POLICY IMPLICATIONS

The 10 policy implications that follow draw on the review of historical evidence provided and on a forward look at disruptive technology trends in the power sector. The momentous technological changes underway—notably, increasingly cost-effective decentralized technologies—are posing fundamental questions about the viability of the traditional centralized utility and promising to change the structure of the power sector. In some frontier markets, the wave of change takes the form of distribution utilities splitting into a wires business and a distribution system operator, whose primary role is to provide a platform that consumers and businesses can use to trade energy both within the distribution segment and into the wholesale power market. In other cases, the new technologies are seen primarily as opportunities to improve the efficiency and effectiveness of the traditional utility.

As these debates play out into an uncertain future, at least two things seem clear.

First, power consumers will no longer be captive to underperforming utilities. The technological disruption in OECD member countries is taking place against a backdrop of universal access to a relatively high-quality and reasonably priced grid service. In contrast, across the developing world, many utility customers are faced with a costly and unreliable supply. Historically, the only alternative for unsatisfied customers was to supply their own electricity using expensive diesel generators. As rooftop solar power becomes cheaper and approaches grid parity, self-generation will become increasingly attractive where utility service is deficient, particularly once battery storage becomes more cost-effective. This development will start to contest the monopoly power of the incumbent utility, potentially providing incentives for improved performance. At the same time, there is the risk that already precarious utilities may be exposed to further financial distress resulting from grid defection.

Second, the speed and coherence of the technological transition will depend critically on the design of the regulatory framework, which shapes the incentives for innovation. Incentives for utilities to innovate depend on the regulatory regime under which they operate, since it is this that determines whether and how investments and operational savings can be turned into profits. Incentives for customers to innovate will depend on how much freedom they are given by the regulatory framework to engage in decentralized energy production and storage activities, as well as the associated impact on tariffs. Incentives for new players to enter the market and innovate will similarly depend on the flexibility of the regulatory licensing regime. In view of this, it is clear that the design of the regulatory framework will give countries a certain amount of discretion to accelerate or impede the uptake of disruptive technologies.

The following policy implications identify how disruptive technologies are likely to affect aspects of the power sector reform agenda.

- *Policy implication #1*. The design of power sector reforms should be informed by the enabling conditions of each country and oriented primarily toward achieving better sector outcomes.
- *Policy implication #2*. The design of power sector reform needs to be thoroughly grounded in the political realities of each country.
- *Policy implication #3*. Greater emphasis should be placed on building institutional capacity for power sector planning and associated implementation.
- *Policy implication #4*. Generation plants should be procured through a transparent and competitive process, with as much contractual flexibility as the context allows.
- *Policy implication #5*. Unbundling should not be the highest priority where more

fundamental financial and governance challenges persist; it should be undertaken primarily to facilitate deeper reforms.

- *Policy implication #6*. Wholesale power markets remain a viable option for countries that have put in place all the foundational measures; others may derive greater benefit from regional trade.
- *Policy implication #7*. Greater efforts should be made to strengthen the corporate governance and managerial practices of state-owned utilities.
- *Policy implication #8*. The regulatory framework needs to be adapted to reflect the institutional context and to accommodate emerging technological trends.
- *Policy implication #9*. Private sector participation in distribution should be considered only when enabling conditions are met.
- *Policy implication #10*. Delivering on the twenty-first century agenda of universal access and decarbonization calls for additional reform measures targeted explicitly at these objectives.

Policy implication #1: The design of power sector reforms should be informed by the enabling conditions of each country and oriented primarily toward achieving better sector outcomes

The 1990s power sector reform model was derived from economic first principles believed to apply universally, independent of context. As a result, it lacks a framework for customizing reform to the country context. In practice, numerous enabling conditions—both economic and political—have emerged as important in shaping its applicability. Across the developing world, systematic differences can be observed in the uptake of the model across countries, depending on their income group, system size, political system, and other factors. Drawing on the case studies that have informed this study, contextual factors also seem to have played a role in shaping the outcome of reforms.

