XSICEL 2021

Transición energética en la 4ta revolución industrial

Universidad Tecnológica de Pereira

UNIVERSIDAD NACIONAL DE COLOMBIA

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Transición energética en la 4ta revolución industrial

Demand Response Program Implementation Methodology: A Colombian Study Case

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Colombia Inteligente

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I. Introduction

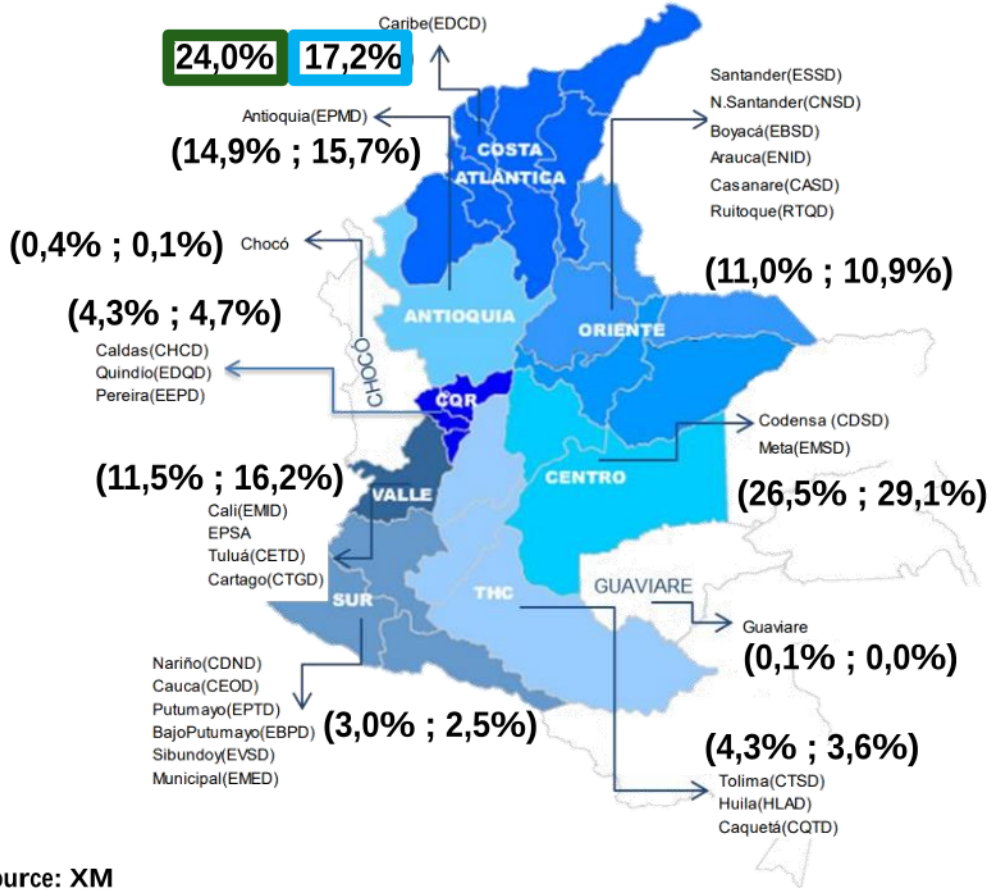
+17GW
Capacity
> 70% renowable

+10GW
Peak demand

Demand
+70TWh-year

70%
Regulated
+15Millions
Energy users
(installations)

30%
Non-regulated
+6.270
Energy users
(installations)



Source: XM
(Data 2020)

I. Introduction

Comprehensive Climate Change Plan for the energy mining sector – PIGCCme- formulated by the Ministry of Mines and Energy.

