The "Úlice Syndrome": A New Generation of Environmental Risks

Luboš Smrčka, Markéta Arltová

***Abstract*—** The work assesses the seriousness of some new risks that have appeared over the last decades as the pressure has mounted for replacing carbon-based fossil fuels with renewable energy. In this respect, the authors conclude that while the replacement of traditional products and resources with their plant-based equivalents may stabilize the demand for traditional resources such as oil and coal, the issues linked to the mass production of these substitutes begin to emerge as unimaginable and uncontrollable. Besides this environmental problem, another one has been identified via mathematical models and assessment of time series: a significant correlation between growing prices of electricity and natural gas and an increasing demand for coal as a cheaper alternative for heating and warm water production in households.

***Keywords*—** biomass, ecology, environmental subsidies, European Union, renewable sources of energy.

I. Introduction

ÚLICE is a small and virtually unknown village in Western Bohemia. It has a population of slightly over 400 inhabitants and the first documented record of its existence dates back to 1329. It became famous for its steam mill, distillery, brewery and a factory for artificial fertilizers that was awarded a prize at the 1867 World Exhibition in Paris.

However, this is a thing of the past. The now-forgotten Úlice did not make press even after a flash flood swept through the streets of the village, bringing water and mud. There were no casualties and material damage was low; several flooded basements and destroyed gardens were almost not worth noticing among the daily offering of news featuring various disasters.

But there is one interesting thing about Úlice after all. The May 2011 flood was the first flood on record. "On record" means that there are no living witnesses of any such event and no records of it exist historically. For the many hundreds of years of the village existence there had been no flood. We could dismiss this by saying that everything happens for the first time or blame the climate change or a number of other popularly-believed phenomena that make the headlines. But the torrential rain that dumped a half-meter layer of mud in the village, while being exceptional, was far from being extreme or unheard of. The rain was heavy but precipitation totals of the kind are recorded in the area quite regularly.

Why did not everything end up just like in the past, i.e. with no consequences? While the problem may seem rather Sherlockian, its resolution is within our grasp as the mud contained one important clue: millions of young plants of miscanthus.

Miscanthus is an industrial crop with a fast growth rate which makes it suitable for the biomass production, i.e. it is among sources of renewable energy. Upon burning biomass, heat or electric energy is produced.

In the fields on the slopes above Úlice, plants native to the Czech Republic had always been grown. Their roots managed to keep the soil together and the thick plant population reinforced the soil that was able to withstand torrential rains. But miscanthus plants are grown far apart in order to support the growth of the organic matter which is the plant's major benefit. Miscanthus roots do not equally grow as deep and are not as valuable in reinforcing the soil, especially when freshly planted. The rain caught the field off guard: the soil was loose after sawing, the plants were spread apart and the plant was nothing like those that had been grown there in the past, with even no related species in the area. Historically, Czech farming has never featured a plant that would be so distant from the usual crops.

While the environmental disaster happened only on a small scale, it has brought about a number of pressing questions.

II. Problem Formulation

The case of Úlice ushers by no means a new issue. It is merely a not-so-usual example of phenomena that we have seen in developing countries that have always seemed so distant from the European Union. For the purposes of the present paper, we may call the issue the "Úlice syndrome".

Let us now examine the problem in its entirety and context.

Over the last twenty or so years, a number of countries have adopted measures to support the introduction of renewable energy sources. We will not go into details however interesting these might be. The important thing is the overall direction and the usual principles applied that may be summed up using selected EU legislation such as EU directives as an example.

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A. Policies and Legislation

This legislation and policies follow several steps: the first includes "problem definition", i.e. a goal such as fuel savings, reduced emissions of a specific pollutant etc. is defined. For example, a directive requiring a minimum amount of biofuel be added to fuels as their renewable segment is introduced by a desire to save fossil fuels. By the same token, a directive introducing a commitment to achieve production of certain percentage of energy from renewable sources is motivated by the effort to save energy from traditional sources. These are presented as a priori positive decisions immune to any criticism.

The legislation then defines approved methods of support by setting e.g. the limits on subsidies for renewable energy which thus become "legalized", in spite of subsidies and other forms of support being generally restricted by various regulations not only within the EU but also in OECD or WTO. This way, a group of products and services that stand beyond these restrictions is created.

