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REGULATORY ASSISTANCE PROJECT

India regulatory toolkit: Distribution: Distributed energy resources

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Introduction

The Energy Conservation Act (2001), Electricity Act (2003), National Electricity Policy (2005), National Tariff Policy (2006), National Mission on Enhanced Energy Efficiency (2010) and the Forum of Regulators Model Demand Side Management (DSM) Regulations (2010) support and promote load management and energy efficiency. Karnataka and Kerala have draft DSM regulations in place, while all other states, except Rajasthan, Uttarakhand, Andhra Pradesh, West Bengal and Arunachal Pradesh have already notified their DSM regulations.

The draft National Electricity Policy 2021 (NEP)[1] envisions a prominent role for distributed energy resources. For example, the NEP envisions that "regulatory frameworks shall be created by the State Commissions to enable aggregation of distributed renewable power generation, micro-storage etc. to help small consumers, prosumers[2] and producers reach the market. On the same lines, aggregation of demand response may also be allowed."[3] It further establishes "a target to meet at least 30% of energy consumption of the rural areas from the distributed renewable energy sources within next five years."[4] It encourages demand response: "Consumer participation in ancillary services market through demand response, directly or through aggregator, shall also be encouraged,"[5] and "incentives for demand response also shall be notified by all State Commissions. Consumers may be given a choice to offer their part or full load for interruption in case of exigencies in the grid in lieu of a lower tariff."[6]

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[1] India Ministry of Power. (2021,15 May). *Draft National Electricity Policy, 2021*. Request for comment and policy. https://powermin.gov.in/sites/default/files/Extension_of_date_for_submitting_comments_on_draft_NEP_2021_till_25_May%20_21.pdf

[2] Prosumer is a customer who consumes and produces/sells electricity. For example, a customer who installs rooftop solar would produce power and consume it themselves, but at times sell back to the grid when they cannot consume all that is produced.

[3] India Ministry of Power. (2022). *Draft National Electricity Policy (NEP), 2022*; Section 3.3.6. In preparation.

[4] NEP, 2022, Section 3.5.4

[5] NEP, 2022, Section 3.3.3

[6] NEP, 2022, Section 3.5.11

The most recent *Report of the Group on Development of Electricity Market in India*[7], issued by the Ministry of Power on 15 May 2023, acknowledges the benefits of distributed energy resources: "Aggregation of distributed energy resources would allow such resources to provide energy and ancillary services at transmission and distribution level"[8] and specifies "various requirements for implementing a framework for aggregation of Distributed energy resources in the country"[9] by the Forum of Regulators. Further, the newly issued Indian Electricity Grid Code[10] (IEGC) references the utilisation of demand response and distributed generation resources. For example, Section 31 (2) (a) of the IEGC requires that "demand estimation by SLDC shall be for both active power and reactive power incidents on the transmission system based on the details collected from distribution licensees, *grid-connected distributed generation resources*, captive power plants and other bulk consumers embedded within the State." Section 31 (4) (a) of the IEGC requires that "SLDCs shall estimate and ensure the adequacy of resources, identify generation reserves, *demand response capacity* and generation flexibility requirements with due regard to the resource adequacy framework as specified under Chapter 2 of these regulations."

Deploying distributed energy resources (DERs) at scale provides an opportunity to improve electric system efficiency, reduce consumer costs and combat emissions. DERs include elements such as energy efficiency, demand response, storage resources, distributed generation closer to load such as rooftop solar and more. DERs are not just resources behind the meter, but also include community-based resources connected to the distribution segment and emerging applications such as managed electric vehicle charging. DERs empower customers to modify their electric usage in a way that would save them money, offer products to wholesale system operators and distribution companies (discoms) to increase system reliability and efficiency, and help reduce emissions. The promotion of DERs, however, requires affirmative action by utility regulators and policymakers.

