November 2019

ENERGY POLICY NOTE

The impact of renewables distributed generation on household electricity prices and utility balance sheets
Evidence from 3 Latin American economies

Simon Commander and Stavros Poupakis[1]

1. *Introduction*

Changes in technology and pressure to decarbonize are forcing transformation in electricity systems. As part of these wider shifts, the proliferation of intermittent, renewables Distributed Generation (DG) has been highly disruptive for incumbent utilities, particularly in restructured electricity markets – such as in Europe. When there is grid parity, households can benefit from generating their own electricity. The risks of grid defection and a hit to utilities' revenues increases when DG with storage is available, particularly if the utility has to retain sufficient capacity to meet potential demand. Conversely, growth in DG can raise avoided costs in the future due to lower levels of investment than are needed in conventional energy, although the integration of intermittent renewables also tends to impose additional costs. In developing countries, the disruptive potential of DG has been largely contained because changes to market structure have generally been less radical (or absent) while commitment to de-carbonization has often been absent or ineffectual. There are, however, signs that this is about to change, not least because of the growing competitiveness of renewables, such as Solar PV and wind. This note looks in particular at the implications of Solar PV adoption for both utilities and households.

In this context, developing country governments characteristically face a trilemma: how can they meet (1) climate change and emissions targets, (2) support the financial stability of their utilities but also (3) provide cheap electricity to consumers? These goals tend not to be mutually consistent. Electricity subsidies – the instrument most commonly used to achieve the third objective – reduce or eliminate the incentives for shifting to low carbon energy, such as renewables, while adoption of the latter in turn can imperil the financial standing – even viability - of incumbent utilities. And because poorer consumers tend to have low renewables adoption rates, in response to any revenue squeeze utilities may simply pass on costs to non-adopters, further negating the third objective.

2. *Evidence from Latin America*

Robust evidence has so far been scanty but data from three Latin American economies - Argentina, Mexico and Brazil – now provide detailed information on the complex interaction of electricity pricing, including subsidies, and the financial status of utilities once renewable DG enters the frame. Although the three countries have significant differences in the extent of electricity market liberalisation, each has powerful incumbent utilities. Argentina and Mexico maintain large electricity subsidies that account for between 1-2% of GDP, along with complicated electricity pricing arrangements involving

[1] Simon Commander, Altura Partners and IE Business School – scommander@alturapartners.org; Stavros Poupakis, University of Oxford – stavros.poupakis@oxfordmartin.ox.ac.uk

increasing block tariffs (IBTs). While those subsidies are rationalised as benefiting the poor, the reality is different. Brazil, in contrast, maintains a unique volumetric price for households for electricity. There are some cross-subsidies but explicit electricity subsidies are absent. In all cases, the shift into low carbon energy use and, in particular, the diffusion of renewable DG remains very limited. Even so, each of these governments has signed up to more ambitious climate change targets, the attainment of which will require far more rapid diffusion of DG.

3. Implications of renewables DG and subsidy removal for utilities

Starting with the financial situation of the utility, subsidies in Argentina and Mexico presently impose large deficits. The average ratio of revenues to costs is 0.8 and 0.4 respectively. In Brazil, by contrast, where subsidies are absent, that ratio is 1.6. A hypothetical removal of subsidies and movement to full cost recovery would require revenues to rise by nearly 20% in Argentina (on the assumption that electricity would be priced volumetrically). For Mexico, eliminating subsidies and achieving cost recovery would require a jump of over 75% in revenues. These are very large adjustments which are difficult to implement politically.

