ISSN 1808-057X
DOI: 10.1590/1808-057x20211503.en

ORIGINAL ARTICLE

Performance measurement systems, environmental satisfaction, and green work engagement*,**

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Received on 07.14.2021 – Desk acceptance on 08.04.2021 – 3rd version approved on 11.19.2021
Editor-in-Chief: Fábio Frezatti
Associate Editor: Cláudio de Araújo Wanderley

ABSTRACT

The aim of this article was to analyze the effects of the (diagnostic, interactive, and combined) use of performance measurement systems (PMS) on environmental satisfaction and the reflections of that on employees' green work engagement. Studies on management control systems (MCS) and environmental results have prioritized organizational variables, such as sustainable/environmental development. Efforts directed toward MCS to foster employees' green behaviors are limited. There is also a call for studies that indicate the interdependence of controls associated with performance, innovation, or other variables in which the environmental context is less contemplated. Employees' engagement is fundamental for organizations to achieve a higher sustainability level. Hence, the study explores employees' perceptions about how the organization investigated uses one management control (PMS) to promote the congruence of organizational and individual objectives within the context of environmental sustainability. The literature is concerned about understanding the role of MCS in green behaviors and results. Most of the studies focus on organizational results such as performance, with little evidence for employees' satisfaction or engagement. Similarly, there is a growing demand to explore MCS interdependence for contexts that go beyond innovation or performance. A single entity survey was conducted in a private Brazilian company from the electric power generation sector, resulting in a sample of 101 employees. For the data analysis, partial least squares structural equation modeling and fuzzy-set qualitative comparative analysis were used. The (diagnostic, interactive, and combined) use of PMS positively influences environmental satisfaction and that supports green work engagement. Environmental satisfaction promotes full mediations between the (diagnostic and interactive) use of PMS and green work engagement. Various combinations of conditions lead to high environmental satisfaction and to high green work engagement.

Keywords: performance measurement systems (PMS), environmental satisfaction, green work engagement, sustainability, management control systems (MCS).

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*Article presented at the XVIII International Congress of Accounting and Auditing (CICA), Lisbon, Portugal, October of 2021.

**The authors are grateful to the Coordination for the Improvement of Higher Education Personnel (Capes) for its financial support in conducting this research.

1. INTRODUCTION

In the literature on management control systems (MCS), an emerging portion emphasizes the concern about sustainable, environmental, and green results (Heggen & Sridharan, 2021; Henri & Journeault, 2010; Rehman et al., 2021; Wijethilake, 2017). Among the MCS, one that has been receiving attention is performance measurement systems (PMS), which consist of a wide range of financial and non-financial metrics (Bedford et al., 2019). PMS can be used to convey sustainable and green objectives to enable a common vision for all organizational actors (Hristov et al., 2021; Lisi, 2015). For this communication of organizational strategies and goals to the employees, the management can use PMS diagnostically or interactively (Henri, 2006). The diagnostic use focuses on monitoring and accompanying the achievement of goals, while the interactive use seeks to stimulate learning and attention (Simons, 1995).

The diagnostic or interactive use of PMS can also occur through the mutual and dependent combination of these controls, called interdependence (Choi, 2020; Grabner & Moers, 2013). Basically, the interdependence of the controls can lead to complementary (compensating, reinforcing, or enabling) or substitutionary (inhibiting, exacerbating, or instigating) effects, intensifying or modifying the effect of the controls on the achievement of some organizational objective (Grabner & Moers, 2013; Bedford, 2020). By considering the strategic objectives related to sustainability, and considering that the literature on diagnostic and interactive uses of PMS suggests that this combination generates a complementary effect (Henri, 2006; Müller-Stewens et al., 2020), it is speculated that the combination of the interactive and diagnostic use of PMS can drive (reinforce) employees' environmental satisfaction and reflect on green work engagement, as according to the research gaps that follow.

First, satisfaction with organizational environmental engagement potentially leads employees to higher levels of green work engagement (Côté et al., 2021; Rayton & Yalabik, 2014); that is, the inspiration, pride, immersion, enthusiasm, happiness, and energy of employees to carry out environment-related tasks (Aboramadan, forthcoming). The PMS literature traditionally highlights positive effects on job satisfaction (Franco-Santos et al., 2012; Souza & Beuren, 2018) and work engagement (Awan et al., 2020), but less is known for the environmental context. Along general lines, the evidence suggests that using PMS can promote environmental satisfaction (Hristov et al. 2021; Lisi, 2015; Paillé et al., 2020) and result in green work engagement (Aboramadan, forthcoming; Bhutto et al., 2021; Çop et al., 2021); that is, environmental satisfaction can potentially play a mediating role.

Second, MCS studies and environmental results have prioritized organizational variables, such as sustainable or environmental performance (Heggen & Sridharan, 2021; Henri & Journeault, 2010; Rehman et al., 2021; Wijethilake, 2017). Efforts directed toward MCS to foster environmental and green behaviors in employees are more limited, as observed in the studies of Rötzel et al. (2019), which analyze environmental MCS as an antecedent of individual managerial performance in relation to environmental results, and of Aguiar (2020), who explores the pro-environmental values statement (informal control) as an antecedent of individuals' pro-environmental behavior. However, evidence of MCS with satisfaction and engagement in the environmental and green context is more limited.

Third, Bedford (2020) explains that new research on the interdependence and complementarity between management controls is relevant for broadening the empirical knowledge on the theme. In light of that, there is a call for studies that indicate the interdependence of controls associated with performance (Henri, 2006; Kreutzer et al., 2016; Ylinen & Gullkvist, 2014), innovation (Henri & Wouters, 2020; Müller-Stewens et al., 2020), or management control effectiveness (Bedford et al., 2016), in which the environmental context is less contemplated (Heggen & Sridharan, 2021) and requires more evidence.

In light of the gaps presented, this study aims to analyze the effects of the (diagnostic, interactive, and combined) use of PMS on environmental satisfaction and the reflections of that on employees' green work engagement. Besides the need for a greater understanding of the result of MCS use on organizations' sustainable and green results (Heggen & Sridharan, 2021) and the effects of control combination (Bedford et al., 2016; Henri & Wouters, 2020; Kreutzer et al., 2016; Müller-Stewens et al., 2020; Ylinen & Gullkvist, 2012, 2014), this research is warranted for the lens attributed (the employees' individual perception). Their engagement is fundamental so the organization can achieve a greater level of sustainability (Paillé et al., 2016). Thus, the study explores employees' perceptions, so that management can choose the (diagnostic, interactive, or combined) use of PMS to achieve sustainable objectives.

