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Review of internalization of externalities and dynamics of atmospheric emissions in energy sector of Baltic States

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ABSTRACT

The existence of external costs can lead to market failure. This is because the free market generally ignores the existence of external costs. Pollution taxes and other flexible market instruments are being applied to internalize external costs of atmospheric emissions. Subsidies to renewable energy technologies are also being applied to internalize positive external benefits of renewables as these technologies have lower life-cycle emissions of classical pollutants and GHG emissions in comparison with fossil fuel based energy generation technologies.

The paper applies "context-mechanism-outcome" (CMO) theoretical framework based on realistic evaluation theory for review and assessment of the level of internalization of externalities and their impact on atmospheric emissions of classical pollutants in Baltic States. The paper aims to compare external costs of atmospheric pollution and pollution taxes and other measures to internalize externalities in Baltic States and to relate them to the trends of emission of classical pollutants in these countries. The external costs of atmospheric pollution were compared in Baltic States together with atmospheric pollution taxes and other policy measures used to internalize external costs of atmospheric pollution in Baltic States. The analysis of trends of atmospheric pollution by classical pollutants in Baltic States indicated positive trends since 2004 in all analysed countries. Though review of internalization of externalities in Latvia indicated the lowest levels of external costs internalization in terms of pollution taxes, excise taxes and feed-in tariffs and subsidies from EU Structural Funds for renewables, the atmospheric emission reduction trends for classical pollutants are very favourable in Latvia except air pollution by ozone. This indicates that the degree of internalization of external costs related to specific pollutants does not necessary imply emission reduction of these pollutants as other factors as well as country context also play very important role and further investigations of this problem are necessary.

1. Introduction

Economists have shown that when externalities are present, markets are not efficient unless these external costs and/or benefits are internalized and economic agents take into account these costs when making decisions [1,2]. There several types of important externalities associated with electricity generation: external costs of atmospheric pollution, positive external benefits associated with use of renewable energy sources which are carbon free and have lower life-cycle emissions of classical pollutants in comparison with fossil fuel based energy generation technologies etc [3].. When harmful fossil fuel emissions are not priced, the unregulated market will over-use fossil fuels and under-use substitutes, such as renewable energy sources (RES) [4]. Similarly, if the atmospheric emissions are not priced, there will be no incentive for firms to find technologies or processes to implement pollution mitigation measures and to reduce the emissions [5].. In most – but by no means all – cases, the externalities from the fossil fuels are greater, implying the market will under-provide renewable energy. Un-priced environmental externalities from either fossil fuel or renewable energy use would imply an over-use of energy in general, or an under-use of potential energy efficiency improvements [6]. One of the reasons to support renewable energy – to internalize external benefits of these technologies and to make them competitive in the market. Internalization of external costs of atmospheric pollution by implementing pollution taxes should have impact on reduction of emissions into atmosphere and also on increase of usage of renewable energy sources as the higher costs of electricity produced from fossil fuels because of pollution taxes makes renewables more competitive and more attractive for energy generation [7]. There are various policies and measures for internalization of externalities in electricity generation sector: pollution taxes, subsidies to renewables in the form of Feed-in prices, support from EU Structural Funds and other funding sources etc.

The paper aims to review and compare external costs of atmospheric pollution and policies and measures applied for internalization of externalities in electricity sector of Baltic States and to assess the

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level of internalization of external costs and its impact on atmospheric emissions of classical pollutants in these countries.

The main goals to achieve the main aim of the paper:

- to review literature on external costs of atmospheric pollution and their internalization;
- to construct theoretical model for review and assessment of internalization of externalities in electricity sector and its impact on atmospheric emission reduction in this sector;
- based on constructed context-mechanism-outcome (CMO) model to analyse **context** and compare external costs of atmospheric pollution in Baltic States;
- based on constructed CMO model to analyse external costs internalization **mechanisms** and compare atmospheric pollution taxes and other policy measures to internalize external costs of pollution in Baltic States;
- based on constructed CMO model to analyse **outcomes** and to compare development of atmospheric pollution by classical pollutants in Baltic States;
- to develop policy recommendations based on the main findings of analysis conducted

The methods applied: comparative analysis and assessment, graphical analysis, systematization and generalization.