Experience suggests that it may be helpful to think about power sector reform engagements in two phases, depending on the nature of the country environment. This overall framework is depicted in table O.3, which presents the reform measures likely to be applicable in more challenging versus more mature environments, as well as the enabling conditions that signal a country's readiness for various aspects of the reform package.

In more challenging environments, a basic set of preliminary reform measures is proposed. This applies to countries that may be challenged by low incomes, fragile settings, small scale, or other limiting factors. The priority in these environments should be to work toward a foundation of good sector governance and basic financial viability, without embarking on overly complex structural reforms.

The policy implications are as follows:

- *Regulation*. Critical at this juncture is to adopt a transparent and well-founded tariff-setting methodology and to apply it each year. This could be done by a regulatory agency or, at this stage, by a competent unit within the Ministry of Energy or the Ministry of Finance. An adequate initial aspiration for tariff-setting would be to ensure financial viability through recovery of enough capital costs to service and repay existing debt. Equally important would be for the Ministry of Energy to lay the foundations for monitoring the quality of service. The process of tariff and quality regulation should be integrated with other processes for overseeing state-owned enterprises (relating, for example, to performance contracts or fiscal transfers).
- *Restructuring*. This is unlikely to be a high priority at this stage. A vertically integrated power system may be easiest to manage while putting in place strong foundations for the sector. However, the entry of the private sector into generation—through

TABLE O.3 Customizing power sector reforms to country context

	More challenging environments	Enabling conditions	More mature environments
Regulation	Establish clear tariff-setting methodology with oversight from ministry of energy or finance. Aim for achievement of limited capital cost recovery (that is, financial viability). Establish clear quality-of-service framework with oversight from Ministry of Energy.	• *Cost recovery ratio exceeds 70 percent.* • *Revenue collection ratio exceeds 90 percent and is enforced by disconnection.* • *System losses are below 15 percent.* • *Electrification rate exceeds 80 percent.* • *Regular audited financial accounts are compliant with international financial reporting standards.* • *Modern IT systems are in place and deliver good operational data.* • *Regular tariff adjustments are in line with regulatory methodology.* • *The political context is supportive, in terms of ideology, leadership, and stakeholders.* • *Generation capacity reaches 1–3GW.* • *No major bottlenecks exist on the transmission grid or in fuel supply.*	Create separate regulatory entity. Aim for full capital cost recovery. Ensure enforcement of quality-of-service regulation.
Restructuring	Retain vertically integrated utility, and selectively introduce private investment for new plants.		Restructure the power sector to separate out the transmission system operator and ensure adequate degree of competition in generation.
Privatization	Focus on establishing sound corporate governance arrangements and good managerial practices for power distribution, with special focus on human resource management and measures to promote financial discipline. Prioritize electrification through carefully planned parallel efforts with reach of the grid and off-grid, backed up by strong political commitment and adequate public funding.		Strengthen commercial incentives in distribution through measures such as: credit-rating and bond issues; stock market listing; and/or private sector participation.
Competition	Ensure adequate technical capacity for power system planning directly linked to competitive procurement of generation. Introduce economic dispatch of generation plants administered by utility.		Open the grid to third-party access and allow bilateral contracting between generators and large customers. Create wholesale power market. Conduct supply auctions for investment in new plant.

Source: World Bank.
Note: GW = gigawatts; IT = information technology.

supply contracts with the utility—can play a valuable role in expanding capacity.

- *Private sector participation.* It may be best at this stage to limit private involvement to generation. For the distribution segment, the emphasis should be on building good governance and managerial practices, particularly with respect to financial discipline and human resource management.
- *Competition.* The only relevant form of competition at this stage is likely to be competition for the right to build new generation plants. Particularly critical is the development of the technical capacity required to conduct least-cost planning to determine what plants to build, with mandatory links to a competitive procurement process. Furthermore, some of the benefits of a competitive market can be mimicked through the administrative practice of economic dispatch.

