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Florence School of Regulation

Introduction to “Regulation Waves”

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Regulation is an internationally shared knowledge

Regulation changes with society & economy…

-- -- -- -- The 2 classics of Regulation-- -- -- --

- 1- Universal Access, Monopoly & Cost of Service
- 2- Opening Commodity Markets & Incentive Regulation

-- -- -- -- The today's many updates-- -- -- --

- 1- (Incentive Regulation + Innovation) = RIIO
- 2- The "Coupling Regulation" & Sector Integration
- 3- The "Dynamic Regulation" called by "Prosumer" revolution
- 4- The "3D Dynamic Regulation"called by Digital interactions in a multi-level system

> You can ask Pr Anoop Singh for an adaptation to India's realities


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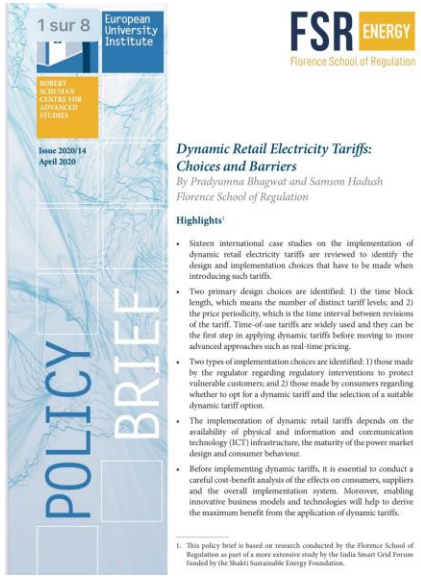
Charging up India's Electric Vehicles
By Pradyumna Bhagwat, Samson Yemane Hadush, Swetha Ravi Kumar Bhagwat
Florence School of Regulation
Issue 2019/15
October 2019
POLICY BRIEF
Highlights
• India's ambitious electric mobility targets are highly dependent on the availability of robust charging infrastructure and readiness of the power system to integrate the additional flexible EV load.
• Indian policymakers at state and national level are proactively pursuing actions for developing EV charging infrastructure (EV service providers) on supply-side and EV users' (demand side). Further enhancements for supply-side can come from the role of distribution companies (DISCOMs), tariff design, incentives, permitting processes and data privacy, and on the demand side from payment methods, minimum facilities, charging station user registration and consumer complaints.
• EV charging business in India is at its early stage, and it has a large scope for business model innovation. As EV penetration increases and market grows, innovations can be expected in the areas of service provision, partnership and pricing.
• EV load can increase peak demand and distribution grid congestion. Solutions are emerging to avoid more investment in generation and network capacity such as time-varying tariff and flexibility measures taken by the DISCOM to deal with these issues.
• V2X is still in an early stage but would become relevant as the market matures. The accuracy in predicting the availability of V2X resource and minimising market entry barriers for V2X service provision can be improved through aggregation, allowing smaller minimum bid volumes and contract periods, asymmetric products and shorter lead times.
• The search for the most appropriate solutions would benefit from regulatory sandboxes both at the national and state level.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Issue 2020/14
April 2020
POLICY BRIEF
Dynamic Retail Electricity Tariffs: Choices and Barriers
By Pradyumna Bhagwat and Samson Hadush
Florence School of Regulation
Highlights[1]
• Sixteen international case studies on the implementation of dynamic retail electricity tariffs are reviewed to identify the design and implementation choices that have to be made when introducing such tariffs.
• Two primary design choices are identified: 1) the time block length, which means the number of distinct tariff levels; and 2) the price periodicity, which is the time interval between revisions of the tariff. Time-of-use tariffs are widely used and they can be the first step in applying dynamic tariffs before moving to more advanced approaches such as real-time pricing.
• Two types of implementation choices are identified: 1) those made by the regulator regarding regulatory interventions to protect vulnerable customers; and 2) those made by consumers regarding whether to opt for a dynamic tariff and the selection of a suitable dynamic tariff option.
• The implementation of dynamic retail tariffs depends on the availability of physical and information and communication technology (ICT) infrastructure, the maturity of the power market design and consumer behaviour.
• Before implementing dynamic tariffs, it is essential to conduct a careful cost-benefit analysis of the effects on consumers, suppliers and the overall implementation system. Moreover, enabling innovative business models and technologies will help to derive the maximum benefit from the application of dynamic tariffs.
1. This policy brief is based on research conducted by the Florence School of Regulation as part of a more extensive study by the India Smart Grid Forum funded by the Shakti Sustainable Energy Foundation.