2. External costs of atmospheric pollution and their internalization policies and measures inn energy sector

Almost every energy system, aside from its beneficial consequences to society, causes adverse effects as well [8]. In general, costs associated with atmospheric pollution, specifically with global warming range widely and differ for fuels [2]. In order to compare the environmental impacts of various electricity production technologies the most widely accepted approach today relies on external costs, i.e. monetary value of damages caused by electricity production [3]. External costs are a significant part of total social costs and, in the case of renewable energy sources (RES), are quite low [9], while major damages, such as acid deposition, adverse health effects of pollution, loss of crop yield and biodiversity, soiling of building facades, accelerated corrosion of materials, and various climate change impacts are mainly caused by the production of traditional electricity and are not reflected in the prices of fossil fuels [10–12]. Externalities occur at all stages of a fuel cycle [13], yet path to assessing externalities is mined with difficulties and uncertainties. Externalities can be reduced by improving fuel cycles, switching between fuel cycles, a more efficient end-use of energy and reductions in energy consumption [13]. Nonetheless, ultimate goal of externalities valuation is achieved when economically efficient allocation of resources is being made – through the integration of externalities in energy prices. This particular integration or so-called internalization of external costs into the full energy production cost has been considered an efficient policy instrument for reducing negative impacts of energy supply and use [14]. Furthermore, internalization of external costs can be seen as major reason to support renewable energy. Economists have shown that when externalities are present, markets are not efficient unless these external costs are internalized and economic agents take into account these costs when making decisions [1]. Furthermore, if the market does not reflect all the costs of damage made by traditional fuel energy, market prices do not provide the right signals for economic agents and thus cannot ensure optimal allocation of scarce resources [6].

Although a significant research effort in measuring external costs caused by electricity production has been made [15–17], the implementation of appropriate internalization strategies is still hampered by a lack of reliable external cost data [8]. It is usually the governments' role to step in to ensure that prices are right through certain types of regulation [10]. Moreover, extent to which prices are corrected depends on the degree to which the external costs are internalized [1]. Different internalization measures can be applied in order to internalize external cost into the price of fossil fuel energy. One of them are subsidies, which have been widely used to address externalities [18,19]. These subsidies to renewables in the form of feed-in tariffs are widely applied and are among major instruments used by public authorities to support renewable electricity supplies in their infant stages [19–21]. These types of tariffs are structured as fixed-price tariff, which guarantee electricity operators a set price for electricity sold to the grid, or as premium tariff, which adds a definite bonus to the wholesale market price perceived by generators [22]. Well-designed feed-in tariff systems for renewables with guaranteed access to the grid have proven the strongest reliability and success [22]. Other types of RES support policies exist, such as tradable certificates, tax incentives and investment grants, net metering policies, and tendering schemes all of which are applied in European countries separately and in combination with other policy incentives [23], however, feed-in tariffs are the most widespread promotion scheme in Europe for electricity made of RES [22]. Furthermore, European countries have increased their use of environmental tax instruments by designing new tax bases, like taxes on sulphur dioxide, plastic bags, solid waste and batteries [23]. These pollution taxes are applied to reduce other tax distortions in the economy, to internalize external costs of atmospheric emissions and it provide public revenues which can be recycled [24]. Economists agree, in concept, pollution taxes are the most cost-effective means of reducing pollution, nonetheless it remains unpopular mostly due to public distrust of politicians to spend environmental taxes solely on environmental measures and issues of tax distribution – there is concern such a tax burden will be unfairly distributed [25].

In the following section the theoretical model will be developed for comparative assessment of the level of external costs internalization and its impact on atmospheric pollution reduction in Baltic States.

3. Theoretical model

The comparative analysis and review of internalization of external costs and assessment of its impact on atmospheric pollution reduction in selected countries was performed based on realistic evaluation approach and "context-mechanism-outcome" (CMO) model developed by Pawson and Tilley [26]. The main idea of this approach is statement that in order to make evaluation of policies impact the realist evaluators aim to identify the underlying generative mechanisms that explain 'how' the outcomes were caused and the influence of context. Pawson and Tilley (1997) used the term "scientific realism" considers that an intervention works (or not) because actors make particular decisions in response to the intervention (or not) [26]. The main issue in this theoretical model is the "reasoning" of the actors in response to the resources or opportunities provided by the intervention is what causes the outcomes. Or in other words "generative mechanism" of outcome is based on the underlying social or psychological drivers that "cause" the reasoning of actors [27]. For example, a similar system of pollution taxes implemented in the specific countries may have achieved different outcomes in specific countries. The mechanism generating different outcomes may relate to different context of the countries. Context matters: firstly, it influences "reasoning" and, secondly, generative mechanisms can only work if the circumstances are right. Finally, the context may provide alternative explanations of the observed outcomes, and these need to be taken into account during the analysis [28].

The difference between realist and other kinds of programme theory-based evaluation approaches is that a realist programme theory specifies what mechanisms will generate the outcomes and what features of the context will affect whether or not those mechanisms operate. Ideally, these elements (mechanisms, outcome, and context) are made explicit at the evaluation design stage, as it enables to design the data collection to focus on testing the different elements of the