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Government of India
www.nsgm.gov.in

Impact Assessment of Smart Grid Pilot Projects Deployed in India

Introduction

- NSGM, MOP engaged QCI to assess the impact of implementation of Smart Grid Pilot projects, covering both utilities and consumers.

- QCI conducted impact assessment activity in nine (9) DISCOMs, one (1) academic institute and one (1) Knowledge Center where pilot projects have been implemented/ongoing.

- Assessment findings are based on the information provided by DISCOMs as of March 2019.

- Pilots projects were at various stages of execution during the time of assessment.

Why Impact Assessment?

- The Smart Grid pilot projects were under execution for considerable timeframe.

- Compare the adopted vis-à-vis deployed functionalities.

- Impacts, benefits to utility / consumers where pilots under implementation.

- Identification of challenges faced and future course of action.

- Collation of learnings from pilots for large scale deployments.

Survey Methodology (1/2)

Utility
- Functionalities mentioned in DPRs, tender documents vis-à-vis the current scenario.
- Discussion with various stakeholders on an exhaustive questionnaire prepared in regard to implementation and working of functionalities.
- Analyzing reports generated by DISCOMS such as AT&C losses, SAIFI/SAIDI etc.

Consumer
- Consumer survey to collect end user feedback
- A minimum of 50 consumers were surveyed from each DISCOM (Except in IIT Kanpur and Manesar)
- A detailed questionnaire to gain insights on satisfaction levels and benefits accrued to consumers.

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- Discussions held with Mysore, CESCOM for better understanding of the intricacies involved in the projects and refining the questionnaire.

- The pilots findings were incorporated and questionnaire was refined for further assessment.

- To conduct the assessment, two teams of three professionals visited each Smart Grid Pilot Project for physical verification and to take feedback from utility officials and consumers.

Summary of Findings (1/2)

S.NO.	Pilot Project	Advanced Metering Infrastructure	Billing Using AMI	Peak Load Management	Power Quality Management	Outage Management	Micro Grid/Distribution generation system
1.	Smart Grid Pilot Project at Guwahati, APDCL	Implemented	Not Implemented	Not In Use	Not In Use	Partially Implemented	Not Implemented
2.	Smart Grid Pilot Project at Naroda, UGVCL	Implemented	Implemented	Not Implemented	Not Implemented	Not Implemented	Not opted
3.	Smart Grid Pilot Project at Panipat, UHBVN	Implemented	Implemented	Not In Use	Partially Implemented	Implemented	Not Implemented
4.	Smart Grid Pilot Project at Kala Amb, HPSEB	Implemented	Implemented	Partially deployed	Not opted	Implemented	Not opted
5.	Smart Grid Pilot Project at Mysore, CESC	Implemented	Implemented for consumers on one feeder	Not In Use	Not opted	Partially Implemented	Not Implemented
6.	Smart Grid Pilot Project at Puducherry, PED	Implemented	Not Implemented	Implemented-consumers haven't taken part yet.	Not opted	Not opted	Not opted
7.	Smart Grid Pilot Project at Jeedimetla, TSSPDCL	Implemented	Not Implemented	Not In Use	Implemented	Not In Use	Not opted
8.	Smart Grid Pilot Project at Agartala, TSECL	Implemented	Implemented	Not In Use	Not opted	Not opted	Not opted
9.	Smart Grid Pilot Project at Siliguri, WBSEDCL	Implemented	Implemented	Not In Use	Not opted	Not opted	Not opted
10.	Smart City R&D Platform Pilot Project at IITK	Implemented	Implemented	Not Implemented	Not opted	Not Implemented	Implemented
11.	Smart Grid Knowledge Centre at MANESAR	Implemented	Implemented	Implemented	Implemented	Implemented	Implemented

**The reason for "Not Implemented / Not In Use" cases are mainly regulatory/testing/political issues etc.

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The below table depicts the reduction of AT&C Losses of the assessed utilities across defined ranges:

Decrease of greater than 10 percentage points	Decrease of 5-10 percentage points	Decrease of 0-5 percentage points	Increase of percentage points
WBSEDCL, TSECL, APDCL	UGVCL, CESC	HPSEBL, PED, TSSPDCL,UHBVN	-

Pilot Project Wise Findings

SG Pilot at Guwahati, APDCL

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AT&C losses, Billing & Collection Efficiency
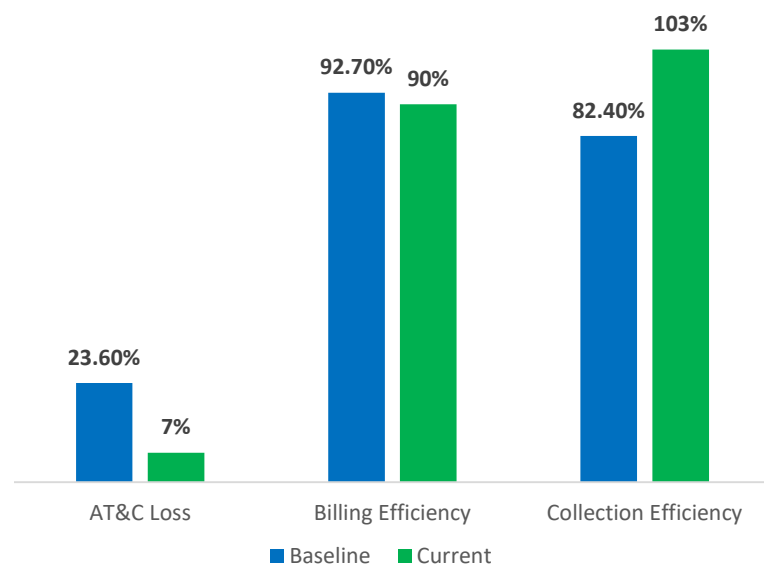
Consumer Awareness

Consumer Outage

AT&C losses chart values:
- AT&C Loss: Baseline 23.60%, Current 7%
- Billing Efficiency: Baseline 92.70%, Current 90%
- Collection Efficiency: Baseline 82.40%, Current 103%

Legend: Baseline, Current

Consumer Awareness chart:
- Not Aware 94%
- Aware 6%

Legend: Not Aware, Aware

Consumer Outage chart:
- Once in more than a month (rarely): 44%
- Monthly: 16%
- Weekly: 20%
- Never: 0%
- Daily: 20%