Section 1 in this chapter describes the types of DERs that can be deployed. The benefits of DERs – from the perspectives of the system, participating DER customers, non-participating customers and society – are described in Section 2. International experience with utilisation of DERs is presented in Section 3. The DER options available in India and the potential for future DERs are discussed in Section 4. The role of DER Aggregators and the need for private market players who can bring in capital and technical expertise is presented in Section 5. Finally, Section 6 articulates the steps that regulators can take to facilitate DERs including modifications to discom business models, business rules for DER Aggregators and customer education.

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[7] See the Power Market Roadmap (PMR) at EQ International. India Ministry of Power, Group on Development of Electricity Market in India. (2023). *Report of the Group on Development of Electricity Market in India.* https://www.eqmagpro.com/report-of-the-group-on-development-of-electricity-market-in-india-eq-mag/

[8] PMR, p. 9

[9] PMR, p. 69

[10] Central Electricity Regulatory Commission. (2023). *Indian electricity grid code*. https://cercind.gov.in/Regulations/180-Regulations.pdf

Section 1: Distributed energy resources

It would be useful to define what DERs are for the purpose of this document. We will use the definition from the federal regulator in the United States, the Federal Energy Regulatory Commission (FERC).

The FERC defines a distributed energy resource as "any resource located on the distribution system, any subsystem thereof or behind a customer meter."[11] These resources may include, but are not limited to, resources that are in front of and behind the customer meter, electric storage resources, intermittent generation, distributed generation, demand response, energy efficiency, thermal storage, and electric vehicles and their supply equipment – as long as such a resource is "located on the distribution system, any subsystem thereof or behind a customer meter."

Section 2: Benefits of distributed energy resources

The benefits of DERs can be described from different perspectives, including those of the system, participating and non-participating customers and society. Key benefits from each perspective are discussed below.

System benefits

From a system perspective, the benefits can be grouped into reliability, resilience, costs and integration of renewable resources:

- Reliability: DERs offer products and services to assist the wholesale operators and discoms in maintaining and/or enhancing system reliability. The products and services include providing energy, capacity and various ancillary services.
- Resilience: The implementation of DERs adds to system resiliency as the resources are more localised and can continue to provide power to consumers even if the central generating resources and transmission assets fail. Further, DERs accelerate service recovery; localised systems that ride through system outages can help accelerate the re-energisation of the whole system.
- System costs: DERs can be cheaper resources than those that are centrally generated, and thus when optimally utilised can lead to lower overall system costs, especially in market-based systems where prices typically are set by the cost of generation units on the margin.
- Integration of intermittent renewable resources: With increased intermittent resources in the system, there is an immense demand for flexible resources – and the demand will increase with rapid penetration of intermittent resources. Many DERs can provide the flexibility that system operators require.

[11] U.S. Federal Energy Regulatory Commission, Docket No. RM18-9-000 Order on 17 September 2020. https://www.ferc.gov/sites/default/files/2020-09/E-1_0.pdf

Participating customers

Customers who can provide DER products and services can benefit by lowering their electric bills either by reducing consumption or by selling products and services to system operators. Many DERs can also provide enhanced reliability to participating customers, as part or all of their needs can be met by the DERs on their premises, and they are thus less reliant on utility-provided power, which can be subject to outages.

Non-participating customers

Reduced system costs and enhanced system reliability as a result of DERs are a benefit for all customers, even those who do not own the DER assets.

