An Economic and Environmental Analysis of the Impact of Higher-Blended Biodiesel on the Philippine Economy

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By

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Abstract

The Biofuels Act of 2006 (RA 9367) was legislated to reduce the Philippines' dependence on imported fuels and to protect public health and the environment. Under the Act, the Department of Energy (DOE) is authorized to increase the proportion of biodiesel blend upon the recommendation of the National Biofuels Board (NBB) and upon consideration of the domestic supply and availability of the locally produced biodiesel component. Beginning at 1% blend, the mandate was raised to 2% in February 2009. In June 2013, the NBB recommended an increase in the biodiesel blend to 5%.

Results of the numerical analysis indicate that the proposed policy will lead to a rise in the price of biodiesel, inducing users to reduce consumption. The total loss to consumers due to the price increase is estimated at P3,767.47 million for 2016. This negative economic impact far outweighs the positive environmental effects in terms of reduced greenhouse gas emissions and health benefits due to reduced morbidity and mortality, with the net loss amounting to P3.26 billion for 2016 alone. These projections, along with the observed upward trend in relative world prices for coconut oil and crude oil prices plus the bleak scenario for domestic coconut production scenario, augur well for a postponement of raising the blend, at least in the short run.

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Introduction

The Biofuels Act of 2006 (RA 9367) was legislated to reduce the Philippines' dependence on imported fuels and to protect public health and the environment. Pursuant to this policy, all liquid fuels for motors and engines sold in the Philippines shall contain locally sourced biofuels components. Moreover, the law specifies incentives (zero specific tax, exemption from VAT, exemption from wastewater charges, financial assistance to producers) to encourage investments in the production, distribution, and use of locally produced biofuels at and above minimum mandated blends. This Act also enables government agencies to implement programs that will encourage local production of biofuels such as feedstock,[1] jatropha propagation, and fuel bioethanol programs.

The Biofuels Act mandates that diesel engine fuels in the Philippines should contain a proportion of biodiesel blend. Under the Act, the Department of Energy (DOE) is authorized to increase the proportion of biodiesel blend upon the recommendation of the National Biofuels Board (NBB) and upon consideration of the domestic supply and availability of the locally produced biodiesel component. As specified in the Philippine Energy Plan (PEP) of 2013-2030, the biodiesel blend mandate was expected to increase gradually throughout the period to 5% by 2015; 10% by 2020; and 20% by 2025. Beginning at 1% blend, the mandate was raised to 2% in February 2009. In June 2013, the NBB recommended an increase in the biodiesel blend to 5%.

Economic Impact

To see the effect of an increase in the mandated blend from 2% to 5%, we first begin with a base price of P22.45 per liter for petrodiesel and P40.00 per liter for (pure) biodiesel. Combining the two will yield a composite price of P22.80 per liter for the 2% blend, following the formula:

$$\boldsymbol{P_{composite} = (percentBD)(P_{biodiesel}) + (1 - percentBD)(P_{diesel})}$$

where: $P_{composite}$ is the composite price per liter of blended diesel;
$P_{biodiesel}$ is the price per liter of pure biodiesel;
P_{diesel} is the price per liter of petrodiesel; and
Percent BD is the specified biodiesel blending.

If the mandated blend increases, then the price of blended diesel is expected to rise from P22.80 per liter to P23.33 per liter. This P0.53 surge in price will induce diesel users to reduce consumption, the exact amount depending on the price elasticity of demand, η. Table 1 summarizes the market effects of increasing the biodiesel blend from 2% to 5% under two alternative scenarios of η = -0.25 and η = -0.50..