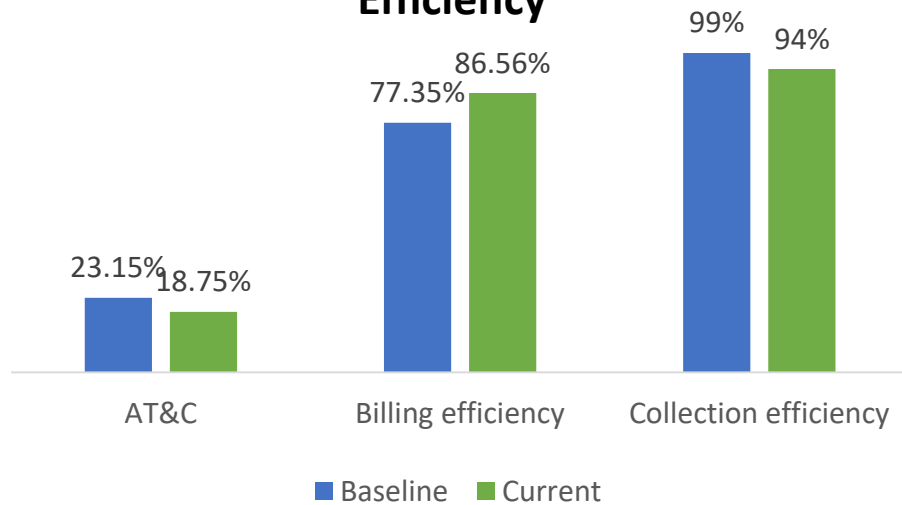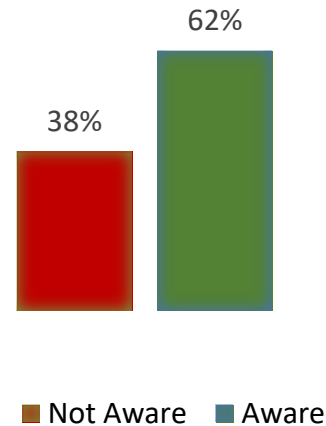Legend: Once in more than a month (rarely), Monthly, Weekly, Never, Daily

- Total No. of Consumers - 14,519. Total No. of Smart Meters Deployed - 14,082.
- The DISCOM has achieved the promised target of 15% AT&C loss, with an **overall reduction of over 10%** from the baseline.
- Fluent Grid Ltd. is currently working with APDCL for a new consumer portal for smart grid consumers which will be integrated with the already existing R-APDRP portal.
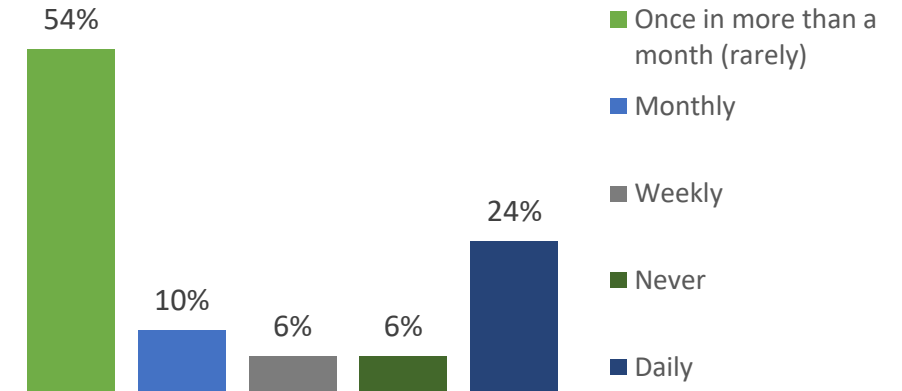- MDMS/MDAS were implemented and retrieving data from CT meters only.

SG Pilot at Panipat, UHBVN

AT&C losses, Billing & Collection Efficiency

AT&C: Baseline 23.15%, Current 18.75%
Billing efficiency: Baseline 77.35%, Current 86.56%
Collection efficiency: Baseline 99%, Current 94%

Legend: Baseline, Current

Consumer Awareness

Not Aware 38%, Aware 62%

Legend: Not Aware, Aware

Consumer Outage

Once in more than a month (rarely) 54%
Monthly 10%
Weekly 6%
Never 6%
Daily 24%

Legend: Once in more than a month (rarely), Monthly, Weekly, Never, Daily
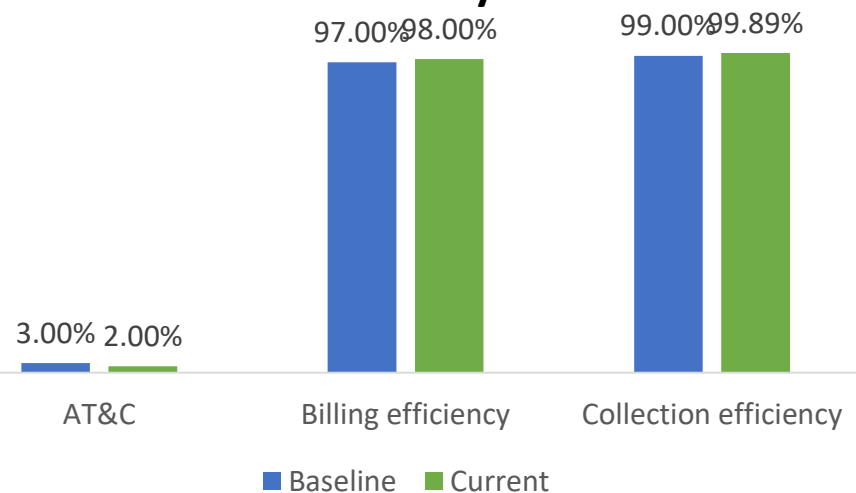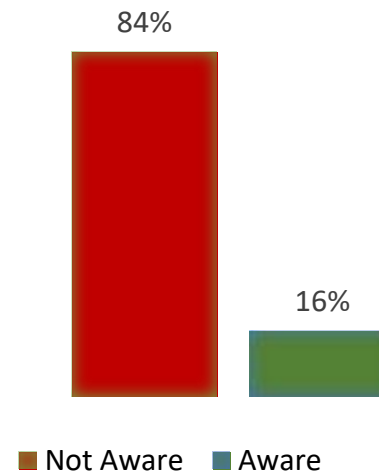
- Total No. of Consumers - 11,000. Total No. of Smart Meters Deployed - 10,366.
- The DISCOM had expected AT&C Loss of 14.66%. But there has been an **overall reduction of over 4.4%** in the AT&C loss from the baseline loss.
- 7518 number of remote connections and disconnections were done from Sep 2018 to March 2019.
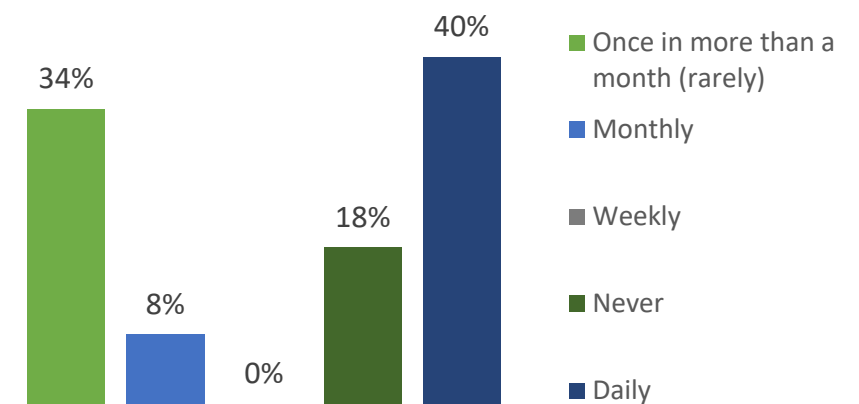- Consumer Portal hasn't been developed for pilot consumer as of March 2019.