In more mature environments, it becomes feasible to contemplate a more sophisticated package of reforms, as long as these improve sector outcomes. This applies particularly to middle-income countries with stable political environments and large power systems, where progress has been made toward good governance and financial viability for the sector. Given that reform is a means to an end, the priority in these environments should be to identify where power sector performance

continues to fall short of expectations and to pursue more advanced reform measures geared to delivering results in these specific areas.

The policy implications are as follows:

- *Regulation.* Thought should be given to establishing a separate regulatory entity if one does not already exist. It now becomes more important to set tariffs to achieve full capital cost recovery, as well as to tighten enforcement of quality-of-service regulation. Strengthening the regulatory framework is particularly critical if the policy objective is for the sector to repay investment finance at market rates.
- *Restructuring.* This is the right juncture at which to consider vertical unbundling to create a separate transmission system operator that will support impartial third-party access to the grid. At the same time, it becomes important to break up generation assets to provide for sufficient competitive pressure among market players.
- *Private sector participation.* Countries moving toward a wholesale power market should ideally divest at least part of their generation assets to the private sector to ensure some diversity of ownership among competing companies. In the distribution tier, countries experiencing operational inefficiencies may wish to consider private sector participation. Where public utilities are performing efficiently, the case for private sector participation is weaker; the need to raise additional capital, however, may make it necessary for the utility to obtain a credit rating to support access to bond finance, or a minority stock exchange listing, both of which will also have the desirable effect of tightening the utility's financial discipline.
- *Competition.* Countries at this stage are ready to consider the transition to a wholesale power market. This should be accompanied by parallel supply auctions or an equivalent measure to ensure timely development of adequate new generation capacity.

The transition from challenging to mature environments can be gauged in terms of certain key enabling conditions. In practice, it may not be necessary or feasible for countries to meet every one of these enabling conditions; however, the more conditions that are met, the better are the prospects for implementation of the more sophisticated reforms. Most of these enabling conditions are related to readiness for the introduction of private participation in distribution. This is more likely to succeed when certain minimum thresholds of financial viability and commercial efficiency have been passed, and when the challenge of electrification is at a reasonably advanced stage. Good financial and operational data systems will also help to reduce information asymmetries and increase confidence among private participants, as will a good track record of regulatory tariff-setting and a conducive political environment. Other enabling conditions are more directly related to the establishment of wholesale power markets. In particular, the power system should be large enough to support at least five competing generation firms (at least 3 gigawatts) and to generate enough turnover to justify the fixed costs of establishing market platforms (at least US$1 billion in annual revenues).

Policy implication #2: The design of power sector reform needs to be thoroughly grounded in the political realities of each country

Commitments to power sector reform should reflect a sober assessment of the country's political economy. The 1990s reform model drew heavily on economic first principles, with no explicit attention to the political dynamics of the reform process. Yet, the reality is that the power sector is highly politicized across much of the developing world. Understanding a country's political dynamics and how they impinge on stakeholder interactions in the power sector should be the starting point for any power

sector reform. Rather than overlooking the political dimension, a smart reform process should be adapted to fit the political context, harnessing potential reform champions and explicitly engaging in consensus-building with contrarian groups.

The policy implications are as follows:

- *Undertake a political economy analysis before engaging in reform.* The analysis should aim at discovering how the power sector touches upon the country's vested interests and political groupings to identify potential winners and losers from reform. It should also consider whether the proposed direction of reform is compatible with the country's ideological orientation and broader political system. The findings of the political economy analysis should explicitly guide the design of the reform program to be adopted.
- *Integrate outreach and communication efforts to engage all relevant stakeholders.* The communications campaign should be based on messages that can be used by the reform champions to articulate the value proposition associated with the reform. Those messages can be disseminated through a variety of channels. Communications should be complemented by outreach that directly engages with all stakeholders, particularly those most threatened by the reform process. In addition to an intensive effort at the outset of a reform process, there is a need to monitor the state of public opinion throughout implementation, as sudden changes in the political environment can easily lead to reform reversals.

