University of Hawai`i at Mānoa Department of Economics Working Paper Series

Saunders Hall 542, 2424 Maile Way,
Honolulu, HI 96822
Phone: (808) 956 -8496
www.economics.hawaii.edu

Working Paper No. 16-13

The Public Economics of Electricity Policy with Philippine Applications

By
Majah-Leah Ravago
James Roumasset

September 2016

The Public Economics of Electricity Policy with Philippine Applications*

Majah-Leah Ravago and James Roumasset†
University of the Philippines, University of Hawaii
and Energy Policy and Development Program

Abstract

Electricity policy in many economies is charged with multiple objectives including affordability, sustainability, inclusivity, and renewability. Unless these objectives can be reconciled, the pursuit of one will detract from the pursuit of another. We provide a framework for culling some objectives and reconciling other by extending the traditional view of efficiency. Philippine power policies are characterized and evaluated with respect to conflicting objectives and the problem of incomplete deregulation. We also make preliminary suggestions regarding investment planning for generation and transmission, including the suitability of short-cut metrics such as *levelized* and *avoided* costs and the prospects for increased competitiveness.

JEL codes: Q4, Q48, Q41
Keywords: Electricity, renewable energy, excess burden, deregulation, competition, Philippines

---

* This research reported here is a product of the Energy Policy and Development Program (EPDP), a four-year program funded in part by the U.S. Agency for International Development (USAID) and implemented by the UPecon Foundation, Inc. The contents or opinions expressed in this paper are the authors' sole responsibility and do not necessarily reflect the views of USAID, the United States Government or the UPecon Foundation, Inc. Any errors of commission or omission are the authors' and should not be attributed to any of the above.

† Majah-Leah Ravago is Assistant Professor at the University of the Philippines and Program Director of the Energy Policy and Development Program (EPDP) of the Philippines. James Roumasset is Professor Emeritus (pending) at University of Hawaii and an EPDP fellow. This paper benefited from the comments of participants of the EPDP Research Workshop held in Tagaytay City on 6 Nov. 2015. We thank J. Kat Magadia and Shirra de Guia for their excellent research assistance, Arlan Brucal and Karl Jandoc for their help with the graphs, and Arsenio Balisacan, Lee Endress, Matthias Fripp, Michael Roberts, Steve Salant, and Nori Tarui for useful discussions.

The Public Economics of Electricity Policy with Philippine Applications

Majah-Leah Ravago and James Roumasset
University of the Philippines and University of Hawaii

What objectives should power policies advance? How should the provision of electricity be organized, and what is the role of prices, markets, competition, and regulation? How should the efficient levels of investment in generation and transmission be incentivized? We discuss these issues in generation and in the Philippine context in the sections that follow. Part 1 makes the case that multiple objectives should be either culled or reconciled with the unifying objective of social welfare and is illustrated through the case against subsidies of renewably-sourced generation. Part 2 provides the case for deregulation and competition and reviews the Philippine situation. Part 3 provides an overview of the theory of efficient generation mix, transmission patterns, and pricing, including the possible roles of levelized and avoided costs in the location of intermittent renewable sources of generation and the possible economic cost of renewable subsidies in the Philippines. Part 4 concludes.

1. Too many objectives spoil the broth

Electricity policy in many economies such as the Philippines is charged with multiple objectives including sustainability, inclusivity, the promotion of renewability, and many more. Unless these conflicting objectives can be reconciled, the pursuit of one will detract from the pursuit of another. We will elucidate the nature of these and other objectives and provide a unifying framework by extending the traditional view of efficiency. Electricity has a number of special features that are often considered unique, including the need to coordinate generation and consumption instantaneously and the variability of demand over space and time. Moreover, the spatial market functions (transmission and distribution) are typically considered natural monopolies while the generation and retailing functions are not.

1.1 Sustainability

Sustainable development calls for the extension of the principles of public policy to the *environomy* – the union of the environment and the economy (Roumasset et al. 2010, Balisacan et al. 2015). This requires inclusion of natural resource depletion and pollution in production and consumer-preference structures. As Solow (1991, 1992) and Heal (2000, 2008) have articulated, sustainability also includes an injunction not to discriminate against the future. In practice, this may involve discount rates that account for the opportunity costs of investment but do not otherwise discriminate against policies and projects that generate benefits in the distant future. As usual, the objective function depends on the welfare of present and future generations, but no additional objectives are needed.[1] Implementing the comprehensive solution will require internalizing spillover effects into market signals, including the damages

[1] It is instructive that Ed Barbier, who invented the famous Venn diagram (multi-objective) approach to sustainable development in 1987, recanted the same year when the Bruntland Commission report came out (Ravago et al., 2010).

that today's carbon emissions (a stock pollutant) impose on the future. It also requires resource extraction policies that motivate private and public decision makers to account for the future opportunity cost of using natural resources in their decisions (Endress and Roumasset 1996, Endress et al. 2005). Thus, rather than jumping to the conclusion that greater reliance on self-sufficiency and renewable resources will automatically advance sustainability, an extension of economic welfare to include intergenerational equity and environmental-economic interdependence is necessary.

1.2 Inclusivity

Evaluating electricity policies and projects according to some (typically unspecified) metric of vertical equity is likely to detract from sustainability as outlined above and lead to an incoherent policy mix. One way to avoid conflicting equity and efficiency objectives leading to the dead end of the "new welfare economics" is to recognize that taxpayers obtain benefits from consumption of basic needs by the poor (Harberger 1984), particularly food, housing, health, and education. Since basic-needs provision generates consumption externalities for taxpayers, optimal expenditures thereon can be at least partially addressed under the rubric of efficient public goods provision. The question then becomes whether access to electricity should be regarded as a basic need. If so, some level of subsidy may be warranted. If not, the subsidy question hinges on other possible market failures, including the collective demand for poverty reduction.

Lee et al. (2016) show that the social benefits of "leapfrogging" to small, isolated solar systems as a strategy for rural electrification may generate very limited benefits compared to "real," grid-connected electrification,[2] due to its typically small size and unsuitability for nighttime use.[3] However, the binary classification into real and truncated power blurs the distinction between being connected to the main transmission grid and being part of an off-grid distribution network. The latter are typically both more expensive and less reliable, at least before subsidies. Thus the appropriate comparison should involve at least three alternatives:

1. Installing new substations and corresponding distribution networks along the major transmission grids.
2. Extending existing off-grid distribution networks and opening new ones. (These are typically higher unit cost systems.)
3. Providing stand-alone (e.g. solar) facilities and very small, multi-household networks, including the option of charging stations for rechargeable batteries.

A benefit-cost comparison of these alternatives should consider the extent of capacity, reliability, time of day constraints and costs (with and without subsidies).[4]

[2] Despite Wolfram's (2016) disparaging remarks about the term "leapfrogging" (from the NY Times) the term seems to be retaining some currency.

[3] Lee et al.'s (2016) unfavorable result may derive partly from the Kenya program offering solar systems much smaller than what the budget would have allowed (see comment to this effect at Wolfram, 2016).

[4] Wolfram (2016) refers to category 1 as "real" electricity. Category 3 is not "real" in the sense that capacity (usable watts) is limited and it is often only available during certain times of the day. By introducing category 2, we see that the quality of electricity is a continuum, not a dichotomy.

The cost-effectiveness of pro-poor pricing (e.g., increasing block or "lifeline" rates) can be similarly evaluated. Since extending access by the means listed above and charging full-cost rates would not provide much benefit to the poor, one must compare the cost-effectiveness of subsidizing rates to low-income consumers with other programs such as contingent-cash transfers. On the other hand, removing existing distortions (e.g. artificial limits to competition and ratepayer-funded subsidies) that lead to unnecessarily high prices will help both non-poor consumers as well as poor households with access to electric power.

1.3 Renewability

While *renewability* is commonly regarded as an objective, this is a category mistake.[5] Renewability is a possible means to the end of environmental quality. Asserting it as an end in itself suppresses the requisite analysis. Externalities due to carbon and other emissions can be internalized by taxing emissions according to the damages that they inflict. This will promote renewable and clean energy as the eventual scarcity drives petro-chemical prices up and innovations reduce the costs of renewable sources such as solar (Chakravorty et al. 1997). As illustrated in what follows, using renewable subsidies to distort this efficient transition leads to unnecessary burdens and economic waste, exacerbated by the increased taxation needed for their finance.

1.3.1 Taxpayer-funded subsidies

Figure 1 portrays the case of a taxpayer-funded subsidy to make an economy self-sufficient in energy by displacing power from imported petro-chemicals with domestically-produced renewable energy, such as wind and solar. Perhaps the most common vehicle for the deliverance of the subsidy is a tax-credit offsetting part of the cost of purchase. For many years in Hawaii, for example, consumers could get a 65% rebate on the cost of photovoltaic systems through Federal and State tax credits.

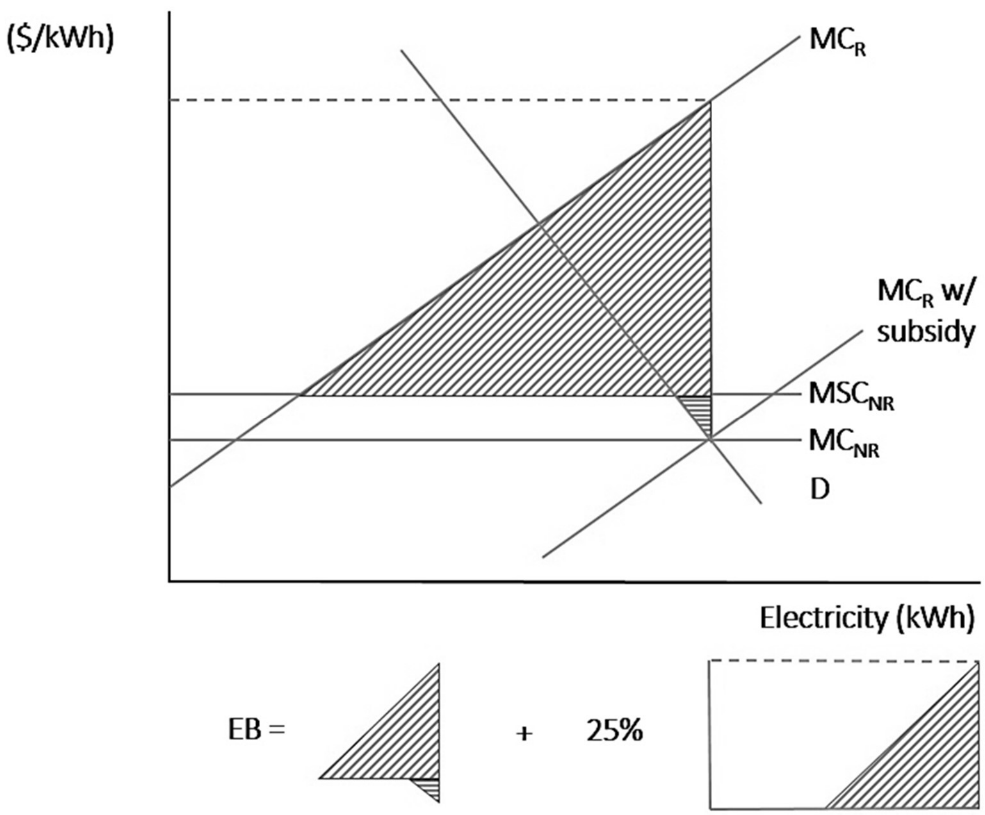
Assume that burning petro-chemicals incurs a *marginal damage cost* equal to the value of the incremental damages from pollution and carbon emissions. The marginal social cost of power generation from such polluting non-renewable sources (MSC_{NR}) is given by the marginal private cost of generation (MC_{NR}) plus said marginal damage cost. Socially efficient production occurs where MSC_{NR} intersects the demand curve, D, which in turn represents marginal social benefits. Self-sufficiency is attained via a subsidy (intersection of D and "MC_R w/ subsidy") just high enough to entirely displace non-renewables. As shown, the primary source of deadweight loss (excess burden, EB) is the extra costs of attaining a renewable portfolio standard of 100%, including costs of smoothing intermittent production to fit the load demanded by consumers. In a competitive environment or well-regulated monopoly scenario, renewable subsidies would also lower the price of electricity to consumers below the marginal social cost, including

[5] Dasgupta (1995) similarly suggests that *strong sustainability* involves a category mistake. Under what conditions maintaining the stock of natural capital promotes intertemporal welfare is a matter for analysis, not assertion (see e.g. Endress et al. 2005).

pollution costs (Borenstein 2012b). This results in the small additional excess burden triangle as shown.

Another source of excess burden is the fiscal costs of the subsidy. Since the subsidy itself is a transfer, that does not in itself cause economic loss. The excess burden comes from the taxes required to finance the subsidy. As surveyed by Bird (2005), estimates of marginal excess burden (MEB) vary widely. For the U.S., Ballard et al. (1985) estimate an MEB from 17-56%, Feldstein (1995) a much higher 165% and Diewert et al. (1998) conclude that MEB should be a minimum of 23%. In his estimate of the excess burden of Hawaii's Clean Energy Initiative, Endress (2013) uses the conservative estimate of 25%, which is used in the illustration (Figure 1).

Figure 1. The excess burden of a taxpayer-funded self-sufficiency subsidy



The terminology of the double dividend debate may be instructive. The double dividend of emission taxation refers to the benefits of internalizing the marginal damage cost of emissions (first dividend) and the additional dividend from recycling the revenue obtained through a reduction in other distortionary taxes.[6] In our example of a subsidy instead of a tax, both these dividends are negative. Moreover, the first dividend has two parts: the (large) excess cost of power provision and the (small) cost of marginal benefits being below marginal social costs. The

[6] The term "double dividend" was coined by David Pearce (1991).