SG Pilot at Kala Amb, HPSEB

AT&C losses, Billing & Collection Efficiency

- AT&C: Baseline 3.00%, Current 2.00%
- Billing efficiency: Baseline 97.00%, Current 98.00%
- Collection efficiency: Baseline 99.00%, Current 99.89%

Legend: Baseline, Current

Consumer Awareness

- Not Aware 84%
- Aware 16%

Legend: Not Aware, Aware

Consumer Outage

- Once in more than a month (rarely): 34%
- Monthly: 8%
- Weekly: 0%
- Never: 18%
- Daily: 40%

Legend: Once in more than a month (rarely), Monthly, Weekly, Never, Daily
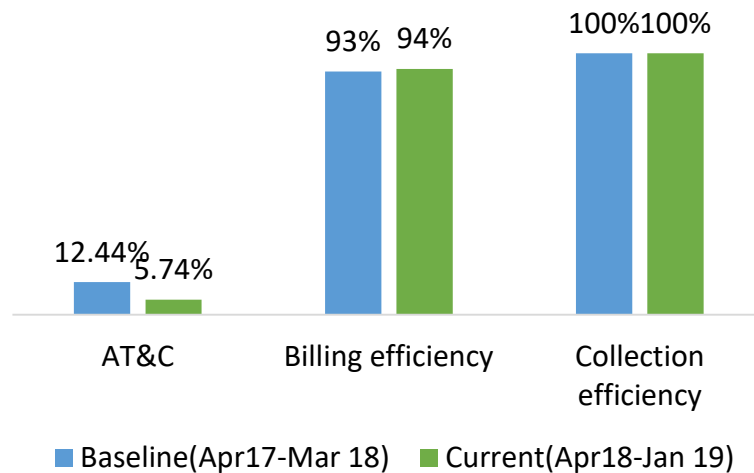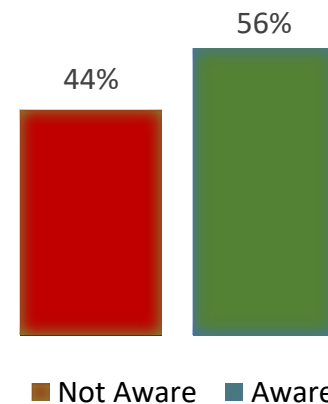
- Total No. of Consumers - 1,554. Total No. of Smart Meters Deployed - 1,335.
- The DISCOM had expected AT&C Loss of 1.86% . There has been an **overall reduction of over 1%** in the AT&C loss from the baseline loss.
- Consumer portal for smart grid pilot consumers has been developed but integration of the same with RAPDRP portal was in process as of March 2019.
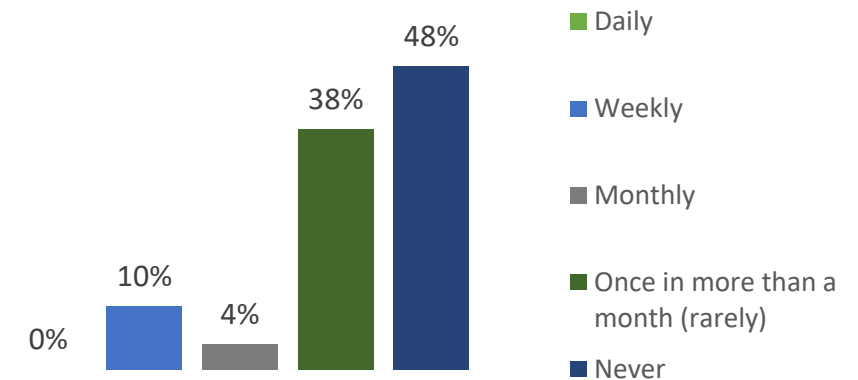
SG Pilot at Naroda, UGVCL

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AT&C losses, Billing & Collection Efficiency

93% 94%
100% 100%
12.44% 5.74%

AT&C   Billing efficiency   Collection efficiency

■ Baseline(Apr17-Mar 18)   ■ Current(Apr18-Jan 19)