In the end, the legislative and executive branches of governments in individual states are authorized to adopt measures that will implement the legislative tasks in each individual country.

Please note that within this process there is no space for economic analysis or for an analysis of the environmental impacts of the envisaged decision. When the EU decides on introducing certain percentage of renewable energy, for example, it does not condition its decision by introducing limits on the maximum allowable impacts of the decision's implementation or the limit where the cons would outweigh the pros, be it in the environmental, economic or even social sense.

In other words, this legislation clearly defines a goal which has to be met "at any cost" (as the cost is capped neither in absolute terms nor in terms of e.g. percentage of energy price growth, government expenditure or GDP). By the same token, meeting of the goal is expected regardless of "any side effects" or "social costs" it may have.

B. Example of Policies

To support our view, let's now look at specific examples of "supranational environmental legislation":

- Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity from renewable sources in the internal electricity market,
- Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport,
- Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity,
- Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

In fact all the aforementioned directives bear significant resemblance. Another document, "Renewable Energy Road Map – Renewable energies in the 21st century: building a more sustainable future", issued by the Commission on 10 January 2009, is also worth our attention. As the name suggests the document's aim is not to inform or to introduce a draft plan but rather it comes as a declaration of the necessity to meet the goals presented therein. And the goals are by no means meager, with the document stating that "appropriate and achievable goals include 20% of energy from renewable sources and 10% of energy from renewable sources in transport..." But already at the time of the drafting of the road map was it apparent that some effects of promoting renewable energy had not been expected and the European institutions were in for an unpleasant surprise. In Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, the following statements may also be found: "

The European Council of March 2007 reaffirmed the Community's commitment to the Community-wide development of energy from renewable sources beyond 2010. It endorsed a mandatory target of a 20 % share of energy from renewable sources in overall Community energy consumption by 2020 and a mandatory 10 % minimum target to be achieved by all Member States for the share of biofuels in transport petrol and diesel consumption by 2020, to be introduced in a cost-effective way. It stated that the binding character of the biofuel target is appropriate, subject to production being sustainable, second-generation biofuels becoming commercially available and Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels being amended to allow for adequate levels of blending. The European Council of March 2008 repeated that it is essential to develop and fulfill effective sustainability criteria for biofuels and ensure the commercial availability of second-generation biofuels. The European Council of June 2008 referred again to the sustainability criteria and the development of second-generation biofuels, and underlined the need to assess the possible impacts of biofuel production on agricultural food products and to take action, if necessary, to address shortcomings. It also stated that further assessment should be made of the environmental and social consequences of the production and consumption of biofuels"[1].

The very last part of the quote contains the most important message. While the wording of the quote endorses all goals in an unchanged scope, the final part contains a note which, under due public administration, should come first, i.e. that all consequences of the decision must be carefully assessed.

C. Impacts of Legislation

Any adopted legislation has naturally certain consequences that are manifested by pressures and changes within the society. If, for example, fuels in transport should be substituted with a certain percentage of energy from

renewable sources, here represented by plants, the basic question we have to ask when contemplating the impacts of the legislation is how, at what cost and under what conditions we are capable to produce the required amount of the plant substitute in question.

We should begin by verifying whether the plant substitute also presents a more environment-friendly alternative compared to traditional fuels and whether there are any side effects such as adverse effect on the longevity of engines etc. It is general knowledge now that the first generation of substitute petrol and diesel additives oftentimes lacked even these basic qualities. This, however, is not examined by the present work.