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REPORT
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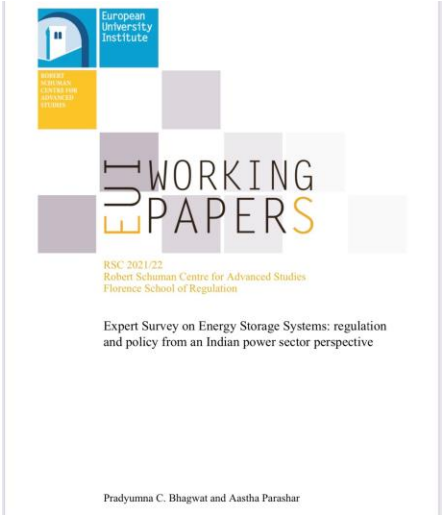
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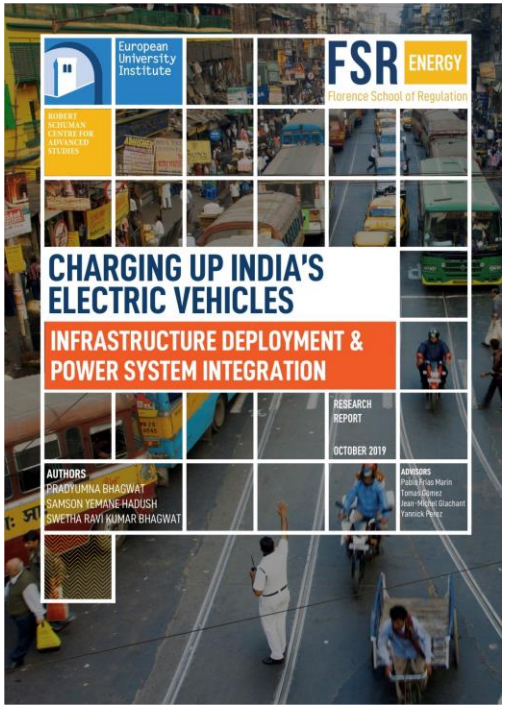
Robert Schuman Centre for Advanced Studies
Florence School of Regulation
Expert Survey on Energy Storage Systems: regulation and policy from an Indian power sector perspective
Pradyumna C. Bhagwat and Aastha Parashar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CHARGING UP INDIA'S ELECTRIC VEHICLES
INFRASTRUCTURE DEPLOYMENT & POWER SYSTEM INTEGRATION
RESEARCH REPORT
OCTOBER 2019
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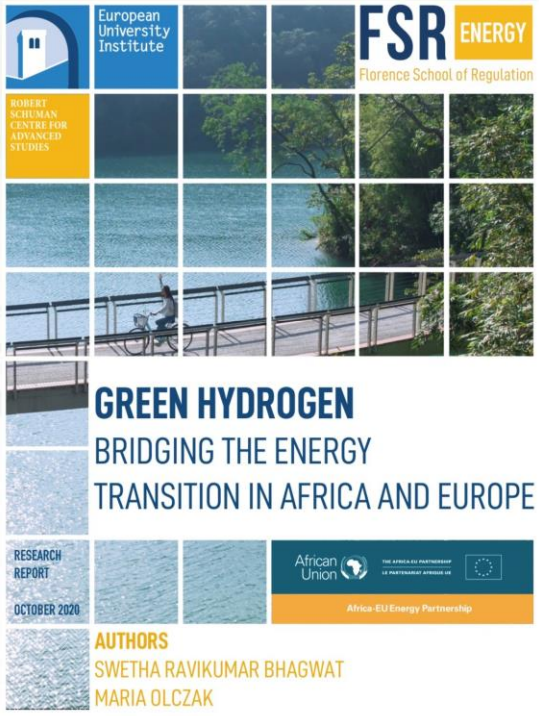
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GREEN HYDROGEN
BRIDGING THE ENERGY TRANSITION IN AFRICA AND EUROPE
RESEARCH REPORT
OCTOBER 2020
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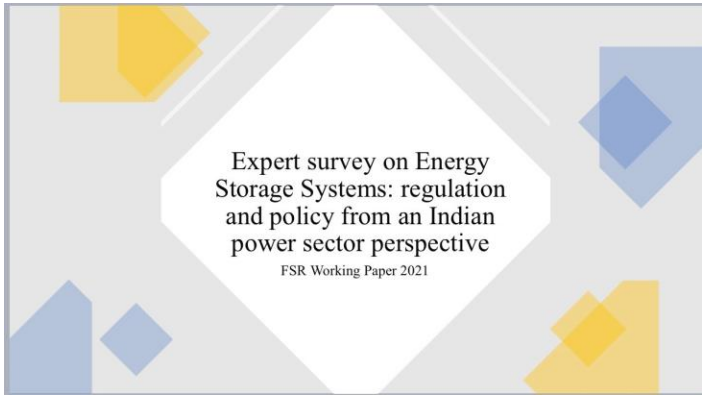