Consumer Awareness

44%   56%

■ Not Aware   ■ Aware

Consumer Outage

48%
38%
10%
0%   4%

■ Daily
■ Weekly
■ Monthly
■ Once in more than a month (rarely)
■ Never
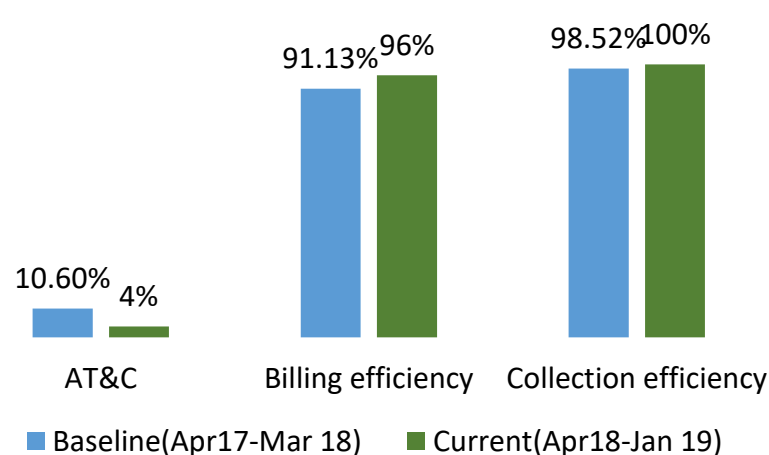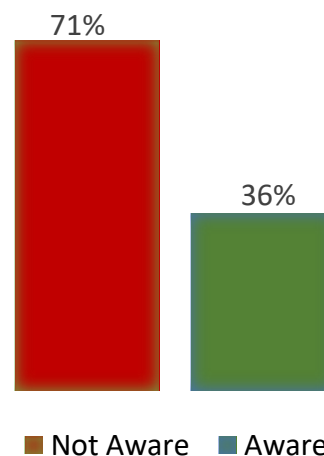
- Total No. of Consumers – 23,760. Total No. of Smart Meters Deployed – 23,760.
- The DISCOM has achieved the promised target of 8.44% AT&C Loss, with an **overall reduction of over 5%** from the baseline.
- 8561 remote connection and disconnection have been done from Oct 2018 till March 2019
- On an average 10436 consumers per month are billed using AMI
- Portal has been developed for pilot project consumers but wasn't shared with consumers as of March 2019.
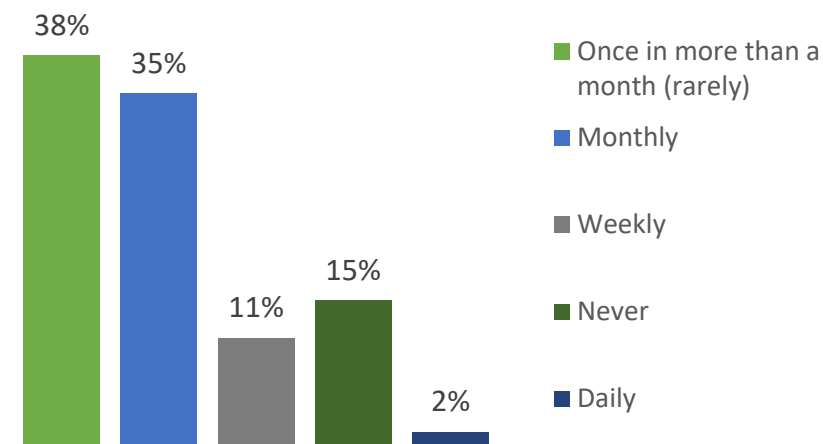
SG Pilot at Mysore, CESC

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AT&C losses, Billing & Collection Efficiency

- AT&C: Baseline 10.60%, Current 4%
- Billing efficiency: Baseline 91.13%, Current 96%
- Collection efficiency: Baseline 98.52%, Current 100%

Baseline(Apr17-Mar 18) Current(Apr18-Jan 19)

Consumer Awareness

- Not Aware 71%
- Aware 36%

Consumer Outage

- Once in more than a month (rarely) 38%
- Monthly 35%
- Weekly 11%
- Never 15%
- Daily 2%
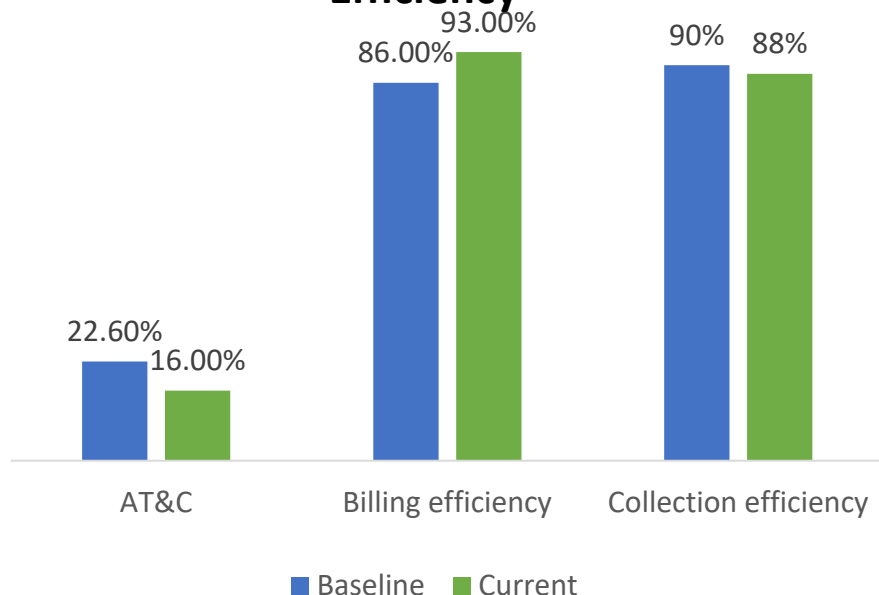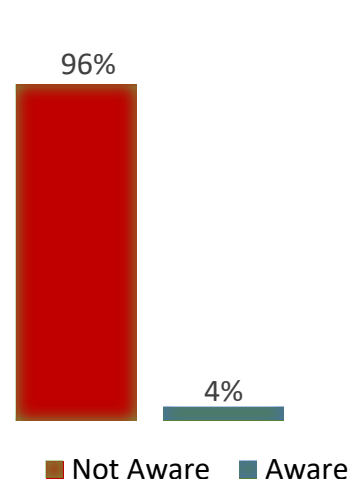
- Total No. of Consumers - 21,824. Total No. of Smart Meters Deployed - 20,863.
- The DISCOM has achieved the promised target of 5.7% AT&C loss, with an **overall reduction of over 5%** from the baseline.
- 11515 number of remote connections and disconnections have been done from Sep 2017 to Dec 2018
- Annual saving of Rs.1,200,000/- by remote connect / disconnect facility and savings of 1,35,000 per annual by replacement of under loaded DTC.
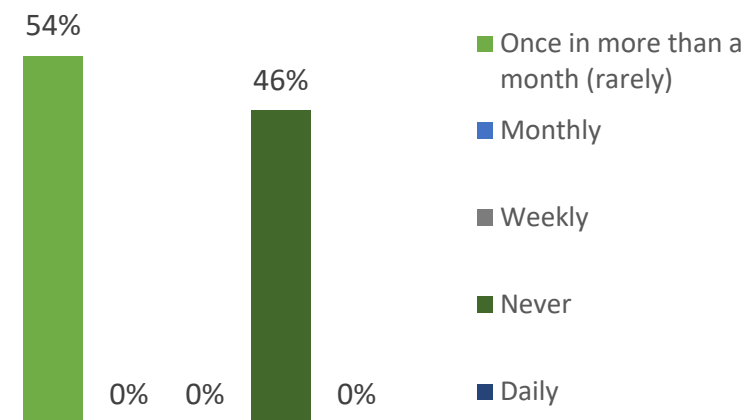
SG Pilot at Puducherry, PED