The question we are asking now is whether a sufficient amount of substitute fuels for transport could be produced, respecting the requirement of at least basic profitability. From what we know today, this effort seems rather problematic. Given the impossibility or unsuitability of analyzing certain phenomena that are inherent in the growing production of gas and diesel additives, let us at least present a few facts:

On the global scale, industrial crops have started to squeeze out food crops as the former offer certain advantages, such as almost guaranteed commodity prices. The years 2005 to 2008 saw the most important changes, with the World Bank stating in its report of 9 April 2008 that since 2005 the price of wheat had grown globally by 181% (cereals are one of the major ingredients in bioalcohol production that is used as an additive to petrol or directly as a fuel for passenger cars; the United States, for example, uses up to 1/3 of its cereal production for these purposes). According to the identical report, food in general had become 83% more expensive (by March 2008). Today we are already aware of that impacts that substituting food crops with industrial ones has had: in a number of third world countries, and most notably in the poorest ones, the standard of living has plummeted, oftentimes below the level of mere survival. Haiti, Indonesia and a number of African countries have reported drastic figures concerning hunger deaths as humanitarian organizations have been unable to provide for a sufficient amount of food at the new prices. The food crisis has caused some 100 million additional people to go hungry every day.

Among other factors, the problem is that soil in the European Union is not extensive enough to be able to produce the expected 10% of bioadditives to oil-based fuels as envisaged by the directives. While this fact is known, it remains largely underestimated.

Other issues are present as well: we are aware of the extensive areas constantly deforested in Brazil not only in order to obtain timber but also to gain an ever increasing space for the production of sugar cane as this plant is also used for the production of bioalcohol, besides sugar. Brazil is also known for its program of bioalcohol-powered cars. A number of other countries, such as Sumatra and Indonesia, have provided a growing space to industrial crops as opposed to those serving as food. While the tough price increase of 2005 to 2008 was eventually managed, most probably at the cost of millions of human lives, the issue still continues gaining momentum.

D. Prospects of Biomass

With its directives, the European Union is one of the most prominent drivers of biomass demand. In this case, we refer to biomass in its widest sense, a sum of living organisms and plants that may have the potential to become a source of energy, rather than referring to a specific fuel. In 2006 the European Environment Agency published its study where it specified the potential for biomass-based energy production. The estimate was based on the assumption that biomass would not disturb the environmental balance or biological diversity, i.e. the estimate assumed minimum adverse effects of biomass employment.

The report concludes on a positive note when it claims that by 2030, as much as 15% of energy demand in the European Union could be satisfied with energy produced from agricultural and forestry waste from purely European sources. By the same token, the identical method could be used to produce approximately 18% of heat, 12.5% of electricity and 5.4% of fuel for transport. Again, all this using biomass from European sources [2].

The figures published by the European Environment Agency are in obvious conflict with the projections made by the EU in its aforementioned directive – without adverse secondary effects, the European continent is capable of producing about a half of the biomass that is needed in order to meet the goal of biofuel consumption in transport. Moreover, the Agency's estimate applied to a period 10 years later where as much as one tenth of petrol and diesel sold in Europe should be covered from renewable sources according to the directives. However, this is just the lessor of problems.

In its forecast, the European Environment Agency also assumed much quicker advances in researching biofuels of second and third generations whose effectiveness should be allegedly much higher than the case has been for the first generation biofuel (in this context, effectiveness is measured as decrease in emissions and carbon in particular rather than energy effectiveness). It has however become apparent that the introduction of biofuels will be significantly less environment-friendly than expected; while this does not mean that there would be no decrease in emissions, it is likely to be much less pronounced, especially in the transport segment.

This is the result of two factors: Firstly the consumption of cars has decreased, as have emissions for both gasoline and diesel engines. As a result, the reduction of emissions happens at a significantly faster rate than expected. Secondly, the total emissions arising from transport of biofuels are much higher than the optimistic studies thought. The attempt to grow biomass-producing crops in less fertile areas has lead to the need for more intensive care, i.e. increased fuel consumption during the growing season including increased consumption of fertilizers and higher related costs. Additionally, if fertilizers are converted into units of environmental pollution, then, all factors duly considered, burning one liter of bioalcohol results in a reduction of emissions of 10 to 30 percent compared to burning one liter of petrol.

As a result, the introduction of biofuels is generally more beneficial as a measure for reducing the dependency of Europe on energy imports rather than a way of improving the environment.

E. The Czech Example

Let us now use some examples from the Czech Republic to demonstrate how government measures, which are intended as an important contribution to the environment quality, may actually prove to have an adverse effect on a number of environmental aspects as well as on important economic parameters and even cause further environmental damage.

