrees of complexity, starting from simple models initially applied to small realistic test cases, such as the IEEE test networks.