To enable the study, a single entity survey was conducted in a private company from the electric power

sector, resulting in a sample of 101 middle and lower level managers. The choice of company is warranted for its participation in the Corporate Sustainability Index (ISE) of the *B3* S.A. – *Brasil, Bolsa e Balcão* (B3) exchange and in sustainability and clean energy generation rankings. The survey inquired about the extent of (diagnostic and interactive) PMS use, environmental satisfaction, and the green work engagement perceived by the employees. For the data analysis, mixed methods analyses were employed: partial least squares structural equation modeling (PLS-SEM) and fuzzy set qualitative comparative analysis (fsQCA). While PLS-SEM is used to test the hypotheses, fsQCA is used in a complementary way.

The contributions of the research encompass the theoretical field and organizational practice. Within the theoretical context, there are three main implications. The first derives from exploring the role of MCS in individual sustainable behaviors (Aguiar, 2020; Rötzel et al., 2019) instead of organizational ones (Heggen & Sridharan, 2021; Henri & Journeault, 2010; Rehman et al., 2021; Wijethilake, 2017), thus aggregating evidence on MCS use to direct employees' sustainable environmental behaviors. Second, it contributes by exploring MCS interdependence exclusively in sustainable contexts (Heggen & Sridharan, 2021), as opposed to innovation and performance results (Henri, 2006; Henri & Wouters, 2020; Kreutzer et al., 2016; Müller-Stewens et al., 2020; Ylinen & Gullkvist, 2014). This answers the recent call from Bedford (2020) to explain the interdependence and combination of management controls under new circumstances. In addition, it aggregates evidence regarding fsQCA use to find combinations of equally effective management controls for certain outputs (Bedford et al., 2016; Cruz et al., 2022; Einhorn et al., 2021; Frare et al., forthcoming). Finally, it contributes by exploring antecedents of environmental satisfaction and green work engagement (Aboramadan, forthcoming; Bhutto et al., 2021; Çop et al., 2021), especially regarding how management can use management controls to achieve these aims.

For organizational practice, the study adds evidence and offers insights for managers and employees concerning how the MCS used by the former lead the latter to sustainable attitudes and promote congruence between organizational and individual objectives. In general, the research findings indicate that if the company intends to stimulate these environmental behaviors (environmental satisfaction and green work engagement) in its employees, it needs to use performance measures to accompany progress toward the goals, monitor the results, compare them with expectations (diagnostic use), and, at the same time, facilitate the discussion among superiors, subordinates, and peers, provide a common vision, and enable all to focus on common problems and critical factors for success (interactive use).

2. THEORETICAL FRAMEWORK AND HYPOTHESES

2.1 PMS Use and Environmental Satisfaction

PMS represent one of the MCS used by organizations to convey goals and objectives to employees (Ferreira & Otley, 2009; Henri, 2006). PMS can be used diagnostically or interactively, where the former is represented by feedback and reviewing critical points in the implementation of the defined strategy and the latter is represented by stimulating dialogue and learning, disseminating knowledge and fostering the collaboration of all with the organization's strategic priorities (Henri, 2006; Simons, 1995). PMS are used to quantify the efficiency and effectiveness of actions (Neely et al., 1995) and include measures that are "financial or non-financial, internal or external, short or long term as well as *ex post* or *ex ante*" (Henri, 2006, p. 533). There can be various beneficial effects of PMS, such as promoting job satisfaction (Lau & Sholihin, 2005; Souza & Beuren, 2018), but in environmental contexts the evidence is more limited.

Employees' environmental satisfaction is defined as the way they feel in relation to the organization's environmental engagement and how much this meets their expectations. The absence of environmental satisfaction can lead to employees ignoring green attitudes, such as the efficient use of resources and the search to solve environmental issues (De Young, 2000; Paillé et al., 2020; Pelletier et al., 1996). Assuming that satisfaction is related to performance, peer support, and commitment (Paillé et al., 2016), greater environmental satisfaction can result in better environmental performance on the part of employees; and organizations with more satisfied employees tend to present greater engagement as a whole (Hicklenton et al., 2019). In summary, environmental performance promotes a mood among employees that favors green decisions; that is, satisfied individuals tend to pay greater attention to their environmental responsibilities within the organization (Amrutha & Geetha, 2021; Kim et al., 2019). Therefore, understanding

how MCS can promote environmental satisfaction appears to be appropriate for better explaining that phenomenon.

Evidence suggests that the interactive use of ecocontrols positively influences environmental performance, but that this does not occur with the diagnostic use, which may require an association with other elements of the organization's MCS to result in better green performance (Heggen & Sridharan, 2021). Thus, PMS can potentially convey environmental strategies and goals to employees (Hristov et al., 2021; Lisi, 2015), which tends to be beneficial for their environmental satisfaction. Environmental satisfaction significantly increases employees' voluntary environmental behavior in the workplace (Amrutha & Geetha, 2021), which highlights the role of understanding its antecedents. Considering the relevance of environmental satisfaction for achieving the green performance expected by the organization, and the (interactive or diagnostic) role of PMS in communicating strategic objectives regarding environmental questions to employees, it is assumed that:

> H_{1a-b}: the diagnostic (H_{1a}) and interactive (H_{1b}) use of PMS have a positive direct effect on environmental satisfaction.

MCS do not operate in isolation (Malmi & Brown, 2008); they interact with other factors that permeate organizations and, in some cases, the use of two or more MCS can dependently and mutually combine, which is called interdependence (Choi, 2020; Grabner & Moers, 2013). This combined effect can be complementary (it compensates, reinforces, or enables) or substitutionary (it inhibits, exacerbates, or instigates) (Bedford, 2020). According to the literature on diagnostic and interactive uses of control (Henri, 2006; Müller-Stewens et al., 2020), in this case the interdependent effects tend to complement each other, reinforcing both uses of PMS; that is, in isolation they present positive effects for certain control problems and, combined, they resolve this or that problem even more effectiveness (Bedford, 2020). The combined use of diagnostic and interactive PMS can create a beneficial interaction that adds to the action of each one, improving the individual effects through dialogue and feedback regarding strategic questions (Grabner & Moers, 2013; Henri, 2006; Müller-Stewens et al., 2020). Henri (2006) labels the result of the combination of the diagnostic and interactive uses as "dynamic tension," while, more recently, Müller-Stewens et al. (2020) refer to it as a "control combination," considering that both can (individually and jointly) drive certain behaviors (Simons, 1995).