Expert survey on Energy Storage Systems: regulation and policy from an Indian power sector perspective
FSR Working Paper 2021

Part I: the two classics of Regulation

Classic 1: Universal Access, Monopoly & Cost of Service

- Society wants to give access to modern energy (electricity) to many or to all
- Electricity is delivered by monopoly grids, connecting crowds of consumers to very large size generators (in the 100' of MW)
- Monopoly access to generation permits to lower energy affordability, with cross-subsidizing tariffs

- Vertical integration "Monopoly Grids + Energy Generation" is regulated with "Cost of Service"
- "Cost of Service" Regulation = because regulation frames the characteristics of key products & services, + the access rights to the grid, + particular classes & clauses of tariffs; regulation also guarantees that all the costs of the regulated undertaking will be covered by the sum of its revenues.
- Parallel to this guarantee to recover the "costs of services", regulator keeps the right to deem "reasonable" or "unreasonable" each key cost of the regulated.

Second classic of Regulation: the Incentives

Classic 2: Opening Commodity Markets & Incentive Regulation

- When total size of system is (x) times the size of a single efficient generator; total size consumption is (x) times the size of single efficient supplier > > Room to create open markets
- Markets open for the commodity (energy & power); grids stay as regulated monopolies (transmission& distribution)
- Markets for professionals: *B2B* – wholesale market; Markets for non-professionals: *B2C* – retail markets >> B2B Energy is priced as a commodity; and Cross-subsidies can survive in Tariffs

Second classic of Regulation: the Incentives

Classic 2: Opening Commodity Markets & Incentive Regulation

- **Incentive Regulation rewards the "monopoly improvements", thanks to a family of tools**

❖ **Price Cap for Opex (while RoR for Capex): any decrease of Opex shared between company & society**

❖ **Performance Based Regulation (for losses, congestion costs, balancing costs): if performance better than defined targets = extra reward; worse than targets = punishment**

❖ **Menu of Contracts (sophisticated alternatives to Price Cap & PBR) Extra performances give defined extra rewards; but without minimum revenues if Bad Perf (= extra risk; kind of generalized PBR)**

❖ **Yardstick Competition (Relative performances among all the regulated give rewards & punishments) – kind of mandatory "Menu of Contracts" for all, where 'the' contract is set by the "best of class"**

Today Update1: Incentive + Innovation

Incentive Regulation assumes that companies innovate on their own:

That Opex is lowered, Performances increased, More risky contracts taken from the Menus, etc.