Society

Many or most DER resources are clean energy resources. As they replace some of the more polluting central generation resources, various emissions (e.g., carbon, sulphur oxides (SOx), nitrogen oxides (NOx), particulate matter (PM)) in the system can be reduced. This would benefit customers in nearby areas where these pollutants can cause health and economic harm, and global society at large with the reduction in carbon emissions. DERs can better empower consumers, lower consumer energy bills, enhance system reliability and reduce emissions.[12]

Section 3: International experiences with utilisation of distributed energy resources

DERs are growing at a rapid pace in many countries. In the United States, according to a report from Mackenzie's Grid Edge Research team, DER penetration is expected to grow from 78 megawatts in 2017-2021 to 175 gigawatts in 2022-2026, more than doubling in a short period of time.[13] The report projects a significant increase in flexible demand capacity. The authors attribute this growth to corporations achieving sustainability goals, supported by climate and environmental, social and governance capital; extreme weather driving resilience needs and DER solutions, including local distribution generation, storage and electric vehicles; and increased electricity prices and the price elasticity driving DERs, including heat pumps, smart thermostats and energy efficiency.

The development of better control systems that allow for more responsiveness between increasingly complex DER systems and the grid, the potential for artificial intelligence to further improve the readiness of DERs to support the grid, and the availability of data that can further improve analytics will all contribute to the increased pace of deployment of DERs.

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[12] Addepalli, R. (2023). *Discom business models require changes to promote distributed energy resources.* RAP. https://www.raponline.org/wp-content/uploads/2023/01/rap-discom_policies_India.pdf

[13] Hertz-Shargel, B. (2022, 4 February). Distributed energy is poised to take center stage in 2022, but policymakers and regulators must step up. *Utility Dive.* https://www.utilitydive.com/news/distributed-energy-is-poised-to-take-center-stage-in-2022-but-policymakers/618331/

The European Union (EU) has been at the forefront of promoting and supporting the deployment of DERs as part of its efforts to transition to a sustainable low-carbon energy system. The EU has implemented various policies and initiatives to encourage the development and integration of DERs across its Member States. A study by CE Delft[14] estimates that 83% of EU households could become prosumers by 2050.[15] 'Clean energy for all Europeans', an EU package, reforms EU electricity markets and promotes the integration of renewable energy sources.[16] As part of these initiatives it recognises the rights of citizens to produce, store or sell their own energy, either independently, through an aggregator, or in a citizens' energy community.

Section 4: Distributed energy resource value for India

This section identifies the benefits of enhancing DERs in India. Regulators in India should facilitate large-scale penetration of DERs, complementing the large-scale renewable resource growth, because it offers a pathway toward a sustainable, reliable and inclusive energy system. By proactively addressing regulatory challenges, promoting market mechanisms and ensuring fair competition, regulators can facilitate the integration of DERs and drive the transition to a cleaner and more resilient energy future. Enhancing DERs supports:

- Renewable energy integration: DERs, such as solar, are key contributors to India's renewable energy goals. By promoting and regulating DERs regulators can facilitate the integration of clean energy sources into the grid, helping to reduce dependence on fossil fuels, lower greenhouse gas emissions, and achieve national renewable energy targets.
- Energy security and resilience: DERs enhance energy security by diversifying the energy mix and reducing reliance on centralised power generation. With distributed generation and storage, DERs can mitigate the associated risks, grid failures and disruptions, thereby increasing the resilience of the energy infrastructure.
- Consumer empowerment: DERs enable consumers to become active participants in the energy sector. By generating their own electricity, consumers have greater control over their energy consumption, costs and environmental impact. Regulators can ensure fair access, net metering arrangements and favourable policies that empower consumers to benefit from DERs and make informed choices about their energy use.

[14] CE Delft. (2016). *The potential of energy citizens in the European Union*. https://ce.nl/publicaties/the-potential-of-energy-citizens-in-the-european-union/

[15] European Parliamentary Research Service (EPRS). (2020). Will distributed energy resources (DERs) change how we get our energy? *At a glance – Thinking about tomorrow*. https://www.europarl.europa.eu/RegData/etudes/ATAG/2020/651944/EPRS_ATA(2020)651944_EN.pdf

[16] EPRS. (2019). Promoting renewable energy sources in the EU after 2020. *Briefing – EU Legislation in Progress.* https://www.europarl.europa.eu/RegData/etudes/BRIE/2017/599278/EPRS_BRI(2017)599278_EN.pdf