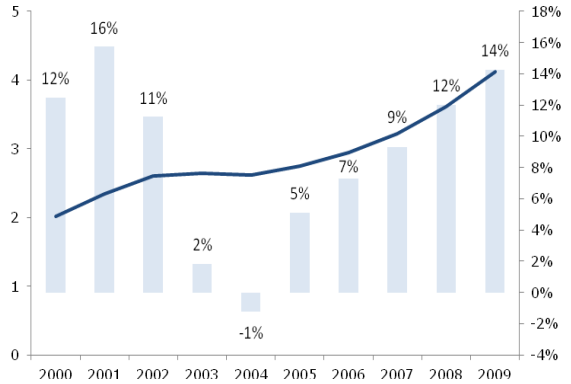

Fig. 1 Household electricity prices in 2000–2009(CZK) [4]

Along with many other countries, the Czech Republic went through a period of strong support of solar electric power plants which has resulted in several negative impacts. One of them is the growth of electricity prices (Fig. 1) due to incentives awarded to photovoltaic sources. The year-on-year price growth in 2009 amounted to 14 percent. This has made electricity, which is a relatively clean energy source, disadvantaged compared to other resources, most notably brown and black coal that have much more dire environmental consequences.

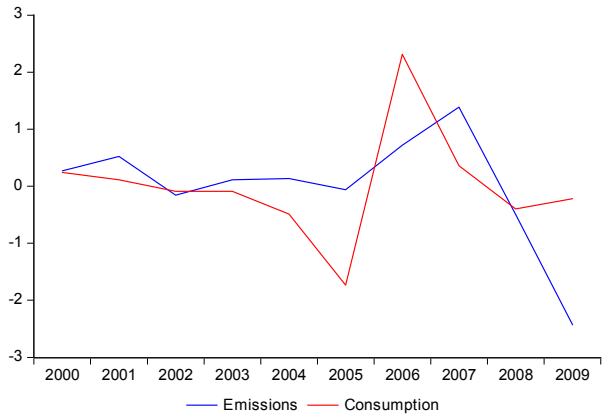

Fig. 2 Household consumption of fossil fuels (thousands of tons) and CO2 emissions in 2000–2009. Note: the data have been normalized for the plot [4], [5]

Somewhat paradoxically, due to the high electricity prices, fossil fuels have become the cheapest heating alternative for households. Compared to 2005, in 2006 this was manifested in a significantly increased household demand for fossil fuels, which then led to increased pollution levels (Fig. 2).

For the period of 2000–2009, the relationship between fossil fuel consumption and CO2 emissions may be expressed as:

$$emissions_t = 0.082 consumption_t \quad (0.004)$$

which means that for each additional ton of fossil fuels consumed by households, the average increase in CO2 emissions amounted to 0.082 Mt. The correlation of R2 = 45 % indicates an average level of dependency. The selective ACF confirms that the model is of a high quality, albeit prone to instability due to a low number of observations.

The second reason for the instability of the model is the fact that while households are one of key polluters in the Czech Republic, especially due to the high use of furnaces in households, they are not alone. During the first two years of the new century, several emission-reducing programs, targeted at major industrial polluters, were initiated with the help from government subsidies. Its effects started to appear following year 2005. It is also worth noting that the aforementioned year-on-year growth in household consumption of fossil fuels in 2006 amounted to 213 %; while the figure might have been affected by the prevailing weather patterns over the winter months, the effect of households shifting to solid fuels as a source of heating due to the electricity price development undoubtedly remained a major factor.

Table I. Households by heating method (as a percentage of total households) [6]

Year	District heating	Solid fuels	Natural gas	Electricity
1991	36.95	43.78	16.57	1.50
2001	38.16	19.48	35.59	6.50
2002	38.01	19.45	35.77	6.49
2003	38.04	19.45	35.75	6.49
2004	37.70	19.33	36.24	6.44
2005	37.60	18.46	37.25	6.41
2006	37.42	17.98	37.99	6.33
2007	37.24	17.80	38.37	6.30
2008	37.16	17.43	38.69	6.27
2009	36.84	17.62	39.00	6.25

As Table I. shows, in 2009, the trend of decreasing use of fossil fuels in household consumption became reversed. It is equally important to note in this respect that one third of families depend on district distribution for heat and warm water supplies as a significant part of these supplies are provided for by coal-burning plants. It is also a known fact that transition of these plants to an environment-friendly alternative, let alone renewable sources of energy, is hindered most often by the price issue.