The literature on the interaction between different forms of control suggests that it is possible to create interdependent effects, whether these controls are mechanistic or organic (Ylinen & Gullkvist, 2012, 2014), formal or informal (Kreutzer et al., 2016), interactive or diagnostic (Müller-Stewens et al., 2020), or interactive, diagnostic, and enabling (Heggen & Sridharan, 2021). The effects of the interdependence between controls are not yet conclusive and may be related to other factors, such as to the level of environmental uncertainty faced by the organization (Henri & Wouters, 2020). Despite it not being new in the literature that the forms of control can affect each other and modify the transfer of the organizational strategy to the employees (Otley, 1980; Speklé & Widener, 2020), studies on the combination of MCS can be observed, where the synergy between the different controls may be more beneficial than their individual use, especially surveys, which can provide a better understanding of the effects of that combination (Speklé & Widener, 2020). Based on evidence that the interdependence between controls can be beneficial including for sustainable outputs (Heggen & Sridharan, 2021), it is proposed that:

> H_2: the combination of diagnostic and interactive uses of PMS controls has a positive direct effect on environmental satisfaction.

2.2 PMS Use, Environmental Satisfaction, and Green Work Engagement

The literature indicates that employees' satisfaction with certain work conditions is positively associated with their work engagement (Côté et al., 2021; Rayton & Yalabik, 2014). Work engagement consists of "a positive, fulfilling, work related state of mind that is characterized by vigor, dedication, and absorption" (Schaufeli et al., 2002, p. 74). Green work engagement, in turn, is defined by the energy the employee uses in their tasks/activities related to green work, in which they are willing to exert efforts within that context (Aboramadan, forthcoming). Along general lines, green work engagement permeates employees' inspiration, pride, immersion, enthusiasm, happiness, and energy for carrying out environment-related tasks (Aboramadan, forthcoming). Consequently, green work engagement is crucial for maintaining a positive state of mind among employees, with regard to the constant execution of tasks focused on the environment (Çop et al., 2021).

Despite the discussion of the association between satisfaction and engagement at work, for the environmental and green context the evidence is more limited. Individuals' pro-environmental behaviors are commonly instigated by their satisfaction with the environmental conditions

enabled and perceived within the context they are part of (Pelletier et al., 1996), even within the context of the organizations in which they work (Paillé et al., 2020). Thus, satisfaction with organizational environmental engagement can potentially lead to positive green behaviors by employees (Paillé et al., 2020), where the study speculates on the particular effect of that environmental satisfaction on green work engagement. As employees perceive and feel satisfied with the organization's pro-environmental efforts (Paillé et al., 2020), their inspiration, pride, immersion, enthusiasm, happiness, and energy to carry out environmental tasks can be increased (Aboramadan, forthcoming). Thus, it is expected that:

> H_3: environmental satisfaction is positively associated with green work engagement.

Satisfaction with organizational environmental engagement can have beneficial effects on the relationship between the perception of organizational support for the environment and positive environmental results by the employees (Paillé et al., 2020). Forms of management for the environmental context may be a relevant antecedent of green work engagement (Aboramadan, forthcoming). MCS such as the pro-environmental values statement can lead individuals to carry out actions that foster environmental sustainability (Aguiar, 2020). Employees who perceive green organizational policies and guidelines that support the execution of environmental tasks tend to engage more in green work, aiming to reduce possible negative ecological impacts and acting in a socially responsible way (Bhutto et al., 2021). It is thus presumed that the (diagnostic and interactive) use of PMS, besides influencing satisfaction with the organization's environmental engagement, exerts an indirect effect on green work engagement, through environmental satisfaction. The proposition is aligned with the literature that proposes that MCS promote sustainable and green results and feature as a recent and pertinent demand (Heggen & Sridharan, 2021; Henri & Journeault, 2010; Rehman et al., 2021; Wijethilake, 2017).

The evidence from the literature suggests that PMS use can positively influence employees' satisfaction (Franco-Santos et al., 2012; Souza & Beuren, 2018), as well as being beneficial for work engagement (Awan et al., 2020). Despite the literature in the environmental context lacking empirical evidence, it is hoped that the logic shown is perpetuated. Along these lines, it is argued that the ways the organization accompanies, monitors, reviews (diagnostic use), enables, and discusses (interactive use) the performance measures (Henri, 2006) can convey the environmental strategies to the employees (Hristov et al., 2021; Lisi, 2015), which enables an increase in satisfaction with organizational environmental commitment (Paillé et al., 2020) and, through that environmental satisfaction, a reflection on green work engagement (Aboramadan, forthcoming). Thus, it is proposed that:

> $H_{4a\text{-}b}$: the diagnostic (H_{4a}) and interactive (H_{4b}) uses of PMS have a positive indirect effect on green work engagement through environmental satisfaction.

Figure 1 presents the conceptual model and the relationships proposed in the research hypotheses.

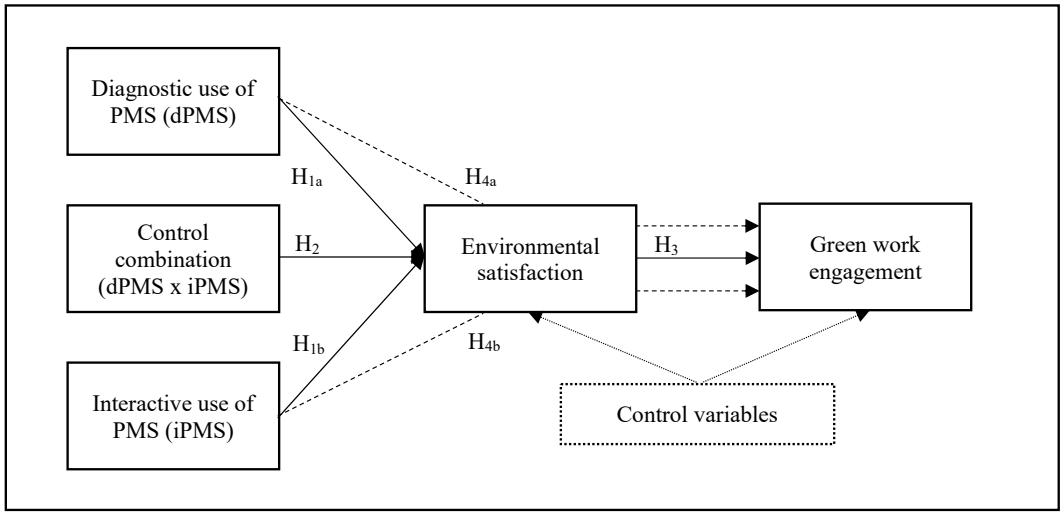

Figure 1 *Conceptual model*
Note: *The control variables are age, gender, time in the company, and position.*
PMS = performance measurement systems.
Source: *Elaborated by the authors.*