Policy implication #3: Greater emphasis should be placed on building institutional capacity for power sector planning and associated implementation

The 1990s model had little to say on the issue of planning. The implicit assumption was that the advent of a wholesale power market would somehow circumvent the need for planning. The ultimate goal of the 1990s model was to create a competitive market. At the time, it was assumed that private investments in power generation would be adequately guided by price signals. The role of the state was seen primarily as the regulator of a privately owned and operated competitive sector, and great emphasis was placed on the creation of a capable regulatory institution and associated legal framework. Central planning functions were overlooked or downplayed. Indeed, in some countries, the planning function traditionally housed in national power utilities or line ministries fell through the cracks as power sector reform processes worked to unbundle the incumbent utilities and to build technical capacity in regulatory agencies operating outside of line ministries. In practice, power markets proved difficult to establish in all but a handful of developing countries; even there, price signals have not provided an adequate basis for investment decisions.

The policy implications are as follows:

- *Create strong technical capacity for planning and empower the planning function.* The development of a strong planning capacity for the development of new generation and transmission infrastructure should be prioritized as a critical component of power sector reform. Various alternative institutional models have been successfully used around the world to locate the planning function, including the line ministry, the transmission utility, the system operator, or a dedicated technical agency. Regulators can play a valuable role in the technical review of investment plans as part of the process of setting revenue requirements for capital expenditure.
- *Make sure the power system plan is actually implemented.* As important as the planning process itself is a strong link between the

power system plan and the procurement of new generation and transmission plant, so that procurement is aligned with the plan and contracted in a timely and cost-effective manner that keeps pace with demand. Without such a clear linkage, governments are vulnerable to unsolicited proposals that may not represent the most cost-effective option for the power system.

- *Incorporate new technologies in power system planning.* Technologies such as distributed energy resources, together with storage and demand response, have the potential to reduce the costs of reaching supply-demand balance. However, the incorporation of such resources is not considered in traditional power system planning, in part because they introduce significant complexity into standard planning methodologies, but also because they would not necessarily be undertaken by the incumbent utility. Storage—in particular—can play multiple roles in the power system, potentially substituting for conventional investments in generation, transmission, and distribution assets. There is a need to modernize planning tools and techniques to integrate such considerations.

Policy implication #4: Generation plants should be procured through a transparent and competitive process, with as much contractual flexibility as the context allows

Although IPPs have proved a popular and effective means of bringing private capital into power generation, much room for improvement remains in the way such projects are implemented. Direct negotiation of projects, often in response to unsolicited proposals, remains widespread across Africa and Asia, raising concerns about value for money and the potential for corruption. At the same time, the need to mitigate risk to reassure investors entering uncharted waters has left many countries with rigid take-or-pay contracts and extensive guarantee clauses that both constrain the efficiency of dispatch and saddle the utility and the government with onerous liabilities.

The policy implications are as follows:

- *Mandate the use of competitive procurement for generation projects.* Competitive bidding of new generation plants should be the default modality for procurement. If unsolicited proposals are considered—only in clearly defined and exceptional cases and when their prefeasibility and compatibility with existing investment plans can be established—they should also be subjected to a competitive process.
- *Maximize the flexibility of contractual provisions.* Risk-mitigation mechanisms will inevitably be needed in unproven environments, but these should be carefully scrutinized and limited to the minimum required to meet investors' legitimate expectations of return. Doing this could mean, for instance, scaling back the volume or duration of take-or-pay clauses or making use of two-part pricing mechanisms that separate capacity and energy charges.
- *Consider the adoption of supply auctions wherever possible.* The foregoing challenges have been successfully addressed by countries that have moved toward the adoption of supply auctions, ensuring a pipeline of regular, well-structured offerings of batches of new generation plant. These are linked to long-term contracts with distribution utilities that give generators first right of supply without committing to take-or-pay arrangements. A growing number of countries are adopting such mechanisms to procure variable renewable energy, and these could readily be extended to cover other technologies.