[1] ***Feedstock*** *refers to organic sources such as molasses, sugarcane, cassava, coconut, jatropha, sweet sorghum or other biomass used in the production of biofuels.*

Table 1. Effects on the Diesel Market of an Increased Blend from 2% to 5%, Biodiesel Price at P40.00 per Liter

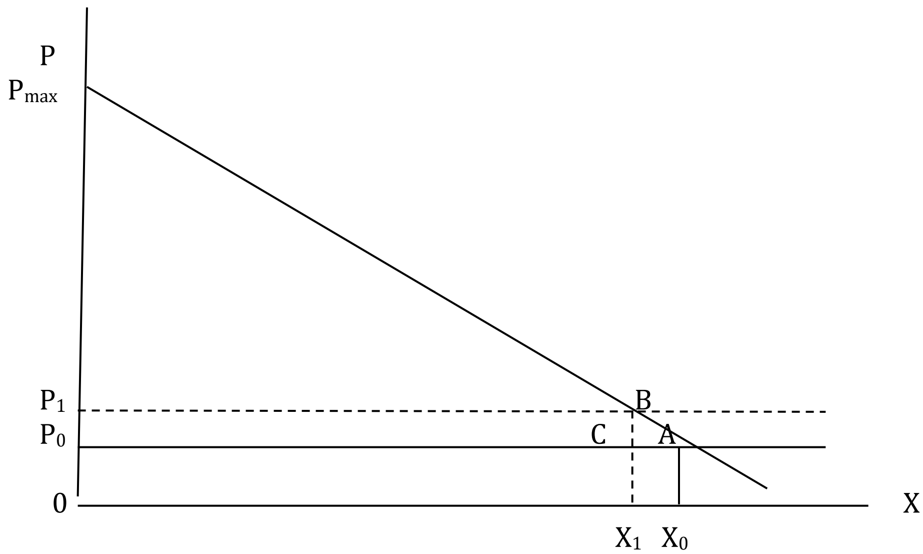
	2% blend	5% blend	
		η = -0.25	η = -0.50
Price petrodiesel	22.45	22.45	22.45
Price pure biodiesel	40.00	40.00	40.00
Price blended diesel	22.80	23.33	23.33
Quantity blended (ML)	7,176.41	7,134.98	7,052.13
Quantity pure biodiesel (ML)	143.53	356.75	352.61
Deadweight cost of underconsumption (million Php)		10.91	32.72
Deadweight cost of overproduction (million Php)		3,756.57	3,712.94
Total loss to consumers (million Php)		**3,767.47**	**3,745.66**

In Table 1, for η = -0.25, diesel consumption falls from 7,176.41 ML (diesel demand for 2016) to 7,134.98 ML per year. The total loss to consumers due to the price increase is P3,767.47 million. The deadweight cost of underconsumption is small at P10.91 million ($0.5*\Delta p*\Delta q$). The major efficiency loss is in the deadweight cost of overproduction, amounting to P3,756.57 million, if the full price of P40.00 per liter for pure biodiesel reflects real resource cost. If this price incorporates some non-competitive profit or quasi-rent, that amount is not a deadweight loss but is merely a transfer. Nevertheless, from a social equity and distribution standpoint, the transfer is from mostly poor diesel users (public utility commuters, drivers, and operators, municipal fishermen with diesel-run motorboats) to the owners of biodiesel plants.[2] For η = -0.50, the last column of Table 1 shows that the fall in consumption is bigger, the total loss to consumers and the deadweight cost of overproduction are smaller, but the deadweight cost of overconsumption is larger compared to η = -0.25.

Figure 1 (not drawn to scale) offers a heuristic representation of the market results of raising the biodiesel blend mandate.

[2] *See de Gorter and Just (2009) for a full exposition of the underlying model.*

Figure 1. Effects on the Diesel Market of an Increased Blend



Let point A be the initial state of X_0 = 7,176.41 ML per year and P_0 = P22.80 per liter with a 2% blend. If the mandate is raised to 5%, the blended price rises to P_1 = P23.33 per liter. Quantity consumed will fall to X_1, the magnitude depending on the price elasticity of demand. The total loss to diesel consumers is the area P_0P_1BA; the deadweight cost of underconsumption is the triangle ABC; and the deadweight cost of overproduction is the rectangle P_0P_1BC.