3. METHODOLOGICAL PROCEDURES

3.1 Population and Sample

A single entity survey was conducted in a private company that operates in the Brazilian electric power generation sector. The use of this method derives from the relevance of research that explores a particular organizational context in depth, enabling an understanding of the phenomena and beliefs reflected on the various areas and on the organization as a whole (Almeida et al., 2021; Cruz et al., 2022; Frare & Beuren, 2020; Mucci et al., 2016). The company considered in the study is multinational and has operated in Brazil for at least 20 years. It is considered large-sized, it has more than 60 power stations in the country, and, in 2020, it presented a net operating profit of more than R$ 12 billion. In addition, it has various initiatives related to the environment and social responsibility, as well as being listed in sustainability indices and rankings (ISE of the B3, Clean200, and Latin Trade IndexAmericas), which corroborates its suitability for achieving the study's objectives.

The data collection was authorized by the people and culture management area of the company in question, which, after two meetings with one of the researchers, provided a non-public dataset with the names and emails of 373 employees of the Brazilian headquarters of the organization who work in middle- and lower-level roles (managers, coordinators, and analysts) in managerial career positions, all eligible for the company's PMS. Despite PMS generally being developed and used by top managers, exploring how they are used and conveyed in the middle- and lower-level managers' perception is relevant for understanding the effects over the public the actual goal is to reach (Baird et al., forthcoming). The contact via email was made with all 373 employees through a letter presenting the research, as well as the link to access the online survey. The collection was cross-sectional, covering the first two months of 2021. It warrants mentioning that a batch of reminders of the research was sent 15 days after the first contact. The collection resulted in 101 respondents, among which most carry out the role of analyst (59), are men (56), are older than 35 (57), and have worked in the company for more than five years (60).

3.2 Research Variables

All the research constructs are based on the previous literature and the items were measured on a seven-point Likert-type scale. The complete research instrument can be consulted in Appendix A. The (diagnostic and interactive) use of PMS (independent variable) was measured based on four and seven items, respectively, taken from Henri (2006). The respondents were invited to evaluate how much (1 = not at all and 7 = to a great extent) the company's management currently uses performance measures for items such as "track progress towards goals" and "monitor results" (diagnostic use) and "enable discussion in meetings of superiors, subordinates and peers" and "enable the organization to focus on critical success factors" (interactive use).

Environmental satisfaction (mediating variable) was measured based on four items taken from Paillé et al. (2020), who adapted them from Pelletier et al. (1996). Paillé et al. (2020) made alterations in the original environmental satisfaction scale (Pelletier et al., 1996) for the context of employees' environmental satisfaction with organizational environmental commitment. The measurement of the items consists of a scale of agreement (1 = totally disagree and 7 = totally agree) in questions such as "in my opinion, the amount of attention given to the environment by my employer has been satisfactory" and "the employer policies developed to deal with the environment are excellent."

Green work engagement (dependent variable) was measured based on six items taken from Aboramadan (forthcoming), who adapted them from the scale of Schaufeli et al. (2006). Aboramadan (forthcoming) made modifications in the original work engagement scale (Schaufeli et al., 2006) for the context of green work engagement. The items were measured on a scale of agreement (1 = totally disagree and 7 = totally agree), with questions such as "my environmental-related tasks inspire me" and "with environmental tasks at my job, I feel bursting with energy." In the organization in question, examples of environmental tasks are recycling and organic waste reuse practices, developing environmental reports, and discussing and proposing environmental strategies.

Besides the constructs based on multi-items, the study uses four control variables in the conceptual model. The binary-type variables were controlled: age of the individual (0 = up to 35; 1 = 36 or over); gender (0 = male; 1 = female); and time working in the company (0 = up to five years; 1 = six years or more). These variables are commonly controlled in studies within the context of individuals' sustainable behaviors (Li et al., 2020; Zhang et al., 2020),

for which reason they were included as control variables. The variable referring to position (0 = analysts and 1 = managers/coordinators) was also controlled to determine whether there is homogeneity in the perceptions of the respondents from different levels/roles, since they all work in managerial career roles at the middle or lower levels.

3.3 Data Analysis Procedures

The hypotheses of the study were tested based on PLS-SEM, in the SmartPLS software. PLS-SEM is largely employed in research in the management and business area (Hair et al., 2019), primarily as it does not require normal data, it enables complex modeling, and it is compatible with a small *n* (Hair et al., 2017). Applying this technique involves two main stages of evaluation: (i) measurement model; and (ii) structural model (Hair et al., 2017, 2019). To evaluate the statistical adequacy in relation to the *n* (101), the sample power test was conducted in the G*Power 3 software, in which, with the effect size of 0.15, α *prob err* of 0.05, and power (1-β *prob err*) of 0.80, the sample is shown to be adequate for our modeling.

In addition to the employment of PLS-SEM, the study uses fsQCA, in the fsQCA 3 software. fsQCA permeates an asymmetrical approach that enables the researcher to understand which conditions are necessary or which combination of conditions is sufficient for a particular outcome to occur (Ragin, 2008). fsQCA provides a holistic and complex overview of the investigated phenomena, helping to understand the configurations among the elements that can provide the same outcome (equifinality) (Fiss, 2011). The literature reveals benefits for a more holistic vision of the theme studied through the combined use of PLS-SEM and fsQCA (e.g. Frare & Beuren, 2020, 2021; Rasoolimanesh et al., 2021) even in the context of management, business, and sustainability (e.g. Latif et al., 2020; Shahzad et al., 2020).

The use of fsQCA enables us to explore possible combinations between management controls that are equally effective for a particular objective, proving to be a valid supplement for regression-based techniques (Bedford et al., 2016; Bedford, 2020; Cruz et al., 2022; Frare et al., forthcoming). For example, while regression-based techniques enable it to be highlighted whether the combination (interaction effect) between the diagnostic use and interactive use of controls is significantly associated with a particular outcome (e.g. Müller-Stewens et al., 2020), fsQCA enables us to find equally effective solutions for that outcome derived from the diagnostic use and interactive use of controls, together with more analyzed conditions (e.g. Einhorn et al., 2021). Therefore, the main purpose of employing fsQCA in this study is to understand whether combinations between the diagnostic use and interactive use of PMS are sufficient to promote high environmental satisfaction and whether combinations of these three conditions promote high green work engagement, considering the employees' characteristics (age, gender, and time in the company) that are relevant for that context (Li et al., 2020; Zhang et al., 2020).

