Economics Bulletin

Volume 36, Issue 4

The impact of energy market mergers on “green” producers' cost efficiency incentives: some preliminary results

Kevin Currier
Oklahoma State University

Susanne Rassouli-Currier
University of Central Oklahoma

Abstract

Employing a highly stylized model of an energy oligopoly, we examine the cost efficiency incentives facing renewable energy (RE) (i.e., green) producers under a RE quota implemented via a Feed-in Tariff. In addition, we examine some implications of these incentives. We show that under Cournot competition, green producers have limited incentives to exploit learning-by-doing cost savings, but that a merger between the green producer and a fossil-fuel based (“black”) producer can fully restore these incentives. As expected, the merger leads to higher consumer prices ceteris paribus. However, the enhanced post-merger incentives to exploit cost reduction potential in the green technology leads to lower consumer prices. Policy makers should consider these potential impacts when assessing the potential costs and benefits of mergers between green and black energy producers.

We would like to thank an anonymous referee for several useful comments and suggestions.
Citation: Kevin Currier and Susanne Rassouli-Currier, (2016) "The impact of energy market mergers on “green” producers' cost efficiency incentives: some preliminary results", *Economics Bulletin*, Volume 36, Issue 4, pages 2474-2481
Contact: Kevin Currier - kevin.currier@okstate.edu, Susanne Rassouli-Currier - scurrier@uco.edu.
Submitted: September 05, 2016. **Published:** December 21, 2016.

1. Introduction

Around the world, initiatives are being undertaken to reduce harmful greenhouse gas emissions. In the EU for example, the 2030 Framework for Climate and Energy Policy calls for a 40% reduction in emissions (relative to 1990 levels) and a simultaneous increase in the share (a "green quota") of renewable energy (RE) to a minimum of 27% by the year 2030 (European Commission 2014).

One common mechanism for enforcing a green quota in an electricity market is a Feed-in Tariff (FIT) system. Under such a regime, RE (i.e., "green") producers receive a per-unit production subsidy to offset higher production costs. These subsidies are typically funded from general tax revenue or an end-user tax on electricity (i.e., a ratepayer surcharge). Regardless of the funding mechanism, there is a presumption on the part of the government that the subsidies to green producers will be phased out over time as green producers' experience cost reductions from experiential learning in generation as well as other points in the RE production chain such as equipment manufacturing and installation etc. (Couture and Gagnon, 2010). In view of the expectation that green producers will ultimately become cost competitive with fossil fuel based ("black") producers, it is useful to examine green producers' incentives to fully exploit these costs savings.

Recent research has documented the existence of perverse cost incentives facing green producers in electricity markets employing various RE support mechanisms. Within the context of an electricity markets employing both a RE quota and an emissions tax, Currier (2016a) demonstrates that green producers have incentives to engage in strategic collusive cost padding (i.e., incurring pure waste, managerial perquisites etc.). In addition, Currier (2016b) shows that in an electricity market employing both a cap and trade scheme and a green quota, there will always be one green producer with an incentive to both pad its own costs as well as attempt to disadvantage rival green producers.

In this paper, we provide some preliminary results on cost reduction incentives facing green producers in energy oligopolies operated under green quotas implemented via FIT systems. Employing a highly stylized example, we demonstrate that the green producer in a two-producer (one green, one black) duopoly will not have an incentive to fully exploit all potential cost reductions. In addition, we show that under the existing green quota, a merger between the green and black producer will not only be profitable but will also fully incentivize all potential cost reductions attainable in the RE technology. Our results provide preliminary evidence that perverse cost efficiency incentives in RE markets may be reversed through mergers between green and black producers.

A recent case of interest is the case of Total SA's (Europe's third-largest oil producer) acquisition of SunPower (the second-largest solar panel manufacturer in the USA) of 2011. One explicitly stated motivation for this acquisition was the enhanced potential for SunPower to exploit additional cost efficiencies (RE technological improvements) (Bloomberg 2011). Our results demonstrate that such mergers may in fact permit attainment of the full cost reduction potential of the RE technology.