Policy implication #5: Unbundling should not be the highest priority where more fundamental financial and governance challenges persist; it should be undertaken primarily to facilitate deeper reforms

In the past, power sector restructuring has, at times, been treated as a panacea for reform and prioritized as an early reform measure. However, in and of itself, power sector restructuring does little to tackle the fundamental issues of weak governance and financial fragility that plague the power sector in many developing countries. Moreover, restructuring a sector that suffers from weak governance and financial fragility may only exacerbate the challenges of technical coordination and financial payment along the supply chain.

In reality, unbundling was never intended as an isolated reform measure but rather as a necessary precursor for a competitive market. Unless the latter is a realistic possibility in the medium term, restructuring the sector may not be a pressing matter. Unbundling entails significant transaction costs, as well as the potential loss of economies of scale and scope, which should not be underestimated (Pollitt 2008; Vagliasindi 2012). For these reasons, the relevance of unbundling to smaller power systems is particularly questionable. There is a well-established minimum size threshold of 1 gigawatt before countries should even consider embarking on sector restructuring, and a further threshold of 3 gigawatts before they definitely need to unbundle should they be preparing for the establishment of a wholesale power market.

The policy implications are as follows:

- *Consider unbundling when there is a clear purpose for doing so and where enabling conditions are in place.* The purpose behind unbundling might be to establish a wholesale power market in the not-too-distant future or to introduce private sector participation in a specific segment of the industry but not elsewhere. The enabling conditions would include (1) a minimum system size of at least 1 gigawatt to avoid the loss of economies of scale and (2) adequate institutional governance, including strong payment discipline and technical coordination along the supply chain.

Policy implication #6: Wholesale power markets remain a viable option for countries that have put in place all the foundational measures; others may derive greater benefit from regional trade

The 1990s power sector reform model held up a competitive power market as the endpoint of reform. The aspiration remains legitimate, but it has proved to be farther out than originally envisaged. The difficulty of fulfilling the many enabling conditions that a wholesale power market requires has deferred indefinitely the introduction of such markets across much of the developing world. Nevertheless, their attainment remains a valuable and legitimate aspiration, provided that the enabling conditions can be met. Indeed, the present wave of technological disruption only increases the value of wholesale power markets, which, when properly designed, can support the discovery of rapidly evolving costs and foster the integration into the power system of variable renewables, ancillary services, battery storage, and demand response.

The policy implications are as follows:

- *Ensure that the enabling conditions for a wholesale power market are in place.* Countries should not consider developing such a market until a wide range of preconditions have been met. These include the following: (1) a fully restructured power sector that has created at least five competing generators

with diversified ownership, (2) an absence of significant constraints in transmission or fuel availability, (3) a financially viable sector with a solid payment chain, (4) solid regulatory practices, and (5) sufficient system size. A wholesale power market entails certain fixed costs that are unlikely to be justified by the potential efficiency gains until the market is large enough. As a rule of thumb, power markets are not likely to become very interesting until a country reaches a national market turnover of around US$1 billion, which is equivalent to a power system size of some 3 gigawatts.