2 MtCO2e (18%)

Source: MINENERGÍA

II. Reference framework

1 Demand respond program

Availability for disconnection
Hourly period

2 MW 20 MW 76 MW

1.3% of the hourly demand
1% of the daily national demand

2 Turn-off Pay program

This program has only worked once
Montly period

Savings by
GWh-2016

+530 GWh

3 Voluntary Disconnectable Demand

VDD not committed in bilateral contracts

Availability
GWh-Day 2020

[5,9 – 11,5]

[246 – 480] MW

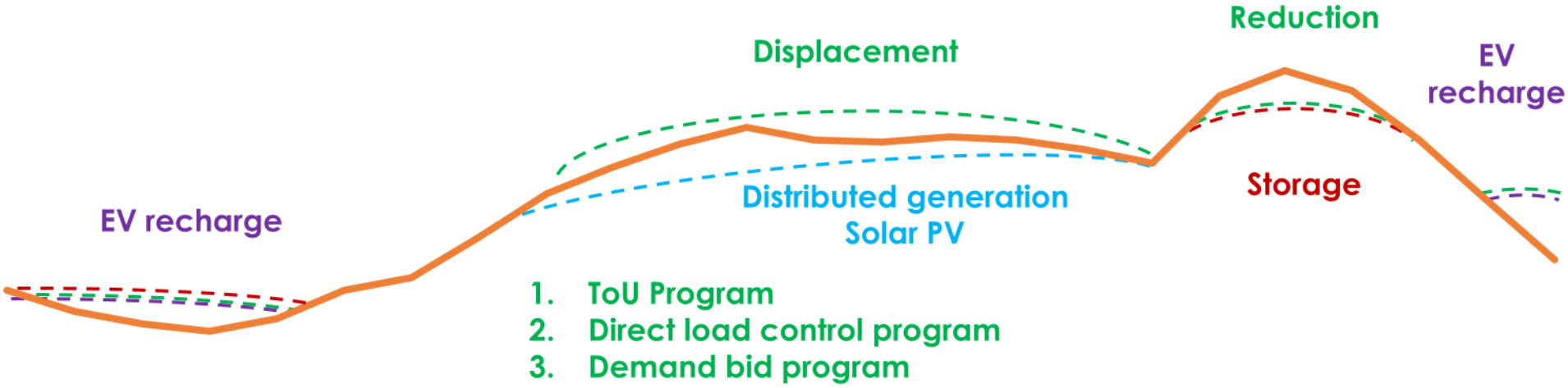
DR programs are only used when a critical condition is present in the power system

Source: XM

II. Reference framework

Demand respond→ Active users !

Reduction or displacement of electrical energy consumption generated by incentives or others

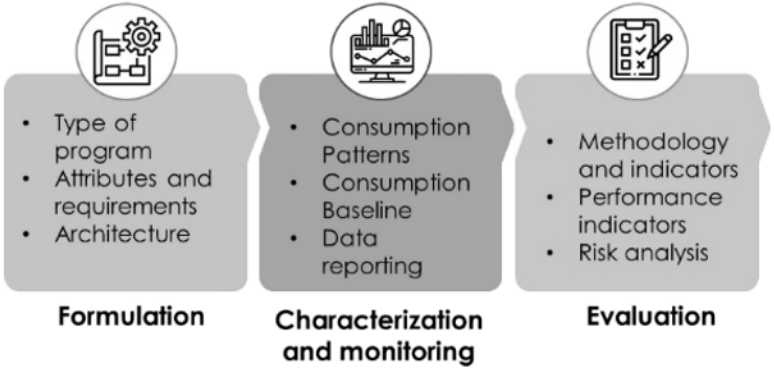


Resource integration schemes: Microgrids / VPP / Energy Communities

P0 P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15 P16 P17 P18 P19 P20 P21 P22 P23

II. Reference framework

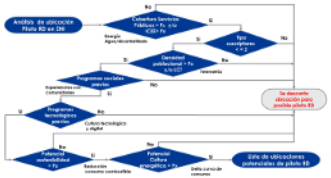
Stages and components of a DR program



Aspects for empowering the active user of DR programs

III. Proposed methodology

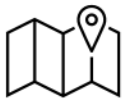
Regulatory feasibility
Actors and roles
Implementation potential
Development phases



Gathering information

- Coverage of public services
- User characteristics
- Experiences social programs
- Technological programs experiences
- Potential sustainability
- Potential energy culture