Table 1: Impact of Solar PV adoption on utility's deficit (Argentina & Mexico)/surplus (Brazil) under current pricing arrangements

	Solar PV Adoption rate	
	10%	***50%***
Argentina		
Without avoided costs	+11%	+54%
With avoided costs	-3%	-16%
Mexico		
Without avoided costs	+3%	+12%
With avoided costs	-2%	-13%
Brazil		
Without avoided costs	-5%	-48%
With avoided costs	-3%	-18%

Using household survey and administrative data from these three countries, we have conducted a series of micro-simulations for different Solar PV adoption rates and subsidy regimes. *Table 1* reports what the impact of Solar PV adoption under current pricing rules would be on the utility. We assume a diffusion path conditioned on dwelling size and ownership for both Argentina and Brazil and consumption for Mexico. In the Argentine case, at a low adoption level (10% of consumers) the utility's deficit would increase by around 11%. At a 50% Solar PV adoption rate there would be a 54% increase in the deficit. In both instances, this assumes that costs do not change materially. However, assuming that Solar PV adoption unlocks avoided costs (such as lower investment requirements), at 10% adoption this could allow a 3% decline in the deficit compared to the current situation that would rise to 16% for a 50% adoption rate. In the Mexican case, a 10% adoption rate would lead to a 3% increase in the deficit while a 50% adoption rate without avoided costs would increase the deficit by 12%. With avoided costs in the 50% adoption scenario, the utility's deficit would decline by 13%. In Brazil, at a 10% adoption rate, with or without avoided costs the surplus of revenues over costs declines by 3-5%.

In the case of a 50% adoption rate without avoided costs the surplus of revenues over costs declines by 48%; if there are avoided costs the surplus declines by 18%.

What would happen in Argentina and Mexico if electricity subsidies were removed, pricing was volumetric and Solar PV was introduced but avoided costs were not realised? In both Argentina and Mexico, at a 10% Solar PV adoption rate, the utility's revenues would fall by around 3% opening up a small deficit. However, at a 50% adoption rate, the ratio of revenues to costs would fall to 0.86. In Mexico, at 10% adoption, the ratio of revenues to costs would fall to around 0.96 but at 50% adoption this would go to 0.79. Without avoided costs the financial implications for the utility would be seriously negative.

In sum, with current pricing and subsidies, Solar PV diffusion at scale (viz., 50%) will clearly result in a further hit to the utility's financial position if there is no associated fall in costs. If Solar PV adoption allows avoided costs, in Argentina and Mexico the utility's deficit declines compared to the current situation even if the deficit remains large. In Brazil, the erosion of the surplus of revenues over costs is significant, even with avoided costs. Some of these effects hold with cost reflective pricing and Solar PV adoption at scale where a significant gap between revenues and costs opens up. It should be noted that any avoided costs that arise are unlikely to be instantaneous and will further depend on overhaul of the utilities' business strategies as well as supportive regulatory changes.

4. *Implications for households from moving to cost-reflective pricing and DG*

Households will also be affected by a shift to cost-reflective pricing as well as DG adoption. However, the impact will vary depending on the volume of consumption and the existing tariffs facing particular households.

Table 2: Argentina and Mexico: Impact of Removal of Electricity Subsidies on Electricity Prices for Different Levels of Electricity Consumption (with/without VDT and Solar PV) (percentage change relative to current prices)

	Low user	***Mid-level***	***High***
Volumetric pricing			
Argentina	+16%	+37%	+22%
Mexico	+230%	+333%	+250%
With VDT			
Argentina	-29%	+13%	+39%
Mexico	+63%	+277%	+250%
With VDT & 50% Solar			
Argentina	-29%	-12%	+17%
Mexico	+63%	+44%	+16%

Table 2 shows the percentage increase in unit electricity prices that would result from an instantaneous elimination of subsidies. In Argentina a low volume residential consumer of electricity would be subject to an average increase of 16%, while mid- and high-volume consumers would experience an increase of between 22-37%. In Mexico, the increases would be massive, ranging between 230% for low volume consumers to 250-333% for mid and high-volume consumers!

What would be the impact of introducing Solar PV adoption in a cost reflective pricing regime? There would be little impact on unit prices at low rates of adoption. But at 50% adoption in Argentina, both middle and higher volume consumers would experience a significant fall of between 14-23% relative to the cost recovery case without Solar PV. In Mexico, the same groups of consumers would experience a price decline of between 35-45% while in Brazil, they would face prices that were between 25-30% lower. This is because adoption will mostly be centred on better-off households who have both the income and infrastructure to permit DG adoption.