A more complete estimation of the economic welfare effects of raising the mandated biodiesel blend should take into consideration the effects on other related markets and the existing distortions and externalities in these other markets. For example, the increase in the pump price of diesel will increase the demand for gasoline, a close substitute. To the extent that the Biofuels Act of 2006 also mandates an ethanol blend for gasoline (10% ethanol since 2012), it is highly likely that the marginal social cost of the blended gasoline is above its market price. An expansion in the consumption of gasoline due to the increase in diesel pump price triggered by an increase in the biodiesel blend mandate may therefore even add on to the deadweight costs discussed above.

It should be mentioned that the price of P40.00 per liter for pure biodiesel may be a conservative estimate. If we use P50.00 per liter as base, then the deadweight cost of increasing the mandated blend from 2% to 5% rises to P5,914.18 million. Is P50.00 per liter a reasonable price? It is hard to find online data on the “market” price of pure biodiesel. A DOE presentation reports a wide range of prices for coco methyl ester (CME), as seen in Table 2 (de Guzman, 2015). These CME price fluctuations are probably wider than petrodiesel price movements.

Table 2. Coco Methyl Ester (CME) Price Range

Year	Price (pesos/liter)
2010	34 – 80
2011	57 – 106
2012	30 – 88
2013	29 – 60
2014	38 – 75

Source: de Guzman (2015).

The website http://www.ph.all.biz/biodiesel-bgg1064229 lists several Philippine companies that produce and sell biodiesel, each with the teaser, "Get latest price." But upon clicking the button, one is asked the amount and periodicity of purchase, with a pop-up window that says, "Please introduce yourself; elaborate on the specifications and actuality of price; find out the delivery options or self-pickup, terms of payment." No price quotation appears at all. In short, the domestic CME market is not that transparent.

Environmental Impact

One of the main objectives of the Biofuels Act is of course to "mitigate toxic and greenhouse gas (GHG) emissions." Expected to offset the deadweight costs in the overproduction and underconsumption of biodiesel discussed earlier are environmental benefits, including a sizable reduction in GHG emissions based on life cycle analysis, and substantial health benefits from reduced toxic air pollutants.

A recent survey of studies on the economic impact of climate change and its marginal damage costs reports a mean estimate of \$25/MT as the social cost of carbon for a 3% social rate of time preference (Tol, 2013). With 3.67 MT of CO_2 per MT of C, this amounts to \$91.75/MT of CO_2. As this is for the whole world, Gayer and Viscusi (2014) suggest prorating this to any specific country according to the country's share in world GDP, which for the Philippines is only 0.44%.[3] The social cost of carbon dioxide emissions for the Philippines is therefore \$0.4037/MT or P19.3776/MT of CO_2 at an exchange rate of P48/\$1. At 1,684.24 MT of CO_2 per ML of biodiesel, the social cost of CO_2 emissions is thus P0.0326 per liter of biodiesel. In the aggregate, Table 1 shows that for 2016, if the mandate for biodiesel is raised from 2% to 5%, for η = -0.25, the increase in pure biodiesel consumption will be 213.22 ML, so that the total reduction in the social cost of CO_2 emissions is only P7.02 million. If the country's contribution to the global GHG cost is measured as its share in world population instead of GDP, the reduction in the social cost of carbon emissions rises to P25.88 million.

The health benefits from the reduction in particulate matter (PM) with the higher biodiesel blend may amount to P443.5 million in 2015, according to Vergel and Tiglao (2013). The benefits include savings in treatment cost and increased productivity and working life quality due to the expected reduction in morbidity and mortality with the reduction in respiratory illnesses due to cleaner air as the mandate is increased from 2% to 5% biodiesel blend. Projected to 2016 to factor in a 6.5% population and income growth, the health benefits sum up to P472.34 million.

[3] *See Ravago et al. (2016).*

Summary of Economic and Environmental Impact

Table 3 summarizes the economic, environmental, and health impacts of raising the mandated blend for biodiesel from 2% to 5%. The negative economic impact far outweighs the positive environmental and health benefits, with the net loss amounting to P3.26 billion for 2016 alone. The estimate of economic impact is even conservative, as it is based on a biodiesel price of only P40.00 per liter.

