Agronomy Research **15**(2), 406–416, 2017

Regulatives for biorefineries

V. Hönig[1,*], Z. Linhart[2], P. Procházka[3] and K. Pernica[1]

[1]University of Economics, Faculty of Business Administration, Department of Strategy, W. Churchill Sq., CZ130 67 Prague 3, Czech Republic
[2]University of Economics and Management, Department of Marketing, Nárožní 2600/9A, Prague 5, Czech Republic
[3]Czech University of Life Sciences Prague, Faculty of Economics and Management, Department of Economics, Kamýcka 129, CZ165 21 Prague 6, Czech Republic
[*]Correspondence: vladimir.honig@vse.cz

Abstract. The relationship between uncertainty and risk–taking behaviour towards innovations and Common Market protection are investigated in this article. Therefore, the aim of this article is to assess points of control over market regulation protecting innovative products. It was found that risk of creative destruction due to implementation of innovations is increased by regulators due to antimonopoly metric they use. EU fiscal policy implementation in renewable fuels in Czech Republic of both EU and CZ calculations is compared. Historical data has shown that regulators have collapsed market of high condensed biofuels. Pattern of fine calculation has explained a market collapse. Comparison of excise duty of favoured biofuels was compared with subsidies for photovoltaics. Substitution of former fossil fuels taking into account excise duty and subsidies of alternative or renewable energies is less market distorting than recent tariffs of excise duty and fines to first generation biofuels.

Key words: biofuel, biodiesel, diesel, excise duty, tax policy.

INTRODUCTION

Biorefinery is understood as processing of any biomass into products, except of fuels. Still, biofuels are observed in this article to investigate impact of market access and crude oil market prices. Impact of both is valid for innovations generally, including of biorefinery ones. It is expected that biorefinery innovation has no competitors yet but, traditional crude oil substitutes will kill it by pushing forward regulation criteria, which cause irregular support and punishments of alternatives. Market access criteria may undercompensate or overcompensate one alternative against others or one country against other countries.

For example Czech biodiesel is exposed to excise duty compensations and fines while photovoltaic energy is supported until 2035 year. This example is generalising different phases of commercialisation by calculation pattern and with feedback of historical data for biofuel. This calculation with time series data has created sustainable economic environment other biorefinery or circular economy innovations oppose to alternatives and substitutes. Alternatives are products only partly satisfy future demand, oppose to substitutes. Substitutes for biorefinery products are non–renewable like

products made of crude oil (De Wit & Faai, 2010; Mezule et al., 2016; Kall et al., 2016). Relationship between fossil fuels satisfying recent demand is neither alternative nor substitute but competitive.

Objective of this article was to assess points of control over market regulation of to protect innovative products of biorefineries against non–renewable or global competitors. Sustainability, social responsibility principles and efficiency indicators in derived pattern remunerating impact of regulations will allow innovative products survive into market maturity (Dumortier et al., 2011; Gorter et al., 2011).

For example, B99 blends from the United States were offered for sale at USD 53.25 per 100 liters ($2.78 a gallon) while the German cost of production for biodiesel was USD 64 per 100 liters ($3.34 a gallon). Therefore, European Biodiesel Board (EBB) forecasts that the European biodiesel industry would stagnate in coming years oppose to annual growth between 30% and 65% of past five years (Kram, 2007). Maximal volume of biofuel in fossil fuel is technically limited by standards EN 590 for diesel fuel and EN 228 for gasoline. At least 6% vol. of FAME (Fatty Acids Methyl Ester) and 4.1% vol. are sold in Czech Republic according to air protection law 201/2012. Maximal volume of FAME is 7% vol. in diesel fuel according to EN 590.[3] Biodiesel at petrol stations is called either B100 with 100% of FAME or B30 eventually synonymously SMN30 with 30% of FAME in diesel fuel and ethanol E85 with 85% vol. of bioethanol in gasoline for modified engines minimising its negative impact are highly concentrated biofuels at Czech market. It is important to distinguish between B100 in EU or B99 in USA market. The small ‘splash’ of fossil diesel, if added to a tanker of biodiesel from, for example, Malaysia, in a U.S. port, would qualify the entire shipment for the U.S. tax credit. After getting the credit, the tanker could continue to Europe–the ‘dash’–and receive European fuel tax credits. In effect, the fuel would be subsidized once by U.S. taxpayers and again by the Europeans (Kram, 2007). This repeated global story of support and collapse of biofuels, including of development and ban of biofuels in Brazil, is worth of standardisation of market access in this article.