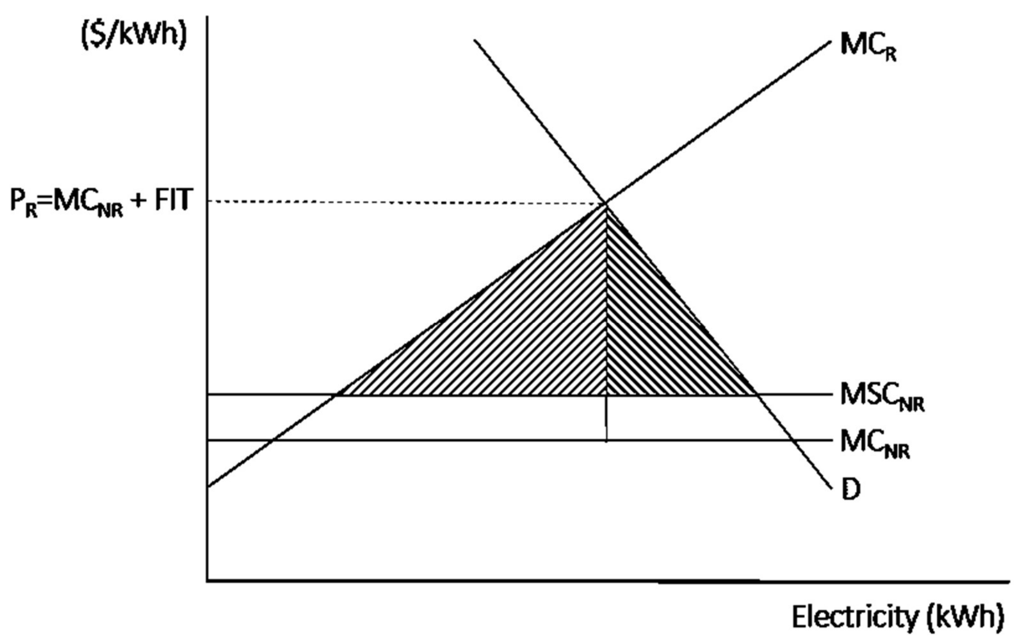
second negative dividend is the extra tax friction needed to finance the subsidy, e.g. 25% of the revenue rectangle.

1.3.2 Tied to be FIT

Instead of a taxpayer-funded subsidy on supply, many countries rely instead on feed-in tariffs (FITs) for the promotion of renewable energy. We assume that the retailer/distributor is mandated to buy a certain percentage of their sales from renewable sources and that regulation succeeds in emulating competition.[7]

How should FIT rates be set? Figure 2 illustrates the case wherein the regulator sets a "self-sufficiency" price such that electricity demand (D) equals the domestic supply (MC_R) of renewable-sourced power by equating the FIT to the difference between the self-sufficiency price and the marginal cost of the non-renewable substitute (MC_{NR}). For the typical assumption that the demand curve is more inelastic than the supply curve, one can readily observe that the supply-side burden has been reduced more than the demand-side burden has increased. The high retail price reduces the quantity demanded, thus displacing the highest cost renewable energy. Since this type of FIT is fully funded by ratepayers, it does not require raising other taxes and incurring a negative revenue recycling effect. Thus it appears, on the basis of the "two dividends" that the FIT is considerably less than the taxpayer subsidy, i.e. taxpayer gains are more than consumer losses.

Figure 2: The Excess Burden of a Uniform Feed-in Tariff



[7] Inasmuch as costs are increased, rate-of-return regulation would further increase profits and warrant even higher prices.

However, the analysis is complicated by the existence of a third "dividend", called the *tax interaction effect*, *which accounts for the increased burden* from pre-existing tax distortions.[8] In the case of FIT, the question is how much higher power prices exacerbate pre-existing distortions, in particular, existing taxes on capital. This effect may be quite large inasmuch as capital and electricity are complements in both industry and households and the price of capital has already been artificially raised by personal and corporate income taxes and by artificial restrictions on the use of foreign capital.[9] Moreover, to the extent that manufacturing is an engine of growth, there is a case for artificially lowering the cost of capital in manufacturing, e.g. as practiced in Korea and Japan, in order to partially internalize coordination externalities (Roumasset and Barr 1992, Ravago et al. 2016). This means that the general equilibrium effects of increasing energy prices are higher still.

To the extent that the regulatory authority has accurate information about the generation cost schedules of different sources, it can act as a discriminating monopsonist and economize on the supply-side excess burden by paying renewable sources only what is necessary for said supplies to be forthcoming. This case is illustrated below (section 3.3) for the case of FIT in the Philippines, but could apply to taxpayer subsidies as well. In summary, we do not know *a priori* whether the large, negative double-dividend of the taxpayer-funded subsidy is greater or less than the triple negative dividend of the ratepayer subsidy.

The true costs of FIT are likely to be between the extremes of a perfectly discriminating and perfectly non-discriminating monopsonist. The regulatory authority, of course, does not have perfect information and cannot simply pay discriminatory prices as it moves up the supply curve. Instead the authority is likely to charge one price for wind power, one for solar, one for biomass, one for run-of-river hydro, etc. according to what those sources "need" to be viable suppliers. But since the levelized costs of these sources will vary by project, this approach is unlikely to provide even an approximation of the marginal cost curve. Moreover, in an attempt to be "fair," the implementing bureaucracy may limit the quantity of particular sources, in effect catering to lobbying pressures instead of minimizing cost. It is easy to see how these policies are likely to result in departures from the least-cost supply schedule of renewables. As discussed in section 3, however, all renewables are not created equal and will have different effects on electricity price and the amount of carbon that is displaced (Novan 2015, van Kooten 2015).

In summary, we cannot say whether taxpayer-funded or FIT subsidies cause the largest excess burden. The former impose large excess burden costs on the power sector and from fiscal drag, but induce a smaller exacerbation effect. FIT subsidies cause a smaller excess

[8] For example, Bovenberg and Goulder (1996) argue that this third dividend is negative for an emission tax and is likely to outweigh the positive recycling effect, thereby making the second best emission tax less than its first-best level.

[9] Goulder and Williams (2003) find that the tax interaction effect may be an order of magnitude higher than the partial equilibrium effect.

burden in the power sector and have no fiscal costs but may impose a large cost in terms of the rest of the economy. Either approach imposes a large burden on the economy.[10]

Other variations on the theme can be analyzed. For example, when there is a wholesale market, FIT mandates will cause the wholesale price to fall by increasing the supply of renewables (van Kooten 2013), but will simultaneously increase regulated retail rates in order to allow the utility to recover mandated costs. Indeed, the generally accepted presumption that renewable subsidies will lower the price of power (e.g. Borenstein 2012a), should not be applied to retail prices. Casual empiricism suggests that the economies with the highest subsidies (e.g. Spain, Germany, Denmark, and California) have higher power prices, not lower. This may be primarily because ratepayers rather than taxpayers fund the subsidies via FIT programs or mechanisms that operate through regulation. Under *decoupling*, for example, distribution utilities obtain modest increases in revenues independent of costs, thereby incentivizing the utilities to promote renewable generation but at the cost of higher consumer prices.

The unnecessary welfare burden can be avoided by recognizing environmental quality as the relevant welfare-promoting objective that renewability is meant to promote. In the standard welfare theoretic apparatus, public policies should be those that maximize the welfare of the general public.[11] Given the rapid progress in renewable technologies and the increasing scarcity of non-renewable fuels in the long run, the challenge is to put policies in place that will facilitate an efficient transition. The first requirement for the efficient use of renewables is to internalize the social costs of petro-chemicals by placing a pollution tax equal to the marginal damage cost imposed on the economy in question, not the worldwide social cost of CO2, e.g. estimated at $25 per ton (Nordhaus 2015).[12] While the Philippines only represents 0.4% of the world economy, its vulnerability is considerably more. But even if damages from climate change in the Philippines are as much as 10 times higher than indicated by their share of world income, the appropriate carbon tax would still only amount to $1 per ton.[13] On the other hand if an efficient, comprehensive, and binding global agreement were in place involving all countries,

[10]Empirical estimates are scant, but Endress (2013) estimates that a single program, taxpayer-funded subsidies of distributed solar power, shrunk the Oahu economy by almost $1 million per day even though photovoltaics accounts for only a small part of Oahu's power supply.

[11] The dilemma in the *new welfare economics* is that absent a consensus regarding the social welfare function, welfare economics comes to a dead end. However, in the *new new welfare economics* (Stiglitz 1987), it is possible to assert limits of said function that translate to a reasonably narrow set of possible optimal solutions. Moreover, a case can be made in countries such as the Philippines with fairly efficient transfer mechanisms such as CCTs, that the welfare weight given to poor families should not exceed the inverse of the social cost of transfers to the poor. This means that even if one half of the most cost-effective transfer program is lost to tax friction and disincentives to the poor, the welfare weight for poor families should not exceed 2.

[12] Eleven tons of CO2 contains three tons of carbon. Therefore, a SCC of $25/ton of CO2 is equivalent to $92/ton of carbon. For a meta-analysis of diverse estimates of the social cost of carbon, see Tol (2011).

[13]Even for the USA (with its 22% share of the global economy), using global damages instead of correctly using domestic damages amounts to applying an unjustified global multiplier of 4.4 to 14.3 times US damages in calculating the benefits of reducing carbon emissions (Gayer and Viscusi 2016).

the appropriate carbon tax in the Philippines would be the full $25.[14] But even absent a global climate-change agreement, taxes on local pollutants (primarily SO_2, NO_2, and particulates) are still warranted and will stimulate the market to provide renewable substitutes. All things considered, emission taxes of 10-15% on coal could be justified even without a binding global agreement.[15]

Another appropriate target for policy intervention is the internalization of externalities from knowledge spillovers. In particular, subsidies for R&D aimed at lowering the cost of sourcing electricity from renewables are warranted (Acemoglu et al. 2012). But again, this is a global externality. If an agreement were in place, the Philippines should contribute its appropriate share of the R&D subsidy. Otherwise, the subsidy should be set according the Philippine share of benefits from the additional knowledge produced. If the Philippines is unlikely to have a comparative advantage in things like solar panels and wind turbines, this share would be quite small (and technical progress in renewable-sourced electricity will continue without Philippine subsidies). However, R&D subsidies may be warranted on adaptive research, for example, on renewable designs that are more suitable to the Philippine economy.

The percentage of electricity from renewables will increase without RPS mandates or unwarranted subsidies as non-renewable resources are depleted, technical change continues, and externalities are appropriately internalized (Chakravorty et al. 1997 and 2008). In addition, government policy can *facilitate* the greater use of renewables in accordance with its role in pursuing economic efficiency. In particular, the following are in line with Adam Smith's *night-watchman* functions and should be pursued as efficiency warrants.

1. Providing an informative transmission investment plan based on calculations of optimal generation mix and location, including flexibility of said plan regarding new generation opportunities identified by the private sector.
2. A well-functioning forward market allowing independent intermediaries to enter the retail market.
3. Streamlining red tape regarding the entry of new generating facilities.
4. Providing information to potential investors regarding a state-of-the-art menu of renewable techniques.
5. Technical assistance in the installation and operation of generating facilities.
6. Training technical personnel.
7. Assistance with technical and financial feasibility studies.
8. Overseeing the upgrading of transmission and distribution infrastructure, in particular to accommodate the intermittency associated with greater penetration of Variable Renewable Electricity (VRE), primarily solar and wind power.

1.4 Other objectives

[14] If the Philippines were part of an incomplete global coalition, the optimal carbon tax for coalition members would be correspondingly less (Nordhaus 2015). A $25 carbon tax converts to $92/ton of CO2.

[15] A ton of coal emits 2.86 tons of CO2. In the face of unemployment, a case can also be made for taxes on domestic coal production to be less than the taxes on imported coal.

While the over-riding objective of economic policy is social welfare, other possible intermediate objectives can be found in documents dealing with electricity policy, for example in the Philippines (see Section 2.2). Among these are reliability, affordability, and self-sufficiency.

Like renewability, *self-sufficiency* as an objective can be rejected as a category mistake and, as discussed above, for reducing social welfare. *Reliability* as an intermediate objective would require extending the basic efficiency principles discussed above to account for uncertainty such as demand fluctuations, equipment failure, intermittency problems, and natural disasters. *Affordability* follows from the efficient pursuit of consumer welfare, modified by the equity considerations discussed under *inclusivity* in section 1.2.

The pursuit of multiple objectives is likely to be infeasible, e.g. as in the case of economic growth, poverty alleviation, and environmental preservation when these are misleadingly viewed as separate components of sustainable development (Ravago et al. 2010).[16] And even if the over-arching goal of intertemporal welfare is replaced by multiple well-defined (albeit arbitrary) metrics, we are still left with the problem of how the objectives are to be weighed. The proliferation of objectives thus removes accountability in setting priorities for public spending and sets the stage for unlimited rent-seeking since almost any program can be justified on the grounds of some subset of objectives. And when the government programs retard or fail to advance other objectives, the response is often to patch on ever increasing mandates, subsidies, and other distortions resulting in a black hole of government spending (Roumasset 2000).

In cases where the government commitment to a particular objective is clear, the key is to interpret that objective as a dimension of the common good. As discussed above, this leaves several avenues by which the government can facilitate the integration of more renewable sources in ways that reduce the cost of power, including environmental costs.

2. Deregulation and market organization

2.1 Unbundling

Complete electricity deregulation is often presumed to require unbundling all of the basic functions of electricity provision, i.e. into generation, transmission, retailing, and distribution, and the formation of forward and spot wholesale markets under the auspices of a market governing authority.

Generation and retailing are suitable for privatization and competition. Transmission and distribution are commonly regarded as natural monopolies due to the potential for inefficient duplication of network infrastructure. It appears that there are economies of scope in transmission. Instead of, say, building transmission lines from each generator to specific

[16] Another example is the National Food Authority's pursuit of low and stable prices for consumers and high and stable prices for producers (Roumasset 2000).

distribution substations, one can imagine that the network is pooled by means of a trunk line "hub" that is joined to the substations by "spokes".[17]

In the New Zealand variant of unbundling, companies are allowed to have both generation and retailing arms. Generating and retailing divisions, however, are not allowed to have bilateral contracts with one another. Instead, generators must sell all of their power to the wholesale market and retailers must buy all of their electricity from the market. Moreover, the bids from the generating and wholesale arms must be within 5% of one another. This incentivizes each division to act as if they are competitors in a completely unbundled market while retaining possible economies of scope in generation and retailing. The country has accordingly achieved a highly efficient wholesale market and efficient operation of generation and retailing, even without complete unbundling.[18]

The USA has largely deregulated generation but has left several large "utilities" in place that handle both retailing and distribution. This requires regulation of retail pricing. Instead of simply setting prices that limit the rate of return on capital, today's regulators attempt to control expenditures as well, aiming to set regulations to motivate utilities to undertake efficient investments. However, this ideal is sometimes compromised by the "other objectives" problem, e.g. the pursuit of renewable energy and repaying stockholders who have been victims of previous attempts at deregulation (Borenstein 2012a, 2012b).

2.2 The Philippine case

Before the landmark passage of the Electric Power Industry Reform Act (EPIRA) in 2001, the power industry in the Philippines was vertically integrated and the National Power Corporation (NPC) had monopoly over power generation and transmission.[19] Appendix A provides the history of power policies in the Philippines and the structure of the industry before and after EPIRA. Despite private sector investment in 1993-1994, reliability problems continued, end-consumer rates were still highest in the region, and the distribution network was characterized as being highly fragmented (DOE 2000; Villasenor 2000). The operation of NPC, a government owned and controlled corporation, had accumulated a huge debt, exacerbating the country's already stressed fiscal situation.[20]

---

[17] Noble Laureate Vernon Smith (1993, 1996) argues in contrast that the common observation of parallel transmission lines suggests that competition among transmission providers may also be feasible.