Table 3. Impact of Raising the Mandated Biodiesel Blend from 2% to 5%, 2016 (In Million Pesos at Current Prices)

Economic	
Deadweight cost of underconsumption	(10.91)
Deadweight cost of overproduction	(3,756.57)
Environmental	
Saving in social cost of carbon emissions, GDP weights	7.03
Saving in social cost of carbon emission, pop'n weights	25.88
Health	
Benefits from reduced mortality	442.17
Benefits from reduced morbidity	30.17
TOTAL	**(3,262.23)**

Concluding Remarks

To determine the feasibility of raising the blend of biodiesel, it is also imperative to examine the trends and gaps in prices between crude oil and coconut oil in the world market. Table 4 below shows the trends in the global prices of crude oil in comparison to coconut oil based on the April 2016 World Bank projections. It can be seen that the ratio of coconut oil to crude oil prices (in US$/MT), while softening in the early part of this decade, rose to 3.06 in 2015 and is expected to reach an average 3.30 for 2016 to 2020. This suggests that **raising the blend from 2% to 5% would lead to even higher diesel fuel cost**. This finding is in line with the results of NEDA's Preliminary Assessment of 2015.

Table 4. Trends in World Prices of Crude Oil and Coconut Oil (in Constant 2010 US dollars)

Year	Crude oil, average		Coconut oil	Coconut oil/ Crude oil
	($/bbl)	($/mt)	($/mt)	price ratio
2000	35.48	253.63	566.03	2.2317
2005	60.88	435.14	703.48	1.6167

2010	79.04	564.98	1123.58	1.9887
2011	95.47	682.44	1588.10	2.3271
2012	97.60	697.62	1032.42	1.4799
2013	98.13	701.45	886.86	1.2643
2014	90.89	649.70	1208.84	1.8606
2015	48.04	343.38	1050.16	3.0583
2016	38.10	272.34	1208.00	4.4357
2017	45.70	326.66	1154.00	3.5327
2018	47.90	342.39	1103.00	3.2215
2019	50.20	358.33	1055.00	2.9401
2020	52.60	375.98	1008.00	2.6810
2021	55.20	394.57	964.00	2.4432
2022	57.90	413.87	921.00	2.2253
2023	60.70	433.88	880.00	2.0282
2024	63.60	454.61	840.00	1.8477
2025	66.30	473.91	802.00	1.6923

Note: Values from 2016 onwards are World Bank projections
Source: World Bank Commodities Price Forecast (19 April 2016)

A rise in the biodiesel blend is expected to affect both consumers and producers. Despite the projected price increase resulting from the policy, the “supply-utilization projection based on the data from the Philippine Statistics Authority/Bureau of Agricultural Statistics (PSA/BSA) indicates the likely difficulty of meeting the increased demand of coconut/copra for the proposed 5% blending rate" (NEDA, 2015). Notwithstanding the optimistic production targets of the Philippine Coconut Authority (PCA), the estimated surpluses would still be “not enough to cover the requirements of the proposed 5% blending rate.” Thus, even without the cost and benefit calculations given in Table 3, the relative world price trends in coconut oil and crude oil prices plus the bleak scenario for domestic coconut production augur well for a **postponement of raising the blend, at least in the short run.**

In the medium to long term, a review of the Biofuels Act of 2006 is in order, as several economic studies (such as de Gorter and Just, 2009) point to the distortive effects of mandates and subsidies in addressing climate change issues. Applied welfare economics suggests that the best approach to correcting a distortion is to impose taxes or subsidies so that marginal private cost is made to align with marginal social cost. In the case of GHG emissions, the appropriate action is to impose an environmental tax on the fuels that cause the emissions. The proposal of imposing excise taxes on fuels (particularly diesel) being floated by the Department of Finance is a move in the right direction. Meanwhile, the equity objective of uplifting the economic well-being of coconut farmers is best met by agricultural policies that raise their productivity.

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