Biofuels are supported by decreased excise duty according to law about mineral oils 353/2003. Certified origin and savings of carbon equivalent emissions according to sustainability criteria are two obligatory conditions for awarding decreased excise duty to high concentrated biofuels. Size of biofuel support is derived from need of competitiveness of biofuel and agriculture sectors and connected industry. Also policy objectives as decreased import dependence of renewable energy sources according to EU objectives decreasing emissions of greenhouse gases (GHG) justify excise duty relief for biofuels. Technically, excise duty is paid for total volume of fuel and fuel blending or producing company receives difference between total and decreased excise duty from fuel back (Bansea et al., 2011; Nazlioglu, et al., 2013). EU Commission has approved continuous support of biofuels from first July 2015 until end of 2020. Czech law has implemented this EU directive by law 382/2015 innovating laws about excise duties and air protection from 1st January 2016.

Biodiesel must be mixed with fossil diesel fuel according to EN 590 standard if sold by distributor. Higher costs of biofuels are offset by subsidy or lower excise duty, which EU regulations has changed in year 2016. Actually the new excise duty was collected with half year delay. This retroactive rule and decrease of fossil fuel prices is analysed in this article in selected months before and after rules were changed. But B100 will not return to the biofuel market immediately without corresponding subsidy.

Presented data allow to evaluate whether this policy implementation failure had positive or negative effects later (Kumar et al., 2013; Kochaphum et al., 2015; Pointner et al., 2014).

MATERIALS AND METHODS

Analysis of time series of interval indices has assessed average monthly prices for years 2015 and 2016.

Data were collected from:

- Research Institute of Agricultural Engineering, p.r.i.;
- Ministry of Industry and Trade of the Czech Republic;
- ČEPRO, joint stock company;
- Ministry of Agriculture of the Czech Republic (patterns bellow);
- Ministry of the Environment of the Czech Republik;
- Union zur Förderung von Oel– und Proteinpflanzen (UFOP).

Excise duty for biofuels was introduced in Czech Republic first time for year 2016. Therefore, relief from excise duty rate was calculated for B100 biodiesel for selected months of 2015 and 2016 years for comparison.

Following patterns were used:

$$PRb = Db - Pb \tag{1}$$

where: *PRb* is calculated level of compensation or overcompensation of biofuel in EUR per l. Negative value means no overcompensation. Overcompensation shows size of excise duty, which should be implemented for biofuel or biofuel blend with fossil fuel. *Db* is tax rate relief of biofuel in EUR per l. *Pb* is needed support for biofuel in EUR per l.

$$Pb = \frac{Nb - Nf}{Sb} \tag{2}$$

where: *Pb* is needed support for biofuel in EUR per l. *Nb* are costs of using biofuel in EUR per 100 km; *Nf* are costs of using fossil fuel in EUR per 100 km; *Sb* is biofuel consumption in l per 100 km.

$$Nf = VOCf \cdot Sf + Uf \tag{3}$$

where: *Nf* are costs of using fossil fuel in EUR per 100 km; *VOCf* is wholesale price of fossil fuel in EUR per l including full excise duty; *Sf* is fossil fuel consumption in l per 100 km; *Uf* are cost of maintenance of vehicle using fossil fuel in EUR per 100 km.