[18] If there are further efficiency gains to be made, it appears that these may come from the transmission and distribution sectors, which account for 50% of electricity rates (personal correspondence with the CEO of New Zealand's Electricity Authority).

[19] Before EPIRA, Executive Order (EO) 215 put an end to monopoly power in generation by the NPC in 1987.

[20] Another contributing factor was the failure to complete and operationalize the Bataan nuclear power plant, partially constructed under dubious contracting arrangements during the Marcos administration. The Build-Operate-Transfer (BOT) Law (RA 6957) was partially motivated by a desire to improve incentives in electricity generation, but it proved to be too late.

The industry experienced a major policy shift with the passage of EPIRA in 2001. The objectives of EPIRA were to increase competition and lower market prices by privatizing generation and unbundling the four functions and setting up a wholesale spot market. Transmission and distribution were meant to be left as regulated monopolies. EPIRA created and transferred ownership and management of the transmission network to the National Transmission Company (TransCo), which later transferred management to the National Grid Corporation of the Philippines (NGCP)[21] as per RA 9511.

Provisions of the Retail Competition and Open Access (RCOA) law, intended as furtherance of EPIRA,[22] aimed to gradually increase competition such that eventually all consumers could switch retailers anytime, e.g., as in Singapore and New Zealand. Competition was planned to be phased in gradually, starting by making only large customers "contestable" in the sense that retailers can compete for their business and then progressively phasing in more inclusive standards of contestability. To date, EPIRA has missed the deadlines prescribed by law. The end-goal of establishing a competitive retail sector should have been realized in 2007, but the contestability program was only begun in December 2012. At the end of 2015, 1MW per month was the minimum qualification to be a "contestable customer."

Nonetheless, EPIRA has achieved some milestones, most notably the establishment of the Wholesale Electricity Spot Market (WESM) and transfer of the management of transmission assets a private concessionaire (the NGCP). Despite misgivings about EPIRA, going back to a vertically-integrated public utility may have unfortunate consequences for public debt, unless a strong and independent regulatory system could prevent the profligate use of subsidies for political purposes. But for the vision of EPIRA to be fulfilled, competitiveness in both the generation and retailing sectors needs to be increased.

2.2.1 Industry concentration in power generation

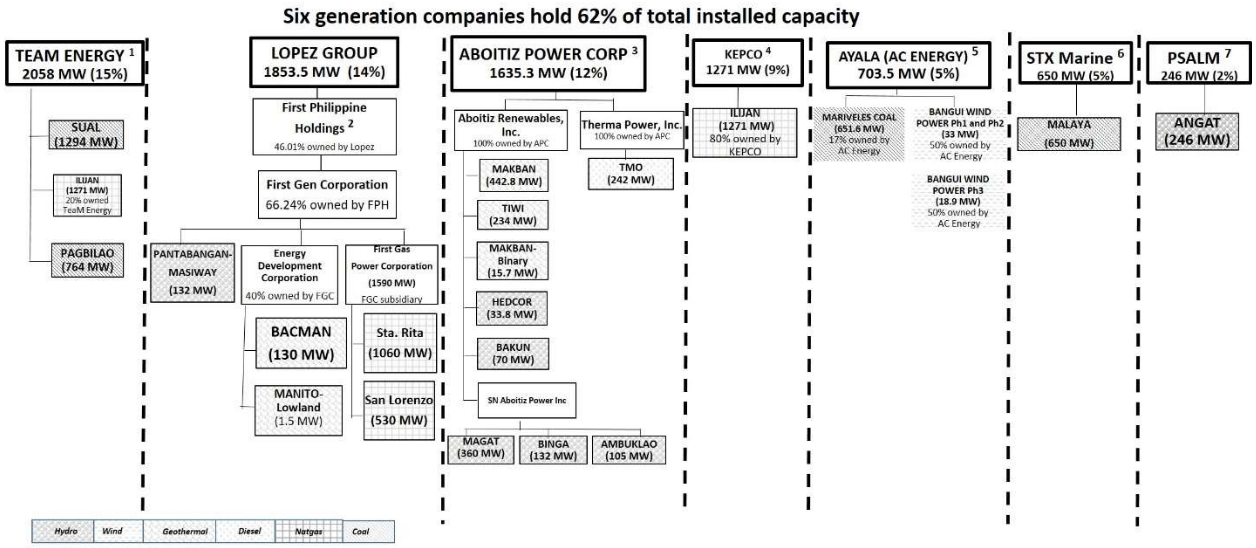
New entry in the generation sector has been slow, and competition remains limited. Figures 3 and 4 illustrate the concentration ratios for generation in Luzon and the Visayas.[23] The figures show that the KEPCO group, the Lopez companies, and Aboitiz control a large proportion of the generation market. Matthes et al. (2005) suggest that market dominance potentially exists when three firms control at least 50% of the market or five firms control 66% of the market.

[21] NGCP is a consortium consisting of Monte Oro Grid, Calaca High Power Corp, and State Grid Corporation of China.

[22] Meralco is currently asking the courts to invalidate RCOA, however, on the grounds that it is in conflict with EPIRA and its implementing rules and regulations (Rivera, 2016).

[23] Mindanao is not considered here inasmuch as security and other political issues have delayed privatization.

Figure 3. Generation Concentration in Luzon



Source: Department of Energy, 2015

- *Total installed capacity in Luzon – 13,598.4 MW*

1 Team Energy – a partnership between noted Japanese firms Tokyo Electric Power Company and Marubeni Corporation

2 First Philippines Holdings – the parent and controlling shareholder of First Gen. First Gen is the primary holding company for the power generation and energy-related businesses of the Lopez Group

3 Aboitiz Power Corp - a publicly listed holding company that, through its subsidiaries and affiliates, is a leader in the Philippine power industry and has interest in a number of privately-owned generation companies and distribution utilities a wholly-own

4 KEPCO -stands for Korean Electric Power Corporation. It expanded its operations in the Philippines in 1995

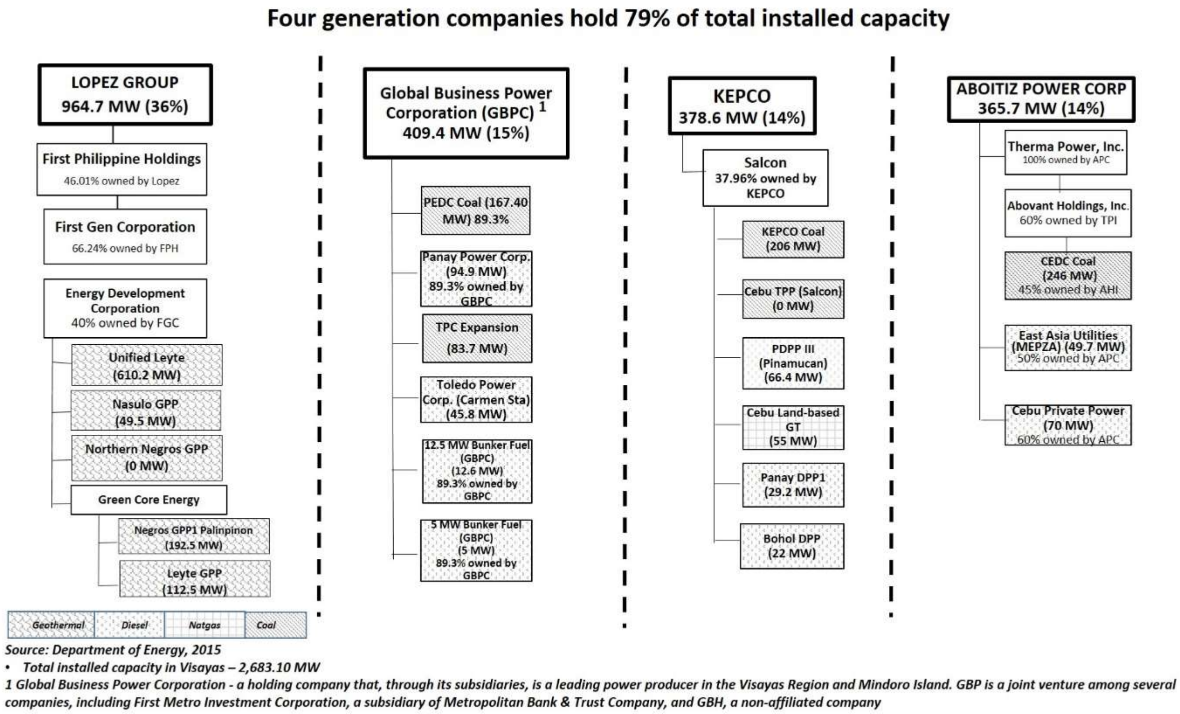
5 AC Energy- is a wholly-owned energy-focused holding company of Ayala Corporation, with investments in solar, wind, hydro and conventional energy sources

6 STX Marine Inc -A South Korean company which formally taken over the operation and maintenance of the Malaya thermal power plant under a one-year contract executed with PSALM

7 PSALM- a wholly-owned and -controlled government entity

The concentration ratio for the top four groups (denoted as CR_4) in the Visayas is 79%. For Luzon, the top four groups control 50% of the market share. While there is no strict relationship between market share and market dominance, the top three Visayas firms would be considered dominant and the top four Luzon firms would be considered marginally dominant according to the Matthes et al. rule (2005). High concentration ratios need not be taken as *prima facie* grounds for anti-trust actions, however. For example, an active forward market can induce even a concentrated generator market to approximate competition, provided that both retailers and generators are required to buy and sell on the wholesale market instead of engaging in bilateral contracts (see e.g. Wolak, 2001).

Figure 4. Market Concentration in Generation, Visayas



2.2.2 Lack of competition in the retail sector

Under EPIRA, the retail sector is envisioned to eventually become competitive. Provisions of the Retail Competition and Open Access (RCOA) are aimed at gradually growing the "contestable" retail market so that all consumers including households would be eventually able to switch retailers anytime, e.g. as in Singapore and New Zealand.

Four years after its intended implementation, RCOA's commercial operation and its integration with the wholesale spot market commenced in June 2013. ERC suspended licensing of suppliers in October 2014, however, due to unresolved issues regarding license issuance to retail suppliers. Further delays in implementation caused generators to contract with DUs instead of reserving power for open access.[24] The suspension was lifted in April 2016 when ERC issued a resolution adopting new rules regarding licensing and other requirements. The mandatory inclusion of consumers with 750KW of monthly consumption was also postponed until June 2017.

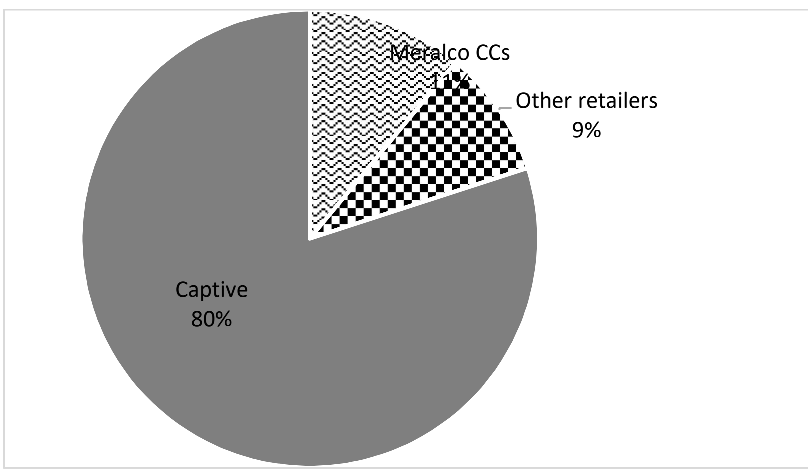
As a result of these delays, the analysis of the distribution function cannot be entirely separated from the retail function. Appendix B describes the companies and extent of

[24] Lotilla (2015) in his presentation at the UPSE-Ayala Lecture Series.

competition in the distribution sector. Even if RCOA were realized, retailing would not be completely unbundled from generation due to the provision of limited cross-ownership, whereby a distribution utility is allowed to source no more than 50%[25] from its affiliate generation company. This provision poses a concern to EPIRA's goal of making the retail sector competitive inasmuch as cross-ownership allows for transfer pricing.[26]

In competition law, the concept of relevant market matters. It is defined as the intersection of the relevant product market and the relevant geographic market. For distributors, the relevant markets have been exogenously defined as franchise areas. As of December 2015, contestable customers make up 20% of consumption in the Meralco franchise area (Figure 5). Meralco serves to 55% (11/20) of these through its retail subsidiary, MRLCOLRE. Other electricity retail suppliers (RES) serve the remaining 45%.

Figure 5. Retail concentration in the Meralco Franchise area



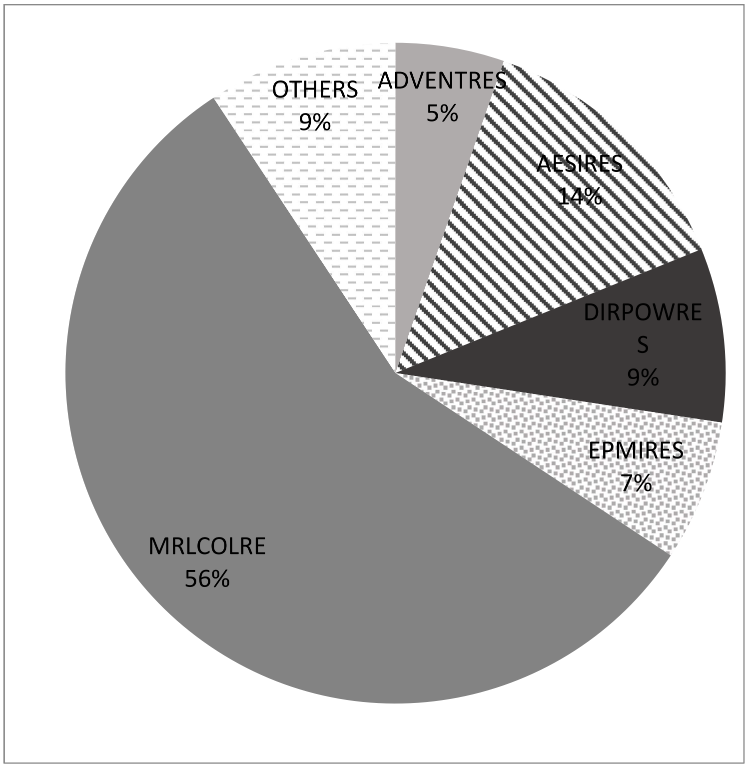
Source: PEMC Annual Retail Market Assessment Report (2015)

There are only about 376 registered contestable customers in the entire Philippines -- mostly industrial and commercial users given the requirement of 1MW average consumption per month. MRLCOLRE serves 212 of these (56%). The next largest retailer, AESIRES (a subsidiary of Aboitiz Energy Solutions, Inc.) serves 51 contestable customers or 14% of the consumption market (see Figure 6).