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AT&C losses, Billing & Collection Efficiency

- 22.60% / 16.00% — AT&C
- 86.00% / 93.00% — Billing efficiency
- 90% / 88% — Collection efficiency

■ Baseline   ■ Current

Consumer Awareness

- 96% Not Aware
- 4% Aware

■ Not Aware   ■ Aware

Consumer Outage

- 54% Once in more than a month (rarely)
- 0% Monthly
- 0% Weekly
- 46% Never
- 0% Daily

■ Once in more than a month (rarely)
■ Monthly
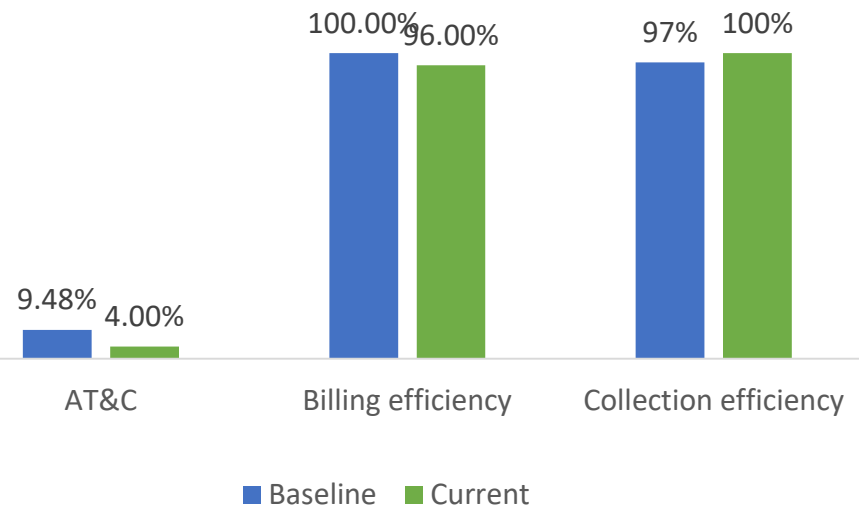■ Weekly
■ Never
■ Daily

- Total No. of Consumers - 33,499. Total No. of Smart Meter Deployed – 28,916.
- The DISCOM had expected AT&C Loss of 8.86% but there has been an **overall reduction of over 6.6%** in the AT&C loss from the baseline loss.
- Consumer portal has been developed but wasn't shared with the consumers as of March 2019.
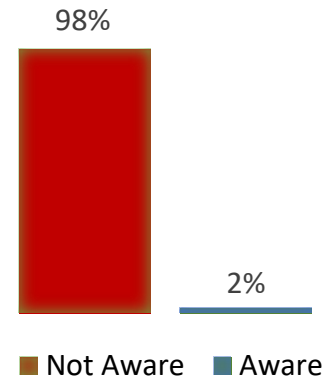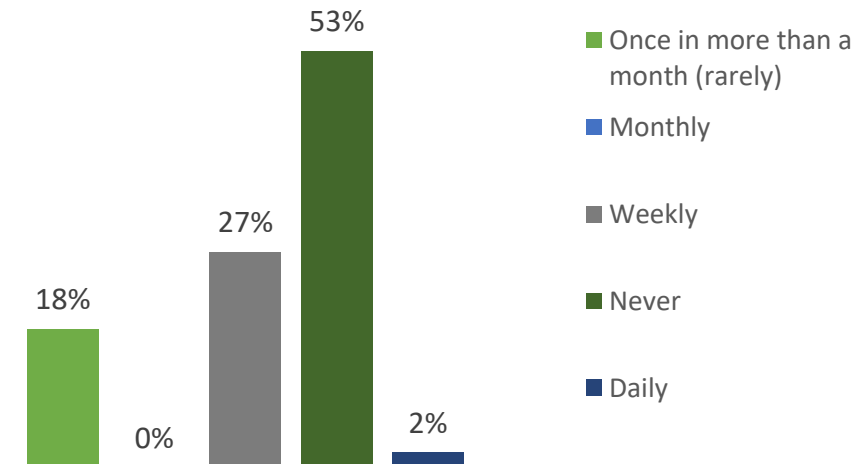
SG Pilot at Jeedimetla, TSSPDCL

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AT&C losses, Billing & Collection Efficiency

- AT&C: Baseline 9.48%, Current 4.00%
- Billing efficiency: Baseline 100.00%, Current 96.00%
- Collection efficiency: Baseline 97%, Current 100%

■ Baseline ■ Current

Consumer Awareness

- Not Aware 98%
- Aware 2%

■ Not Aware ■ Aware

Consumer Outage

- Once in more than a month (rarely): 18%
- Monthly: 0%
- Weekly: 27%
- Never: 53%
- Daily: 2%

■ Once in more than a month (rarely)
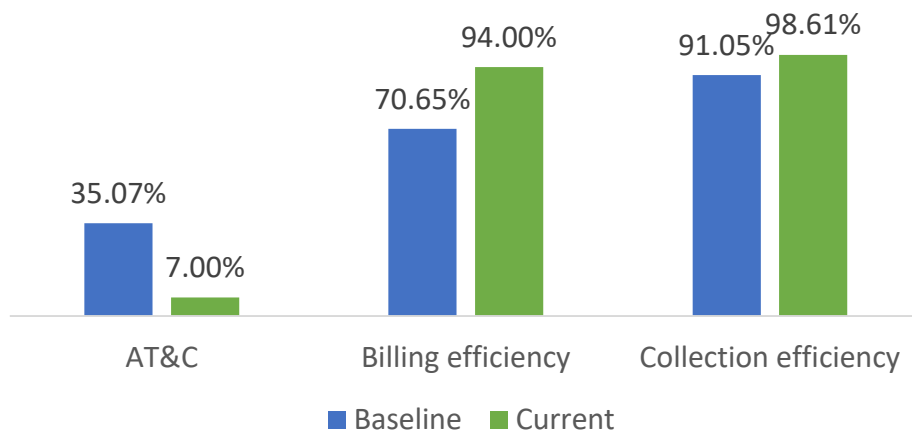■ Monthly
■ Weekly
■ Never
■ Daily