4. DATA ANALYSIS

4.1 PLS-SEM Analysis

The study's measurement model contains a reflexive logic regarding the composition of the constructs. To address the interaction/combination of controls (diagnostic use and interactive use of PMS), a product term with a centered mean is employed (Henri, 2006; Müller-Stewens et al., 2020). In the model, the factorial loads, internal consistency reliability, convergent validity, and discriminant validity are evaluated (Hair et al., 2019), as highlighted in Table 1.

Table 1
Measurement model

Panel A – Descriptive statistics, internal consistency, and convergent validity									
	Mean	**SD**	**Factorial loads**	**α**	**rho_A**	**CR**	**AVE**		
1. Diagnostic use of PMS	6.092	1.120	[0.894; 0.965]	0.951	0.952	0.965	0.873		
2. Interactive use of PMS	5.537	1.208	[0.745; 0.898]	0.924	0.932	0.938	0.686		
3. Environmental satisfaction	5.750	1.040	[0.730; 0.927]	0.867	0.878	0.911	0.719		
4. Green work engagement	4.678	1.619	[0.863; 0.945]	0.953	0.963	0.962	0.809		
Panel B – Discriminant validity: Fornell-Larcker/HTMT									
	1	2	3	4	5	6	7	8	9
1. Diagnostic use of PMS	**0.935**	0.646	0.541	0.166	0.482	0.049	0.017	0.128	0.259
2. Interactive use of PMS	0.604	**0.828**	0.567	0.352	0.465	0.061	0.076	0.173	0.304
3. Environmental satisfaction	0.497	0.522	**0.848**	0.462	0.117	0.121	0.124	0.142	0.303
4. Green work engagement	0.160	0.339	0.431	**0.899**	0.216	0.118	0.052	0.078	0.146
5. Control combination	-0.469	-0.444	-0.112	-0.206	–	0.059	0.112	0.026	0.122
6. Age	0.048	0.053	0.115	0.113	0.059	–	0.026	0.372	0.215
7. Gender	0.003	0.031	-0.100	0.027	0.112	-0.026	–	0.121	0.124
8. Time in the company	0.125	0.167	0.138	0.082	-0.026	0.372	-0.121	–	0.370
9. Position	0.254	0.291	0.286	0.148	-0.122	0.215	-0.124	0.370	–

Note: *In Panel B, the values in bold on the diagonal are the square root of the average variance extracted (AVE), the values on the diagonal below are the correlations according to the Fornell-Larcker criterion, and the values on the diagonal above are the heterotrait-monotrait ratio of correlations values (HTMT).*
CR = composite reliability; SD = standard deviation; PMS = performance measurement systems.
Source: *Elaborated by the authors.*

The measurement model appears to be adequate, as the factorial loads are higher than or equal to 0.708, the internal consistency assumptions – Cronbach's alpha (α), rho_A, and composite reliability (CR) – have values above 0.70, the convergent validity – average variance extracted (AVE) – has values above 0.50, and the discriminant validity meets the Fornell-Larcker and heterotrait-monotrait ratio of correlations (HTMT) criteria (Hair et al., 2017, 2019). The Fornell-Larcker criterion establishes that the square root of the AVE should be higher than the correlations with the other constructs (Hair et al., 2017), while the HTMT criterion presupposes values lower than 0.90 (Hair et al., 2019).

In the study, two analyses are employed to determine the quality of the survey conducted. Harman's single factor test was conducted to ascertain possible problems regarding common method bias derived from applying self-administered questionnaires (Podsakoff et al., 2003). This test resulted in four factors that account for 78.28% of the total variance of the model, the first of which represents 43.24% of the total variance and therefore does not represent a problem as the value is below 50%. We also evaluated the existence of possible problems regarding non-response bias, which consists of possible distortions of profiles and perceptions among respondents and non-respondents (Armstrong & Overton, 1977). As the characteristics of the non-respondents are unknown, the study compares the first 10 and last 10. After conducting the test of means among all the items, an absence of differences is verified between the first and last respondents (lowest p value = 0.112).

The structural model was evaluated regarding the possible multicollinearity between the independent variables, explained variance of the endogenous variables, and predictive accuracy (Hair et al., 2017, 2019). Table 2 also presents the path analysis relationships.

Table 2
Structural model

Panel A – Path analysis				
Relationship	**Beta (β)**	***t*-statistic**	***p*-value**	**Decision**
Direct effects				
dPMS → ES	0.352	3.502	0.000***	H_{1a} accepted
iPMS → ES	0.401	3.697	0.000***	H_{1b} accepted
Combination of controls → ES	0.131	1.843	0.065*	H_2 accepted
ES → GWE	0.396	3.598	0.000***	H_3 accepted
Mediation effects				
dPMS → GWE	-0.185	1.349	0.178	H_{4a} accepted
dPMS → ES → GWE	0.139	2.531	0.011**	
iPMS → GWE	0.238	1.563	0.118	H_{4b} accepted
iPMS → ES → GWE	0.159	2.798	0.005***	
Control variables				
Age → ES	0.052	0.569	0.569	
Age → GWE	0.067	0.712	0.467	
Gender → ES	-0.133	1.567	0.117	
Gender → GWE	0.061	0.614	0.540	
Time in the company → ES	-0.038	0.368	0.713	
Time in the company → GWE	-0.010	0.101	0.919	
Position → ES	0.097	1.059	0.290	
Position → GWE	0.009	0.086	0.932	
Panel B – Quality criteria				
	Max. VIF	**R^2**	**Q^2**	
ES	1.746	0.352	0.252	
GWE	1.810	0.174	0.171	

dPMS = diagnostic use of performance measurement systems (PMS); GWE = green work engagement; iPMS = interactive use of PMS; ES = environmental satisfaction; VIF = variance inflation factor.
** p < 0.10; ** p < 0.05; *** p < 0.01.*
Source: *Elaborated by the authors.*

The statistical analysis of Table 2 provides support for accepting the six hypotheses of the study (H_{1a}, H_{1b}, H_2, H_3, H_{4a}, and H_{4b}). No control variable was significant. The discussion of these findings is better observed in section 4.3. Regarding the quality of the modeling, the absence of multicollinearity is perceived, since the variance inflation factor (VIF) of the exogenous constructs presents values lower than 3 (Hair et al., 2019). The coefficient of determination (R^2) shows that environmental satisfaction results in 35.2% and green work engagement results in 17.4% of the explained variance. Finally, the model's accuracy is adequate, as the Q^2 values are higher than 0 (Hair et al., 2019).