$$Nb = (VOCb + Db + CMb) \cdot Sb + Ub \tag{4}$$

where: *Nb* are costs of using biofuel in EUR per 100 km; Part of pattern in bracelets symbolises not supported price of biofuel or fuel blend. *VOCb* is wholesale price of fossil fuel in EUR per l; It can comprise also part of excise duty; *Db* is valid tax rate relief for biofuel in EUR per l; *CMb* is price motivation of consumer to use biofuel in EUR per l; *Sb* is biofuel consumption in l per 100 km; *Ub* are vehicle maintenance costs, which runs on biofuel in EUR per 100 km.

$$Uf = \frac{CO \cdot 100}{Vf} \tag{5}$$

where: *Uf* are vehicle maintenance costs, which runs on fossil fuel in EUR per 100 km;

CO is price of oil replacement in EUR; *Vf* is km distance between oil replacements in vehicle running on fossil fuel;

$$Ub = \frac{CO \cdot 100}{Vb} \tag{6}$$

where: *CO* is price of oil replacement in EUR; *Vb* is km distance between oil replacements in vehicle running on biofuel.

$$Us = \frac{CO \cdot 100}{Vs} \tag{7}$$

where: *Us* are vehicle maintenance costs, which runs on fuel blend in EUR per 100 km; *CO* is price of oil replacement in EUR; *Vs* is km distance between oil replacements in vehicle running on fuel blend.

$$Sb = Sf \cdot Kb \tag{8}$$

where: *Sb* is biofuel consumption in l per 100 km; *Sf* is fossil fuel consumption in l per 100 km; *Kb* is coefficient of increased biofuel consumption, dimensionless.

Biofuel or fuel blend consumption calculation pattern 8 can be applied in case that mileage consumption is not default and only coefficients of increased consumption of biofuel or fuel blend are available.

$$Ss = Sf \cdot Ks \tag{9}$$

where: *Ss* is fuel blend consumption in l per100 km; *Sf* is fossil fuel consumption in l per100 km; *Ks* is coefficient of increased fuel blend consumption, dimensionless.

Biofuel or fuel blend consumption calculation pattern 9 can be applied in case that mileage consumption is not default and only coefficients of increased consumption of biofuel or fuel blend are available.

$$Ks = \frac{CVf}{CVb} \tag{10}$$

where: *Ks*… is coefficient of increased fuel blend consumption, dimensionless; *CVf*... calorific value of fosil fuel (MJ/l); *CVb*… calorific value of biofuel (MJ l^{-1}).

Coefficient of increased fuel consumption and consumer motivation coefficient was assessed due to higher price of vehicles with adapted engines for emission standards EURO 5, EURO 6 and standard for storage by operators according to Czech standard 65 6500/2012.

$$CMb = kp + kt + ka \tag{11}$$

where: *CMb*… total consumer motivation (EUR l^{-1}). From that: *kp*… coefficient of increased costs of vehicles or engines (1.3); *kt*… coefficient storage and shelf life (0.5); *ka*... coefficient of used additives and reagents (0.2).

These patterns were applied in Fig. 1. Development of local market (Fig. 2), export and import (Fig. 3), consumption (Fig. 4) and reserves (Fig. 5) is summarised in calculation of needed support (Fig. 6). Consequences of missing needed support are shown in Fig. 7.

RESULTS AND DISCUSSION

Historical data and calculation of variables were applied in search of sustainable climate for selected innovative product oppose to alternatives and substitutes. Each innovation is notified according to EU rules to receive support allowing it to become market competitive.

Comparison of B100 biodiesel compensation shows difference of some EUR 0.30 for selected months of 2015 and 2016 years. Special attention should be driven to the end of the year, which explains next year compensation level, probably due to leaking or confusing information (Fig. 1).

B100 (FAME biodiesel) has lost competitiveness due operation of excise duty policy. This calculation proved to be true as B100 fuel is disappearing from list of offered assortment of petrol stations. Volume of excise duty overcompensation in 2015 should be repaid until 30 June 2017 year. Overcompensation occurs for positive values and undercompensation for negative values.