5. *Pricing with a distributional focus*

In Argentina and Mexico, movement to cost recovery has proven to be a political non-starter. Even gradual upward adjustments have been problematic given the size of the subsidies and the bargaining power of their beneficiaries. So, what options are there for addressing this roadblock while simultaneously making progress on the deployment of renewables?

One approach would be to move towards a system of cost reflective pricing alongside lowering prices for smaller consumers or poorer households. The usual prescription is targeting on the basis of income, but this may not always be feasible. Instead, a simpler approach focussing on energy consumption volumes – such as Volume Differentiated Tariffs (VDT) - may provide a more practical route. These explicitly offer lower tariffs to smaller consumers. To look at the consequences of applying a VDT, 2-3 consumption bands - with tariffs faced by low volume household consumers set at between 45-55% of the price faced by larger consumers of electricity - are simulated.

Table 2 shows that introduction of a VDT in Argentina consistent with cost recovery would result in the unit price for low volume consumers falling by 29% (as against a rise of 16% without a VDT) relative to current prices. Mid-volume users would also see a far smaller increase (13% vs 37%) while high volume consumers would experience a larger increase (39% vs 22%). In Mexico, the increase for low volume consumers drops sharply to 63% (as against 230%) and also falls for mid-volume users. The increase remains unchanged for large consumers of electricity. As such, introducing a VDT softens the scale of increase but there is nevertheless a substantial jump in prices.

Now, consider what happens when Solar PV is introduced alongside the VDT focussing on cases where the scale of adoption is large (viz., 50%). There is no impact on prices for low volume consumers in Argentina. However, mid-volume users see a fall in prices compared to current levels while high volume users experience a small increase. Similarly, in Mexico high Solar PV adoption ensures that the increase for both mid- and high-volume consumers becomes significantly smaller. What would be the implications for the utility's finances? In Argentina, with avoided costs the ratio of revenues to costs would be 0.94; without avoided costs it would fall to 0.78. To put this in context, the current ratio (without Solar PV and with subsidies) is 0.81. In Mexico, with avoided costs and high adoption, the ratio would be 0.96 falling to 0.51 without avoided costs (the current ratio without Solar PV and with subsidies is 0.39).

Finally, in the Brazil case, compared to the current situation (remembering that there are no subsidies), a VDT lowers unit prices for smaller consumers by 38%. Mid-volume consumers face unchanged prices and high-volume consumers experience a 7%

increase. Maintaining a VDT with Solar PV deployment at 50% adoption leaves prices facing smaller consumers almost unchanged but mid-volume consumers have nearly a 30% decline and high-volume consumers a 16% decline relative to the case of a VDT and cost recovery without Solar PV. With Solar PV adoption and without avoided costs, the current surplus of revenues over costs would shrink by more than half and by around 25% if avoided costs are realised.

6. Conclusion

Developing countries struggle with objectives for electricity pricing and markets that are inherently difficult to reconcile. Political pressures drive subsidies which in turn retard the adoption of new energy sources and technologies that can help meet climate change goals. And those technologies in turn can sap the financial vitality of utilities – some have even referred to a death spiral. Using information from three major Latin American economies, renewables DG adoption is shown to put pressure on utilities' balance sheets. The scale of that damage depends significantly on whether DG allows avoided costs. However, these costs are often a second order issue when compared to the damage that electricity subsidies create. The barriers to eliminating – or modifying – those subsidies are mostly political. For both Argentina and Mexico, wholesale abolition of subsidies would lead to large price increases. This can be mollified by using VDTs that help deliver relatively low-priced electricity principally to small volume residential consumers. At the same time, Solar PV diffusion at scale alongside VDTs can lower prices facing the larger consumption brackets, albeit with some accompanying deterioration in the utility's finances. Again, the extent to which Solar PV deployment facilitates avoided costs for incumbent utilities is critical.