2. The Basic Model

To analyze cost reduction incentives, we consider a stylized electricity market consisting of a single green producer producing output x and a single black producer producing output y. Cost functions are $C_x(c, x) = cx^2/2$ and $C_y(y) = y^2/2$ respectively. As noted earlier, reductions in the cost parameter c are assumed to reflect experiential learning in RE generation as well as RE equipment manufacturing and installation etc. We let total market output $x + y = q$, with inverse market demand $p(q) = 200 - q$.

The market is operated under a green quota which stipulates that green production constitute at least 25% of total production. We assume this constraint is binding and hence $x = .25q$. The green quota is implemented via a per-unit subsidy s paid to the green producer, funded by an end-user tax t on electricity consumption.[1] The values of the tax and subsidy are stipulated by the policy maker to ensure budget balance $tq = sx$ as well as satisfaction of the green quota in equilibrium.

3. Pre-Merger Cost Reduction Incentives

We first examine the green producer's incentive to adopt cost saving methods under Cournot competition. Green producer profits are

$$\pi_x = p(q)x - tx + sx - C_x(c, x) = (200 - x - y)x - tx + sx - cx^2/2 \tag{1}$$

and black producer profits are

$$\pi_y = p(q)y - ty - C_y(y) = (200 - x - y)y - tx - y^2/2 \tag{2}$$

Maximization of (1) with respect to x yields the green producer's reaction function

$$x^r = (200 - y - t + s)/(2 + c) \tag{3}$$

Similarly, maximization of (2) with respect to y yields the black producer's reaction function

$$y^r = (200 - x - t)/3$$

Under Cournot competition, market equilibrium output levels, price, tax and subsidy are determined by equations (4) – (8) below:

1. This is the regulatory practice in many countries, including Germany and Malaysia (Böhringer and Rosendahl 2010, SEDA Malaysia, 2013).

$$x = (200 - y - t + s)/(2 + c) \quad (4)$$

$$y = (200 - x - t)/3 \quad (5)$$

$$t(x + y) = sx \quad (6)$$

$$x = .25(x + y) \quad (7)$$

$$p = 200 - x - y \quad (8)$$

The parameterized solution values of the variables are given by[2]

$$x(c) = \frac{800}{35+c} \quad (9)$$

$$y(c) = \frac{2400}{35+c} \quad (10)$$

$$t(c) = \frac{200(-5+c)}{35+c} \quad (11)$$

$$s(c) = \frac{800(-5+c)}{35+c} \quad (12)$$

$$p(c) = \frac{200(19+c)}{35+c} \quad (13)$$

Figure 1 provides an illustration for the case of $c = 9$ using the reaction functions denoted by RF_x and RF_y. In equilibrium, for any value of the cost parameter c, the values of the tax and subsidy are determined such that the green quota $x = .25(x + y)$ (denoted by line G in the diagram) is satisfied.

[2] Observe from equation (10) that if black producer emissions are proportional to output, then reductions in the green producer's cost parameter will *increase* emissions.