Therefore, 2016 prices with excise duty, which was associated with fine for its late introduction, which is further called undercompensation for B100 oppose to year 2015 in the case of this article (Fig. 1).

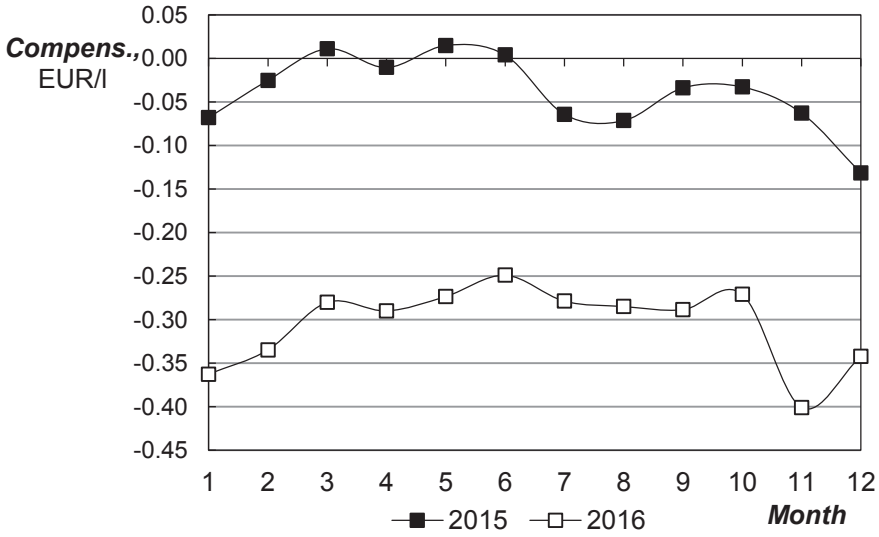

Figure 1. Calculated compensation in 2015 and 2016.

Till 30 June 2017 the excise duty rate will be decreased back to standard level of other EU countries. But, crude oil price development is hardly to predict. Therefore, calculation of undercompensation or overcompensation should be adapted for actual crude oil prices and tax rate changes. Than used patterns will standardise market access for all involved parties.

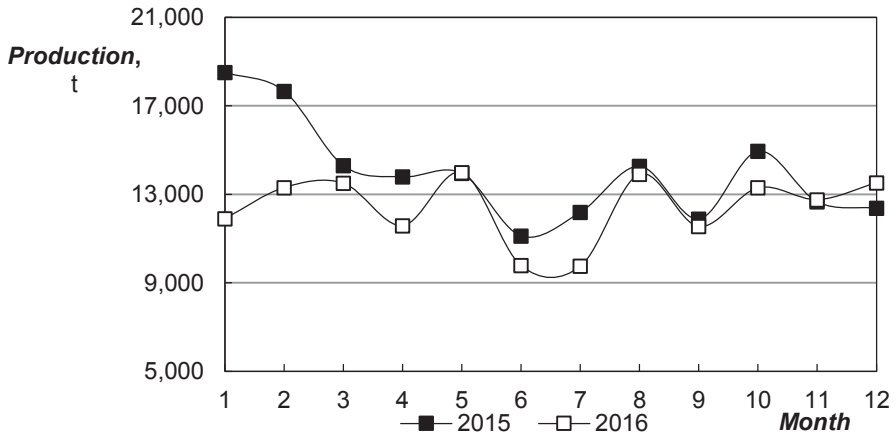

Figure 2. Local biodiesel production in years 2015 and 2016.

Compensation is not equal for all EU countries due to inconsistencies in applied rules. Firstly, local biodiesel production can be related to above mentioned support. Big decrease of production of biodiesel in beginning of 2016 year (Fig. 2) can be explained by decreased support from 2015 to 2016 level (Fig. 1). But, than production level of both years have merged. Production data for 2016 are incomplete.