- Total No. of Consumers - 11,906. Total No. of Smart Meters Deployed - 8,882.
- The DISCOM has achieved the promised target of 7.48% AT&C loss, with an **overall reduction of over 5.48%** from the baseline.
- 3 phase meters weren't installed at the DISCOM as of March 2019 .
- Consumer portal and an application has been developed for smart grid pilot consumers but they had not been given access as of March 2019.
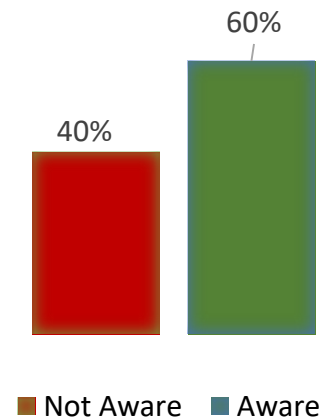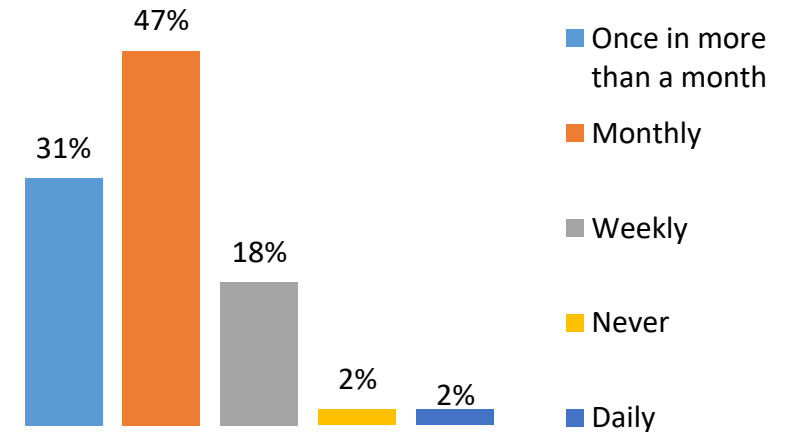
SG Pilot at Agartala, TSECL

AT&C losses, Billing & Collection Efficiency

- AT&C: Baseline 35.07%, Current 7.00%
- Billing efficiency: Baseline 70.65%, Current 94.00%
- Collection efficiency: Baseline 91.05%, Current 98.61%

Legend: Baseline | Current

Consumer Awareness

- Not Aware 40%
- Aware 60%

Legend: Not Aware | Aware

Consumer Outage

- Once in more than a month: 31%
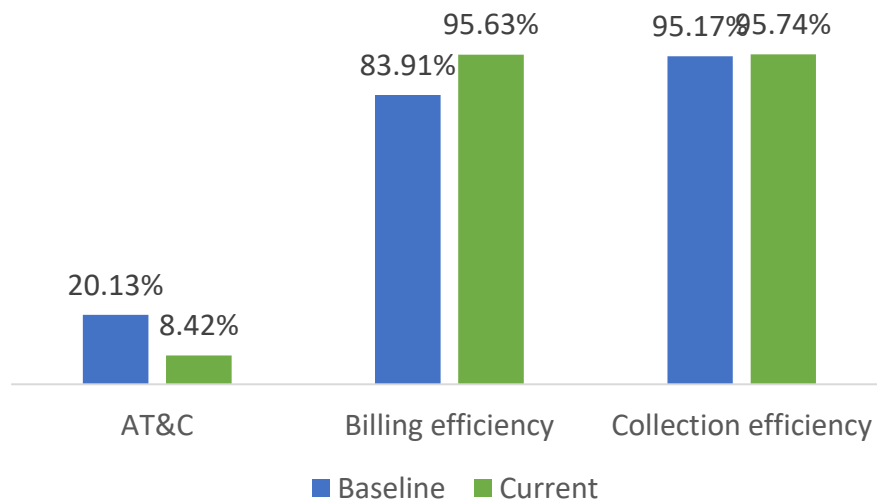- Monthly: 47%
- Weekly: 18%
- Never: 2%
- Daily: 2%

- Total No. of Consumers - 45,000. Total No. of Smart Meters Deployed - 42,530.
- The DISCOM has achieved the promised target of 14.00% AT&C loss, with an **overall reduction of over 28.07%** from the baseline.
- A consumer portal has been developed for smart grid pilot consumers but the same wasn't shared with consumers as of March 2019.
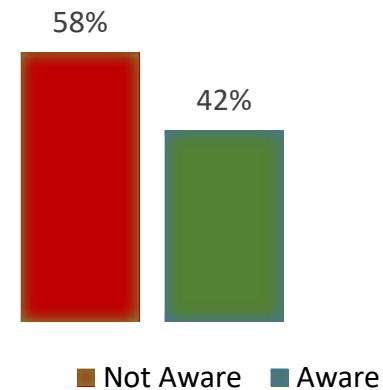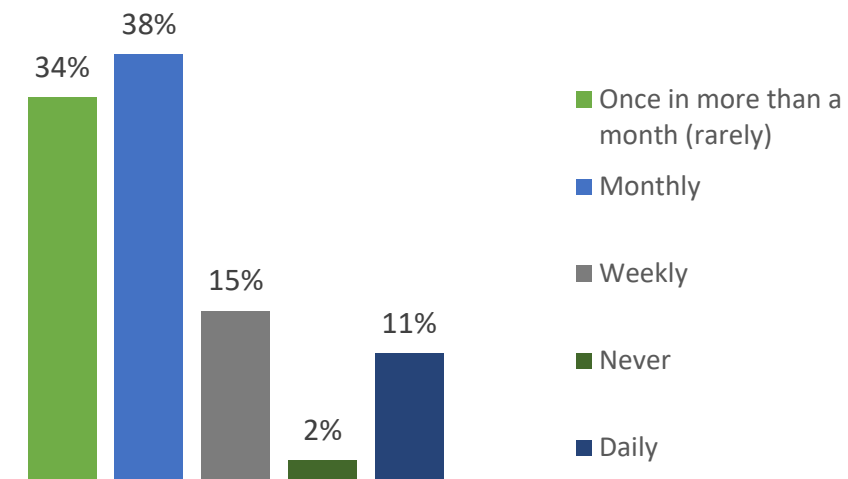
SG Pilot at Siliguri, WBSEDCL

AT&C losses, Billing & Collection Efficiency

AT&C: Baseline 20.13%, Current 8.42%
Billing efficiency: Baseline 83.91%, Current 95.63%
Collection efficiency: Baseline 95.17%, Current 95.74%