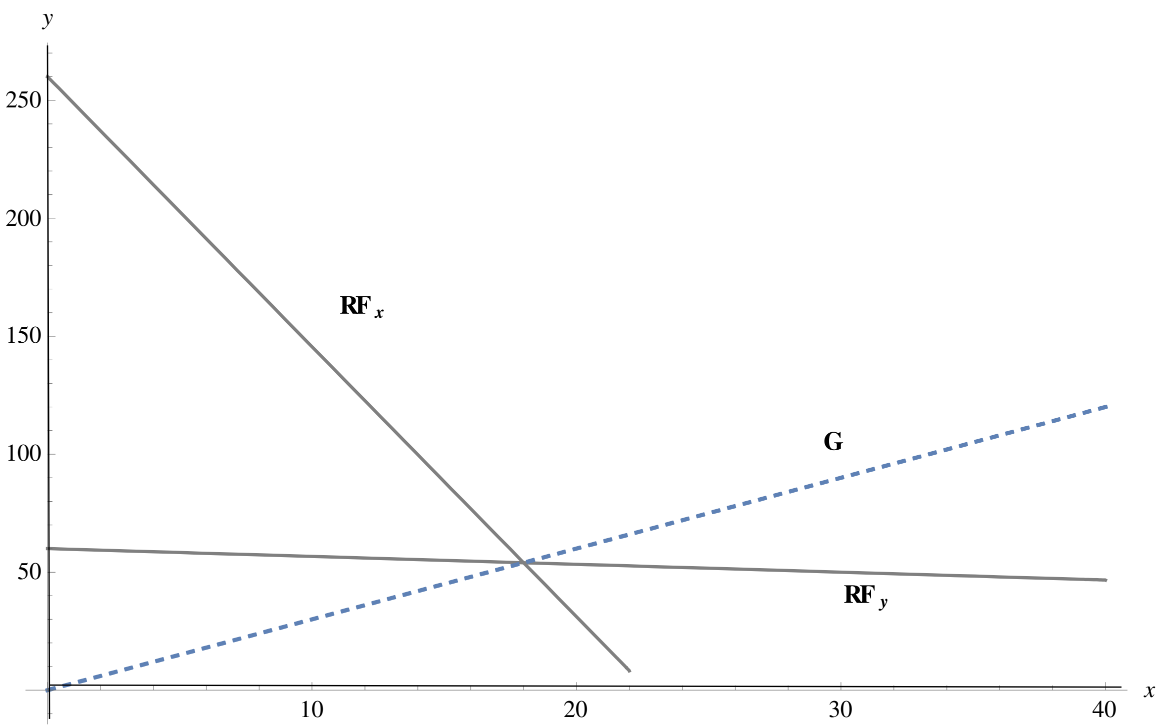

Figure 1

As noted earlier, there is an expectation on the part of the government that the RE support scheme will be phased out as green producers become cost competitive with black producers over time. Within the context of our example, we thus assume that the *initial* value of the green producer's cost parameter is $c = 40$ but that experiential learning etc. will, over time, reduce the cost parameter to $c = 5$, in which case $s = t = 0$ using (11) and (12).[3]

To examine cost reduction incentives by the green producer, observe that green producer maximized profits are $\pi^x \equiv p(c)x(c) + \big(s(c) - t(c)\big)x(c) - C(c, x(c))$ which, using (9) – (13) yields $\pi^x = 320000(2 + c)/(35 + c)^2$. Figure 2 below provides an illustration.

[3] It should be noted that the choice of the level of the green quota must be consistent with the lowest achievable value of the cost parameter c^{min} so that $s = t = 0$ when c is reduced to c^{min}. If the green quota is not consistent with the value of c^{min}, the green producer could require a negative subsidy (i.e., a tax).