4.2 fsQCA Analysis

The study employs fsQCA to understand which conditions are necessary and/or sufficient for high environmental satisfaction (Model A) and high green work engagement (Model B). This technique involves three main stages (Ragin, 2008), the first of which is the calibration of the original data for intervals of the fuzzy scale, with values ranging from 0 to 1, with anchors for the full set membership, crossover point, and full non-membership (Ragin, 2008). For the variables (constructs) composed of more than one item, the average is calculated (Crespo et al., 2019; Kaya et al., 2020). Next, the anchors at points 7, 4, and 1 are used, respectively, to calibrate the variables (Cruz et al., 2022; Galeazzo & Furlan, 2018; Wang et al., 2021). The other variables considered (age, gender, and time in the company) are calibrated according to their binary nature (Ragin, 2008).

The second stage evaluates whether there are necessary conditions (consistency ≥ 0.90) or almost always necessary conditions (consistency ≥ 0.80) (Ragin, 2008). Note that the diagnostic use (consistency = 0.947) and interactive use (consistency = 0.905) of PMS are necessary for high environmental satisfaction. Similarly, high green work

engagement requires the presence of diagnostic use (consistency = 0.961) and interactive use (consistency = 0.957) of PMS, as well as environmental satisfaction (0.980). The demographic conditions (age, gender, and time in the company) are not presented as necessary by any group. The third stage consists of analyzing sufficient conditions and implies elaborating a truth table of 2^*k* rows (*k* = number of conditions) (Ragin, 2008). To refine the truth table, the study employs a consistency threshold (0.80) (Ragin, 2008). The intermediate solutions (Ragin, 2008) obtained after these processes are highlighted in Table 3.

Table 3
Sufficient solutions

Conditions	Model A	Model B				
	SA1	SA2	SB1	SB2	SB3	SB4
PMS						
Diagnostic use	●	●	●	●	●	●
Interactive use	●		●	●	●	○
Sustainability						
Environmental satisfaction	–	–	●	●	●	●
Age						
≤ 35 years old ○ / > 35 years old ●		○	●			○
Gender						
Male ○ / Female ●		○		○	●	○
Time in the company						
≤ 5 years ○ / > 5 years ●		○		●	○	○
Raw coverage	0.884	0.170	0.593	0.414	0.269	0.109
Unique coverage	0.728	0.014	0.208	0.100	0.118	0.029
Consistency	0.971	0.963	0.816	0.840	0.862	0.890
Overall coverage	0.898	0.840				
Overall consistency	0.967	0.813				

Note: *Model A: environmental satisfaction = f [diagnostic use of performance measurement systems (PMS), interactive use of PMS, age, gender, and time in the company]; Model B: green work engagement = f (diagnostic use of PMS, interactive use of PMS, environmental satisfaction, age, gender, and time in the company).*

SA = solutions for model A; SB = solutions for model B.

● = presence of the condition; ○ = absence of the condition; no circles = indifference of the condition.

Source: *Elaborated by the authors.*

The consistencies of the solutions and overall of the models are adequate (> 0.80) (Fiss, 2011; Ragin, 2008). In turn, the coverage can be compared (analogously) to the R^2 of the regression models (Fiss et al., 2013), whether exclusively in the solution (unique coverage), of the solution, even shared with other solutions (raw coverage), or by all the solutions of the model (overall coverage) (Ragin, 2008). In addition, the values of the overall coverages are within the range suggested in the literature (0.25-0.90) (Ragin, 2008). For example, in Model A, the solution that contemplates the highest proportion of cases (coverage) is S1A, 88.4% in raw form and 72.8% exclusively. In this solution, it is shown that the presence of diagnostic use of PMS and interactive use of PMS leads to high environmental satisfaction, with indifference regarding age, gender, and time in the company.

5. DISCUSSION OF THE RESULTS

The (diagnostic and interactive) use of PMS presents a positive effect on environmental satisfaction, which supports H_{1a} and H_{1b} ($\beta = 0.352$ and $\beta = 0.401$, respectively, $p < 0.01$). Both forms of control are necessary for high environmental satisfaction and compose the solution that contemplates more cases, indifferently of age, gender, and time in the company. With relation to the interactive use, the previous literature is corroborated with regard to the environmental outputs in general, but there is a different finding regarding the diagnostic use (Heggen &

Sridharan, 2021), which can be positively beneficial for certain contexts, such as in environmental satisfaction. Similar findings to that of this study were observed by relating the diagnostic and interactive uses of MCS with innovation (Müller-Stewens et al., 2020). These results suggest that both the diagnostic use of PMS (through control and feedback) and the interactive use (through discussion and learning) (Henri, 2006) feature as allies in increasing environmental satisfaction, which can foster motivation and the exchange of experiences among peers, increasing the employees' interest in greener actions (Paillé et al., 2020).

H_2 was supported ($\beta = 0.131$, $p < 0.10$), which indicates that the combination of the diagnostic and interactive uses of PMS is positively associated with environmental satisfaction. The asymmetric combination of these two controls is the main solution for the employees reaching high environmental satisfaction. This positive result of the combination of controls is consistent with the previous literature (Grabner & Moers, 2013; Henri, 2006; Kreutzer et al., 2016; Müller-Stewens et al., 2020; Ylinen & Gullkvist, 2012, 2014) and extends the discussion of the combination of the diagnostic and interactive uses of PMS to sustainable results. The acceptance of hypotheses H_{1a}, H_{1b}, and H_2 provides insights that can support the definition of combinations of MCS for achieving environmental satisfaction, that is, satisfaction with the organizational environmental engagement perceived by the employees. Consequently, environmentally satisfied individuals in the workplace tend to present higher levels of voluntary ecological behavior, such as using recycled material and avoiding unnecessary printing (Amrutha & Geetha, 2021). Figure 2 explores, in more details, the effect of that combination of controls in favor of environmental satisfaction.