Baseline — Current

Consumer Awareness

Not Aware 58% — Aware 42%

Consumer Outage

Once in more than a month (rarely) 34%
Monthly 38%
Weekly 15%
Never 2%
Daily 11%

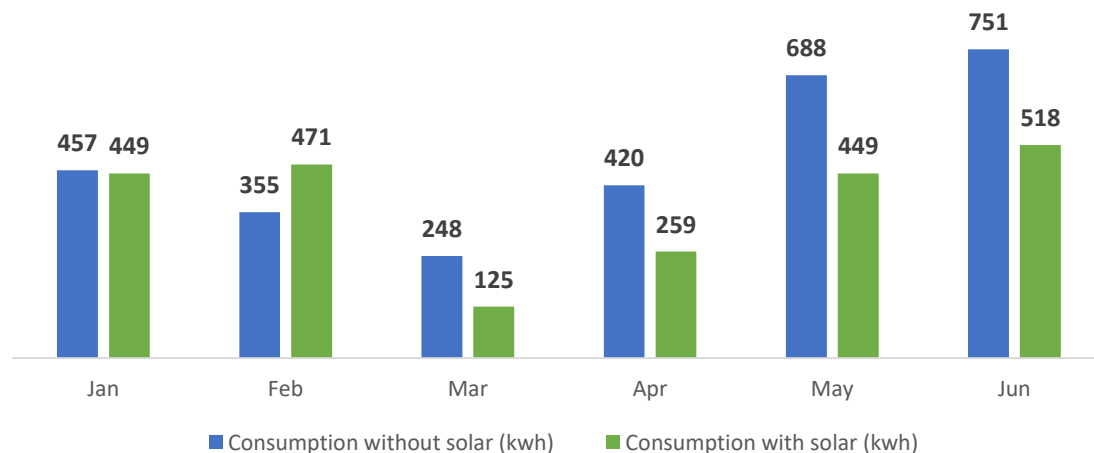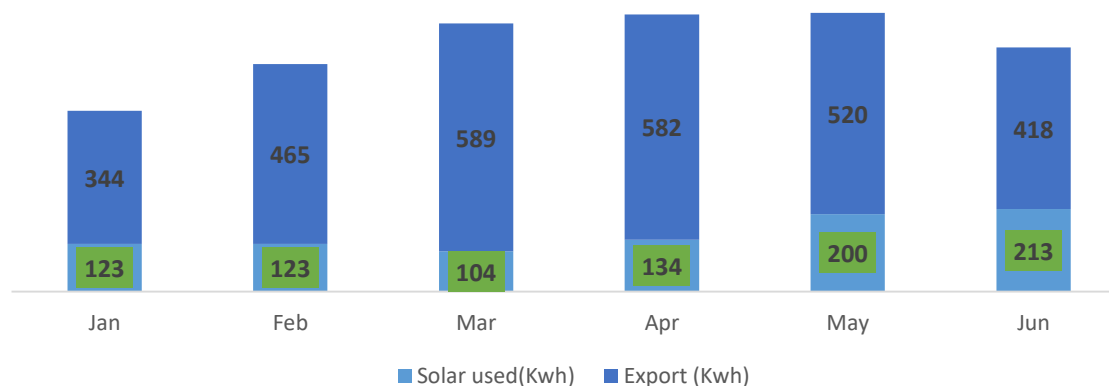- Total No. of Consumers - 5,275. Total No. of Smart Meters Deployed - 5,164.
- The DISCOM has achieved the promised target of 11.35% AT&C loss, with an **overall reduction of over   11.71%** from the baseline.
- Crew vehicles are monitored by the CRM system which has helped the DISCOM save a vast sum of money during the last year as fuel consumption and number of kilometres travelled is also kept in check.

Smart City R&D Pilot at IIT Kanpur

- Total No. of Smart Meters Deployed - 27 (20 households + 7 hostels)

- RES integration of roof top solar installed in all the 20 houses with an individual capacity of 5kw.

- On going research activities in developing hardware such as Raspberry Pi ,Relay , Open HAB.

- Consumer Portal has been shared with the consumers. Also, HAS app has been developed for the controlling of loads

- Home automation System has been implemented for all the pilot consumers .

Comparison of electricity consumption before/after solar

Month	Consumption without solar (kwh)	Consumption with solar (kwh)
Jan	457	449
Feb	355	471
Mar	248	125
Apr	420	259
May	688	449
Jun	751	518

Solar Generation

Month	Solar used(Kwh)	Export (Kwh)
Jan	123	344
Feb	123	465
Mar	104	589
Apr	134	582
May	200	520
Jun	213	418

Smart Grid Knowledge Centre

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                    ┌──────────────────┐
                    │   Components     │
                    └──────────────────┘
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| AMI | OMS | PLM | Smart Home (HAN) | Substation Automation model | Digital Library | Micro Grid | Training Centre | EV Charging |
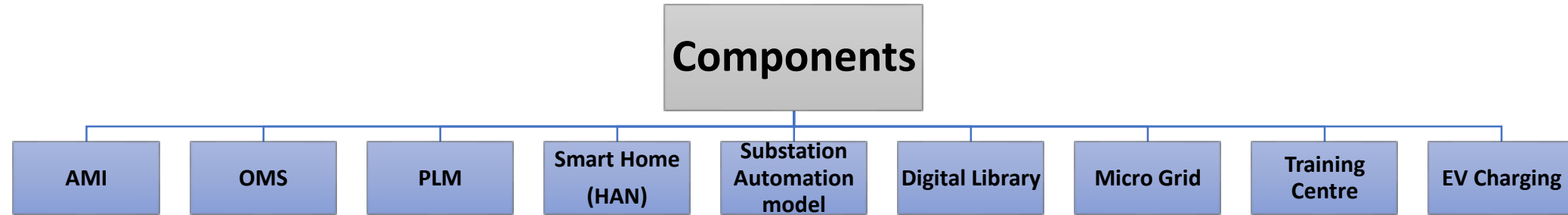
- **Continuous trainings** are being conducted by SGKC for effective knowledge management transfer.

- Micro grid comprised of PV Solar rooftop established.

- Weather Monitoring Station with sensors for wind and solar measurement are established at the centre.

- **2 Electric Vehicles and EV Charging Ifra** were already present.

1. Total number of meters installed at pilots stands at 1.56 lakhs.

2. Utilities observed **Reduction in AT&C losses** and achieved results <u>near to the target</u>

3. **Integration of Smart Grid system with RAPDRP** has been achieved in projects like Tripura, Assam, West Bengal

4. **Consumer Portals** have been developed in <u>many</u> pilots and shared with customers

5. Peak Load Management (PLM) successfully tested by Pilot Utilities however **regulatory constraints** made PLM deployment on hold.