The increased demand for fossil fuels on the part of households cannot be dismissed as a marginal phenomenon. Considering the fact that households in the Czech Republic are

responsible for 40% of all pollution, the growth in demand for fossil fuels becomes all the more important. And it certainly does not support the government's goal of preventing further air pollution.

The key problem we have to deal with when introducing mechanisms to support the existence of renewable sources of energy is one that is known from all regulatory attempts at influencing economic development and activity via economic and particularly financial instruments: it is impossible to set up – at least in a truly democratic and free economic environment – parameters of financial regulation so that these could not be misused in order to generate profit that goes beyond profit in other industries not subject to state regulation.

This also ushers the issue of terminological confusion prevalent in the European Union as well as other developed countries. The term "financial regulation" constitutes in fact a system of subsidies that are to ensure a sufficiently dynamic development of an industry subject to support. As we may see, regulation does not mean "influencing" or "directing" the development but, rather, stands for "support". This is an important aspect that should not be omitted: within the European context "regulation" may have a broader sense than the one we are used to or in which the word is usually employed.

The following table is especially illustrative. It shows the wide range of costs of reducing emissions by one ton of CO2 in the Czech Republic when using different sources of renewable energy. Biomass, as we may see, is doing quite well, offering stable costs of emission reduction.

Table II. Costs of reducing emissions of CO2 equivalent (CZK/ton) [3]

Solar energy	6,000 – 12,200
Insulation	2,000 – 9,100
Heat pumps	1,500 – 8,800
Solar thermal energy	2,000 – 8,000
Wind energy	2,000 – 5,000
Geothermal energy	3,000 – 4,000
Biomass	1,500 – 4,000
Biogas	3,000 – 3,500
Small water power plants	2,000 – 2,500

Note how different the ranges are for individual items in our list. This clearly shows one thing: there are substantial differences in the costs of reducing emissions using different sources of renewable energy, ranging from optimal to utterly bad. The only renewable sources that present a range of costs that could be referred to as "normal" in the economic sense include small water power plants, biogas cycles and maybe goethermal energy. However, the Czech Republic has only a limited potential for small water power plants and the use of geothermal energy is difficult. The biogas production is limited and there is no easy way of increasing it. If the European directives are to be adhered to, the Czech Republic's only choice is to employ sources of highly fluctuating, as well as pricey, costs. That fact that cannot be understated is that historically, renewable energy sources were a more expensive alternative to energy from the traditional sources, they continue to be costlier and the situation is unlikely to change in the short to mid-term horizon. So the commitment by the states to use a certain share of energy from renewable sources will result in these states having to subsidize an increasing volume of energy production in order to make it more profitable. As state subsidies in fact present redistribution, in essence the states have agreed to either increase taxes or to increase energy prices in order for them to pay compensations to the producers of eco-friendly energy that will make the undertaking profitable. The Czech Republic chose to walk the latter path.

III. Problem Solution

Subsidy policies create imbalances affecting both the economy and the environment. Given the wide range of costs of emission reduction, which could be considered an indicator of energy effectiveness of these systems, we need to set subsidies in a way that would promote production of energy via every single method. Within this process, mistakes do happen as the case was in the Czech Republic. In just a few next years, tens of billions of crowns will be spent as a result of mass support in order to finance solar power plants, whose installed capacity in the country has exceeded 2,000 MW in 2011, i.e. the installed capacity of the Temelín nuclear power plant (Fig. 3). Yet, given the geographic conditions in the country, this causes a major concern in terms of grid stability, while also requiring massive resources to ensure additional sources of energy should the weather patterns or seasons put the solar system out of operation.

