NOVEL APPROACH FOR AUTOMATED CROSS-SECTORAL RENEWAL PLANNING FOR POWER AND GAS GRIDS

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Introduction

Optimal maintenance and ongoing renewal of energy grids are crucial, due to the high age structure of the operating resources as well as the current and future challenges in the energy sectors [1]. For this, there are various strategies that can be used. The maintenance and renewal strategy used by the grid operators varies depending on the equipment and sector. This paper presents a concept for automated renewal planning that applies the strategy cross-sectoral. The aim is the reduction of the costs through a cross-sectoral renewal with a common trench for electricity cables and gas pipes. This reduces the number of measures, the customer acceptance of these and the total incurred costs by the grid operator.

Methodology

In the following, a concept for automated cross-sectoral renewal planning is shown. The automation is performed as a python script for the geoinformation software QGIS [2]. In this novel approach the focus rests on electricity cables and gas pipes due to the installation in a common trench and resulting cost reductions. For this purpose, an extended Period-Based Maintenance Strategy [3] with the consideration of different lifetimes for material types has been applied. The core functions of the method (QGIS functions) are buffer zone, intersection and symmetrical difference. The function buffer zone creates an area with a defined distance around line objects. Intersection provides the selection of lines within the buffer zone and the symmetrical difference returns the lines outside the buffer zone as a result. Through these functions, a spatial reference can be created between the lines and pipes of the medium voltage, low voltage (LV) and gas grid. The spatial reference is used for the cost calculation, which is using the net present value method [4]. In the cost calculation, it is examined whether a cost reduction results from bringing a measure forward in time to use a common trench for the electricity cable and gas pipe.

The concept, shown in Image 1, iteratively checks all lines in each observation year for parallel lines through the described QGIS tools and determines the costs for separate and joint exchange. Based on these costs, a decision is made as to whether a single exchange in the exchange years will take place or a joint exchange in the observation year.

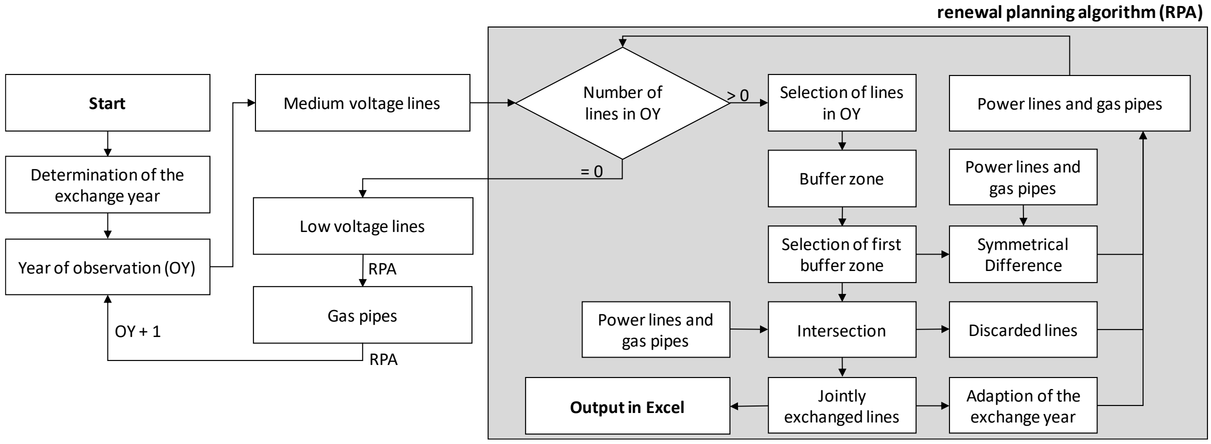

Image 1: process diagram of the cross-sectoral renewal planning

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Results

The results of the simulation of the LV grid (Image 2) demonstrate that two thirds of the LV lines can be exchanged cross-sectoral with the gas pipes. This reduces the costs of the exchange in both sectors. The jointly exchanged electricity cables are illustrated in green and the individually exchanged ones in red. The electricity cables are illustrated red, if the exchange years of the electricity cable and the gas pipe are too far apart, so that there is no cost reduction in a cross-sectoral exchange.
Through the cross-sectoral exchange the length of the required trenches until 2050 can be reduced from 3,158 m to 2,396 m.

Image 2: Results of a cross-sector exchange of a real low-voltage grid

Acknowledgment

Efforts in this field are made with the research project “SektorPlan”, which is supported by EFRE program funded by the European Union (support code: EFRE-0801816)

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