FORMULATION OF SECTORAL STUDIES (ELECTRICITY, FUEL, INDUSTRY AND AGRICULTURE) AND PROPOSITION OF DESIGN OPTIONS FOR CARBON PRICING INSTRUMENTS

COMPONENT 1 OF THE PMR IMPLEMENTATION PHASE

P5.D2

Executive Summary

PRODUCT 5

Recommendations for alternative scenarios of pricing instrument packages

The consortium

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CONTENTS

OVERVIEW

This report presents the recommendations of options for designing carbon pricing instruments for the Brazilian economy, under Component 1 of the Implementation phase of PMR Brazil, for greenhouse gas emissions related to the combustion of fuels (including its production and refining), electricity generation, industrial processes and agricultural activity.

The options were initially indicated in sectoral studies (electricity, fuels, industry and agriculture) and discussed at the meetings that followed with the responsible teams of these studies, the Ministry of Finance, the World Bank, sector representatives and consultants of Vivid Economics and Ricardo.

This Report seeks to organize these price instrument recommendations with differentiated versions of pricing packages, combining the possibilities of revenue use and the need of alignment of the existing sectoral instruments.

This organization was developed within a common analytical framework that guides adjustments in the final designs of the instruments and allows the identification of the main efficiency and distributive issues that must be addressed in the next PMR project phases of economic and regulatory impacts analysis.

1 INTRODUCTION

The texts of the Sectoral Reports of Component 1 of the PMR Implementation phase, and the various discussions at subsequent meetings and workshops[1], generated wide range of options for carbon pricing based on the productive and regulatory structure of the studied sectors, i.e. GHG emissions from the burning of fuels, from electricity generation, from industrial processes and from agricultural and livestock activities.

P5 Product articulates and organizes these proposals within a common theoretical-conceptual framework. As new price instruments can act either in a way that is complementary or contrary to existing sectoral policy instruments, the possibilities of aligning these sectoral instruments with the new carbon pricing instruments were also suggested. Likewise, the different possibilities of using the revenues generated by the selected instruments were evaluated as well as how these can affect the economic agents and cost-effectiveness of the price signal.

The analysis guides adjustments in the final designs of the price and sector instruments and enables the identification of the main cost-effectiveness and economic impacts that should be addressed in the next phases of the PMR Project, which consists on the economic and regulatory modeling.

This report considers carbon emissions as equivalent CO_2 emissions (CO_2e) of all GHGs included in the National Inventory of Anthropogenic GHG Emissions Not Controlled by the Montreal Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6). Cost-effectiveness is thus understood as the minimization of control costs (Real - R$ - per reduced ton) to achieve a certain goal of reducing GHG emissions.

It should be noted that Component 1 does not model these recommendations but offers a theoretical-conceptual approach considering international experience and national circumstances. In this way, it points out packages options potentially more cost-effective in light of the productive structure of the analyzed sectors, considering also the emission profile, available mitigation options and the interaction with existing sectoral policy instruments.

The analysis of the economic impacts and political, legal and institutional economic barriers are, respectively, objects of Component 2A (economic modeling) and Component 2B (regulatory impact assessment).

This report, part of Component 1, identifies, for the next components, the specific issues of efficiency, impacts distribution and barriers of political economy that require an additional quantitative and qualitative empirical analysis.

[1] See http://www.spe.fazenda.gov.br/pmr_brasil.

2 THEORETICAL-CONCEPTUAL FRAMEWORK

Pollution is a typical case of negative externality, that is, a market failure to price and internalize a cost that affects third parties[2]. The balance between the acceptable level of pollution and the costs of controlling it is an economic problem, and the socially desired pollution amount is estimated by equalizing the marginal costs of control with the marginal costs of non-control damages. That is, the quantity in which the cost of control compensates for the avoided damages. By achieving this amount of socially desired pollution, the externality would be internalized.

This internalization can be achieved with instruments of control or price (market). With control instruments the emission or technological standards are established common to all emitters of a pollution source. Thus, all economic agents have to adopt the same emission standards and/or technology that allow them to achieve the control goal.

With the pricing, whether tax or market, the decision to reduce emissions or pay the emission price is made by the regulated source economic agent, which compares the price of the pollutant being priced with its marginal mitigation cost. Therefore, the regulated agent chooses the cheapest option to comply with the regulation, either by:

- reduction of emissions, with the adoption of production or consumption practices, either of less emitting inputs or products;
- absolute reduction of consumption or production; and
- no reduction of emissions and payment of the price.

The latter option of not reducing emissions associated with the flexibility of payment is what characterizes the price instrument and differs it from the command and control instruments. In addition, due to this difference, it is possible to achieve a reduction target in a socially cheaper way, because opportunities are created to minimize costs with the freedom of technological choice combined with the decision to pay (or not), according to control costs and production and expansion targets of each pollutant responsible agent. Then, it is expected that lower-cost economic agents reduce more their emissions, because it is cheaper to them to control than to pay the price.