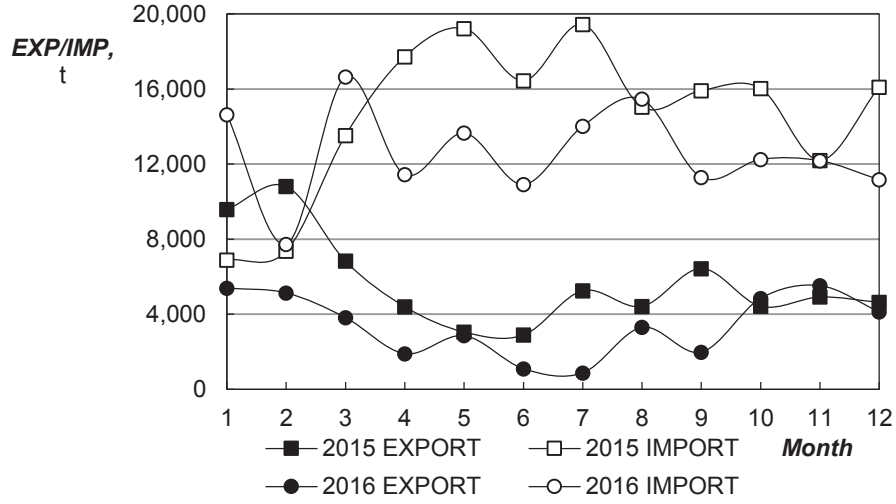

Figure 3. Export and import of biodiesel in years 2015 and 2016.

It would seem that regulation has maintained production. But, closer look at trade shows that importers have gained market from exporters (Fig. 3). It is possible to conclude that decrease of biodiesel exports is saving support compensation and therefore, decrease of exports was intended by regulators. But, it is not so sure if regulators have intended stimulate imports due to negative impact of indirect land use change (ILUC).

Biodiesel consumption was not influenced as it is assessed by minimal blending level by law of air protection (Fig. 4).

Biodiesel stock changes should follow seasonal curve shape according to summer harvest once per year or processing capacities of crushers as biodiesel is made predominantly from oilseed rape in EU countries. But, big changes in storage reserves may show that biodiesel is produced from other raw materials, which are shipped by super tanker boats to refinery oppose to Rotterdam.

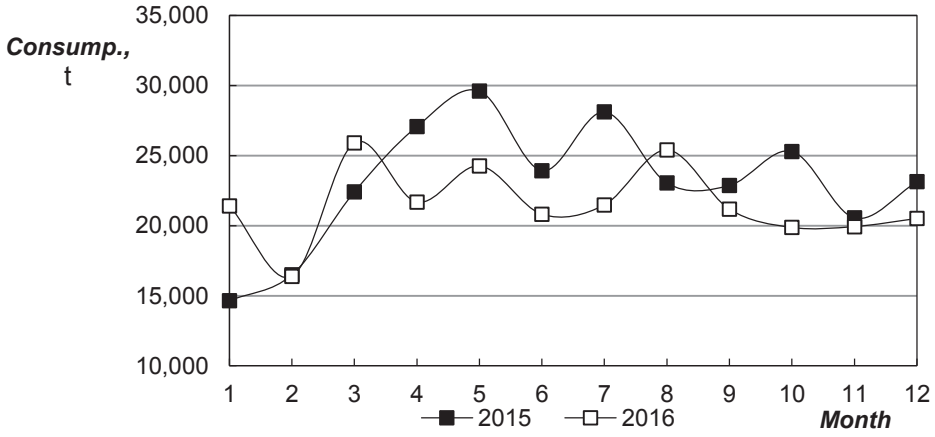

Figure 4. Consumption of biodiesel in Czech Republic in years 2015 and 2016.

Changes of storage reserves (Fig. 5) due to shipped oil or biodiesel originating from palm or soy is negative side effect of regulation as palm oil or biodiesel has more negative impact on climate warming.