[25] Sec 45b of EPIRA states that: "no distribution utility shall be allowed to source from bilateral power supply contracts more than fifty percent (50%) of its total demand from an associated firm engaged in generation..."

[26] By increasing fees paid to their generation subsidiaries, distribution utilities are able to lower their total tax burden.

Figure 6. Retail concentration in the Philippines



Source: PEMC Annual Retail Market Assessment Report (2015)
Note: MRLCOLRE is Meralco's subsidiary, AESIRES is the retail arm of Aboitiz Energy Solutions, Inc., ADVENTRES is AdventEnergy, Inc., DIRPOWRES is DirectPower Services, Inc, EPMIRE is Ecozone Power Management, Inc., ADVENTRES is AdventEnergy, Inc.

3. Optimal investment and Pricing: The Philippine Case

3.1. Methods for determining optimal generation and transmission

How should investment priorities for generation and transmission be evaluated? It is common to rank investments in generation according to the levelized cost of electricity (LCOE), a technique that spreads construction, operation, and maintenance costs over the expected stream of power output to obtain the costs per kilowatt hour of various technologies. Sometimes, LCOE is used in combination with estimates of how much of each technology could be implemented under specified scenarios (for example, hydro-electric and geothermal power may be limited by geography). Now by "stacking" these quantities from low to high unit cost, you get what looks very much like a supply curve. It is easy to see the appeal of this technique among economists.

For a number of reasons, supply is not independent of demand, however. For example, both the utilization rate and the value of a proposed generation plant depend on what resources are available and how the entire system is being operated. One gas-fired plant may be in almost constant operation while another is used primarily during peak hours. And a wind farm that displaces coal generation may have a different value than one that primarily displaces gas. As Joskow (2011) puts it: the prevailing approach that relies on comparisons of the 'levelized cost' per MWh supplied by different generating technologies "is seriously flawed" because it effectively treats all MWhs supplied as a homogeneous product. In an optimized (or even constrained) system, however, the shadow prices of power vary over both space and time.

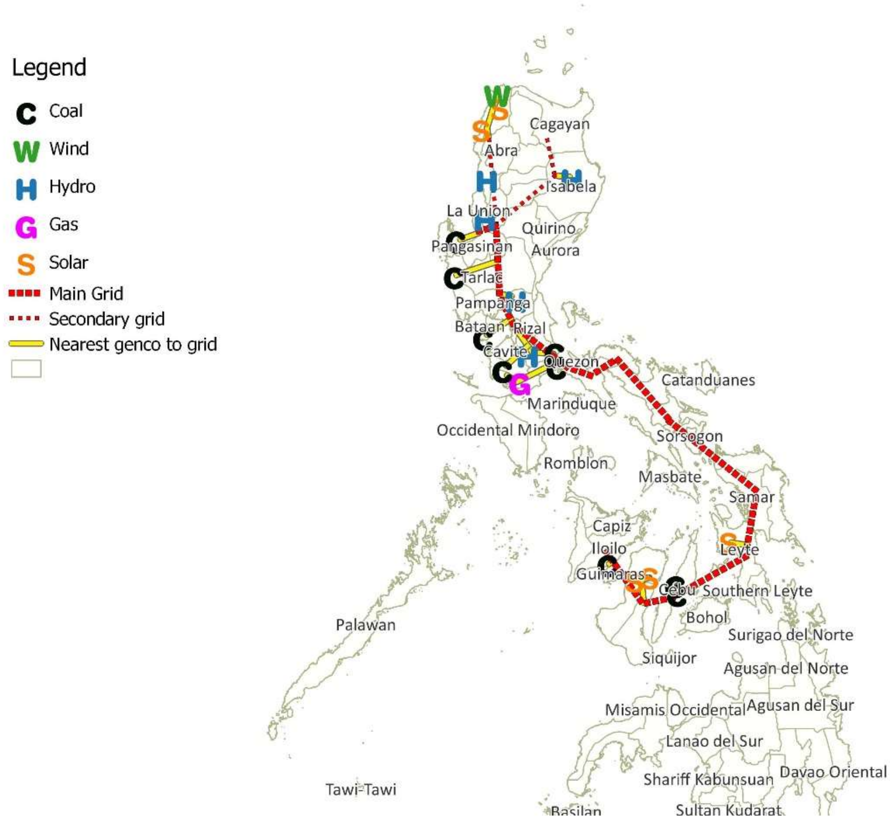
To some extent, a better estimate of optimal generation mix can be obtained by comparing the levelized cost of an additional source at a particular location with its benefits at that location, given by the *levelized avoided cost of electricity* (LACE), the cost saved by reducing the use of existing sources while still meeting the same load (Ueckerdt 2013, EIA 2015). However, there is no way to be sure what will be avoided without an optimization model for the whole system. And if you are able to implement the complete model, the value of an additional plant is given by the increase in the present value of the producer-consumer surplus of the entire system, re-optimized with the additional plant. Once you do the optimization exercise, there is no further value in the avoided-cost construct. Thus the value of LCOE and LACE lies in their joint ability to approximate what the optimizing system can produce albeit at a lower computational cost. Inasmuch as system optimization may be very expensive, a useful research objective is determining under what circumstances shortcut procedures based on LCOE and LACE provide useful approximations.

On the other hand, optimizing models tend to be non-transparent due to their complexity and many constraints, some of which may not have economic foundations. Accordingly, we proceed here by discussing a highly simplified approach that delivers insights about the nature of the economic optimum and its possible relationship to LCOE and LACE.

Figure 7 portrays a stylized version of the generation and transmission grid for the Luzon and Visayas regions of the Philippines. The transmission grid consists primarily of a trunk line from Pangasinan in Northern Luzon, south to Manila, on through Southern Luzon and the Bicol region, then on to Cebu, Negros, and Iloilo. Figure 8 affords an expanded view of the Luzon portion of the grid. Economic geography (e.g. Krugman 1991) can be extended to explain some of the locational patterns shown.

Coal generation (designated by C) tends to be located on the coastal outskirts of population centers. The capacities of the plants shown range from 500 to 1200 megawatts. At these levels, any remaining economies of scale are dominated by transmission and transportation costs. Transportation costs of coal are economized by locating generation plants near ports. Transmission costs (both the long run costs of construction and maintenance and the energy losses associated with resistance in the transmission lines) are economized by locating close to demands.

Figure 7: Stylized transmission grid, Philippines



Coal is not well-suited for providing peak power, however. Traditional coal plants can be ramped down to around 40% of capacity -- but only with substantial losses in efficiency.[27] Building enough coal plants to satisfy peak loads is feasible so long as peak load is not greater than minimum load, but unlikely to be optimal if other more flexible sources are available. This is why coal is typically classified as a "baseload" fuel.[28] Since hydroelectric power can be more easily started and stopped, it can be reserved for its comparative advantage in serving peak hours, depending on the quantity that can be economically developed. Hydropower is typically even cheaper than coal power, so if it is sufficiently abundant, it will be optimally used in off-peak periods as well, thereby necessitating less coal capacity. Less coal plants will then run at higher capacity factors (ratio of average generation to rated capacity), lowering levelized costs and increasing profits.

To illustrate these tradeoffs, consider a case wherein there is no hydro and that excess demand for peak power must be satisfied by open-cycle gas turbines (OCGT), which have higher fuel costs but can be turned off and on with little loss in engineering efficiency. Suppose that coal plants can be ramped down to 75% with little efficiency loss but that losses increase

[27] Cochran et al. 2014

[28] Classifying resources according to their presumed optimal uses should be abhorrent to economists.

sharply after that. Assume further that gas can be turned down to 25% without substantial loss in efficiency. To make things concrete, set peak demand at 10,000MW, off-peak demand at 5,000MW and assume that both periods are 12 hours. One feasible solution would be to build coal plants to satisfy 5,000MW of capacity and to run them at 75% during off-peak hours. This leaves 5,000MW of required gas capacity during peak hours. When run at 25% of capacity, gas production merely fulfills the remaining off-peak requirement. Abstracting from transmission costs, we can now compare the levelized costs for both cases, since we know how many hours the capacity costs must be spread over. If the LCOEs of coal and gas are unequal, we expand the lower cost option and reduce the other until the two levelized costs are equal.

If gas plants can simply be turned off with little efficiency loss, we may find a corner solution in which coal is said to be a "baseload fuel" and gas facilities are reserved as peaking plants. This is not an inevitable solution, however, inasmuch as lowering the hours of operation for the gas plants increases their LCOE. This may also help to explain why the falling relative cost of natural gas in the U.S. (along with pending environmental regulations) led to a dramatic decline of coal-fired generation. There is a penalty associated with the flexible use of coal for both peak and off-peak hours justified only by the lower fuel costs.

Figure 8 is an amplified portrayal of the Luzon grid and major generating facilities on the island of Luzon. Observing the far north of the island, one can see that in low-demand areas where coal is too costly at correspondingly low capacities, it is cheaper to send coal generated electricity north from the more Southern plants. This means, however, that shadow prices in the far north include higher transmission costs and will accordingly be higher than at locations nearer major generating facilities. And in peak periods, the shadow prices in, say, Laoag City in the far northern province of Ilocos Norte will be given by the marginal cost of gas power plus the relatively high transmission costs from Batangas to Laoag. This means that the avoided cost of developing wind and solar in the far north is relatively high such that the LACE values may be above levelized cost even without subsidies, at least at low levels.

Imagine an off-take substation in the far north for example with a peak load of 200MW, an off-peak load of 50MW, and shadow prices of 20 and 5 pesos per KWh, respectively. Consider a wind plant that generates 25MW during the day (peak) and 50MW at night (off peak). Avoided cost is 25MWh times 20,000 pesos/MWh plus 50MWh times 5,000 pesos/MWh all times 12 hours per period. This equals 12(750,000) pesos or 375,000 pesos per hour of avoided cost for the project.[29] As long project costs are less than this, the project is warranted. Larger plants will have a lower avoided cost at the margin since there would be surplus power at night. Moreover, the levelized cost at the margin will increase since the project cost must be spread over a smaller total number of units (actual generation would be adjusted below full potential at night). Wind power should be expanded until the marginal avoided cost (benefits) equals the marginal levelized cost (Ueckerdt 2013).[30]

---

[29]Roughly equivalent to $8,000 of benefits per hour for the project.

[30]There is no need to account for environmental benefits of renewable energy so long as local pollution externalities have already been internalized by emission taxes.

Figure 8: Luzon grid and sources of generation

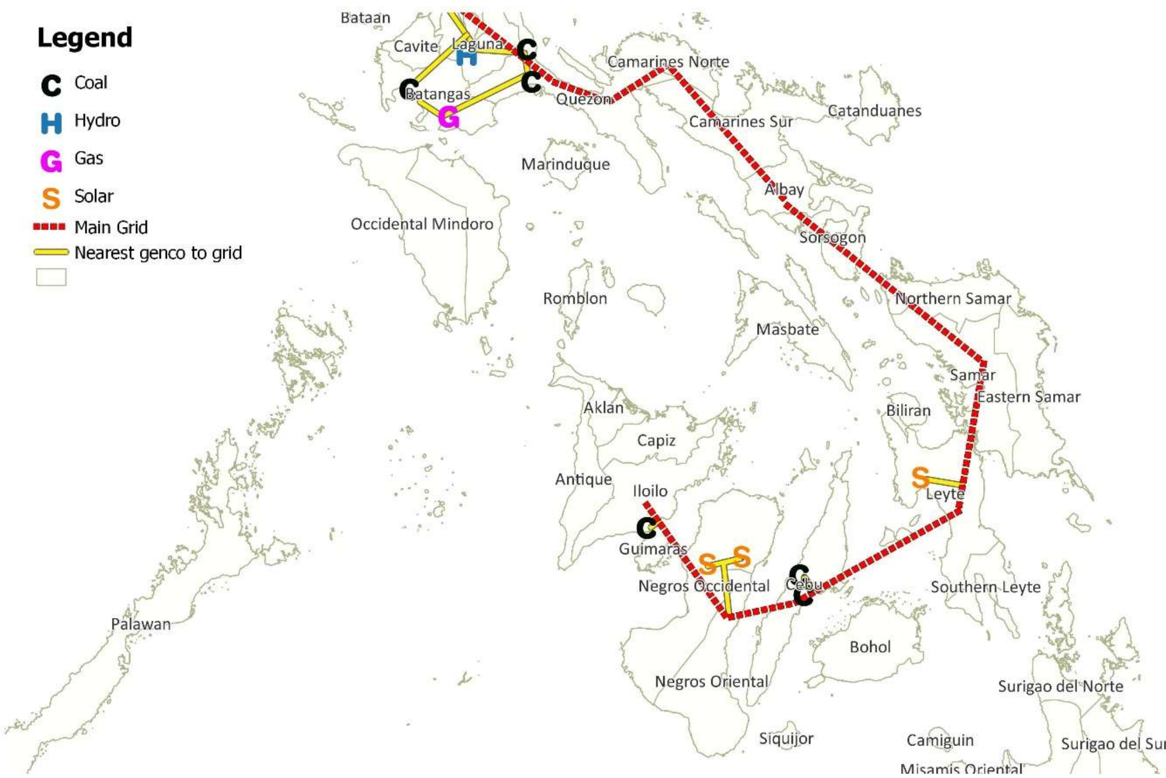
As we can see from this example, in the long-run optimization, LACE values are the same as the optimal shadow prices. If gas-fired generation were used to meet marginal peak demands, peak shadow prices in the North would be given by the levelized cost of gas-fired power in Batangas (near Manila) plus transmission costs. Off-peak shadow prices are given by the levelized cost of coal-fired power at the nearest in-take substation plus transmission costs. Some iteration may be required in obtaining the solution since we don't know the exact output before knowing the required loads. And we don't know the optimal loads without specifying demands at the off-take substations. It is in this sense that supply is not independent of demand, even in the case of constant costs of expanding capacity.

Since solar is a better fit with peak-use periods, it will have higher LACE values than wind power although the levelized costs of solar are typically higher than that of wind as well. In practice, both wind and solar are used in the north (Figure 8).

The same logic should apply to the far South, since gas-fired power is also being transmitted long distances to combine with the coal plants located in Iloilo and Cebu (Figure 9).