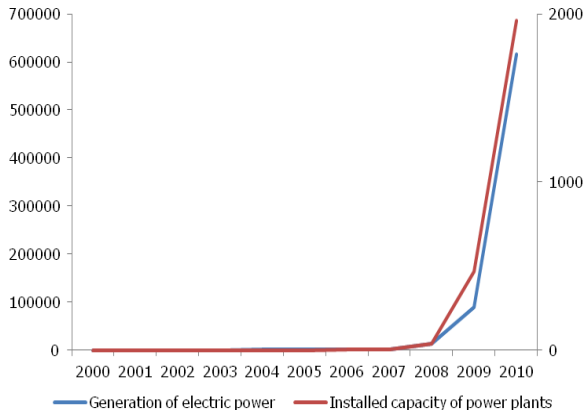

Fig. 3 Electricity production (MWh) and installed capacity (MVp) of photovoltaic power plants in 2000–2010 [5]

Now reverting to the "Úlice syndrome", it has become apparent that while the "solar boom issue" is not new as it has been experienced by other countries (Spain, Italy, Germany), the proliferation of plants suitable for the production of industrial crops usable as biomass was until recently considered an issue reserved almost exclusively to the developing world. And while it is true that these issues have

so far been examined merely at a general level and the number of studies that would consider regional specifics remains low [7], the fact that something like that may happen in Europe has also remained largely ignored.

Pursuant to agricultural guidelines, an area planted in the Czech Republic with rape should not exceed ten percent of total field area. Based on the latest data from the Czech Statistical Office however, the total planted area exceeds as much as 15%. And the area planted with rapes continues growing, despite some efforts to mitigate the effects of legislative regulations containing the binding rules for biofuels.

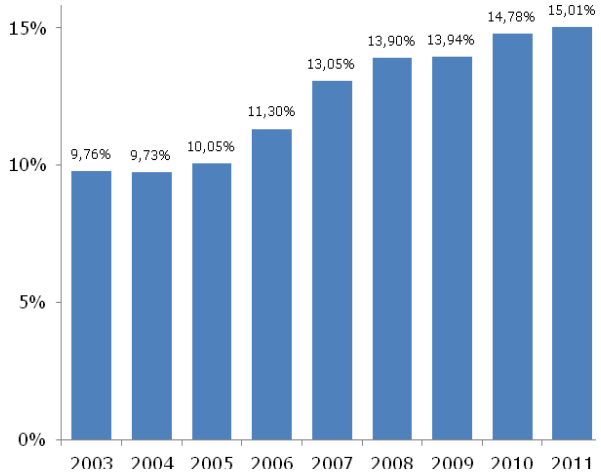

Fig. 4 Rape crops as a percentage of total field area under farm crops in the Czech Republic, 2003–2011 [8]

The situation in other crops is similar to that in miscanthus. The areas planted with these industrial crops grow by multiples due to one simple reason: gaining biomass in the way envisaged by the European regulations, e.g. from forestry waste, is more expensive than using biomass grown in the fields in the form of industrial crops. Therefore if we take one ton of emissions that under the originally intended production method would cost 3,500 to 4,000 CZK to eliminate, we are likely to achieve a much lower biomass price if we choose to grow the right industrial crop instead. Then subsidies, set at generally higher levels, bring a very interesting profit. This simple principle has been the deadly blow to the majority of attempts to promote renewable energy.

This has resulted in a situation, where the decision to support renewable energy by introducing higher purchase prices for "renewable" electricity as opposed to those applied to "traditional" electricity, including that produced by nuclear power plants, is jeopardized by the actual form of support. This is disappointing as there is compelling evidence that alternative resources present a number of advantages, as confirmed e.g. by a study performed by the team of Myšková, Obršálová and Langášek [9]. However, they equally argue that multi-criteria assessment as well as non-economic criteria should be employed within decisions on using renewable energy; in this respect they make a few interesting points: "During selection of alternatives for generating energy it is not possible to proceed only according to purely economic criteria and analyses must be supplemented by additional non-economic criteria. A multi-criteria assessment can successfully be used as a supplementary method to enable an increase in the exactness of decision-making." This, however, changes nothing about the fact that the majority of arguments in favor of renewable resources only apply in situations where the method of their production corresponds to the method originally planned. So far, attempts at scientifically analyzing the issues arising in connection with e.g. biomass have paid very little attention to this particular fact.