- Rural electrification and energy access: DERs have the potential to bring electricity to remote and underserved areas, contributing to rural electrification and improving energy access. Regulators can play a crucial role in creating enabling frameworks, incentives and policies that promote the deployment of DERs in rural communities, fostering economic development and quality of life.
- Grid optimisation and demand response: DERs, coupled with advanced metering and smart grid technologies, enable grid optimisation and demand-response capabilities. Regulators can incentivise DER participation in programmes such as demand response, where consumers adjust their energy consumption in response to grid conditions, leading to improved grid stability, reduced peak demand and optimised resource allocation.
- Technological innovation and job creation: DERs offer opportunities for technological innovation, research and development. Regulators can encourage innovation by fostering a supportive regulatory environment that incentivises investment in DER technologies; developing new products, services and businesses; creating job opportunities; promoting local manufacturing; and driving economic growth in the clean energy sector.

Section 5: Role of DER aggregators and the need for private entities

DER aggregators provide technical assistance to customers participating in DER programmes and aggregate multiple customer loads so they can participate in discom or wholesale market DER programmes. Third party DER providers and aggregators are private entities who bring private capital to the industry; they bring new business models and new technologies to customers to enable them to participate in DER programmes.

While one approach is to rely on discoms to provide DER products and services, other approaches where the reliance is placed on private entities should be seriously considered. Discoms, for the most part, are public sector undertakings with little opportunity for profit. Their focus on delivery does not necessarily translate into expertise in managing DERs or their deployment. Many of them do not have sufficient capital resources to meet their basic obligation to provide reliable service, let alone venture into investing in DER programmes. Many discoms have standard tariffs that simply pass through average aggregate bundled prices. This is not a critique per se, but an acknowledgment of the legacy arrangements. Most are not equipped to develop multiple tariffs to meet the needs of various customer segments or pass through granular wholesale market prices. Further, utility activities are limited to those in front of a customer meter but not behind it. They do not necessarily understand the ways in which various customers use energy, what steps the customers should take to optimise their energy use, or how they can take advantage of DER programmes. Additionally, utilities have not pursued investments in devices or tools behind customer meters to help them participate in DER programmes or provide them with value-added services. Some utilities may also have concerns about allowing third parties to undertake DER activities that could affect their utility systems.

On the other hand, most of these functions can be opened to participation by private entities. There are numerous entrepreneurs and plenty of private capital ready to invest in activities that enable customers to participate in DER programmes and provide them with value-added services. The opportunity to invest in activities that also help climate change goals is attracting even more private players and capital. Not only can these players readily bring in private capital, but they can also bring expertise in deploying the latest technologies to better meet customer and system needs.

Section 6: Suggested actions for policymakers

There are several actions that policymakers and regulators can take to implement DERs. First, they need to understand the value of DERs. Second, they need to develop business rules for DER providers (aggregators).[17] Third, they need to address concerns raised by discoms in implementing DERs.

Distributed energy resource business rules

DER business rules that regulators need to address include the following:

Licensing procedures

Licensing requirements[18] should detail the qualification criteria for distributed energy resource providers, as well as set out the reasons for which licences could potentially be revoked. The qualification criteria could include factors such as the provider's technical capabilities, financial wherewithal, past business experience and credit qualifications. They should not be unduly onerous but should be sufficiently robust to ensure consumers are protected from unqualified providers. The revocation of a licence would be based on the provider failing to meet rules and regulations and violating established norms.

DER programme design rules

DER programmes can offer services to discoms at the retail level and to wholesale system operators at the wholesale level. These programmes should be designed to meet discom or wholesale operator needs on retail or wholesale levels. For example, a discom may need load relief in certain areas for a defined period and call on DER customers to provide load relief at a retail level. Similarly, a wholesale operator can procure ancillary services from the DER providers.