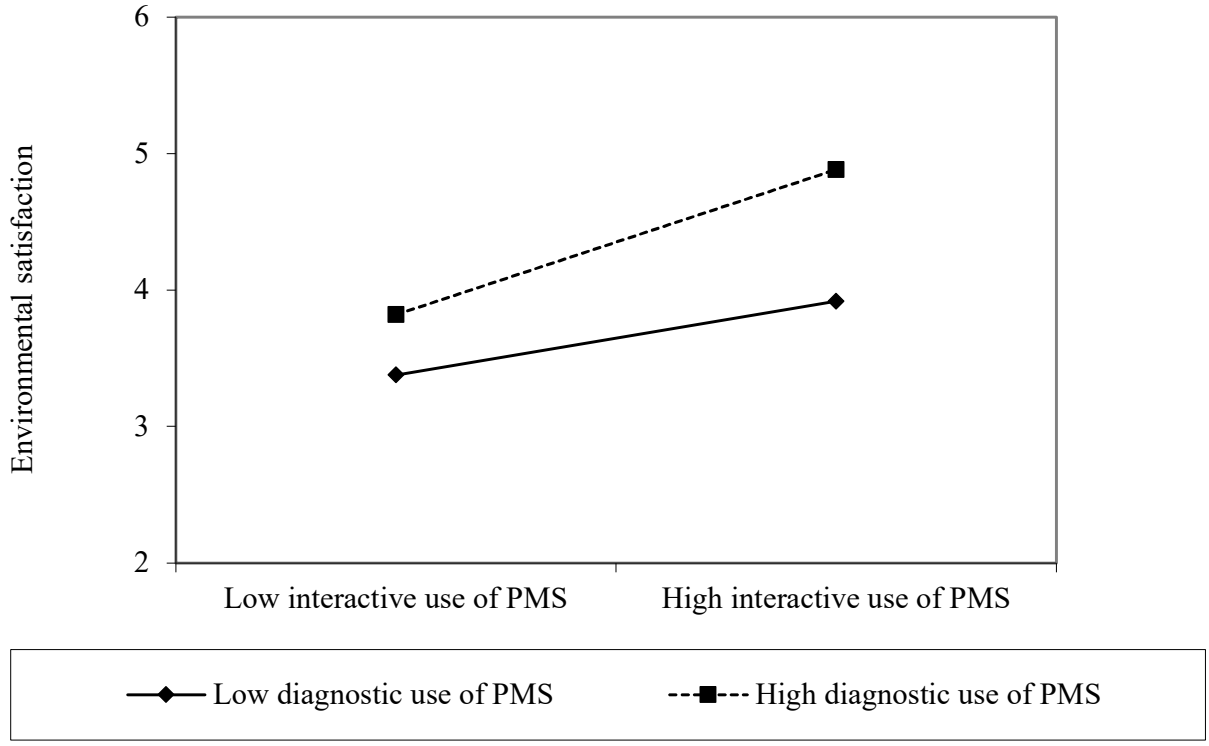

Figure 2 *Control combination and environmental satisfaction*
PMS = performance measurement systems.
Source: *Elaborated by the authors.*

Figure 2 reveals three scenarios derived from the combination of controls and the effect on environmental satisfaction. The first scenario indicates that low levels of diagnostic use and of interactive use of PMS result in low perceived environmental satisfaction. The second scenario shows that when the use of one control is low and that of the other is high (low diagnostic use and high interactive use or low interactive use and high diagnostic use), the effects of the combination of controls remain reasonably constant (on average) in relation to environmental satisfaction. The third scenario highlights that when there is high diagnostic use and high interactive use of PMS, the effect on environmental satisfaction is increased. Table 4 summarizes these three scenarios.

Table 4
Average level of environmental satisfaction (ES) for different levels of the combination of controls

Combination of controls	Low interactive use	High interactive use
Low diagnostic use	3.378 (Scenario I – Low ES)	3.918 (Scenario II – Average ES)
High diagnostic use	3.820 (Scenario II – Average ES)	4.884 (Scenario III – High ES)

Source: *Elaborated by the authors.*

H_3 can be supported, as environmental satisfaction is positively associated with green work engagement ($\beta = 0.396$, $p < 0.01$). In addition, the presence of environmental satisfaction is necessary and sufficient in all solutions for high green work engagement. This finding is consistent with the general literature on satisfaction favoring work engagement (Côté et al., 2021; Rayton & Yalabik, 2014) and extends the discussion to the environmental context (Aboramadan, forthcoming; Paillé et al., 2020). Note that the employees' satisfaction with the organization's efforts in favor of the environment results in higher levels of inspiration, pride, immersion, enthusiasm, happiness, and energy when carrying out environmental tasks.

H_{4a} and H_{4b} are supported, since the diagnostic ($\beta = 0.139$, $p < 0.05$) and interactive ($\beta = 0.159$, $p < 0.01$) uses of PMS have a positive indirect effect on green work engagement through environmental satisfaction. As the direct relationships are not significant, there are two full mediations (Hair et al., 2017). Both the diagnostic use and interactive use of PMS are necessary conditions, besides being sufficient in almost all the configurations for high green work engagement. In three of the four solutions it is perceived that the use of both controls is beneficial for green work engagement. These findings indicate that the ways the organization accompanies, monitors, reviews (diagnostic use), enables, and discusses (interactive use) the performance measures (Henri, 2006) transmit the environmental strategies to the employees (Hristov et al., 2021; Lisi, 2015), which increases satisfaction with organizational environmental engagement (Paillé et al., 2020) and, through environmental satisfaction, reflects on green work engagement (Aboramadan, forthcoming).

Regarding the control variables, it is observed that no symmetrical relationship was statistically significant. First, this reveals the existence of homogeneity of the sample in relation to the positions (analysts and managers/coordinators), which reinforces the perspective of jointly considering samples of middle- and lower-level managers (Baird et al., forthcoming). Second, this finding suggests that, in isolation, age, gender, time in the company, and position are not determinants for satisfaction with the organization's environmental engagement and green work engagement. The asymmetrical approaches indicate various configurations among age, gender, and time in the company, which when combined with other conditions can result in the success of individual green behaviors in the organization. This result partly highlights the relevance of considering these three variables in the context of individuals' sustainable behaviors (Li et al., 2020; Zhang et al., 2020).