This means that even the most sophisticated attempts at achieving a more effective and convenient way of biomass usage, as discussed e.g. by Lisý, Baláž, Moskalyk, and Pospíšil [10], cannot offset any regulatory shortcomings.

This is the real point of the debate: the introduction of renewable energies is not so much of an environmental, technological or political problem. Rather, it is an economic issue. Somewhat surprisingly, this is manifested in some unexpected areas, such as asset valuation [11]. It is a well-known fact that any imbalances introduced into economic relationships from the outside (via policy or regulation) also become apparent in other areas; this is why their effect, while somewhat surprising at first, is a logical outcome of the situation.

IV. Conclusion

The entire environmental economy, i.e. support awarded in the form of subsidies to various renewable sources of energy via state-sponsored programs, become increasingly problematic as it introduces imbalances in both the economic as well as environmental systems.

As the mathematical model of dependency between consumption of fossil fuels and emission level reveals in relation to the gradual introduction of subsidized renewable sources, which resulted in increased electricity prices, the pressure for the development of renewable energy translated, at least in 2005 and 2006, into an abrupt increase in consumption of fossil fuels.

Future scholarly endeavors should include examination of other relationships, as well as relationships arising from longer time series, as similar correlations are likely to exist in other areas.

Moreover, the introduction of subsidy programs is not supported by thorough testing of their impacts they are likely to have on the financial stability of the country and the stability of its ecosystems. If the current European legislation is not reviewed and reassessed within the few upcoming years, further support of renewable sources might become economically and environmentally unfeasible.

The manifestations of the "Úlice syndrome" may be expected to affect increasing land areas since the changes in traditional methods, procedures and crops bring about a number of complications whose severity will be equal to the scope of the changes applied.

REFERENCES

[1] *Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC*, European Commission, EU, 2009.

[2] Ministry of Agriculture of the Czech Republic. (2009). *Akční plán pro biomasu* [Online]. Available: http://www.biom.cz/cz/projekty/akcni-plan-pro-biomasu-pro-ceskou-republiku

[3] M. Zajíček and K. Zeman, "Účet za 700 miliard, Fotovoltaika a růst cen elektřiny (A 700-billion bill: Solar energy and increasing electricity prices)," *CEP*, no. 86, 2010, pp. 55–80.

[4] Energy Regulatory Office. (2011). *Výroční zpráva 2010 (2010 Annual Report)*. Energetický regulační úřad [Online]. Available: http://www.eru.cz/user_data/files/statistika_elektro/rocni_zprava/2010/pdf/elektrina.pdf

[5] Czech Statistical Office. (2011). *Statistical environmental yearbook of the Czech Republic 2010* [Online]. Available: http://www.cenia.cz/web/www/web-pub2.nsf/$pid/CENMJG45KYBJ/$FILE/final_pdf_10.pdf

[6] ISSaR. (2011). *Spotřeba paliv v domácnostech* [Online]. Available: http://issar.cenia.cz/issar/page.php?id=1566

[7] M. Yasouri, "Ecological limitations and sustainable regional development in khorassan province," *WSEAS Transactions on Environment and Development*, vol. 5, no. 2, February 2009, pp. 126–135.

[8] Czech Statistical Office. (2011). *Osevní plochy zemědělských plodin (Areas under farm crops)* [Online]. Available: http://www.czso.cz/csu/csu.nsf/i/tab_3_zemcr/$File/c-2103-11.xls

[9] M. Myšková, I. Obršalová, and P. Langášek, "Economic, environmental and social aspects of renewable energy used for small sources of heating," *WSEAS Transactions on Environment and Development*, vol. 7, no. 8, August 2011, pp. 244–253.

[10] M. Lisý, M. Baláš, J. Moskalik, and J. Pospíšil, "Atmospheric Fluidized Bed Biomass and Waste Gasification," *WSEAS Transaction on Power Systems*, vol. 4, no. 5, May 2009, pp. 157–166.

[11] C. Bonaci, D. Matis, and Jiri Strouhal, "Crisis of Fair Value Measurement? Some Defense of the Best of All Bad Measurement Bases," *WSEAS Transactions on Business and Economics*, vol. 7, no. 2, April 2010, pp. 114–125.

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