- *Avoid getting locked into transitional arrangements.* Countries that are ready to move to a competitive market should consider carefully whether transition mechanisms are really needed, since experience suggests there is a relatively high risk of getting stuck in intermediate stages, in particular, the single-buyer model.
- *Establish a strong transmission system operator.* The transmission utility plays a critical role in a competitive power market, ensuring equitable access of third parties to the grid infrastructure, and potentially also playing a leading role in power sector planning, system planning, and sometimes market operation.
- *Monitor and adapt the design of the wholesale power market based on implementation experience.* Wholesale power markets may not always function according to design. Proactive monitoring for potential abuses of market power is very important, particularly in the early stages, as is the flexibility to learn from this experience and adapt market design accordingly.
- *Provide a parallel mechanism for incentivizing investment in generation.* Short-term market price signals alone are not always adequate to provide incentives for investment in new capacity. Parallel capacity mechanisms are needed, with supply auctions proving to be particularly efficient and effective. Such auctions can be adapted to target low-carbon forms of energy (with associated storage) and can increasingly be used to contract for adequate ancillary services to balance variable renewable energy.
- *Modernize wholesale power markets to accommodate new resources.* Conventional power market designs are not adapted for the presence of variable renewable energy resources, battery storage, or increasingly sophisticated demand response. Integrating them calls for the development of new pricing mechanisms that are able to remunerate the ancillary services required for the successful integration of variable renewable energy, provide suitable price signals to incentivize efficient investment in utility-scale battery storage, and allow demand-response aggregators to participate in the process of dispatch.
- *Participate in regional and cross-border trading arrangements wherever possible.* Regional power markets also offer significant benefits for arbitrage based on differential generation costs and load profiles among neighboring countries. Other benefits include shared reserve margins and greater flexibility to accommodate variable renewable energy. For countries not yet ready to develop wholesale power markets domestically, regional markets can provide an important first step. Nevertheless, even regional markets entail certain basic minimum enabling conditions that cannot always be taken for granted—in particular, creditworthiness on the part of power importers and security of supply on the part of power exporters.
- *Move toward economic dispatch of power plants.* Deviations from principles of economic dispatch are widespread in the developing world, leading to major generation inefficiencies. Countries not yet ready to develop wholesale power markets should consider having their system operator move toward the practice of economic dispatch based on the marginal costs of operating different plants.

Policy implication #7: Greater efforts should be made to strengthen the corporate governance and managerial practices of state-owned utilities

The 1990s reform model focused on privatization of distribution utilities, but the reality is that most remain publicly owned. The creation of corporatized public utilities out of traditional ministerial departments was viewed as a short transitional measure toward eventual privatization, which would lead to a full overhaul of managerial practices. However, given the relatively limited uptake of privatization in the distribution segment, it has become very important to address enduring weaknesses in the corporate governance of public utilities. The evidence shows that there is wide variation in the performance of public utilities; a substantial minority reaches efficiency levels comparable to private utilities, while the majority continues to flag. Better-performing public utilities share many aspects of good corporate governance with each other and with private utilities.

The policy implications are as follows:

- *Improve human resource management of public utilities.* Public utilities should take care to apply aspects of human resource management that are strongly associated with improved performance. These relate primarily to the quality of the selection process for hiring employees—in particular, the application of standard good practices, such as advertising vacancies, shortlisting and interviewing candidates, and conducting reference checks. The liberty to fire employees for underperformance is also found to be important, although this is often difficult to enforce in public sector environments.
- *Strengthen financial discipline of public utilities.* Similarly, public utilities should adopt certain aspects of financial discipline that are strongly associated with improved utility performance. Again, these comprise standard measures, such as the publication of externally audited financial accounts that are prepared in conformity with international financial reporting standards. Another good practice is the explicit identification and costing of public service obligations that cannot be justified on commercial grounds.

Policy implication #8: The regulatory framework needs to be adapted to reflect the institutional context and to accommodate emerging technological trends

The creation of sector regulators has been a popular reform, but many of these entities find themselves regulating public rather than private utilities. The power sector reform model of the 1990s envisaged the creation of a regulatory entity as a prerequisite for introducing private sector participation, particularly in power distribution. The regulator was supposed to play the dual role of protecting private investors from opportunistic government meddling, while also protecting consumers from abuses of privately held monopoly power. The evidence suggests that regulation has functioned much more effectively where the private sector entered power distribution than where utilities remained state-owned.

Moreover, the regulatory regimes of the 1990s did not anticipate the current wave of technological disruption in the power sector. The power sector has seen momentous technological change since the development of the 1990s power sector reform model. The changes are challenging the traditional approach to tariff regulation, which is based on ensuring that the utility collects enough revenue to enable it to roll out new infrastructure. It also raises questions about the traditional design of tariff structures that were often motivated by social policy concerns in a context where consumers were largely captive.