10 years ago, it became clear that innovation had to accelerate (digitalization as smart grids, smart metering) and had to enter into all parts of incentive regulation. British regulator redefined regulation:

>> RIIO >> Regulation as "*Revenues = Incentives + Innovation + Outputs*"

- **What novelties?**
- **Innovation is to face the unknown, to take risks, to do trials & errors. Regulator has to be lenient: it returns to 'cost of service' for testing & experiences; to grants for innovators; to increased ROR for Capex uncertainty**
- **"Sandboxing": where companies learn; the regulator too. With more knowledge, innovation can marry better with 'classic' incentives**

Update1 Cted: Incentives + Innovation

- Incentive Classic Tools are revisited for innovation

*If innovation lowers the costs, it enters Price Cap; Capex too can enter Price Cap: TOTEX can substitute to (Opex Price Cap + RoR for Capex)

> future decrease of TOTEX to be shared between company & society

**If innovation increases performances that can be measured; Performance Based Regulation

For ex: renewables capacity hosted by the grid: performance better than targets = extra reward; worse = punishment

***If innovation requires strong skills: Menu of Contracts Only people with strong skills will take more rewarding / more risky contract

For Ex. UK offshore sea grid: generators can define & build them if they want; then reselling these sea grid assets to sea grid franchisee by auctioning, before starting normal offshore operation

Update2: "Coupling Regulation" & Sector Integration

Just seen that "Incentive Regulation + Innovation" can create structural changes like "*new modules of regulation*" separated from the general regime of regulation (UK: the Offshore transmission sea grids)

Many other cases of "*New* regulatory modules / *Local* regulatory regimes" like:

- **Rural microgrids, minigrids to give access to electricity**
- **Auctions for utility-scale solar parks, or wind farms, with FiT**
- **Local storage, for grids to balance RES intermittency**
- **Planning of charging stations, for EVs & El.bikes**
- **Creation of city gas infrastructures, to decrease local air pollution**
- **Green Hydrogen industrial valleys**

All these new modules de-integrate the regulatory frame; create particular regulatory regimes for particular classes of infrastructure assets or technological systems.

Update2: "Coupling Regulation" & Sector Integration

However these new modules end up articulating themselves with the general regulatory frame in a 4 step process

Step 1- Rolling out of the new infrastructure, or infant technical system, with its particular set of rules

Step 2- At a maturity point; decision if (Unbundling) & (Nomination of a regulated operator) is needed

Step 3- Definition of a maturity regime: (Definition of a Code of operation of the infrastructure or system)< < Alignment >> (Rules of Market Design; maybe with market operator)

Step 4- This modular maturity regime evolves with successive realignments of the pair { infrastructure operation code) & (rules of market design} to operate smoothly this pair in coordination of general regime of regulation

"Coupling of Regulatory Regimes" ends up in general "Sector Integration": all different energy sectors & vectors aligned

Update3 "*Dynamic Regulation*": the Prosumer Revolution

"Innovation" created "new modules of regulation"…

NOW: one single structural change will transform the entire regulation landscape…

Classics of regulation (*Monopoly + Costs of service*) or (*Markets + Incentive regulation*) were both assuming that consumers need access to monopoly grid to get served

"Prosumer" breaks that by investing into self-generation, self-consumption, self-storage, self-management of individual load

Any decision by regulator, or any regulated operator, is followed by *prosumers striking back*: in their behaviour, investment & operation of assets, new decisions to become prosumer.