Planning



Location analysis

- Methodology
- Selection criteria

DR program design

- Characterization of consumption
- Roles and responsibilities
- Attributes of the RD program
- DR promotion strategy

Pre-installation

DR pilot assessment

- Skills and capabilities
- Infrastructure and equipment
- Valuation of benefits
- Cost valuation

Installation & Execution

DR pilot operation

- Better practices
- Activities diagram
- Activities list

DR pilot analysis

- Indicators of performance
- Activity tracking

Evaluation

IV. Study case

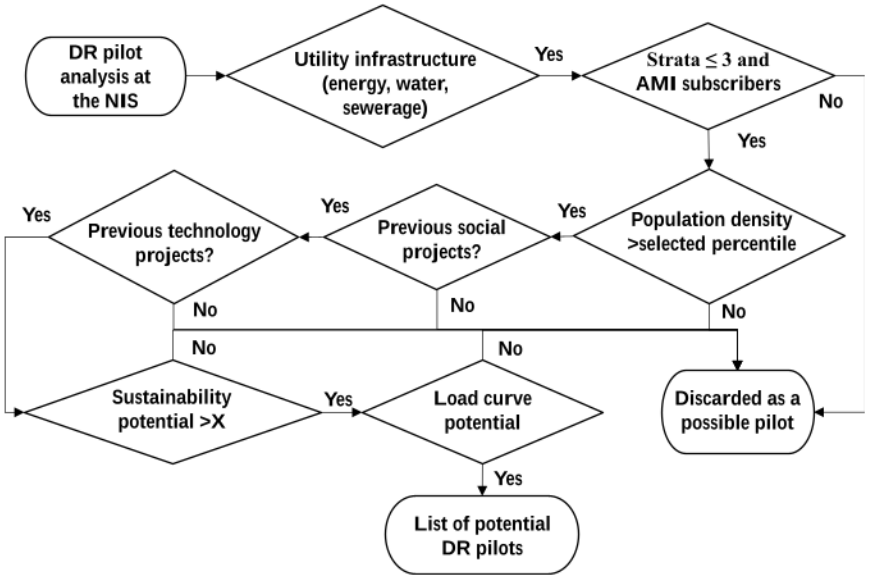
Experiences:

1. **Increased demand**
2. **Reliability risk in power supply**
3. **AMI pilot**

Experiences:

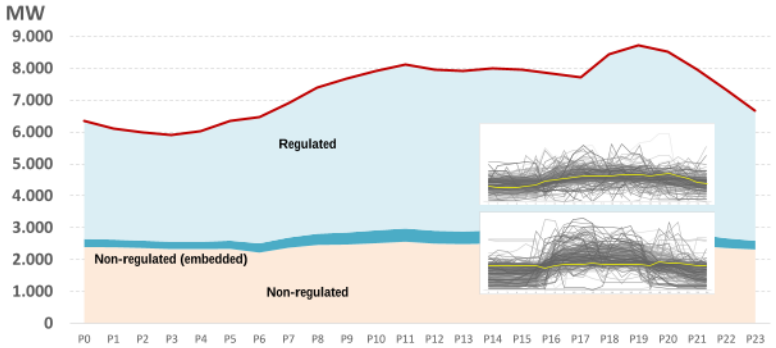
1. **Load management services**
2. **AMI implementation**
3. **User knowledge projects**

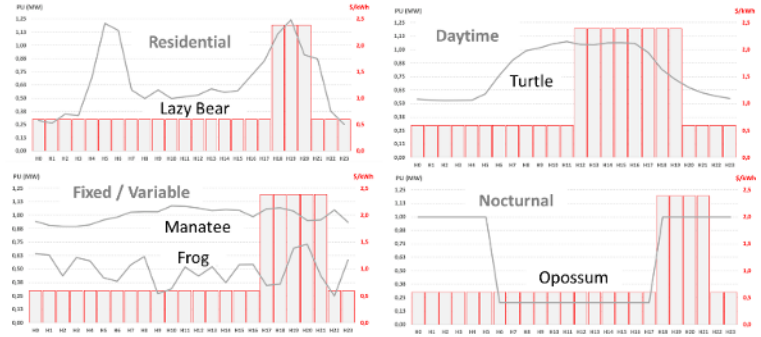
Analysis of the pilot location of the DR program