This time solar dominates wind, however, due to the fact that there is greater total solar energy at the lower latitude and because the wind profile is somewhat less attractive.[31]

Figure 9: Bicol and Visayas Regions



The above provides a sense in which optimal generation capacity can be determined under simplifying assumptions about transmission costs and given loads. If demand curves instead of loads are specified, an iterative procedure can be used whereby the initial loads are approximated, e.g. by actual loads. Next, the optimal shadow price is plugged into the demand schedules, the new load is used as the starting point, and so on. Alternatively, the optimal solution can be determined by the optimal satisfaction of the corresponding first order conditions. Shadow prices at the input substations are given by the levelized cost of the marginal source, evaluated at the quantity supplied. Shadow prices at the off-take substations are given by the shadow price at the marginal source times the percentage of power remaining after deducting the percentage loss as a function of distance and resistance. For example, the shadow price at a major off-take station in the North during peak periods is given by the shadow price of power at the intake substation for gas-fired power (in Batangas) times said percent remaining after transmission.

[31] The ideal is sustained winds at 20-40 mph. Winds that reach 45mph or higher are damaging to the turbines, such that the windmills have to be shut down. In addition, the turbines may be damaged during typhoons (which are more frequent in the Visayas).

The above is premised on the assumption that the far reaches of the transmission system are import regions. However, plans are currently in the works to make the province of Ilocos Norte an exporter of wind power and Negros an exporter of solar power. Note that the benefit cost comparison becomes more restrictive for this case. In addition to marginal benefits (avoided cost) becoming lower and levelized cost becoming higher, transmission cost switches from the benefit side to the cost side. Rather than make these explicit comparisons, the projects have been approved on the basis of the Renewable Energy Act.

Turning to the case of optimal transmission, transmission capacity between two points should be expanded until the difference in shadow prices at the two points is equal to the percentage transmission loss from the point of origin to the destination times the shadow price at the origin. To the extent that intermittent renewable energy sources are instead being approved under mandates of the Renewable Energy Act, this results in an additional dilemma that the tail is wagging the dog. While NGCP is responsible (along with DOE) for developing a transmission development plan, which should be determined simultaneously with optimal generation, they end up having to respond to independent decisions about approval of FIT subsidies in distant locations.

Once optimal generation and transmission have been determined, we can decompose consumption according to its source and compare the optimal solution to the actual. While it may be efficient to source peak-loads from the gas-fired turbines in Batangas, in actuality almost all gas-fired power is consumed in Manila. Monopsony power of the Manila utility (Meralco) would seem to be an unlikely explanation inasmuch as the Visayas Electric Company (VECO) is also quite large. One possibility is that the Batangas gencos have a special relationship with Meralco. Another is that VECO does not have an incentive to underbid Meralco inasmuch as their higher cost power allows them to charge higher rates. In addition, actual transmission charges exceed marginal costs of transmission since fixed costs are recovered via a single transmission "rental" fee.

Even if the distribution of generation is roughly correct, there are potentially large efficiency gains that can be made by pricing in accordance with shadow prices. These will have implications for generation and transmission as well. First, note that the avoided cost of gas is even higher than traditionally calculated by LACE. Like other non-renewable resources, gas in the Philippines is being depleted. Its backstop price is imported natural gas, which is more expensive and will require costly infrastructure for shipping, off-loading, and re-gasification. Accordingly, avoided cost should be calculated to be inclusive of marginal user cost (MUC).[32] This means that peak and off-peak shadow prices are even further apart than they may appear. This increases the importance of time of day (TOD) pricing. By inducing substitution of off-peak for peak use, TOD pricing will cause peak period prices to fall (and by more than off-peak prices rise), resulting in an increase in producer-consumer surplus. New technologies that increase

[32] To the extent that the extraction rate of developed gas fields is dictated by engineering considerations, MUC is determined with respect to the costs of developing new wells (Salant 2014).

consumer responsiveness, such as thermostats that automatically adjust air and water temperature in households, will increase these gains. TOD pricing also has the potential to reduce blackouts from network congestion. Just as congestion pricing avoids a plethora of congestion paradoxes, one would expect similar, albeit smaller, gains in power grids and distribution networks.

Adding spatial charges would also provide welfare gains, inducing consumers to conserve power use according to its real cost. Further research is needed to compare the welfare gains over space with those over time from pricing according to shadow prices.[33] Such changes are likely to be viewed as infeasible or politically unacceptable with the current grid system and regulatory framework. Smart meters would be needed to implement pre-scheduled time of day (TOD) pricing and wholesale-price-plus contracts to consumers (e.g. as offered by one retailer in Wellington, NZ).

Lacking an actual model, we cannot yet say what efficient generation and transmission will mean for the power mix in the medium term. It is possible that coal use will increase even after accounting for environmental costs. As already discussed, existing policies discriminate against coal more than is warranted by the marginal social damage costs to the Philippines of their coal emissions. Depending on the flexibility of gas production from the existing Malampaya gas fields and the prospects for gas storage, it may be efficient to decrease gas-powered generation in accordance with their full marginal costs, including marginal user costs, unless offshore gas fields have been under-explored.[34]

3.2 Pricing

In the traditional utility model, prices are optimally set at long-run marginal costs. Without uncertainty, short run marginal costs are equal to long run marginal costs because of capacity constraints.[35] In the simplest model that accommodates space, there is only one location of generation and therefore, only one wholesale price. Demand is aggregated first to the substation level and then to the point of generation by shifting local demand curves down by the amount of distribution and transmission costs. Substation shadow prices are then given by the wholesale price plus the long run marginal costs of transmission.

The literature on peak-load pricing follows the same marginalist tradition. Since peak and off-peak demands use the same capacity, these demands are vertically summed and equated with the long run marginal cost of increasing capacity, often assumed to be constant

[33] In the case of groundwater for urban use, the spatial gains easily outweigh the temporal ones (Pitafi and Roumasset 2009).

[34] It is even possible that flexible coal plants (with lower minimum running capacities) will come to dominate gas power, although this will depend on how much levelized cost will increase as capacity factors are reduced.

[35] This is the conclusion of the French marginalist school, typically associated with Dupuit, Allais, and Boiteux (see e.g. the discussion in Chick 2007). For a similar finding in the context of irrigation, see Roumasset (1987 and 1989).

(Kahn 1970, Joskow and Wolfram 2012). This results in individualized prices assigned to peak and off-peak periods, which are then added to marginal variable costs to determine the efficiency prices for each period.[36]

Marginal cost pricing may lead to either a revenue surplus or deficit depending on whether marginal cost is above or below average cost (Munasinghe 1981). Either is possible. If electricity is being expanded at the intensive margin some economies of scale may be realized. But if power provision increases at the extensive margin, increasing marginal cost is more likely. Even at the intensive margin, the common observation of widely dispersed generation and parallel transmission lines suggests that economies of scale in generation and transmission have already been exhausted (Smith 1993, 1996). In the case of increasing marginal costs, marginal cost pricing is compatible with block pricing, where inframarginal blocks are charged rates lower than marginal costs, a solution that also promotes equity.

The classic result of pricing according to long run marginal costs derives from the assumption of the certainty and the resultant coincidence of short and long run marginal costs. Once uncertainty is admitted, efficiency pricing should be according to short run marginal cost. But it is not necessarily the case, as commonly assumed, that short run marginal cost is below long run. Once short run marginal cost is properly adjusted for running higher cost generation facilities and line losses/constraints in transmission, short run marginal cost in periods of high demand will be above the expected long run optimum.

The classic literature just reviewed did not distinguish between wholesale and retail prices. Under the assumption that generation originates at a single point and transmission and distribution are priced at marginal costs, this omission is not important. There is just one wholesale shadow price and optimal retail prices are given by the wholesale price plus the marginal cost of transmission and distribution to each location. In the case of multiple generation locations, optimal wholesale prices are in effect FOB or CIF prices depending on whether the substation is a net importer or exporter of power (Jandoc et al. 2015).

It is imaginable, as argued by Smith (1993, 1996), that generation, transmission, retailing, and distribution could all be privatized and that a well-organized market could deliver the optimal shadow prices just described. However, no system worldwide has gone that far. Even where there are well-developed wholesale markets, transmission and retailing remain regulated. Even in the partially deregulated US market, for example, retail prices are largely divorced from optimal pricing levels due to the competing and often conflicting goals of regulators (Joskow and Wolfram 2012). As discussed in Section 2.2, the disconnect between optimal and actual retail prices is likely to be even larger because the wholesale spot market is very thin, there is no forward market, and retail markets are not competitive. With a well-developed forward

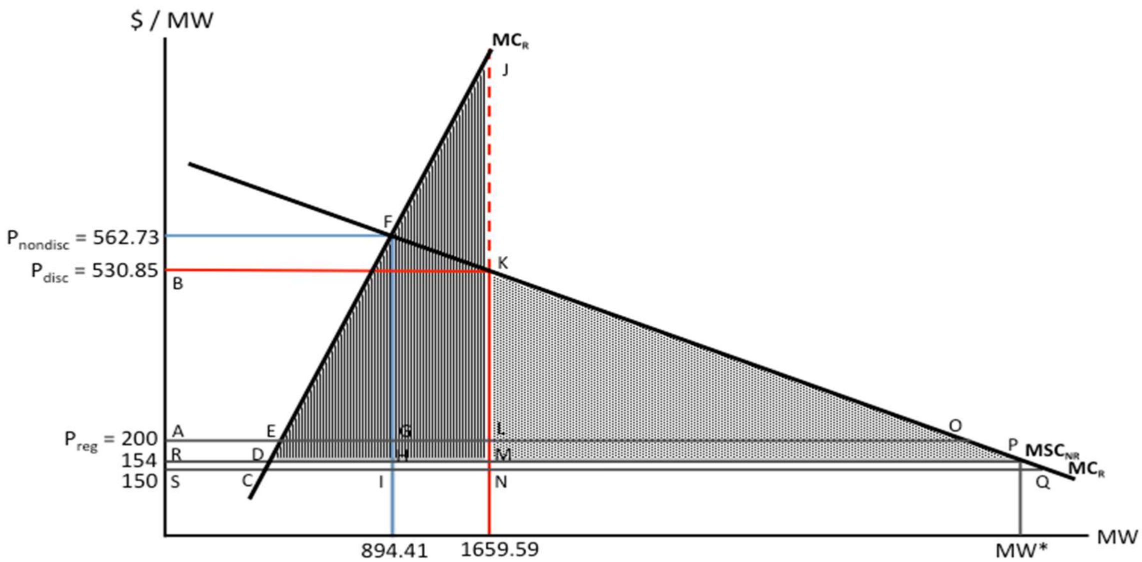
[36]The usual textbook treatment of peak load pricing is a special case of this result, wherein the off-peak demand for additional capacity at marginal cost is zero. In the case of the internal solution, the terms "peak" and "off-peak" may be misleading in the sense that both periods use the full capacity. The difference is simply that one demand curve lies above the other.

market and deregulated retailing, competition is likely to bring a closer convergence of wholesale and retail pricing. This has the potential to increase consumption and welfare overall while at the same time conserving on usage during times of greater scarcity.

3.3 Subsidies for renewables: An illustration of FIT

Instead of the uniform-subsidy case of FIT illustrated in Figure 2, the regulatory authority typically establishes different rates for different generation sources. In the extreme case shown in Figure 10, the authority acts as a discriminating monopolist, such that competitive suppliers are each paid according to their marginal costs.[37]

Figure 10: The Excess Burden of a Perfectly Discriminating FIT



Notes:

JMD: Additional Production Cost = $ 1,712,328/hour
KMP: Lost Consumer Benefits = $ 570,776/hour

Total Economic Waste = $2,283,104/hour = $ 20 billion/year

Demand as function of price: Q = 14400 – 24P
Supply as function of price: Q = -96 + 1.76P

Source: Roumasset et al. 2016

This lowers the ratepayer total amount of the ratepayer subsidy and the price increase needed to finance that subsidy, thus decreasing the amount of demand-side waste. The problem is that

[37] As discussed above, however, this is easier said than done because levelized costs are not a sufficient foundation for determining a least-cost FIT schedule.

lower prices means that higher marginal costs of renewably-generated power must be incurred because of the greater equilibrium consumption. This results in the supply-side excess burden increasing more than the demand-side burden declines. Despite this disadvantage, it is still possible that the discriminatory approach may be preferred on account of the smaller tax interaction effect that lower retail prices imply (to say nothing of the political infeasibility "non-discriminatory" price increase). Roumasset et al. (2016) estimate that the total deadweight loss of this policy could be as high as one trillion pesos per year, as illustrated in Figure 10. Accounting for the fact that actual FIT subsidies are inevitably far from those implied by the least-cost marginal cost schedule would make the estimate even higher.

4. Concluding remarks

A first step in understanding investment needs for new generation and transmission facilities will be to build a relatively simple analytical model to verify and apply the principles discussed above. One could begin, for example, with the major generation facilities and franchise regions in the Luzon-Visayas grid, with their costs of delivering power during different times of day, along with a simple specification of transmission costs and constraints. Once optimal use of existing facilities to meet current loads is determined, one can expand the model to allow for forecasted future loads, e.g. a 50% increase. If pricing policies are to be considered, one needs to replace exogenous loads with demand functions that gauge how responsive consumption would be to specific pricing reforms and other demand management schemes.

Simple model specifications can utilize exogenously specified reserve requirements. If reserve policies are also to be analyzed, uncertainty about demand and equipment failure can be added to the basic model. The recommendations from the economic model would still need to be validated by a more complete engineering model with the full transmission network.
One illustrative hypothesis that could be explored in the economic model is the possibility that existing spatial allocation of generation could be improved, e.g. by reserving gas power for its comparative advantage in serving peak demands, including in the Visayas. On the other hand, if transmission costs justify using gas power in Luzon only, it is possible that the ex post benefits of the Luzon-Visayas connection do not warrant the costs. This may provide cautionary insights regarding the benefits of connecting the Mindanao grid with the Luzon-Visayas grid.

4.1 Policy issues for further research

Should the Philippines pass a renewable portfolio standards (RPS) law? Carbon taxation is not only more efficient (Acemoglu et al. 2012) but it is better for the poor because it grows the economy and lowers the price of electricity, which is consumed disproportionately by lower income households (with the exception of the 10% without access). RPS laws require extracting either additional taxes or higher rates for electricity, either of which potentially causes extensive excess burden. A sounder approach to renewability is to set emission taxes to internalize the *domestic* externality cost of carbon and other pollutants and to facilitate clean energy, including natural gas, by appropriate infrastructure and competitiveness policies.