Update3 "Dynamic Regulation": the Prosumer Revolution

Regulator or Regulated Operator cannot assume that their own alignments - just seen in Update2

[[(Code of operation of the infrastructure or technical system)< < Alignment >> (Rules of Market Design; maybe with market operator)]] will work as they would like

"***Prosumer Revolution***": the whole regulatory regime has to evolve - with successive realignments of its various pairs { infrastructure operation code & rules of market design} to respond to decisions taken by active prosumers

>> "Dynamic Regulation" = continuously coupling the "Regulatory Regimes" with new reactions / new decisions taken by Prosumers

Update4 "3D Dynamic Regulation" Multilevel system interactions

The idea of "dynamic regulation" acknowledges that a new player (the *prosumer*) has enough incentives & liberty of decision-making to always react to regulator & regulated operators' decisions.

"*3D Dynamic Regulation*" is the new system we are entering in.

The electricity system is incredibly changing, in all its dimensions: it's becoming 3D. ..

From the top to the bottom AND within its frontiers, as well as *behind* or *beyond* its frontiers.

"3D Dynamic Regulation" = continuously coupling the "Regulatory Regimes" with novelties popping anywhere…

Update4 "3D Dynamic Regulation" Multilevel system interactions

***Distributed energy resources, *self-generation & self-consumption, *self-storage, *demand response, *charging electric vehicles, etc. are managed with decisions taken "beyond electricity regulation" and "behind the meter"…**

The electricity system was made of Transmission & Distribution encapsulating Generation

A new level of the electricity system appears, at its "bottom": the individual decisions taken "Behind-the-Meter"

"3D Dynamic Regulation" = the electricity system is become multilevel… not anymore controlled by a single "system operator" & its "central dispatch"…

Update4 "3D Dynamic Regulation": Digital interactions

Electricity system is not only become "Multilevel"; it is also become "digitally interactive" in all its dimensions

Digitalisation continuously enabling new players, permitting new products, favouring new types of trade arrangements: towards generalized digitalization, with 5G & "*Internet of Things*"

- **New Players**

Aggregators, prosumers, energy communities, asset fleet managers, platforms

- **New products**

Realtime green energy, blockchained generator, sharing local storage, "smart" charging EV, flexibility as "V2Grid", automated load management

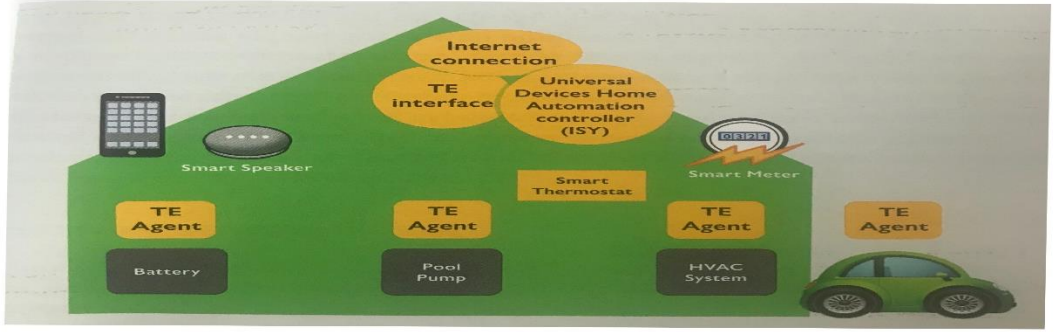
- **New Trade arrangements**

C2B, C2C (Peer2Peer – Blockchain), two-sided Markets (platforms)

Look at a fully digitalized home consumption frame: Pilot 'RATES' in California (33,000 people for 3 years)

1- Each home device is made controllable 2- A central home controller learns how to best manage each device 3- This home controller is connected to relevant el. Markets local or centralized, &Network tariffs, to take best "aggregated home decisions"

1



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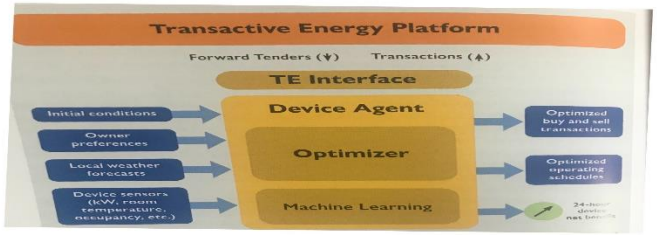