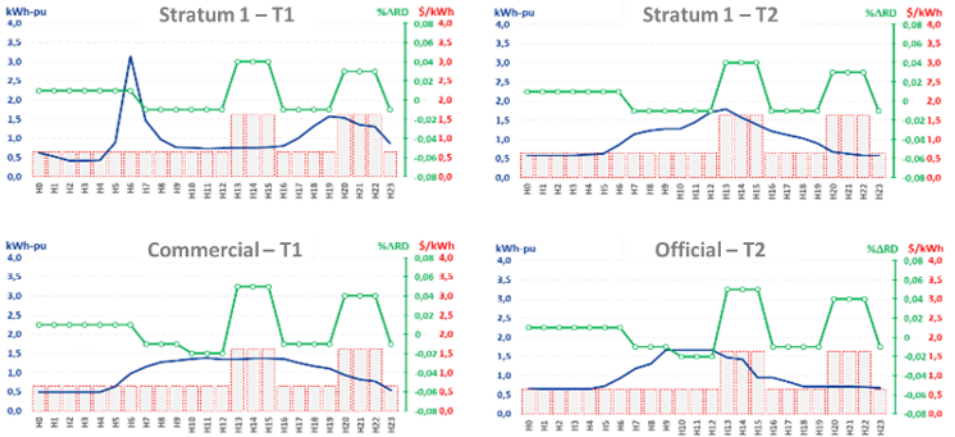
IV. Study case

Main consumption profiles in Colombia





Relationships between consumption, tariff, and Delta DR

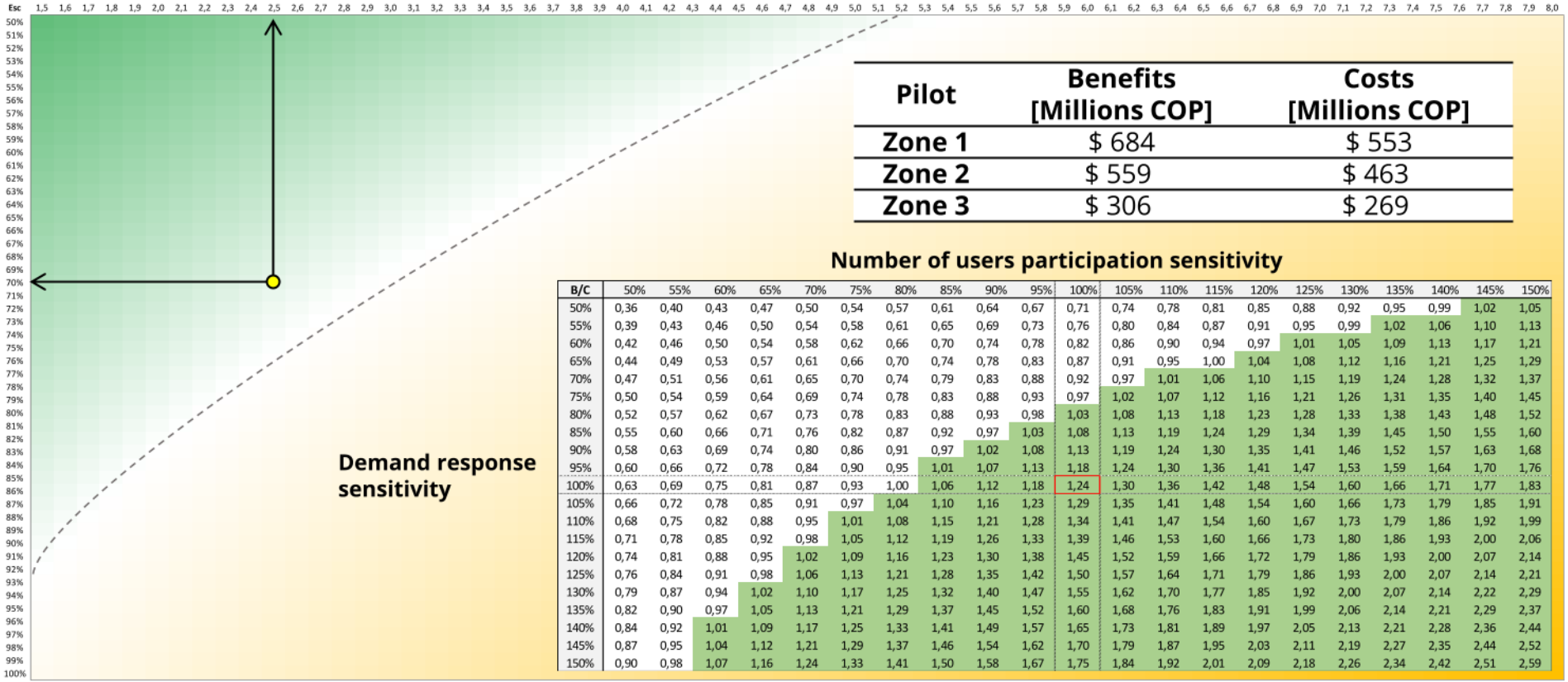


IV. Study case

Type	Benefit [unit] & Economic valuation
Technical	Decrease in the duration of interruptions [min-year]
	Decrease in the number of interruptions [times/year]
	Decrease in consumption during peak hours [GWh]
	Decrease in energy losses [GWh]
Economic - Financial	Incentive payments -Reduction- [GWh]
	Incentive payments -Displacement- [GWh]
	Decrease in subsidies -Reduction and displacement-[GWh]
	Bill savings -Expenses avoided-[GWh]
	Decrease in system operating costs [GWh]
Environmental	Mitigation of GHG emissions [tCO2e]
	Decrease in fuel consumption [GWh]

CAPEX + OPEX
Telecommunication equipment and data plan
Information platform - desktop/mobile -
DR Program Management - DR Team
Communication and training plan
Monitoring plan
Incentives
DR program total cost

IV. Study case



Pilot	Benefits [Millions COP]	Costs [Millions COP]
Zone 1	$ 684	$ 553
Zone 2	$ 559	$ 463
Zone 3	$ 306	$ 269