Fifteen years after EPIRA was passed to make the power sector more efficient by incentivizing competition, both generation and especially retailing remain highly concentrated and uncompetitive.[38] A promising approach is to introduce a forward wholesale market, which tends to increase competitiveness (Wolak 2001). The extent to which a *Competitive Selection Process* (designed to make bilateral contracts more competitive) can provide similar incentives, e.g. as an integrated futures and spot market, requires further assessment. A minimum requirement for a forward market should be the ability of independent retailers to enter the market without their own generation plants, something that is not currently feasible.

Making the transmission sector more efficient is another priority for further research. NGCP is responsible for maintaining and modernizing the grid, but may be hampered by a surfeit of inconsistent oversight as well as lobbying by generating companies and other political pressures. Transmission charges as well as contractual obligations may be unnecessarily hampering cost-minimizing grid integration and could be another candidate for reform. Other promising research issues are listed in Appendix C.

[38] As discussed in section 2.2, the Philippines chose a gradualist approach to retail competition as opposed to free entry from the outset. High levels of industry competition have persisted partly due to delays in the contestability program but also because even large, eligible customers don't switch from the dominant distribution utilities. Without forward market, independent retailers have not been able to enter the market. And generating companies that have tried to vertically integrate into retailing have found it difficult to ensure reliable service. In principle, retailing and distribution should also be unbundled, but the very vocabulary of the industry tends to render such unbundling less salient by referring to both as "distribution utilities."

References

Acemoglu, D., P. Aghion, L. Bursztyn, and D. Hemous. (2012). The Environment and Directed Technical Change. *American Economic Review*, 102: 131-166.

Aldaba, R. (2004). Regulatory Policies and Reforms in the Power and Downstream Oil Industries. *Philippine Journal of Development,* 31(1):65-106.

Balisacan, A., U. Chakravorty, and M. Ravago (Eds) (2015). *Sustainable Economic Development Resources, Environment and Institutions.* Elsevier Academic Press.

Ballard, C., J. Shoven, J. Whalley. (1985). The Welfare Cost of Distortions in the United States Tax System: A General Equilibrium Approach. American Economic Review 75: 128–38.

Bird, R. (2005). *Evaluating Public Expenditures: Does it Matter How They are Financed?* University of Toronto Faculty of Management, International Center for Tax Studies. ITP Paper 0506.

Borenstein, Severin. (2012a). "The Private and Public Economics of Renewable Electricity Generation." *Journal of Economic Perspectives*, 26(1): 67-92.

Borenstein, Severin. (2012b). "The Trouble With Electricity Markets: Understanding California's Restructuring Disaster," *The Journal of Economic Perspectives*, 16(10): 191-211(21).

Bovenberg, L. and L. Goulder (1996). Optimal Environmental Taxation in the Presence of Other Taxes: General Equilibrium Analyses. *American Economic Review*, 86:985-1000.

Chakravorty, U., J. Roumasset, and K. Tse (1997). Endogenous Substitution among Energy Resources and Global Warming. *Journal of Political Economy*. University of Chicago Press, 105(6); 1201-34.

Chakravorty, U., M. Moreaux, and M. Tidball (2008). Ordering the Extraction of Polluting Nonrenewable Resources. *American Economic Review*, 98(3): 1128-44.

Chick, M. (2007). Electricity and Energy Policy in Britain, France and the United States since 1945. Cheltenham: Edward Elgar.

Cochran, J. D. Lew, and N. Kumar (2014). Flexible Coal: Evolution from Baseload to Peaking Plant. *National Renewable Energy Laboratory*.

Dasgupta P.S., 1995, "Optimal Development and NNP", in I. Goldin and L. Winters (eds), The Economics of Sustainable Development, Cambridge UniversityPress, Cambridge.

Diewert, E., D. Lawrence, and F. Thompson (1998). "The Marginal Cost of Taxation and Regulation." In *Handbook of Public Finance*, ed. Fred Thompson and Mark T. Green, 135-71. New York: Marcel Dekker.

Department of Energy (2000). Presentation to the Senate on privatizing the Philippine electricity industry, 20 August 2000.

Department of Energy (2015) 2014 Private Investor-Owned Utilities Monthly Operations Report. PH: Taguig City.

De dios, E. and P. Hutchcroft. (2003). Political Economy in A.M. Balisacan and H.H. Hill (eds.) *The Philippine Economy: Development, Policies and Challenges.* Quezon City: Ateneo de Manila University Press.

Energy Information Administration. (2015). *Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook,* 2015. Retrieved from http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf on March 2016.

Endress, L., J. Roumasset and T. Zhou (2005). Sustainable Growth with Environmental Spillovers. *Journal of Economic Behavior and Organization*. 58(4):527-547.

Endress, L. (2013). *Sustainable Development and the Hawaii Clean Energy Initiative*. Working Paper 2013-4. The Economic Research Organization, University of Hawaii (UHERO).

Fabella, R. (2002). The regulatory environment of the energy sector in the Philippines. 2002 Annual Conference of the Centre for Regulation and Competition, Manchester, United Kingdom, 2-4 September 2002.

Feldstein, M. (1997). How Big Should Government Be?" *National Tax Journal* 50: 197–213.

Gayer, T. and K. Viscusi (2016). Determining the Proper Scope of Climate Change Benefits in U.S. Regulatory Analyses: Domestic versus Global Approaches." *Review of Environmental Economics and Policy* (available at http://ssrn.com/abstract=2446522).

Goulder, L. and R. Williams (2003). The Substantial Bias from Ignoring General Equilibrium Effects in Estimating Excess Burden and a Practical Solution. Journal of Political Economy, 111 (4): 898-927.

Harberger, A. (1984). Basic Needs versus Distributional Weights in Social Cost-Benefit Analysis. *Economic Development and Cultural Change*. 32(3): 455-474.

Heal, G. (2000). *Valuing the Future: Economic Theory and Sustainability*. Columbia University Press.

Heal, G. (2008). Climate Change Economics: A Meta-Review and Some Suggestions. *Review of Environmental Economics and Policy*. 3(1): 4-21.

Jandoc, K., R. Juarez and J. Roumasset (2015). Towards an Economics of Irrigation Networks in K. Burnett, R. Howitt, J. Roumasset, and C.A. Wada (Eds.), *Handbook of Water Economics and Institutions*. Routledge.

Joskow, P. (2011). Comparing the Costs of Intermittent and Dispatchable Electricity Generating Technologies. *American Economic Review.* 101(3): 238-241.

Joskow, P. and C. Wolfram (2012). Dynamic Pricing of Electricity. American Economic Review: Papers & Proceedings 2012, 102(3): 381–385.

Kahn, A. (1970). *The Economics of Regulation: Principles and Institutions*, Volume 1. John Wiley & Sons.

Krugman, P. (1991). Increasing Returns and Economic Geography. Journal of Political Economy. 99(3): 483-499.

Lee, K., E. Miguel, and C. Wolfram (2016). Appliance Ownership and Aspirations among Electric Grid and Home Solar Households in Rural Kenya. Energy Institute at Haas WP 266.

Lotilla, R. (2015). Challenges of Institutional Governance in the Power Sector. Ayala-UPSE Economic Forum. 23 July 2015.

Matthes, F., S. Poetzsch, and K. Grashoff. 2005. Power Generation Market Concentration in Europe 1996-2004. An Empirical Analysis. Institute for Applied Ecology. Berlin.

Munasinghe, M. (1981). Principles of Modern Electricity Pricing. Proceedings of the IEEE 69(3): 332-48.

National Electrification Administration (2015). The Rural Electrification Chronicle 2012-2014.

Nordhaus, W. (2015a). Climate Clubs: Overcoming Free-riding in International Climate Policy. *American Economic Review.* 105(4).

Nordhaus, W. (2015b). A New Solution: The Climate Club. *Climate Shock: The Economic Consequences of a Hotter Planet.* (Wagner, G and Weitzman,M., Issue 2015). Princeton University Press.

Novan, K. (2015). Valuing the Wind: Renewable Energy Policies and Air Pollution Avoided. *American Economic Journal: Economic Policy*. 7(3): 291-326.

Pearce, D. (1991), The Role of Carbon Taxes in Adjusting to Global Warming. *Economic Journal*, 101 (407): 938-48.

Pitafi, B., and J. Roumasset (2009). Pareto-Improving Water Management over Space and Time: The Honolulu Case, *American Journal of Agricultural Economics.* 91 (1): 138-153.

Philippine Electricity Market Corporation (2015). Annual Retail Market Assessment Report. Retrieved from www.wesm.ph/inner.php/downloads/retail_market_assessment_report on March 2016.

Ravago, M.V., J. Roumasset, and A. Balisacan (2010). Economic Policy for Sustainable Development vs. Greedy Growth and Preservationism, in J. A. Roumasset, K. M. Burnett, and A.M. Balisacan (eds.*), Sustainability Science for Watershed Landscapes*. Singapore: Institute of Southeast Asian Studies; Los Baños, Philippines: Southeast Asian Regional Center for Graduate Study and Research in Agriculture.

Ravago, M., J. Punongbayan, A. Brucal, and J. Roumasset (2016). The Role of Power Prices in Structural Transformation: Evidence from the Philippines. 12th International WEAI Conference, Singapore.

Rivera, D. (2016). Meralco nixes new rules on retail competition, open access. *The Philippine Star*, June 3.

Roumasset, J. (1987). The Public Economics of Irrigation Management and Cost Recovery. Agricultural and Rural Development Department. The World Bank.

Roumasset, J. (1989). Decentralization and Local Public Goods: Getting the Incentives Right. *Philippine Review of Economics and Business*. 26(1): 1-13.

Roumasset, J. and S. Barr (Eds) (1992). The Economics of Cooperation: East Asian Development and the Case for Pro-market Intervention. Boulder: Westview Press, 1992.

Roumasset, J. and Endress, L. (1996). The Yin and Yang of Sustainable Development: A Case for Win-Win Environmentalism. *Journal of the Asia Pacific Economy*. 1(2): 185- 194.

Roumasset, J. (2000). *Black-Hole Security*. University of Hawaii Working Paper No. 00-5. University of Hawaii.

Roumasset, J., Burnett, K. & Balisacan, A. (Eds.). (2010). Sustainability Science for Watershed Landscapes*. Singapore: Institute of Southeast Asian Studies*. Los Banos, Philippines: Southeast Asian Regional Center for Graduate Study and Research in Agriculture.

Roumasset, J., M. Ravago, K. Jandoc, and C. Arellano (2016). Filipino 2040: Environmental Resources, Shocks, and National Well-Being (manuscript).

Salant, S., S. Anderson, and R. Kellogg (2014). *Hotelling Under Pressure*. NBER Working Paper No. 20280. National Bureau of Economic Research, Inc.

Stiglitz, J. 1987. Pareto efficient and optimal taxation and the new welfare economics. Handbook of Public Economics. 991-1042.

Solow, R., (1991). Sustainability: an economist's perspective. In: Stavins, R. (Ed)*, Economics of the Environment, fifth ed*. W.W. Norton, New York, NY. (Presented as the Eighteenth J. Seward Johnson Lecture to the Marine Policy Center, Woods Hole Oceanographic Institution, Woods Hole, MA.).

Solow, R., (1992). An almost practical step toward sustainability. (A lecture on the occasion of the 40th anniversary of Resources for the Future. Published 1993*.) Resource Policy*. 19 (3): 162-172.

Smith, V. 1993. Can Electric Power - A Natural Monopoly - Be Deregulated? In H. Lnadsbeg (ed.), Making National Energy Policy. Resources for the Future, Washington DC.

Smith, V. 1996. Regulatory Reform in the Electric Power Industry. Regulation, 33-46.

Tol, R., (2011). The Social Cost of Carbon. Economic and Social Research Institute WP 377, Dublin.

Ueckerdt, F., L. Hirt, G. Luderer, and O. Edenhofer (2013). System LCOE: What are the cost of variable renewables. *Energ*y, 63, 61-75.

Van Kooten, GC. (2013). Economic Analysis of Feed-in Tariffs for Generating Electricity from Renewable Energy Sources in R. Fouquet (Ed). *Handbook on Energy and Climate Change*. Cheltenham, UK, & Northampton, MA: Edward Elgar.

Van Kooten, G.C. (2015). *The Economics of Forest Carbon Sequestration Revisited: A Challenge for Emissions Offset Trading*. Resource Economics & Policy Analysis Research Group (REPA) Working Paper 2015-04. Department of Economics, University of Victoria.

Villasenor, Y. (2000). Asian utilities, report to the Department of Energy.

Wolak, F. (2001). Designing a Competitive Wholesale Electricity Market That Benefits Consumers. Stanford University.

Wolfram, C. (2016). "Real" Electricity Still Comes from the Grid. Retrieved from https://energyathaas.wordpress.com/2016/01/19/real-electricity-still-comes-from-the-grid/ on March 2016.

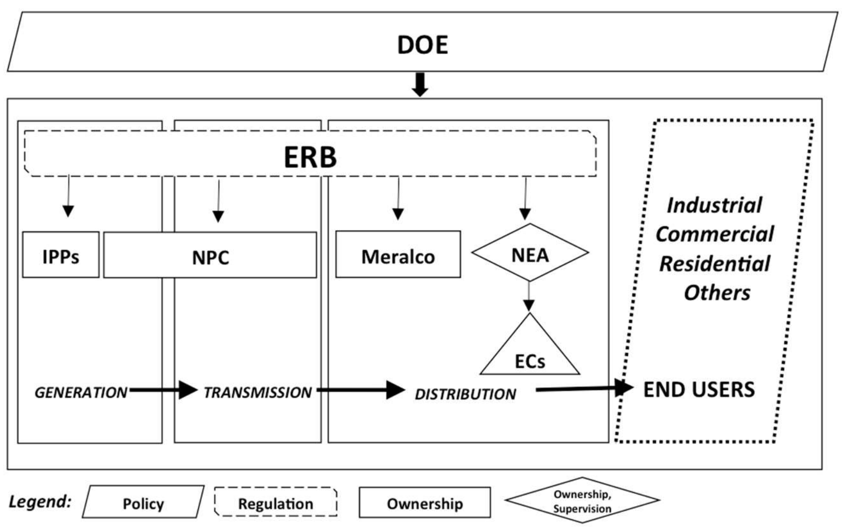
World Bank. (2005). Philippines: Meeting Infrastructure Challenges. Manila.

Appendix A: History of Power Policies in the Philippines

The Philippine power sector was nationalized during the Martial Law years (the early 1970s) and by 1978, power generation was controlled by the National Power Corporation (NPC or "Napocor"). Before the landmark passage of the Electric Power Industry Reform Act (EPIRA) in 2001, Executive Order (EO) 215 put an end to monopoly power in generation by Napocor in 1987. But due to inadequate incentives (Fabella 2002, de Dios and Hutchcroft 2003), sufficient private investment was not forthcoming to prevent the power crisis of 1992-1993.[41] Moreover, even after EO 215, the industry's key components, transmission and generation, were still largely owned and operated by the government through the NPC.