3

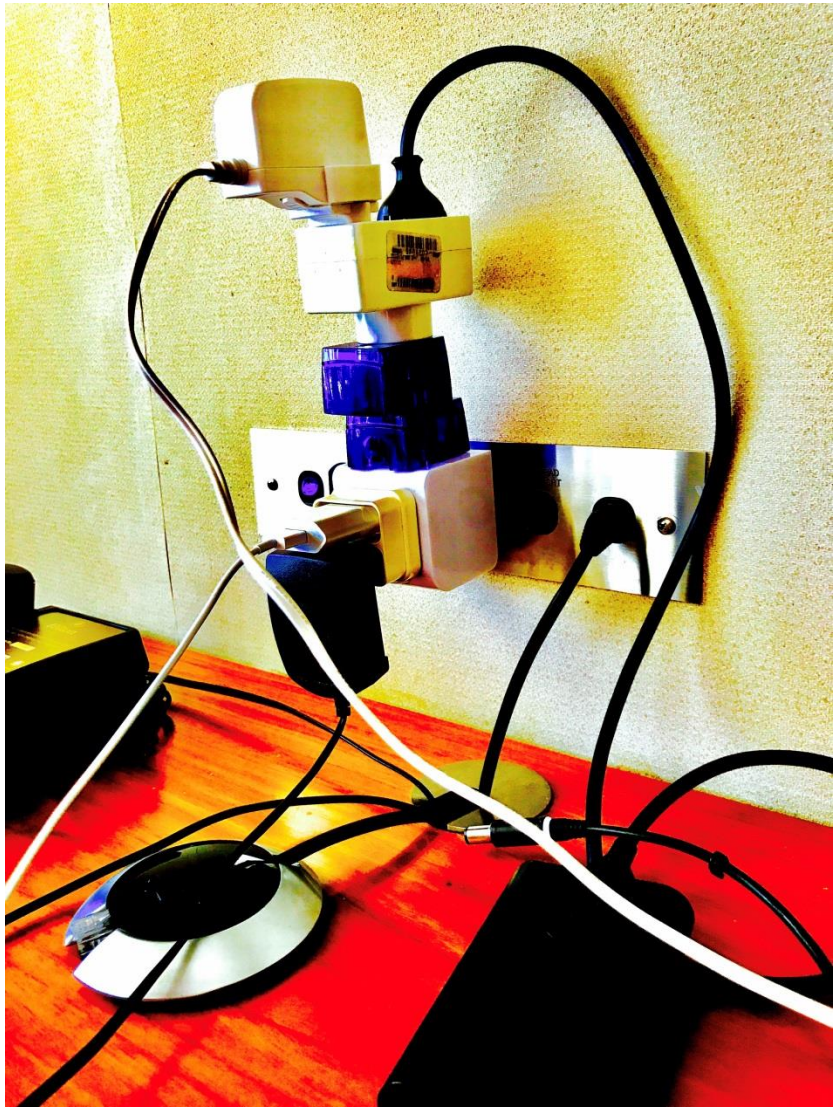
"3D Dynamic Regulation" Multilevel system interactions

Ones still have to align (Operation of Infrastructures & Technical Systems) with (Rules of Market Design) but…

	Infrastructures & Technical Systems Levels		
	TRSM level	DSTRB level	BthM level
Market Designs Rules			
B2B			
B2C			
C2B			
C2C			

A Multilevel Regulation World

become Digitally interactive…



Rearranged as…

"Internet of Energy"

Conclusions: a lot of challenges for regulation, and regulators

<:> Towards a "*New Incentive Regulation*"

to favour structural business innovations

Innovative Business Models to come <through> "Modular Regulatory Regimes" + Their reciprocal "Couplings"

<:> Towards a "*Dynamic Regulation*"

Beyond "Utilility regulation": interacting with New Players, New Products, New Trade Arrangements, with growing "*Behind the Meter*" activities


United, yes we can

United, yes we can

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