DER programmes can be designed to focus on a single element such as energy efficiency, demand response, rooftop solar resources or storage resources, or they can operate as portfolios containing several different DER elements. An example of the latter is known as 'nonwires alternatives' (NWA): this is where a discom can announce a reliability need on its system and solicit DER portfolio proposals in response, instead

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[17] For further details, see Addepalli, R. (2022, 29 September). *Facilitating distributed energy resources requires policy actions.* RAP. https://www.raponline.org/knowledge-center/facilitating-distributed-energy-resources-requires-policy-actions/

[18] For reference, see State of New York Public Service Commission, Case 15-M-0180, Order on 19 October, 2017, establishing oversight framework and uniform business practices for distributed energy resource suppliers. https://dps.ny.gov/system/files/documents/2023/02/order-establishing-oversight-framework-and-uniform-business-practices-for-der-suppliers.pdf

of relying on traditional solutions (cables, transformers, substations or similar).[19] It would then compare the DER responses with the traditional solutions and decide which solution is better for customers and the system (i.e., in terms of cost, system value and environmental attributes).[20]

Any DER programme must be carefully designed by the discom or the wholesale system operator. For example, demand response programme design features would include the following, with clear answers to the related questions:[21]

- Customer call notice requirements: How much notice time will be given to the participating customer before the customer is asked to act?
- Call criteria: Under what system conditions will the customer be called?
- Duration of call: How long will the customer have to stay on the line?
- Customer aggregation requirements: If multiple customers aggregate to meet the needs of the discom or wholesale system operator, what are the aggregation requirements?
- DER programme contract structure: How is the programme contract structured for the DER provider?
- Compensation determination methodology: How will the DER service be valued by the discom/wholesale system operator (administrative, market-based and so on)?
- DER performance requirements: What specific performance criteria would the DER provider have to meet?
- Measurement and verification protocols: How is performance measured for compensation purposes? This includes:
- Baseline measurements
- Performance measurements
- Metering requirements: What are the metering requirements to participate in the DER programmes?
- Testing of DER equipment: What are the criteria for testing DER technical performance capabilities?

Other DER solicitations can be tailored specifically to the DER in question. These programme design parameters should be designed by discoms or wholesale system operators based on system needs and policy goals in consultation with stakeholders, especially the DER providers and approved by the regulators.

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[19] Athawale, R. (2021, June). *Reliability is a challenge but the opportunities are endless*. RAP. https://www.raponline.org/blog/reliability-challenge-opportunities-endless/

[20] For an example, see Con Edison. (2021, January). *Non-wires solutions implementation, community, and outreach plan*. https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B190BD4D8-CEAE-431F-B409-3F4E6F83982E%7D

[21] For an example, see Con Edison. (2022, February). *Commercial demand response (Rider T) program guidelines*. https://www.coned.com/-/media/files/coned/documents/save-energy-money/rebates-incentives-tax-credits/smart-usage-rewards/smart-usage-program-guidelines.pdf?la=en

Establish customer protections

Regulators should establish consumer protections that DER providers must offer to ensure consumers understand the agreements they enter into and are protected from any potential poor service or abuse by providers.[22] These consumer protections could include factors such as:

- Sales agreements: The requirements in the agreements between DER providers and their customers.
- General marketing standards: The standards that DER providers must adhere to in acquiring customers.
- Customer data: How DER providers will ensure privacy of customer data.
- Customer inquiries and complaints: How customer inquiries and complaints will be handled by DER providers.
- Standard customer disclosure statements: The information the DER providers must give to customers.

Modify business rules for discoms

Discoms may be understandably reluctant to promote DERs given the potential negative impacts they could suffer, such as lost sales, concomitant lost revenues and net income, and concerns about potential job losses. In addition, some discoms may not fully appreciate the reliability value and other benefits that DERs bring to the system, the customer and the environment.[23]

To begin with, regulators should articulate certain principles that should be followed in any changes to the discom business model. For example, the unidirectional distribution grid must evolve into a more diversified and resilient distributed model, engaging customers and DER providers. Universal, reliable, resilient and secure delivery service at just and reasonable prices must be ensured. The overall efficiency of the system and consumer value and choice can be enhanced by a productive mix of discom and third-party investment.