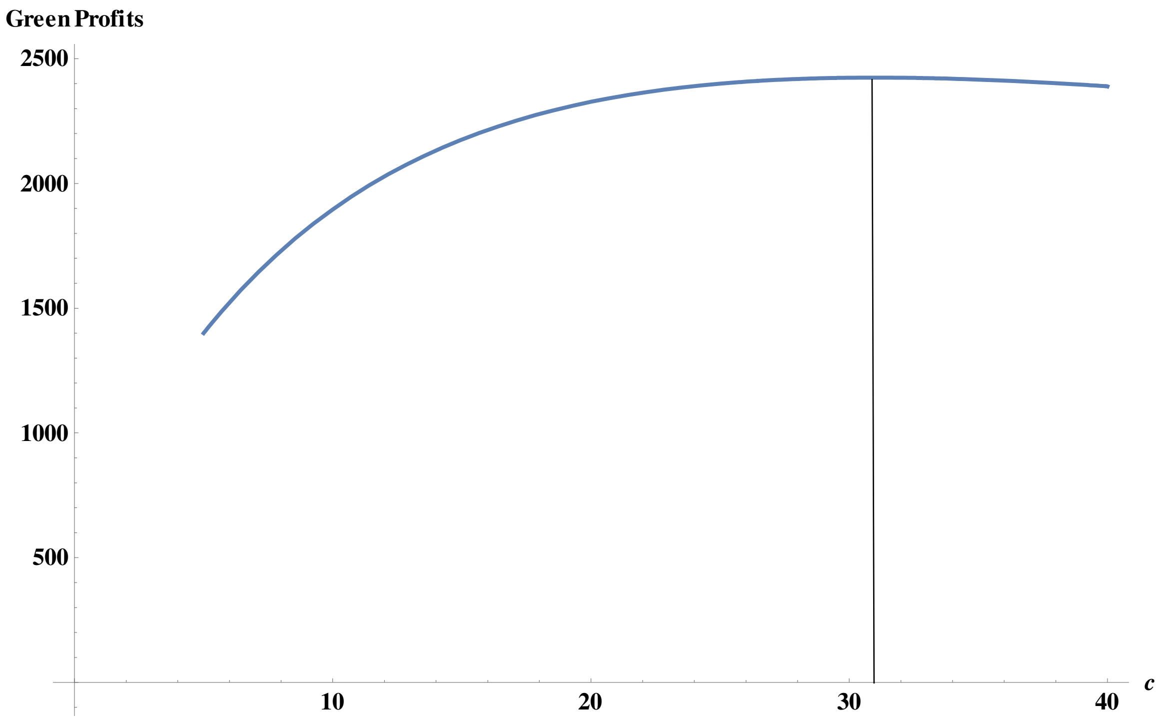

Figure 2

It is straight forward to show that π^x is monotonically increasing in c for $5 \leq c \leq 31$ and monotonically decreasing for $c > 31$. The important implication is that, beginning at $c = 40$, the green producer only has an incentive to exploit cost reduction potential until $c = 31$. Indeed, if the true value of the cost parameter falls below 31, the firm has an incentive to pad costs through a variety of means including managerial perquisites, rent-seeing activities (e.g., political activities designed to prolong subsidization) or simply pure waste. We may conclude then that the anticipated efficiency gains necessary to drive the FIT subsidy to zero will never materialize.

4. Post-Merger Cost Reduction Incentives

We now consider the implications of a merger between the green and black producer. It is assumed that if the merger is permitted, the combined green/black producer must continue to satisfy the policy mandated green quota $x = .25q$ where q denotes the merged firm's total electricity production.

Under the merger, the merged firm will choose black and green output levels to maximize $\pi^M = (200 - x - y).(x + y) - y^2/2 - c\, x^2/2$ subject to the green quota $x = .25(x + y)$, yielding solution values $x^M = 800/(41 + c)$, $y^M = 2400/(41 + c)$ and maximized profit $\pi^M(c) \equiv 320{,}000/(41 + c)$. Figure 3 below demonstrates that the firms do indeed have an incentive to pursue the merger since profits under the merger (post-merger profits) exceed industry profits in the absence of the merger (pre-merger industry profits), i.e., $\pi^M(c) > \pi^x + \pi^y = ((9.28x10^6) + 320{,}000c)/(35 + c)^2$.