   - *Gujarat SERC has asked to file petition along with two (2) year valid data from Smart Grid system.* Toward this direction utilities are trying to present their cases before respective SERCs with historic data

6. **Most of the pilots were deployed with RF/GPRS**

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7. **Meters with more than one communication modules** have been developed/ tested/ deployed to test the multiple communication system as well as to ensure failsafe communication (e.g. UHBVN pilot)

8. **The Power Line Communication (PLC) in Agartala & Panipat** pilots have been successfully deployed affirming possibility to use PLC communication

9. **Remote connect/disconnect feature was also tested** and deployed at some pilots, while some pilot utilities are in the process of obtaining regulatory approval

10. **Smart city R&D platform at IIT Kanpur** is a showcase model with R&D potential to **test integration with Smart cities.** The significant applications deployed include **Home automation system**, **Renewable energy integration**, AMI, essential and non-essential loads segregation

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11. **Smart Grid Knowledge Centre (SGKC)** at Manesar has become a unique set up for showcasing live working models of Smart Grid functionalities and also impart **Training & Capacity Building** activities for skill development of utility professionals and engineers

12. The major functionalities deployed at SGKC include AMI, PLM, renewable energy integration, smart home automation system

13. **Consumer resistance was observed** in some of the pilots during the initial phases. Consumers were sensitized with benefits of Smart Grid deployments though pamphlets, news articles and meetings.

14. Overall consumers are less aware about the smart grid technologies. In general consumers reported to have **experienced improved in quality of power supply**
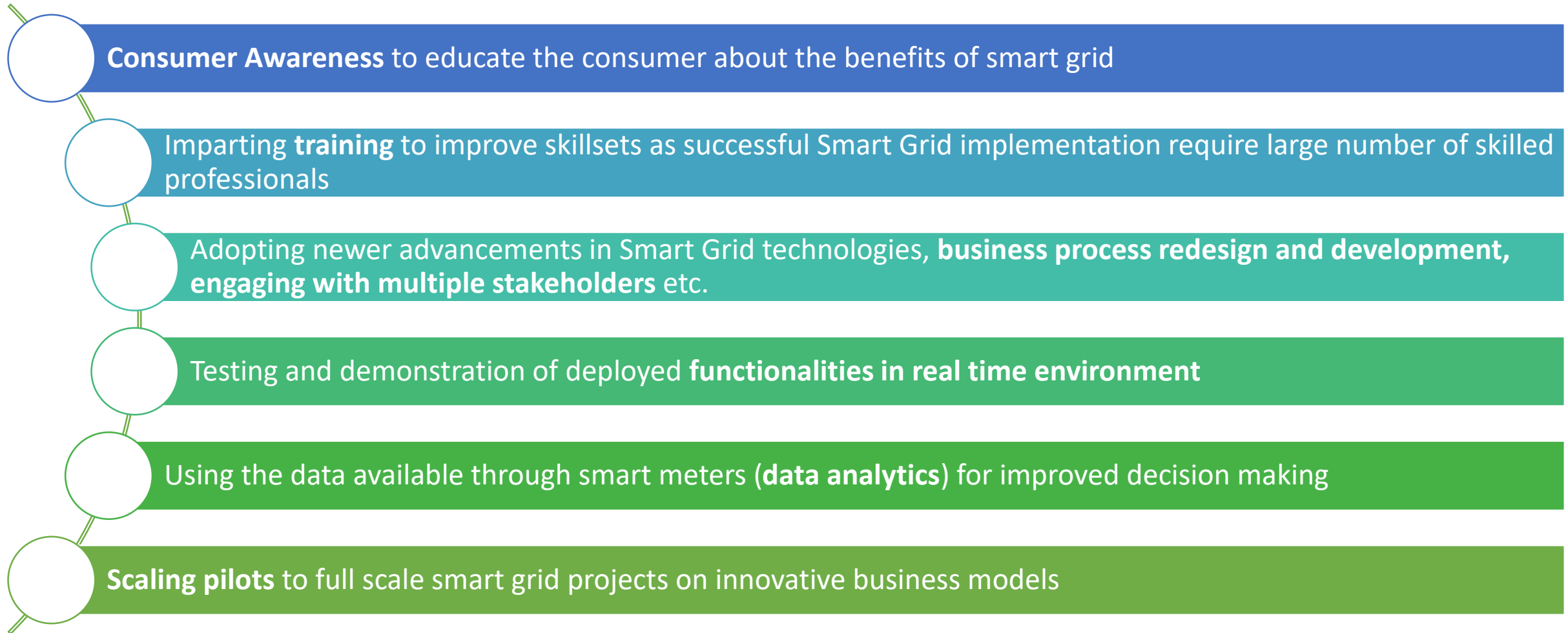
Major Challenges Faced/Reported (1/2)

1. **Consumer indexing** poses a challenge in maintaining system since whenever consumer is tagged to a new DT discrepancy in billing is observed

2. **Regulatory challenges** for implementation of PLM, connect/ disconnect etc.

3. **Integration of Smart Grid system** with existing R-APDRP system and/or legacy MBC systems

4. **No Smart Meter standard was available at the initiation of deployment**. However, some of the utilities have deployed IS 16444 compliant meters, while one of the utilities had gone ahead with certification of IS 16444 which has slowed down the rate of deployment

5. Even though IS 16444 specifies that smart meters shall use IPV6, the major telecom service provides support for IPV4 at present

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6. **Choice of Communication** is limited due to geography and service providers availability and non-competitive rates

7. **Capacity building and Training Challenges** are seen as Smart Grid is a new concept for the utility officials and Skill set enhancement is needed for the systems deployed

8. **Consumer Resistance** was observed with some of the consumers reported increase in billing and also sought political intervention

9. **Non flexibility of communication module** as they are integrated with smart meter of particular vendor and it is lock-in case of **interoperability**

Next Steps Based on Impact Assessment

Consumer Awareness to educate the consumer about the benefits of smart grid

Imparting **training** to improve skillsets as successful Smart Grid implementation require large number of skilled professionals

Adopting newer advancements in Smart Grid technologies, **business process redesign and development, engaging with multiple stakeholders** etc.

Testing and demonstration of deployed **functionalities in real time environment**

Using the data available through smart meters (**data analytics**) for improved decision making

Scaling pilots to full scale smart grid projects on innovative business models

Thank You