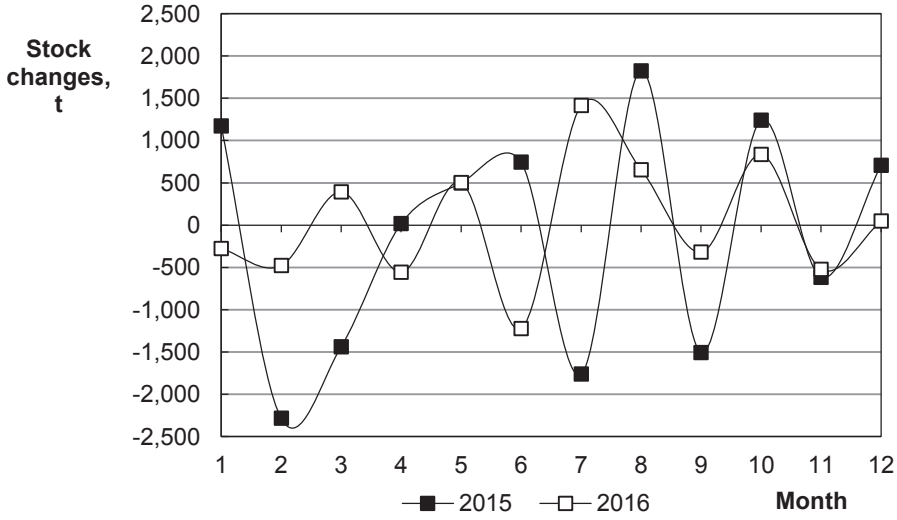

Figure 5. Change of storage reserves of biodiesel in years 2015 and 2016.

The second part of results of this article are patterns for calculation incorporating side effects of production and trade for stability of market support for new products against alternatives or substitutes until they become market ready.

Relatively big attention was given to indices of fuel consumption, which was not deduced from above presented historical data. Literature overview and other articles of authors were used to derive patterns from consumption fuel influencing values. Of course, the fuel consumption may be very different for consumption of other products of biorefinery.

Therefore, consumption part of regulation patterns for stability of market for biorefinery product innovation react on alternatives and substitutes (Fig. 6). Real difference between support about EUR 0.30 (Fig. 1) is bigger than calculated need for support with difference about EUR 0.1 (Fig. 6) because of above mentioned undercompensation.

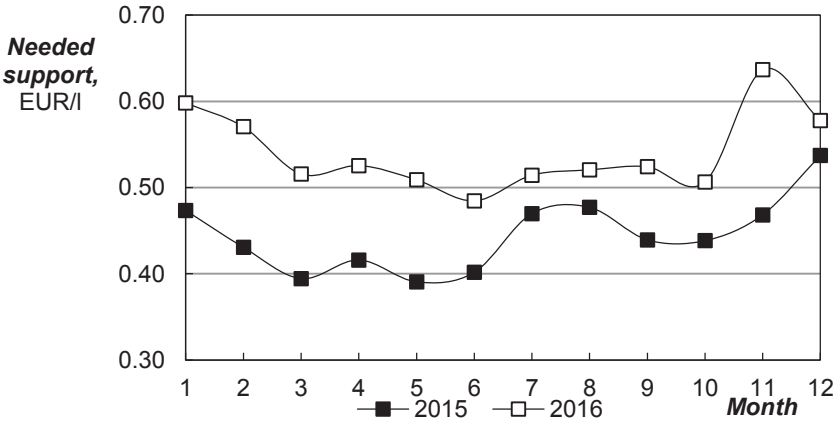

Figure 6. Calculated needed support of biodiesel.

Consequences of market access rules and crude oil price development has collapsed market of high condensed fuels (Fig. 7). This may happen for any biorefinery product, alternative or country.