Figure A1 shows the structure and regulation of the electricity industry during pre-EPIRA reforms from 1987-2001. The sector was comprised of generation, transmission, and distribution (denoted by squares). Private and government generation companies (gencos) constituted the generation sector.

Figure A1. The Electricity Industry Structure before EPIRA



The former were owned by Independent Power Producers (IPPs) and the latter by the National Power Corporation (NPC). About 54% of the total installed generating capacity were owned by NPC and rest was owned by IPPs (Aldaba 2004).[42] Appendix Table 1 provides a list of the

[41]Another contributing factor was the failure to complete and operationalize the Bataan nuclear power plant, partially constructed under dubious contracting arrangements during the Marcos administration. The Build-Operate-Transfer (BOT) Law (RA 6957) was partially motivated by a desire to improve incentives in electricity generation, but this proved to be too late.

[42]Independent Power Producers are private investors engaged in the business of generating electricity. Executive Order 215 allowed private investors to enter the generation sector business thereby ending the monopoly of NPC. Republic Acts (RA) 6957, 7648, 7718 expanded the role of IPPs, although they could initially only sell to NPC (Aldaba 2004).

contracted IPPs, wherein some contracts last until 2030. The transmission sector consisted of the Luzon, Visayas, and Mindanao Grids.[43] The distribution sector combined retailing and physical distribution from off-take substations of the grid to consumers. The Manila Electric Company (Meralco[44]) was the country's biggest power distributor with more than 5.6 million customers at its pre-EPIRA high. The National Electrification Administration (NEA) either owned or supervised the electric cooperatives.

The main regulating body of the generation, transmission, and distribution sectors was the Energy Regulatory Board (ERB) (see Figure A1). The ERB granted licenses to the generation companies and regulated rates on the basis of rate-of-return, thus subjecting them to the standard critique that rate-of-return regulation incentivizes companies to increase costs, especially for capital expenditures (Fabella 2002). The granting of exclusive franchise of the business of distribution fell under the Congress of the Philippines. On the other hand, the planning and crafting of policies was vested in the Department of Energy (DOE). Its functions included demand forecasting of power and developing and implementing projects to match the supply capacity with the demand.

[43]The Luzon grid was extended to Leyte (to utilize Leyte geothermal energy supply) in 1998, thus connecting the Luzon and Visayas grids. Given the limited capacity of the connection, however, the transmission of power from North to South is constrained during peak hours. As a result, DOE typically treats the grids as separate.

[44]Originally, Manila Electric Railroad and Light Company.

Appendix Table 1: List of Independent Power Producer projects.

	Project	Operator	Type	Capacity in Megawatts	Cost (P/kwh) as of bid date	Cooperation period (years)	Commercial operation date	Contract expiration
1	Casecnan hydro electric plant	National Irrigation Administration	PPA	140	$0.165	20	Jan 2000	Jan 2020
2	Natural gas project	KEPCO	BOT	1200	1.2560	20	Jan 2002	Jan 2022
3	Sual Pangasinan Coal fired powerplant	Hopewell Holdings Ltd.	BOT	1000		25	Mar 1999 (phase I) June 1999 (phase II)	June 2024
	(1-10)				1.4370			
	(11-20)				1.3230			
	(21-25)				1.2070			
4	Mindanao II (Mt. Apo) Geo.	PNOC-EDC	PPA	48.25	1.5500	25	Jul 1999	Jul 2024
5	Bakun A/B and C HEP	NMHC/Ever/AEV/Pacific hydro	BOT	65	2.650	25	Jan 2000	Jan 2025
6	San Pascual Cogeneration plant	San Pascual Cogen Co. International	BOO	304		25	June 2001	June 2026
	(1-6)				1.6420			
	(7)				1.6210			
	(8)				1.4530			
	(9)				1.3280			
	(10)				1.2670			
	(11)				1.2230			
	(12)				1.2020			
	(13-25)				0.9510			
7	Pagbilao coal fired TPP	Hopewell Energy Ltd.	BOT	700	1.7840	30	Ap 1996 (phase I) June 1996 (phase II)	June 2026
8	Caliraya-Botican-Kalayaan HEP	IMPSA	BROT	640		25	Jan 2004	Jan 2029
	(1-3)				0.7000			
	(4-9)				1.6000			
	(10-25)				1.0400			
	Without pumping							
	(1-3)				0.7000			
	(4-9)				1.0400			
	(10-25)				0.4300			
9	Mindanao coal-fired powerplant I	State/Harbin	BOT	200		25	Jan 2004	Jan 2029
	(1-5)							
	(6-10)				1.4530			
	(11-15)				1.4940			
	(16-20)				1.5410			
	(21-25)				1.5910			
10	San Roque multi-purpose HEP	Marubeni/SITHE/Italian-Thai	BOT	345	3.3550	25	Jan 2005	Jan 2030
11	Ambuklao Hydro Power Plant	Miescor	ROL	75	1.3500	5	Oct 1995	Oct 2000
12	Bauang, La Union Diesel PP	First Private Power Corp	BOT	215	1.3730	15	Feb 1995	Feb 2010
13	Bataan EPZA Diesel Plant	Edison Global Electric	BOO	58	1.6340	10	Jun 1994	Jun 2004
14	Benguet (Amphohaw) Mini hydro	Hydro Elect. Dev. Corp	ROL	22	88% *NPC rate	5	June 1992	June 2002
15	Binga Hydro Power Plant	Chiang Jiang Energy Corp.	ROL	100	1.1500	15	Aug 1993	Aug 2008

Appendix Table 1 continued: List of Independent Power Producer projects.

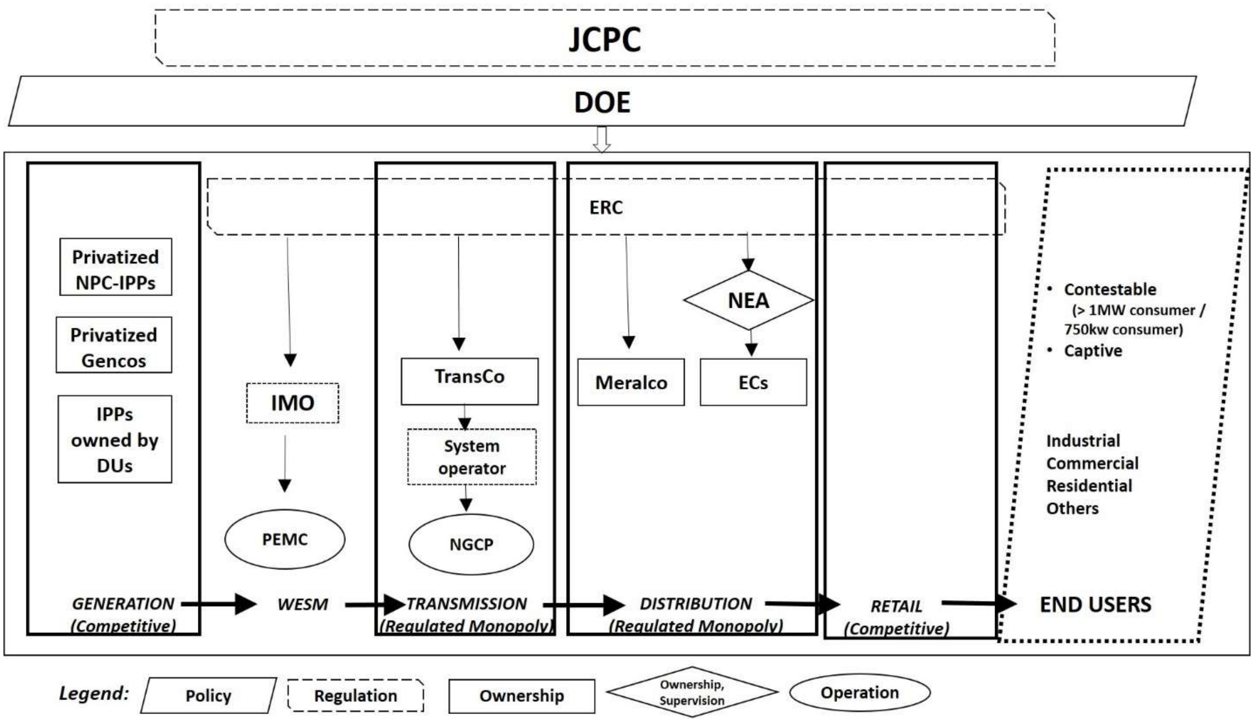
	Project	Operator	Type	Capacity in Megawatts	Cost (P/kwh) as of bid date	Cooperation period (years)	Commercial operation date	Contract expiration
16	Calaca Batangas Diesel Plant	Far East Levingston (FELS)	BOO	90	1.7790	5	Sept 1993	Sept 1998
17	Cavite EPZA Diesel Plant	Magellan Cogen Utilities	BOO	43	1.3460	10	Dec 1995	Dec 2005
18	Clark Air Base Diesel Plant	Electrobus Consolidated Inc.	ROM	50	1.1400	7	Jul 1992	Jul 1999
19	Engineering Island Power Barge	Sabah Shipyard SDN, BHD	BOO	100	1.5680	5	Oct 1994	Oct 1999
20	Gas Turbine (GT) Power Barges	Hopewell Tileman Ltd.	ROM	270	1.9630	10	1993	2003
21	General Santos Diesel Plant	Alsons/Tomen	BOO	50	1.5260	18	Ap 1998	Ap 2016
22	Iligan City Diesel Plant I	Alsons/Tomen	BOT	58	1.4370	10	Jul 1993	Jul 2003
23	Iligan City Diesel Plant II	Alsons/Tomen	BOT	40		12	Dec 1993	Dec 2005
	(1-7)				1.5250			
	(8-12)				1.3180			
24	Leyte A (Leyte-Cebu) Geo	PNOC-EDC	PPA	200	1.6500	25	Nov 1997	Nov 2022
25	Leyte A (Leyte-Cebu) Geo	PNOC-EDC	PPA	440	1.5500	25	Jul 1998	Jul 2023
26	Limay Bataan CC, Block A	ABB/Marubeni/Kawasaki	BTO	300	0.9200	15	SC May 1994	Oct 2009
							CC Oct 1994	
27	Limay Bataan CC, Block A	ABB/Marubeni/Kawasaki	BTO	300	0.9340	15	SC Apr 1993	Jan 2010
							CC Jan 1995	
28	Makban Binary Geo Plant	ORMAT Inc.	BTO	15.73	0.3370	10	Mar 1994	Mar 2004
29	Malaya Thermal Power Plant	KEPCO	ROM	650		15	Jun 1995	Jun 2010
	Unit I							
	(1-4)				0.1670			
	(5-15)				0.3070			
	Unit II							
	(1-4)				0.1530			
	(5-15)				0.2790			
30	Mindanao Diesel Power Barge	Mitsui/BWSC	BTO	200		15	Apr 1994 Jul 1994	Apr 2009
	(1-7)				0.7840			
	(8-15)				0.7950			
31	Mindanao I (Mt. Apo) Geo	PNOC-EDC	PPA	47	1.5578	25	Feb 1997	Feb 2002
32	NAGA Thermal Complex	SALCON	ROM	203		15	May 1994	May 2009
	CTPP-1				1.2790			
	CTPP-2				1.7980			
	CDDP-1				1.3790			
	GT				1.8600			
33	Navotas Diesel Power Barge I	East Asia Power Corp.	BOO	60	1.5598	5	Sept 1994	Sept 1999
34	Navotas Gas Turbine No. 4	Hopewell Energy Int'l Ltd.	BOT	100	2.0690	12	Mar 1993	Mar 2005
35	Navotas Gas Turbines Nos. 1-3	Hopewell Holdings Ltd.	BOT	210	2.0640	10	Jan 1993	Jan 2003
36	North Harbor Diesel Barges	Far East Levingston (FELS)	BOO	90	1.5670	5	Jul 1994	Jul 1999
37	Pinamucan, Batangas Diesel PP	Enron Power Corp.	BOT	105	2.0190	10	Jan 1993	Jan 2003
38	Subic Zambales Diesel Plant I	Enron Power Corp.	ROM	28	1.5487	5	Jan 1993	Jan 1998
39	Subic Zambales Diesel Plant II	Enron Power Corp.	BOT	108	1.6590	15	Mar 1994	Mar 2009
40	Toledo Cebu Coal Thermal Plant	Atlas Consolidated Mining	PPA	55	1.00	10	Jul 1993	Jul 2003
41	Zamboanga Diesel Power Plant	Alsons/Tomen	BOO	100	1.4730	18	Dec 1997	Dec 2015

Notes: PPA Power purchase agreement; BOT Build-own-transfer; BROT Build, rehabilitate, operate, transfer; BOO Build-own-operate

Source: Reside (2001) and National Power Corporation as cited in the *World Bank Country Framework Report for Private Participation in Infrastructure* (2001), Aldaba 2004

With the passage of EPIRA, the landscape shifted primarily to private ownership, with growing competition in the generation sector and the intention to make retailing competitive as well. Figure A2 shows the structure with four sectors: generation, transmission, distribution, and retailing (called "supply" in the Law). As discussed in the text, retail competition was to be achieved by the gradual expansion of the "contestable market," the "segment of electricity end-users who have a choice" among retailers. The industry restructuring will not be complete without the full implementation of the Retail Competition and Open Access Law. Even with said implementation, however, the industry will not be fully competitive without a forward market such that independent retailers will not be at a disadvantage in being able to secure reliable service to their customers.

Figure A2. The Electricity Industry Structure after EPIRA (2001-present)



With the change in landscape, the actors and their roles have also changed. The DOE still has policy and planning responsibilities and oversees NPC and NEA. NPC divested its ownership of government assets through the creation of Power Sector Assets and Liabilities Management (PSALM), which is in charge of asset privatization. The function of NPC has been reduced to missionary electrification including some ownership of Small Power Utilities Groups (SPUGs). NEA still supervises the electric cooperatives. EPIRA also created the National Transportation Company (Transco) that owns the transmission assets. The grid is managed by a concessionaire, the National Grid Transmission Corporation (NGCP, Figure A2), which is responsible for the improvement, expansion, operation, and maintenance of the transmission assets.

The DOE established the Wholesale Electricity Spot Market (WESM), which provides a market and thus, pricing for the uncontracted power outside of the bilateral contracts. WESM is run by the Philippine Electricity Market Corporation (PEMC), which took over as the independent market operator in 2003.