6. CONCLUSIONS AND IMPLICATIONS

This study analyzed the effects of the (diagnostic, interactive, and combined) use of PMS on environmental satisfaction and the reflections of that on employees' green work engagement. For this, a single entity survey was conducted in a private Brazilian company from the electric power generation sector, which was answered by 101 employees, and the PLS-SEM and fsQCA techniques were applied to the data collected. The PLS-SEM results show that the (diagnostic, interactive, and combined) use of PMS can promote greater environmental satisfaction through its positive effect. In addition, greater green work engagement can be achieved with the diagnostic and interactive uses of PMS, which is confirmed by the positive indirect effect through environmental satisfaction, which also positively impacts green work engagement. This suggests that adopting controls and incentivizing learning about sustainability can leave employees more satisfied with the company's posture regarding the theme and, thus, obtain greater participation from them in the actions proposed.

The fsQCA results corroborate the PLS-SEM findings. There appears to be an evident need for the diagnostic and interactive uses to promote sustainable behaviors by employees. It was discovered that two (four) combinations of conditions lead employees to high environmental satisfaction (high green work engagement). In all six of these solutions for success in the sustainable context, the organization should monitor and accompany the goals (diagnostic use of PMS). In the more comprehensive solutions (they contemplate more cases), for every

successful result, the combination of feedback and monitoring controls (diagnostic use) and learning and dialogue controls (interactive use) should be present.

The study presents implications for the literature. Considering the effects of the (diagnostic and interactive) use of PMS has implications in the search for employees' sustainable and green results, since most of the previous studies involve organizational results (Heggen & Sridharan, 2021; Henri & Journeault, 2010; Rehman et al., 2021; Wijethilake, 2017). It also has implications for the discussion on PMS (Henri, 2006), aggregating evidence of the beneficial effects that PMS can provide for individuals' environmental and green behaviors, such as environmental satisfaction and green work engagement. It also contributes by exploring antecedents derived from the forms of management and that stimulate green work engagement (Aboramadan, forthcoming; Bhutto et al., 2021; Çop et al., 2021), as well as corroborating the validation of the environmental satisfaction construct in the context of employees' environmental satisfaction with organizational environmental commitment (Paillé et al., 2020).

The findings of this study also contribute to the literature that discusses the interdependence of controls, which occurs with the combination of two or more MCS in a dependent and mutual way (Choi, 2020; Grabner & Moers, 2013). Previous studies on interdependence of controls explore performance results (Henri, 2006; Kreutzer et al., 2016; Ylinen & Gullkvist, 2014), innovation (Henri & Wouters, 2020; Müller-Stewens et al., 2020), management control effectiveness (Bedford et al., 2016), and environmental performance (Heggen & Sridharan, 2021). They also contribute by using fsQCA to explore combinations of equally effective management controls for achieving a particular outcome (Bedford et al., 2016; Cruz et al., 2022; Frare et al., forthcoming), in this case regarding the diagnostic and interactive uses of PMS (Einhorn et al., 2021). Thus, the study implies a growing debate on the combination of controls, in particular in the search for employees' green behaviors.

The study also has implications for practice. Considering the positive impact of environmental satisfaction on green work engagement, it appears to be vital for managers to understand the role of PMS in promoting these behaviors, in a singular, joint, direct, and indirect way. The strategy can contemplate controls of actions and behaviors (diagnostic use of PMS) as well as promoting dialogue and incentivizing the exchange of experiences among individuals within the organization (interactive use of PMS), in the day-to-day, in specific activities or events, such as workshops and panel debates on green questions, and even in the planning of which green actions will be prioritized by the organization. In light of the growing popularity of subjects related to sustainability and green practices (Paillé et al., 2020), as well as the relevance of this theme for organizations, the findings of this research support managers in planning actions that underpin the achievement of strategic sustainability objectives.

The results and conclusions of the study should be considered with caution in light of the limitations. First, despite the various measures used to minimize CMB, this bias cannot be completely discarded. Second, due to the fact that the data derived exclusively from surveys, financial data or data of another nature are not contemplated. Thus, future studies could adopt new strategies, such as data triangulation with archival data. Third, the sample covers a single organization and the findings may be different for other segments, contexts, and cultures. So, other studies could add new evidence with different samples. In addition, employees of companies that do not participate in sustainability indices and rankings may present different levels of environmental satisfaction and green work engagement.

Fourth, the study specifically considered the interactive and diagnostic uses of PMS, and future studies could expand the findings by using other typologies of MCS. For example, exploring MCS packages adopted by certain organizations (Frare et al., forthcoming; O'Grady & Akroyd, 2016) may be relevant for improving the understanding about controls and respective important combinations for promoting satisfaction and green engagement. Fifth, other factors besides PMS use can potentially promote environmental satisfaction and green work engagement, which could be considered in new studies (e.g. corporate social responsibility and proactive sustainability strategies). Finally, the company's mission statement or its strategy can direct the way in which the MCS are used and how this affects individuals' environmental behaviors (Aguiar, 2020), which could be considered in new studies.

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APPENDIX A

Research instrument

Diagnostic use of performance measurements systems (PMS) *(Henri, 2006)*
Evaluate how much your company's management currently uses performance measures for...
(1 = not at all to 7 = to a great extent)

1. Track progress towards goals
2. Monitoring results
3. Compare outcomes to expectations
4. Review key measures

Interactive use of PMS *(Henri, 2006)*
Evaluate how much your company's management currently uses performance measures for...
(1 = not at all to 7 = to a great extent)

5. Enable discussion in meetings of superiors, subordinates and peers
6. Enable continual challenge and debate underlying data, assumptions and action plans
7. Provide a common view of the organization
8. Tie the organization together
9. Enable the organization to focus on common issues
10. Enable the organization to focus on critical success factors
11. Develop a common vocabulary in the organization

Environmental satisfaction *(Paillé et al., 2020)*
Indicate in each one of the following statements the alternative that best represents your satisfaction with your company's environmental engagement. (1 = totally disagree and 7 = totally agree)

12. For the most part, the programs developed by my employer have address the most important environmental problems.
13. In my opinion, the amount of attention given to the environment by my employer has been satisfactory.
14. So far, I am content with the state of the environment in my area.
15. The employer policies developed to deal with the environment are excellent.

Green work engagement *(Aboramadan, forthcoming)*
Indicate in each one of the following statements the alternative that best represents your satisfaction with your green work engagement. (1 = totally disagree and 7 = totally agree)

16. My environmental- related tasks inspire me.
17. I am proud of the environmental work that I do.
18. I am immersed in my environmental work.
19. I am enthusiastic about my environmental tasks in my job.
20. I feel happy when I am working intensely on environmental tasks.
21. With environmental tasks at my job, I feel bursting with energy.