Fig. 7 shows consequences of above explained market access compensation causing end of biofuel product for ČEPRO Company, which is operating network of EuroOil petrol stations, recently without high condensed biofuels. Fuel distributors apply 6% vol. of biodiesel (FAME) for diesel engines only as it is strictly controlled without any relationship with commodity price development.

Market has reacted on EU fiscal policy by stop of sales of renewable fuels in Czech Republic (Fig. 7). Therefore, EU biofuel competitors could take CZ market over. But, low prices of fossil fuels has reduced turnover of other EU biofuel competitors also. The relationship between uncertainty and risk–taking behaviour towards protection of innovations at Common Market by fiscal measures is neither solving distortions nor collecting taxes at expected level. Photovoltaics and other renewable energy sources, which are also protecting climate warming are not taxed yet, except of biofuels. Therefore, the difference between paid tax and fine for biofuels is uncomparable with support for photovoltaics.

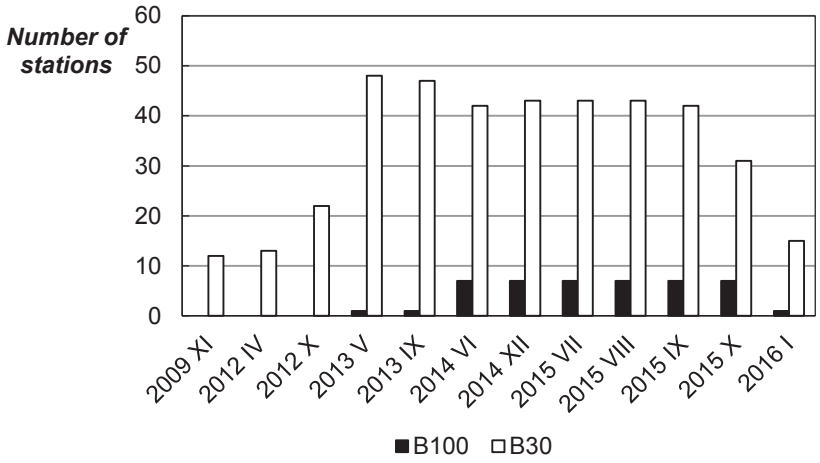

Figure 7. Number of Euro Oil petrol stations offering B100 and B30.

CONCLUSIONS

Used patterns will standardise market access for all involved parties in development of biorefinery alternatives (products). Coefficients and logic of calculation patterns should be validated and extended to other biorefinery products to protect them into market maturity against alternatives and substitutes. The three parts of production, trade and consumption should be kept separate as trade is the most volatile but can recover oppose to production. Consumption patterns are influenced more by political decisions than by regulation. It is enough to issue new norm or support other source, like electric cars and all investments into renewable raw materials are lost. The question is if consumer is enriched? GHG indicators are used for this purpose, which impact on climate warming is not fully justified yet. Therefore, GHG balancing was not included into this article.

We may conclude that equally restrictive rules according to market price development are needed. But, only market access indicators were included in presented patters. Market price development will be verified if market access standardisation patterns will be used and processed in time series for longer time.

Overcompensation of excise duty for biofuels in Czech Republic, which was calculated by presented patterns in this article, was confirmed for 2015 year. High concentrated biofuels went out of the market due to both increased price by overcompensated excise duty and low market price of crude oil, which will affect market share of biofuels also after 30 June 2017 when the excise duty will decrease again. Presented patterns still can forecast reliably rate of excise duty in coming years. Both, forecast level of excise duty and market price of crude oil, is putting biofuels between other biorefinery products if market access is standardised by proposed patters. The proposed market access standardisation of biofuels will deliver lacking energy to developed countries and needed protein to developing countries. The mission of biorefinery will not be solved in one biofuel processing factory, but globally yes, including of contribution of excise duty to state budget.