The policy implications are as follows:

- *Ensure that the instruments of price regulation are consistent with the governance of the utility.* There is little value in applying the instruments of incentive regulation—designed to harness the profit motive of private utilities—to state-owned utilities that are not driven by profit maximization and may not even operate under hard budget constraints. In these cases, it makes more sense to use traditional cost-of-service regulation and focus on creating supportive managerial performance incentives. Even the creation of a separate regulatory entity may be less of a priority when the sector remains state-owned, because, in practice, both the utility and the regulator are likely to be closely overseen by the line ministry, making regulatory independence somewhat illusory. Nevertheless, irrespective of which institution is responsible for regulation, a clear, well-grounded methodology for tariff-setting, applied on an annual basis, is of tantamount importance.
- *Aim for limited capital cost recovery initially.* Most regulatory tariff methodologies are based on principles of full capital cost recovery, including remuneration of the full asset base at the market cost of capital. Where utilities have been privatized, this principle is critical for financial sustainability. However, in the case of state-owned utilities, which often benefit from significant capital grants, it is not essential to remunerate the full asset base at the market cost of capital. Rather, the concern should be to ensure that the utility is able to cover the costs associated with the loans that are carried on its books. This limited capital cost recovery, which ensures the financial viability of the enterprise, is a reasonable interim tariff-setting objective.
- *Integrate regulation with other key public sector processes for state-owned utilities.* In some countries, regulatory frameworks coexist with other forms of state oversight. Utilities may be held accountable through performance contracts with the Ministry of Energy, for example, while tariff-setting is inextricably linked with financial oversight and subsidy decisions that lie in the hands of the Ministry of Finance. Rather than creating parallel tracks, regulation should build upon and integrate these complementary processes. Quality-of-service regulation should be reflected in the key performance indicators determined under performance contracts. Tariff and subsidy decisions should be taken simultaneously in a coordinated manner, ensuring that the overall revenue requirements of public utilities are met through a combination of both sources.
- *Give greater attention to creating a credible regulatory framework for quality of service.* With regulatory attention focused primarily on tariff-setting, efforts to provide a credible framework for monitoring quality of service and enforcing the achievement of the prescribed standards have been inadequate. Such a framework is of critical importance to ensure that regulatory reforms yield tangible benefits for electricity consumers.
- *Test the "future-readiness" of the regulatory framework.* The regulatory pricing regime for power utilities can affect the incentives for adoption of new technologies. For instance, traditional cost-of-service regulation will not encourage a utility to adopt technologies that may reduce demand for energy or meet demand at a lower investment cost. The regulatory licensing regime may also create barriers to the entry of new actors, such as providers of distributed energy resources or demand aggregators. There is therefore a need to review existing regulatory frameworks to evaluate whether they offer adequate incentives for innovation.
- *Ensure that the economics of decentralized electricity supply are reflected in tariff structures.* Electricity tariff structures have traditionally been designed under the premise that consumers have limited alternatives to grid

electricity, so pricing can be guided primarily by considerations of fairness and equity rather than economic efficiency. This practice has led to tariff structures under which costs are recovered primarily through volumetric charges, with extensive embedded cross-subsidies across consumption bands and consumer groups. Because such tariff structures fail to recognize the fixed-cost nature of the power grid, they overreward customers choosing to self-supply and fail to convey time-of-use price signals that would incentivize customers to participate more actively in demand response. Future tariff structures will have to give greater weight to fixed charges that take into account customer load. Volumetric charges will have to reflect time of use and be designed in combination with structures to remunerate prosumers injecting power into the grid.[7]

Policy implication #9: Private sector participation in distribution should be considered only when enabling conditions are met

Privatization of distribution utilities has delivered good outcomes in suitable environments, but it has proved risky where conditions were not right. Private sector participation in power distribution was widely adopted in Latin America and parts of Europe and Central Asia, with outcomes that were quite encouraging. Nevertheless, it has also been associated with disappointing performance and dramatic reversals in cases where the utility was not yet functioning at a basic level or the authorizing environment was weak. Some countries that eschewed utility privatization found other ways to incorporate the benefit of private sector discipline through financial market channels.