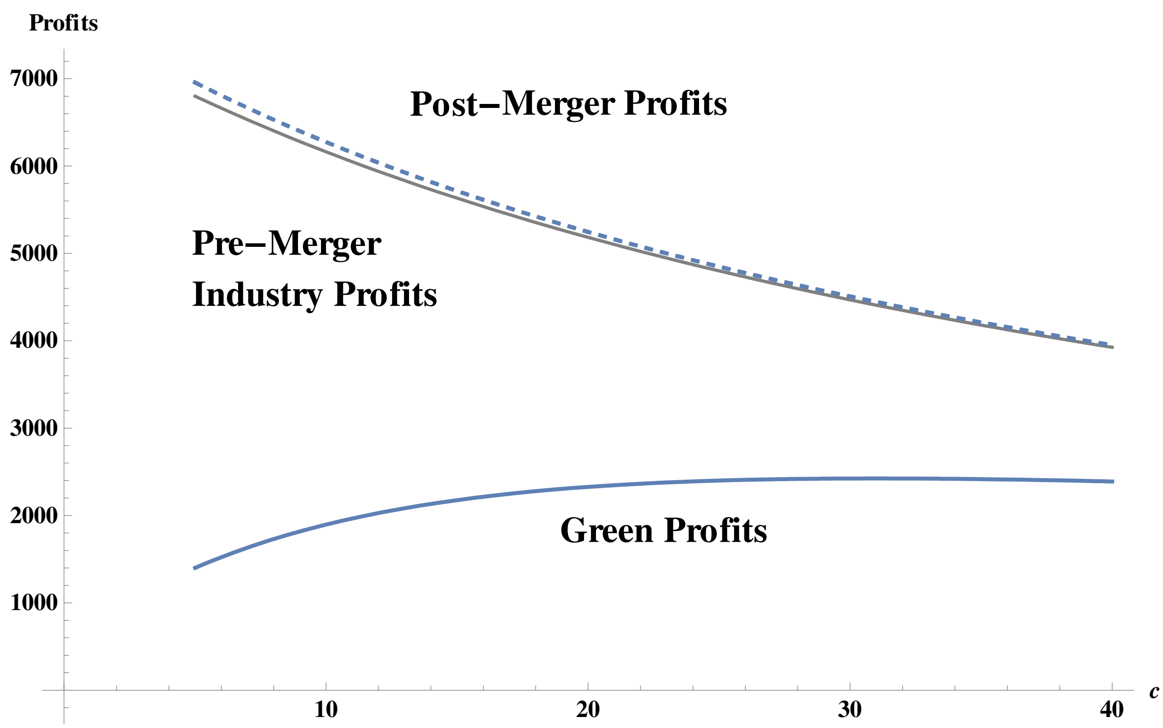

Figure 3

Recall now that in the pre-merger situation, the green producer had no incentive to adopt cost saving methods that would reduce c below 31. However, the merged firm's profit is monotonically decreasing in the cost parameter, implying that the merged firm *will* have an incentive to fully exploit the green technology's cost reduction potential, ultimately satisfying the government's objective of meeting the RE quota in the absence of any subsidization.[4] We observe therefore that the lack of incentive by the green producer to fully exploit the cost reduction potential in the pre-merger situation is a result of the politically imposed FIT system. Furthermore, as figure 4 illustrates, the end user price is reduced the most by permitting the merger. Indeed, in the absence of the merger c is reduced to 31, implying $p = 151.515$, whereas post-merger c will be reduced to 5 implying $p = 130.435$.

[4] By the Envelope Theorem, the observation that post-merger profits are monotonically decreasing in c is true in general.