The very real concerns of discoms must be addressed to help them support the promotion of DERs, including the following:

Lost revenues

Deployment of DERs can lead to lost sales. As a result, it is possible that discoms may lose some revenue and net income. The situation is aggravated if customers participating in the DER programme were previously subsidising other customers. If a customer who was paying more than their fair share in tariffs participates in the DER programme and thus reduces consumption from the utility, the subsidy they were

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[22] New York Public Service Commission, Case 15-M-0180, Order on 19 October, 2017, establishing oversight framework and uniform business practices for distributed energy resource suppliers: Appendix A. https://dps.ny.gov/system/files/documents/2023/02/order-establishing-oversight-framework-and-uniform-business-practices-for-der-suppliers.pdf

[23] For additional details, see Addepalli, R. (2023, 18 January). *Discom business models require changes to promote distributed energy resources*. RAP. https://www.raponline.org/knowledge-center/discom-business-models-require-changes-promote-distributed-energy-resources/

paying to the utility is also reduced, unless there are changes to the tariff design. This concern alone could discourage discoms from implementing DERs lest they lose profitability. Lost sales and profits can be addressed via a rate-making tool such as a revenue decoupling mechanism (RDM), which enables the utility to collect a specified level of revenue in a period, regardless of actual sales levels. This ratemaking practice has been in place for more than three decades in many countries. It was initially introduced so that discoms would have no reason not to support the implementation of energy efficiency measures, but it has also been shown to deal admirably with other sales volatility risks (e.g., weather or changes in the economy) to the benefit of both utility and customer. Decoupling of profits and sales ensures that prudent discom costs continue to be covered even if sales are lost, and it also means that excess revenues will be returned to customers if sales go up. And, because a utility's profitability is no longer tied to sales, reducing costs is the only way that a utility can increase net income in the short run; this gives management a powerful incentive to be efficient.

Performance-based ratemaking

While RDMs remove the disincentive to pursue customer-sited resources, they may not, by themselves, be a sufficient motivation for discoms to embrace and promote DERs. Regulators should consider creating additional profit motives for discoms for successful implementation of DERs. They can, for instance, create metrics that measure successful implementation of DERs and reward discoms for meeting prescribed levels. Performance-based ratemaking models that include incentives for facilitating and increasing DER penetration have been successfully adopted in the United States.

Provide benefit/cost analysis framework

A benefit/cost analysis framework is needed to determine the value of DERs to help decide whether they are worth procuring. A systematic evaluation would lead to more efficient deployment of DER resources. The benefits would include avoided wholesale generation energy and capacity and ancillary service costs; avoided transmission and distribution capacity and operations and maintenance costs; line losses; environmental externalities and the like. Costs include the costs of developing and deploying DER products, services and administrative costs, among others.[24]

Require discoms to implement nonwires alternatives

The traditional business practice for utilities in general is to plan for load growth using a conventional engineering approach to meet the need through the supply side – to build power plants and substations, to extend the network with cables and transformers, and so on. Another approach to consider, however, is whether the demand side can help meet the reliability need just as well as the supply side, but at a

[24] For an illustration of Benefit Cost Analysis framework, see the New York Public Service Commission, Case 14-M-0101, Order on 21 January, 2016, establishing the benefit cost analysis framework. https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={F8C835E1-EDB5-47FF-BD78-73EB5B3B177A}

A useful spreadsheet tool to test whether target interventions create economic and environmental benefits and also reduce the financial burden on discoms is the RUCBREC-G Tool: Regulators' and Utilities' Coalition for a Balanced, Resilient, Efficient and Clean Grid Tool. Weston, F., Patankar, M, Athawale, R., Patel, D., Sarraf, S., Dsouza, C., Choudhary, P., Saindane, D. (2021, 1 March). *Assessment tool for behind-the-meter investments by distribution companies in India.* RAP. https://www.raponline.org/knowledge-center/assessment-tool-behind-meter-investments-distribution-companies-india/

lower cost and in a more environmentally friendly way. This approach is called the nonwires alternative (NWA).