EPIRA created two oversight entities -- the Energy Regulatory Commission (ERC), which replaced ERB (see Figure A1 and A2) and the Joint Congressional Power Commission (JCPC). ERC is a quasi-judicial agency that regulates the power industry. Its main responsibility is to review and approve retail rates and transmission charges. Inasmuch as there are no plans to completely unbundle distribution from retailing, there is no separate regulation of distribution charges. The JCPC, a separate transitory regulatory body, ensures that EPIRA is implemented according to the timing prescribed in the law.

In addition to the two regulatory agencies, EPIRA mandates several market safeguards. Transmission assets cannot be owned by generation nor distribution companies. Distribution utilities are not allowed to source more than 50% of their demands from their own affiliated companies e.g. Meralco's subsidiary, Meralco PowerGen Corporation (MGen). The intention of this limitation on cross ownership was to inhibit market power abuse, discriminatory access, transfer pricing, and cross subsidization (Fabella 2002), but the 50% requirement appears somewhat generous in that regard.[45] Another safeguard is the limit on generation ownership. Section 45a, EPIRA states that "No company...can own or control more than thirty percent (30%) of the installed generating capacity of a Grid and/or twenty-five percent (25%) of the national installed generating capacity..."

Implementation of EPIRA

Despite numerous implementation delays in EPIRA, some milestones have been achieved. The Wholesale Electricity Spot Market (WESM) has been established, aided by the provision that distribution utilities source at least 10% of their demands from WESM for the first 5 years. Inter-grid, intra-grid, and inter-class subsidies have also been removed. [46] The stranded debts and stranded contracts of the National Power Corporation (NPC) are being paid from the *universal charges* levied on all electricity users and through the sale of most government assets by PSALM.[47] The management of transmission assets has also been successfully awarded to a private concessionaire, the NGCP.

Nonetheless, the implementation of EPIRA has not been smooth sailing. In particular, the end-goal of establishing a fully competitive retail sector should have been realized in 2007 (Figure A3). However, the initial opening of RCOA has been delayed and is currently suspended pending review of the pilot period. Various small implementation delays have been encountered, resulting in a domino effect in the establishment of the RCOA.

While the WESM has been established and is considered as one of the significant milestones, the existence of bilateral-contracting outside of the market limits its effectiveness.

[45]To date, however, cross ownership between generation and distribution has not come anywhere near the 50% limit. Meralco doesn't even appear in Figure 3 because it owns less than 5% of the total generating capacity in Luzon.

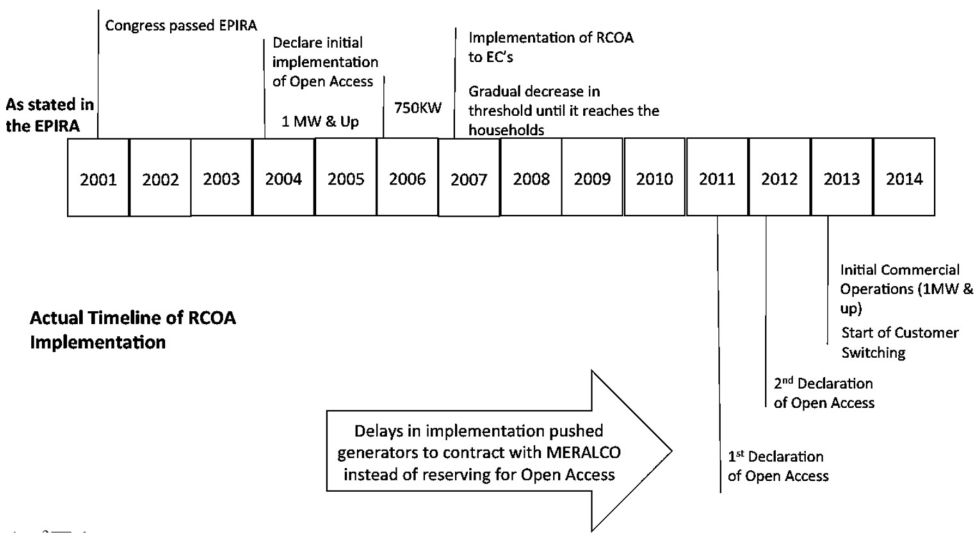
[46] Prior to EPIRA, inter-class subsidies were given for small residential users and social service users (e.g., hospitals, street lamps, among others). An inter-grid subsidy was also allowed whereby Luzon grid users subsidized the Visayan grid users. Lifeline rates for "marginalized" end-users are still allowed.

[47] Universal charges also help

The wholesale market has been very thin, often below 10% of total transactions, which renders the market sensitive to price volatility.[48] Each bilateral contract between a generation company and a distribution utility is reviewed by the ERC. A distribution utility would have several bilateral contracts at any point in time, the average prices of which including those bought at WESM go into the consumers bill as the "blended generation charge." This typically makes up 47% of the total bill of a residential customer. Since WESM is thin, retail rates are largely determined by regulatory review of the bilateral contracts.

Cognizant of bilateral contracting's lack of both competitiveness and transparency, the DOE released a circular in August 2015 mandating all DUs to undergo a Competitive Selection Process (CSP) in contracting their power requirement. This effectively voids bilateral-contracting, but does not solve the issue of thinness of the wholesale market.

Figure A3. Implementation timeline of EPIRA



Adapted from Lotilla (2015).

Seven years after EPIRA, the Renewable Energy (RE) Act or RA 9513 was passed, largely due to pressure from environmental advocates. The main objectives of the RE Law are: (i) reducing dependence on fossil fuels, thus insulating the country's exposure to price fluctuations in international markets and (ii) reducing harmful emissions. As discussed in part 1, promoting greater self-sufficiency tends to reduce welfare, and renewable subsidies are not a cost-effective tool for reducing emissions. Nowhere in the RE Law does it state how it will be

[48] Market thinness has been disputed (e.g. World Bank 2005) on the grounds that all flows of energy are dispatched through the WESM system. In practice however, generators with bilateral contracts make very low bids, and buyers on those contracts make very high bids in order to effect the contracted transaction. This leaves the price to be determined by the residual 10% of the market.

supportive of the goals of EPIRA, especially regarding market completion to bring down the cost of power.

In furtherance of the RE law, the DOE released Circular 2015-07-0014 prescribing the policy of maintaining at least 30% of total generation coming from renewable sources as part of a fuel mix target of 30-30-30-10, i.e., 30% - coal, 30% - renewables, 30% - natural gas, and 10% - others. The incentive for the development of renewable energy resources in the country's total power-generating capacity is facilitated through the implementation of the Feed-in Tariff System. This would not require increasing the renewable share but rather limiting the decrease. The renewable share was about 38% in the 1990s and average around 33% in 2011-2014, largely from hydropower and geothermal.

On the one hand, EPIRA aims to encourage competition and transparency in the power Industry. On the other hand, the Renewable Energy Act aims to reduce import dependence and price fluctuations with protectionist subsidies that shrinks the economy without any evidence that this will stabilize prices. Reforms that aim for "balance" among allegedly competing objectives of growth, health, and environment are not well-founded. A more cost-effective way to reduce emissions relative to direct regulation would be to tax the sources of negative externalities.

Appendix B: Market concentration among distribution utilities

Distribution utilities are obligated to serve potential customers in their franchise areas c leaving them as monopolies absent viable retail alternatives. Under EPIRA, a new entrant to the distribution business requires a congressional franchise. A new entrant to the retail sector requires a license from the ERC.

Appendix Table 2 reports the Herfindahl-Hirschman Index (HHI) of market concentration in distribution for the three main regions of the Philippines. The HHI is computed by squaring the market share of each firm in the market and then summing them up over firms. HHI ranges from close to 0 to 10,000. The closer the market is to a monopoly, the higher the concentration and the higher the HHI. As shown in Table 1, the highest HHI occurs in Luzon (6193), signifying a substantial degree of market dominance by Meralco.

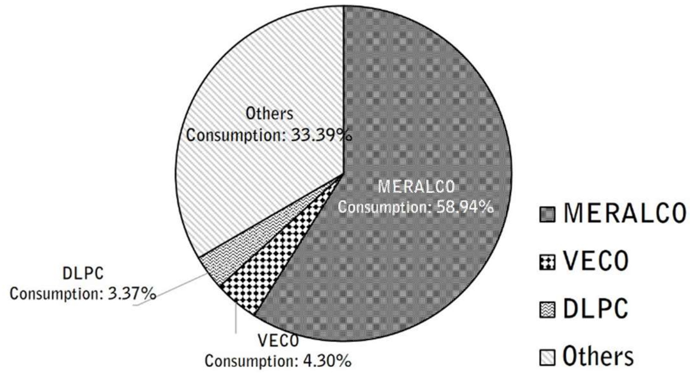
Appendix Table 2. Herfindahl-Hirschman Index (HHI), distribution utilities, 2014 kwh sold

	HHI
Philippines	3520.60
Luzon	6193.87
Visayas	1519.46
Mindanao	1027.66

Note: HHI is computed based on the kwh sold to residential, commercial, industrial, and other customers. Source of basic data: The Rural Electrification Chronicle 2012-2014, National Electrification Administration (NEA), 2015; 2014 Private Investor-Owned Utilities Monthly Operations Report, Department of Energy (DOE), 2015.

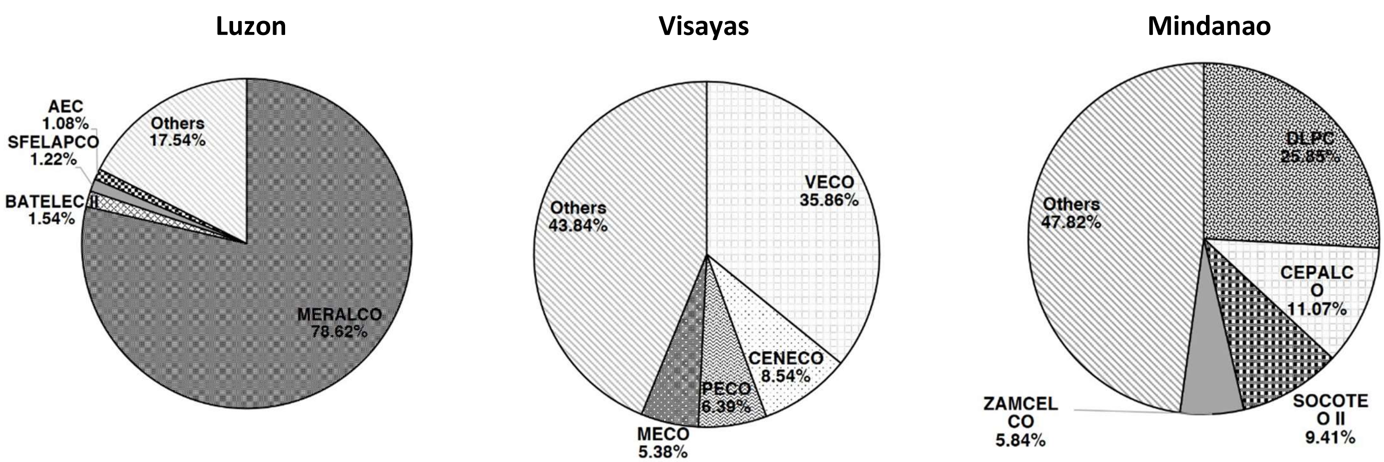
Figure A4 shows the largest distributors as of 2014. Meralco is the largest franchise holder, controlling 60% of the Philippine market. Their franchise area includes Manila and surrounding provinces. It’s market share of Luzon is 79% (Figure A5). This gives Meralco substantial monopoly power and monopsony power as it is by far the largest buyer of electricity from the generation companies. The next largest distribution utilities are Visayan Electric Company (VECO) with 4% and Davao Light Power Company (DLPC) with 3% (Figure A4). Aboitiz Power owns both VECO and DLPC. The remaining franchise areas are served by 122 electric cooperatives (ECs) and 14 Private Investor Owned Utilities (PIOUs).

Figure A4. Retail/Distribution concentration, Philippines



Note: Shares are computed based on the kwh sold to residential, commercial, industrial, and other customers. Source of basic data: The Rural Electrification Chronicle 2012-2014, National Electrification Administration (NEA), 2015; 2014 Private Investor-Owned Utilities Monthly Operations Report, Department of Energy (DOE), 2015.

Figure A5. Concentration in distribution, by broad regions



Note: Shares are computed based on the kwh sold to residential, commercial, industrial, and other customers. Source of basic data: The Rural Electrification Chronicle 2012-2014, National Electrification Administration (NEA), 2015; 2014 Private Investor-Owned Utilities Monthly Operations Report, Department of Energy (DOE), 2015.

Appendix C: Promising Research Issues

The nature, causes, and consequences of market design

1. Nature and consequences (comparative):
    a. What market designs and regulatory policies are used in selected countries (e.g. New Zealand, Australia, Singapore, Thailand, Malaysia, New Zealand, England, France, USA)? What are the prevailing prices (peak/off-peak)?
    b. Regulatory polices? Taxes and subsidies that influence price?
    c. Indicators of competitiveness
2. Causes (political economy) of market design, e.g. in the Philippines
3. Public Economics
    a. Pros and cons of alternative market designs
    b. Benefit pricing vs. taxpayer-funded subsidies
    c. Adjusting pricing for equity (e.g. lifeline pricing and escalating-tier pricing)
    d. Market-friendly conservation policies

Efficiency pricing

1. Price regulation for non-competitive retail sectors: long vs. short run marginal cost pricing, economies of scale, fixed and variable price components, tiered pricing, peak-load pricing.
2. Pros and cons of alternative transmission-pricing models (e.g. two-part tariff incl. congestion charges)

Environmental and renewability policies

1. Is “cheap coal” socially expensive? Compare social LCOEs w/ corresponding avoided cost estimates for coal vs. intermittent renewables.
2. Evaluation of alternative instruments of internalization, e.g. FIT, decoupling, emission taxes

Optimal generation and transmission investments

1. Where are transmission constraints binding?
2. Comparison of LCOEs of different sources at the margin. To what extent are these justified by LACE differences?

Grid management policies

1. Reserve policies at different levels of renewability
2. Optimal composition of reserves vs. demand management

Cost effectiveness of different modes of missionary electrification

1. Classify unelectrified sitios by distance to nearest network and whether said network is “off-grid.”
2. Case studies of cost effectiveness of different levels and modes of electrification

    a. "Grid": connection vs. household level solar vs. sitio-level bio or non-renewable fuel
    b. Sitio-level charging stations (possibly including subsidies of battery driven TVs and radios)
3. Indicative information on benefits (e.g. residential uses facilitated by different levels of provision)
4. Cost-benefit study of connecting an off-grid network to a major transmission grid