Demand response sensitivity

Number of users participation sensitivity

B/C	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%	105%	110%	115%	120%	125%	130%	135%	140%	145%	150%
50%	0,36	0,40	0,43	0,47	0,50	0,54	0,57	0,61	0,64	0,67	0,71	0,74	0,78	0,81	0,85	0,88	0,92	0,95	0,99	1,02	1,05
55%	0,39	0,43	0,46	0,50	0,54	0,58	0,61	0,65	0,69	0,73	0,76	0,80	0,84	0,87	0,91	0,95	0,99	1,02	1,06	1,10	1,13
60%	0,42	0,46	0,50	0,54	0,58	0,62	0,66	0,70	0,74	0,78	0,82	0,86	0,90	0,94	0,97	1,01	1,05	1,09	1,13	1,17	1,21
65%	0,44	0,49	0,53	0,57	0,61	0,66	0,70	0,74	0,78	0,83	0,87	0,91	0,95	1,00	1,04	1,08	1,12	1,16	1,21	1,25	1,29
70%	0,47	0,51	0,56	0,61	0,65	0,70	0,74	0,79	0,83	0,88	0,92	0,97	1,01	1,06	1,10	1,15	1,19	1,24	1,28	1,32	1,37
75%	0,50	0,54	0,59	0,64	0,69	0,74	0,78	0,83	0,88	0,93	0,97	1,02	1,07	1,12	1,16	1,21	1,26	1,31	1,35	1,40	1,45
80%	0,52	0,57	0,62	0,67	0,73	0,78	0,83	0,88	0,93	0,98	1,03	1,08	1,13	1,18	1,23	1,28	1,33	1,38	1,43	1,48	1,52
85%	0,55	0,60	0,66	0,71	0,76	0,82	0,87	0,92	0,97	1,03	1,08	1,13	1,19	1,24	1,29	1,34	1,39	1,45	1,50	1,55	1,60
90%	0,58	0,63	0,69	0,74	0,80	0,86	0,91	0,97	1,02	1,08	1,13	1,19	1,24	1,30	1,35	1,41	1,46	1,52	1,57	1,63	1,68
95%	0,60	0,66	0,72	0,78	0,84	0,90	0,95	1,01	1,07	1,13	1,18	1,24	1,30	1,36	1,41	1,47	1,53	1,59	1,64	1,70	1,76
100%	0,63	0,69	0,75	0,81	0,87	0,93	1,00	1,06	1,12	1,18	1,24	1,30	1,36	1,42	1,48	1,54	1,60	1,66	1,71	1,77	1,83
105%	0,66	0,72	0,78	0,85	0,91	0,97	1,04	1,10	1,16	1,23	1,29	1,35	1,41	1,48	1,54	1,60	1,66	1,73	1,79	1,85	1,91
110%	0,68	0,75	0,82	0,88	0,95	1,01	1,08	1,15	1,21	1,28	1,34	1,41	1,47	1,54	1,60	1,67	1,73	1,79	1,86	1,92	1,99
115%	0,71	0,78	0,85	0,92	0,98	1,05	1,12	1,19	1,26	1,33	1,39	1,46	1,53	1,60	1,66	1,73	1,80	1,86	1,93	2,00	2,06
120%	0,74	0,81	0,88	0,95	1,02	1,09	1,16	1,23	1,30	1,38	1,45	1,52	1,59	1,66	1,72	1,79	1,86	1,93	2,00	2,07	2,14
125%	0,76	0,84	0,91	0,98	1,06	1,13	1,21	1,28	1,35	1,42	1,50	1,57	1,64	1,71	1,79	1,86	1,93	2,00	2,07	2,14	2,21
130%	0,79	0,87	0,94	1,02	1,10	1,17	1,25	1,32	1,40	1,47	1,55	1,62	1,70	1,77	1,85	1,92	2,00	2,07	2,14	2,22	2,29
135%	0,82	0,90	0,97	1,05	1,13	1,21	1,29	1,37	1,45	1,52	1,60	1,68	1,76	1,83	1,91	1,99	2,06	2,14	2,21	2,29	2,37
140%	0,84	0,92	1,01	1,09	1,17	1,25	1,33	1,41	1,49	1,57	1,65	1,73	1,81	1,89	1,97	2,05	2,13	2,21	2,28	2,36	2,44
145%	0,87	0,95	1,04	1,12	1,21	1,29	1,37	1,46	1,54	1,62	1,70	1,79	1,87	1,95	2,03	2,11	2,19	2,27	2,35	2,44	2,52
150%	0,90	0,98	1,07	1,16	1,24	1,33	1,41	1,50	1,58	1,67	1,75	1,84	1,92	2,01	2,09	2,18	2,26	2,34	2,42	2,51	2,59

V. Recommendations

- Aspects such as willingness to change, price-demand elasticity, and impact of price variations must be evaluated in the execution of the pilot.
- Mechanisms that encourage the active participation of users in DR programs must be deepen considering aspects such as knowledge of preferences related to DR programs, identification, segmentation, and the type and quality of the information transmitted.
- The promotion strategies of DR programs must allow for continuous interaction between the users and the company offering the program.
- The selection of the strategy must be based on the characterization and segmentation of the users
- The consumption baseline must be constructed considering quality, accuracy, completeness, simplicity, and alignment.
- The stakeholders involved in the development of the pilot must be defined.
- The simulation of the DR pilot evidenced the potential for energy reduction and displacement in different time bands for each zone. This allows determining the assessment of the benefits from a technical, financial, and environmental point of view.

ACKNOWLEDGMENT

The authors would like to acknowledge the framework project of the Comprehensive Plan for Climate Change Management of the mining and energy sector (PIGCCme) developed by the Ministry of Mines and Energy with the support of the Research Center for Tropical Agriculture.

The authors would also like to thank the companies and member entities of the Colombia Inteligente collaborative network (Demand Response Task Force).

Q&A