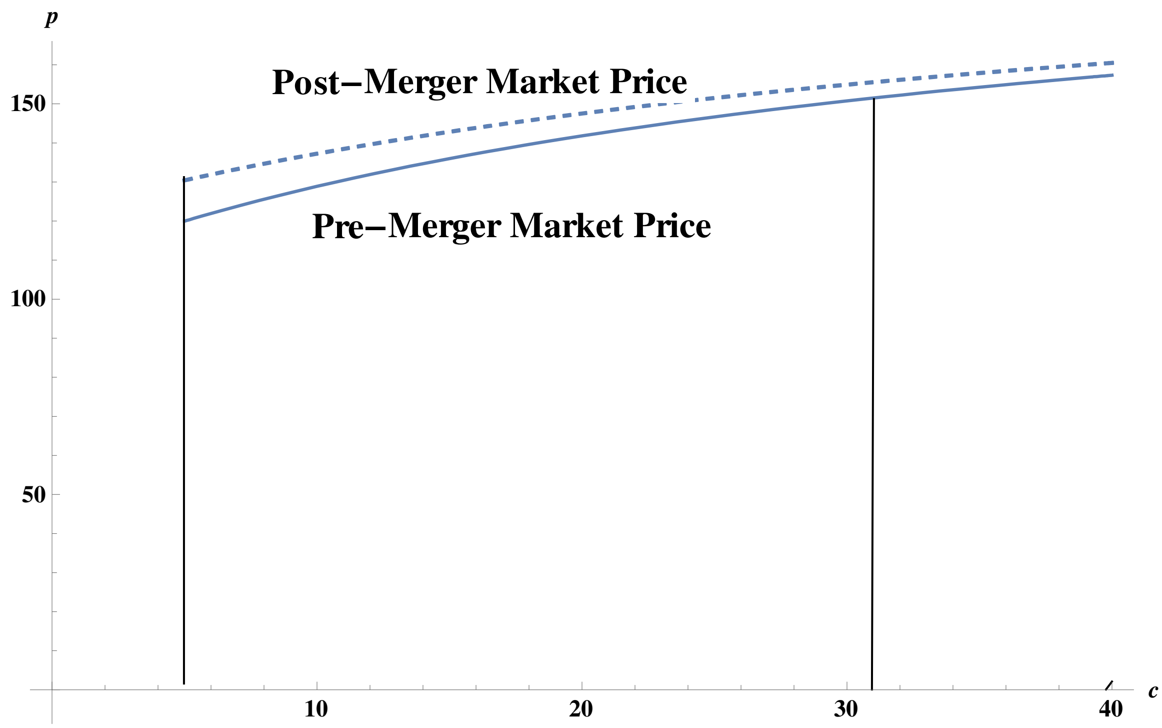

Figure 4

Finally, the monotonic nature of the merged firms' profit ensures that any *additional* (unforeseen) efficiency gains (i.e., reductions in c to a value less than 5) will in fact be exploited post-merger.

5. Conclusions

Concerns about greenhouse gas emissions have led to a variety of policies designed to attack emissions directly (e.g., cap-and-trade, emissions taxation) as well as indirectly by supporting and promoting electricity generation from renewable sources. One common RE policy mandate is the so called "green quota", which aims to ensure that a stipulated percentage of total electricity generation originates from green sources. Green quotas are often enforced via a system of feed-in tariffs where per-unit production subsidies, financed by ratepayers, are paid to green producers to compensate for higher production costs. There is however a presumption on the part of the government that these subsidies will be phased out as experiential learning in all phases of the RE production chain reduce costs to the point that green producers are cost competitive with black producers.[5]

Employing a highly stylized example of an electricity duopoly, we have shown that the green producer will not in general have an incentive to fully exploit the full cost reduction potential of the green technology and could in fact ultimately be expected to engage in strategic cost padding as the green technology matures. However, we have also shown that, not only is a merger between the green producer and the black producer profitable, but that the merger restores the incentive to fully exploit all potential cost savings in the RE technology. Taking this fact into account, consumer prices are reduced the most (and consumer surplus is increased the most) by permitting the merger.[6] In general, the potential for so called "cost synergies" are an important component of competition/merger policy (Viscusi et al, 2005). Our results, while preliminary, demonstrate that in an energy market operated under a renewables quota, the likelihood of *both* the pre-merger and post-merger exploitation of the *full cost reduction potential* of the RE technology, and the implications for consumer prices, should be considered. A more general analysis should focus on the effects of mergers on green producer cost reduction incentives within the context of $n -$ firm $(n > 2)$ oligopolies.

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[5] Formally, the subsidy phaseout is often referred to as "tariff degression".

[6] The effect of a merger on consumer surplus is a major consideration for antitrust authorities (Pittman, 2007). Obviously, overall welfare considerations will depend on the trade-offs between the government's various policy objectives, including reduction of damages from emissions.