Limitations and suggestions: Intentions to collect as much taxes as possible and willingness to punish distortive competitors are legitimate but do not comply with economy of company or sector as global market is involved. Therefore, secondary market for innovations should be created besides forex, commodities and stock market exchanges to allow investors to react more frequently than institutions do. Market of alternative renewable and climate warming protecting materials should be supported by crowd funding in future. This projection exceeds framework of this article, but should be developed in future research.

ACKNOWLEDGEMENTS. The paper was created with the grant support project IGA University of Economics, Prague F3/19/2016 – Economic efficiency of biofuels from waste materials.

REFERENCES

Bansea, M, Meijlb, H., Tabeaub, A., Woltjerb, G., Hellmannc, F. & Verburgc, P. 2011. Impact of EU biofuel policies on world agricultural production and land use. *Biomass and Bioenergy* **35**(6), 2385–2390.

De Wit, M. & Faai, A. 2010. European biomass resource potential and costs. *Biomass Bioenerg.* **34**, 188–202.

Directive 2009/28/EC of the Euripean 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. Brusel 23. 4. 2009. [online]. [cit. 2016–05–06]. Available at: http://eurlex.europa.eu/legalcontent/CS/TXT/PDF/?uri=CELEX:32009 L0028&from=EN

Dumortier, J., Hayes, D.J., Carriquiry, M., Dong, F., Du, X., Elobeid, A., Fabiosa, J.F. & Tokgoz, S. 2011. Sensitivity of Carbon Emission Estimates from Indirect Land–Use Change. *Applied Economic Perspectives and Policy* **33**(4), pp. 673–673.

EN 590+A1. 2010. Automotive fuels – Diesel – Requirements and test methods. ČSNI, 16 pp. (in Czech).

European Commission: Energy Strategy, Secure, competitive, and sustainable energy [online]. [cit. 2016–06–06]. Available at: <http://ec.europa.eu/energy/en/topics/energy–strategy>.

Gorter, H.D., Drabik, D. & Just, D.R. 2011. The Economics of a Blender's Tax Credit versus a Tax Exemption: The Case of U.S. 'Splash and Dash' Biodiesel Exports to the European Union. *Applied Economic Perspectives and Policy* **33**(4), 510–527.

Kall, K., Roosmaa, Ü. & Viiralt, R. 2016. Assessment of the economic value of cattle slurry and biogas digestate used on grassland. *Agronomy Research* **14**(1), 54–66.

Kram, J.W. 2007. The End of 'Splash and Dash'? *Biodiesel Magazine* Available at: <http:// http://www.biodieselmagazine.com/articles/1863/the–end–of–splash–and–dash/>.

Kumar, S., Shrestha, P. & Salam, P.A. 2013. A review of biofuel policies in the major biofuel producing countries of ASEAN: Production, targets, policy drivers and impacts. *Renewable and Sustainable Energy Reviews* **26**, 822–836.

Kochaphum, C., Gheewala, S.H. & Vinitnantharat, S. 2015. Does palm biodiesel driven land use change worsen greenhouse gas emissions? An environmental and socio–economic assessment. *Energy for Sustainable Development* **29**, 100–111.

Mezule, L., Strods, M. & Dalecka, B. 2016. Influence of Mechanical Pretreatment on Fermentable Sugar Production from Lignocellulosic Biomass. *Agronomy Research* **14**(4), 1427–1434.

Ministry of Agriculture, Víceletý program podpory dalšího uplatnění udržitelných biopaliv v dopravě na období 2015–2020 Available at: <http://eagri.cz/public/web/en/mze/ministry/>.
Ministry of the Environment of the Czech Republic Available at: <http://www.mzp.cz/en>.
Nazlioglu, S., Erdem, C. & Soytas, U. 2013. Volatility spillover between oil and agricultural commodity markets. *Energy Economics* **36**, 658–665.
Pointner, M., Kuttner, P., Obrlik, T., Jager, A. & Kahr, H. 2014. Composition of corncobs as a substrate for fermentation of biofuels. *Agronomy Research* **12**(2), 391–396.