Regulators should require discoms to evaluate the use of DERs from the demand side to meet system needs where practical and feasible. The use of a competitive procurement process will allow third parties to offer creative DER solutions that utilise advanced technologies and are cost-effective. Regulators should address any specific discom concerns over implementing NWAs. Regulators can also motivate discoms through performance-based ratemaking as discussed earlier.

Require discoms to provide granular price signals

DERs provide value-added services to the grid, both at the retail and at the wholesale level. Their value is enhanced if they face real price signals that reflect the discom's true costs – and the true value of DERs – as they relate to location and time of use. The discom tariffs should be unbundled into generation, transmission, distribution and customer service so the costs are clear for each segment, and to determine whether there is a cross-subsidy between any of them.

New tariffs should be designed, if they do not currently exist, to provide granular unbundled price signals that will help to tease out cost-effective DERs. These could include hourly supply price signals and location-based supply pricing reflecting cost differentials. For example, it may cost more to serve customers at certain times of the day or season compared to others. Also, due to transmission constraints, it may cost more to serve customers in a particular area than in other places. The tariff pricing signals – or in the case of distribution, which typically does not reflect locational cost differences, DER compensation signals – should reflect these differentials so that DERs can be targeted to higher cost and time locations first. In addition, a benefit-cost analysis framework should be developed to evaluate the cost-effectiveness of DERs.

Conduct pilot and demonstration projects to get experience

Many discoms may not be fully aware of the potential benefits that DERs can bring to the system. Instituting pilot and demonstration projects would be an effective way to share experience, work through the mechanics of DER programmes, and increase knowledge. A pilot project could, for example, test a technology or programme of customer behaviour, alongside a range of different ways of integrating them. Projects should be well-defined to test one or more hypotheses and should produce results in a meaningful time frame in order to evaluate whether they can be rolled out on a larger scale.

Customer education

Without the participation of customers, DERs cannot be implemented. Customers need to understand the value DERs provide to them individually and collectively to the system. They need to be convinced that the benefits of participating in DER programmes outweigh any associated costs. Benefits include savings on electricity bills, more comfort in the home or business, improved system efficiency leading to lower overall system costs, and a reduction in harmful emissions. Costs include infrastructure installations at customer sites to allow them to participate, usage curtailment when called upon and the associated inconvenience, and business costs along with any other opportunity costs.

There are numerous metrics for evaluating costs and benefits from a customer perspective, from a discom/wholesale system operator perspective, and from a societal perspective. Regulators, discoms and wholesale system operators should all provide objective information to customers on the benefits and costs of DER programmes. DER providers will need to work with individual customers and clearly explain the benefits and costs. In parallel, customer education should be designed and delivered. This would reduce soft costs for DER providers in customer acquisition. Regulators, discoms and wholesale system operators can also provide information to customers about qualified DER providers.

Learning more about customers will be valuable for regulators, discoms and new DER vendors and product developers. Finding ways to understand customer behaviour in distinct segments of energy users will help inform many operational decisions.

Recognise complementary policies

The DERs will be complementary to other initiatives taking place. For example, building codes and appliance standards might make new buildings 'grid interactive-ready' or more efficient in the first place, and the same goes for the devices in them. Similarly, emerging DERs such as vehicle charging can also be a consideration for building codes.