The policy implications are as follows:

- *Determine whether the economic preconditions for distribution privatization are in place.* Private sector participation is more likely to be successful in circumstances where (1) there is reasonably accurate information about the operating performance of the utility and the condition of its assets; (2) retail tariffs are relatively close to full (capital) cost recovery (at least 70 percent); (3) it is accepted that customers can be disconnected for nonpayment of bills; and (4) a competent regulator possesses the power to adjust tariffs as needed and the technical competence to monitor quality of service.
- *Evaluate whether the political preconditions for privatization of distribution are in place.* Even when the economic preconditions for private sector participation are in place, political impediments may remain. Private sector participation is more likely to be politically feasible in circumstances where (1) there is a broad, established tradition of private sector–led economic activity; (2) domestic actors can be involved in the privatization; (3) the value of private sector participation is clear; and (4) positive outcomes can be arranged for key stakeholder groups.
- *Explore alternative modalities for engaging the private sector.* The 1990s model considered private sector participation primarily in terms of private ownership, or at least management, of the utility. However, financial markets can provide another channel through which private sector discipline can be introduced into power distribution. This can be done through mechanisms such as listing minority shares of a state-owned utility on a local stock exchange or having the utility secure a credit rating and raise its own bond finance.
- *Maintain a proper focus on energy access.* Strengthening the utility's commercial orientation should sharpen its incentive to expand its market through electrification. However, in many developing countries, unserved customers are unprofitable owing to high incremental costs and relatively low consumption. This underscores the need

to complement distribution reforms with a sound electrification planning process comprising clear targets, an associated public funding program, and a suitable monitoring framework. At the same time, off-grid rural electrification can be advanced by creating a suitable enabling environment for private provision of off-grid solar power.

Policy implication #10: Delivering on the twenty-first century agenda of universal access and decarbonization calls for additional reform measures targeted explicitly at these objectives

Universal electrification eventually comes into conflict with a utility's commercial incentives and requires parallel policy and financial supports. Strengthening utilities' commercial orientation through private sector participation or other means can drive a rapid expansion of connections in urban areas. However, extending access to electricity to the periurban and rural periphery often leads a utility into diminishing and even negative marginal returns on investment, particularly if the power consumption of poor households remains very low. Thus, universal electrification cannot be achieved purely by allowing a utility to pursue commercial incentives. It requires complementary policy action to set access targets, provide sustained public subsidies to offset the associated financial losses, and exploit the opportunities offered by solar technology for off-grid electrification. Looking back over the past 25 years, progress on electrification was not typically synchronized with power sector reform (figure O.14a); rather, it reflected policy commitments that became increasingly likely as a country's per capita income grew. In some countries, the big push on electrification preceded sector reform; in others, it came more as an afterthought.

Power sector reform provides certain enabling conditions for decarbonization, but additional policy and planning measures must be taken to direct investors toward cleaner energy options. Private sector investment in generation can make a significant contribution to expanding renewable energy capacity. In addition, a wholesale power market, particularly when complemented by supply auctions, can provide a useful mechanism for price discovery related to new technologies, as well as a solid economic framework for pricing services ancillary to variable renewable energy and for remunerating demand response. Nevertheless, the evidence suggests that significant progress toward decarbonization over the past 25 years has been primarily driven by policy targets rather than by institutional reforms per se (figure O.14b). For most countries over this period, the overriding policy goal for generation was security of supply rather than decarbonization, leading oil-dependent countries to become less carbon-intensive as they diversified into gas, and hydro-dependent countries to become more carbon-intensive as they diversified into fossil fuels.

The policy implications are as follows:

- *Advance electrification on multiple fronts.* Countries making the most rapid progress toward electrification have done so by making simultaneous progress on- and off-grid, based on an integrated spatial master plan. They typically make long-term commitments to ambitious electrification targets, supporting them with public and donor finance and providing a suitable enabling environment. A critical issue is to ensure that both the upfront and ongoing costs of electricity are affordable for the target populations.
- *Determine explicit policy targets for decarbonization.* Achieving decarbonization goals requires explicit government direction of investment decisions in power generation, as well as incentives for the adoption of low-carbon technologies and more efficient consumption of energy.