Section 7: Conclusion and way forward

DERs hold immense potential for transforming India's energy landscape by promoting renewable energy adoption, enhancing energy resilience, reducing emissions, saving money and empowering local communities. The journey towards a decentralised and sustainable energy system requires concerted efforts from policymakers, regulators, industry stakeholders and consumers alike. To fully leverage the potential of DERs, it is crucial to establish a conducive policy and regulatory environment that encourages investment, streamlines approval processes and incentivises consumer participation. Clear guidelines, standards and financial mechanisms can spur innovation, attract investments and ensure a level playing field for DER project developers.

Capacity-building and awareness initiatives are equally important to equip stakeholders with the knowledge and skills necessary for effective DER planning, implementation and operation. Educational institutions, training centres and research institutions should collaborate to develop specialised programmes that address the specific requirements and challenges associated with DER technologies in the Indian context.

Additionally, market access platforms that enable energy trading, demand response participation and grid integration will foster a vibrant and inclusive DER market. Integration of DERs into the grid infrastructure necessitates robust grid planning, modernisation and grid management tools. By upgrading distribution systems, adopting smart grid technologies and implementing real-time data analytics, India can ensure the seamless integration of DERs while maintaining grid stability and reliability.

Furthermore, rural electrification and energy access initiatives should prioritise the deployment of DERs in remote and underserved areas. Collaborative efforts involving

public-private partnerships and community-driven models can empower local communities, enhance energy access and drive socio-economic development.

Some recommendations for accelerated DER development in India are offered below:

Policy and regulatory framework

Central agencies: Ministry of Power, Central Electricity Regulatory Commission (CERC), Central Electricity Authority (CEA)

- Develop a comprehensive policy framework that supports the integration and deployment of DERs across the country.
- Establish a single-window clearance mechanism to streamline the approval process for DER projects.

Grid integration and system flexibility

Central agencies: Ministry of Power, CERC, Grid Controller of India (POSOCO/ NLDC), Power Grid Corporation

State agencies: State Load Dispatch Centres (SLDC), State Electricity Regulatory Commissions (SERCs)

- Strengthen the grid infrastructure by upgrading and modernising distribution systems to accommodate the integration of DERs, ensuring stability, reliability and seamless bi-directional power flow.
- Explore advanced grid management tools, including smart grid technologies, advanced metering infrastructure and real-time data analytics, to enable effective integration and management of DERs.
- Review the discom system planning and investment criteria. Allow for more transparency in the review and evaluation process to allow third parties to propose solutions that are cheaper, more effective and cleaner.

Rural electrification and energy access

Central agencies: Ministry of Power, Rural Electrification Corporation

State agencies: SERCs, discoms,

Private and community-led mini and microgrids, distributed energy providers

- Prioritise the deployment of DERs in remote and underserved areas to improve energy access and support rural electrification initiatives.
- Establish specific programmes and incentives targeting decentralised renewable energy generation, mini-grids and standalone power systems, enabling off-grid communities to access clean and reliable electricity.
- Foster public-private partnerships and community-driven models to empower local communities in the development and management of DER projects, ensuring sustainability and socio-economic benefits.

Financing mechanisms and market access

Financial institutions: Power Finance Corporation, banks, investors

State agencies: Discoms, distributed energy providers, SERCs, SLDC

- Create DER market rules to enable DER providers to develop business models to offer services to customers.
- Work with system operators to identify and develop specific DER products (and concomitant rules) that DER providers can bring to the market working with customers.
- Develop more granular tariff/price signals to help value DERs with more precision.
- Provide incentives to discoms to facilitate and promote DERs.
- Establish financial mechanisms – such as low-interest loans, grants and subsidies – to incentivise investments in DER projects, particularly for underserved and economically disadvantaged communities.
- Facilitate market access for DERs through the creation of platforms that connect DER project developers, aggregators and consumers, enabling efficient energy trading, demand response participation and grid integration.
- Encourage partnerships between financial institutions and DER project developers to develop innovative financing models.

Energy Solutions for a Changing World

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