[2] Externality exists because the cost or the social benefit (which affects all agents of the economy in the case of climate change) of the production or consumption of a good or service is different, respectively, from the private cost (negative externality) or benefit (externality positive). In other words, problems in the security of property or use rights make private demand or supply in these markets impossible and thus become "external" to them. This conceptual framework follows the basic texts of the economy of pollution; see, for example, Baumol and Oates (1990), Pearce and Turner (1992) Hanley. et al. (1996) and Seroa da Motta (2008). A detailed description of the international experiences cited here can be found in OECD and World Bank (2015), World Bank (2017a and b), ICAP (2018) and CEBDS (2017).

In other words, pricing instruments minimize the aggregate cost of a single mitigation target (quantity) by equalizing marginal abatement costs (control), therefore, they are economically more efficient than command and control instruments[3]. Accordingly, the more heterogeneous the costs of controlling the scope of pricing, the greater the efficiency gain of the price instrument.

The costs incurred with the control and loss of producer and consumer surpluses are the economic impacts resulting from the internalization of the environmental externality. These impacts realign the relative share of production and consumption according to the resulting variations in pollution intensity, thus changing the relative gains and losses of current and future producers and consumers.

In short, the cost-effectiveness of economic pricing instruments allows economic impacts to be minimized, but these cannot disappear, because they reflect the need for adjustments in the economy for the ambition of an emissions control goal. If there were no economic impact then it would not be necessary to impose control goals[4].

This does not mean that the perception of these impacts does not generate political reactions from affected producers and consumers. Although society as a whole wins, the incidence of costs and the benefits of externality control falls on different agents. Even when there is consensus in society about long-term gains, there is naturally a political debate concerned with assessing how reducing the pollution damage costs compensates for these current production and consumption losses. That is, how much the present losses, caused by the greater pollution control, compensate the future gains of that control[5]. The debate is even more controversial when today's losses are compared among the various economic agents.

In the case of climate policies, the externality internalization aims to guide the economy towards a path of lower carbon intensity, and adjustments in the economy tend to be more complex. The political reactions of affected producers and consumers occur **primarily** because, in the short term, mitigation efforts can increase costs, especially energy and land use costs, with cross-cutting effects on the economy.

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[3] It is worth mentioning, however, that this greater efficiency in relation to the instruments of control decreases when there is market power of some regulated agents, behavioral barriers or when the additional cost of implementing the pricing eliminates the relative gains of efficiency. In fact, international experience shows that pricing is usually adopted as one of the instruments in the climate policy mix, along with other regulations, such as setting standards, etc.

[4] In addition to minimizing social costs, the use of pricing revenues may further mitigate this cost, or even generate a double dividend, ie an economic gain in addition to environmental gain (World Bank, 2017b; Jaeger, 2012). See, for example, Bowen (2015) and Barker et al. (2012). However, even if in the aggregate the costs can be null or negative (in the case of the double dividend), the change in the relative price of carbon generates variations in sectoral gains and losses and, therefore, different economic impacts among the economic agents.

[5] In economic language this discussion is summarized in the determination of the social discount rate that values losses and gains in time and in the social utility function that compares losses and gains among contemporaries.

However, in the long term, since mitigation options are often technology-intensive, such reactions can create a technological backwardness that is unfavorable to economies which delay their low-carbon trajectory. The later the decarbonization occurs, the higher its costs, due to the technological and institutional carbon lock-in generated by path dependence and by emission-intensive systems of the economies of scale[6].

Secondly, the opposite reactions to carbon pricing are due to the fact that climate change is a transnational and intergenerational externality, whose estimated damage is uncertain, its magnitude depends on coordinated global action, and whose incidence tends to decades and differentiated between countries.

Therefore, estimates of the aggregate and sectoral economic impacts of the low carbon trajectory by economic modeling and their weighting in a regulatory analysis are crucial analytical processes to consider, ponder and guide more realistic perceptions of the incidence and distribution of these impacts and, thus, to favor consensus in the design of the instruments that encourage this trajectory.

3 COST-EFFECTIVENES EVALUATION OF PRICE INSTRUMENTS

The tax pricing instrument sets a price per unit of emission to achieve an aggregate amount of control, and so each regulated agent determines the quantity to be emitted, which, together, leads to the desired level of control, compatible with the determined price. On the other hand, the market instrument sets the aggregate amount of emission and distributes it within regulated agents in the form of emissions rights (or allowances), which can be negotiated between them and, consequently, transactions between regulated entities determine an equilibrium price.

If these two types of instruments aim at the same emissions quantity to be controlled, in the absence of uncertainty and transaction costs, both generate the same price signal[7]. Thus, the tax price and the market equilibrium price a would be the same for the same goal. Whether it is a tax or a emissions allowances trading scheme[8], they all carry the same equilibrium prices and quantities.

[6] See, for example Erickson et al. (2015) and Unruh (2002).

[7] Transaction costs capture both regulator and regulated agent costs, including the imperfections associated with incomplete information and behavioral barriers. Equivalence is also affected when pricing is restricted to an oligopolistic sector and the supply of emission rights of some regulated firms alters as a consequence of their market power in output that generates the externality.

[8] The independence of the equilibrium price to the emission rights distribution criterion does not prevail if this distribution generates a sufficiently high income effect to vary the generation of the externality. This possibility decreases the greater the number of sources, for example, the case of GHG emissions, in particular, when restricted to a country.

It is the marginal cost of control curve[9] of each regulated entity that will guide the individual decision to control and not pay the price or not to control and pay the price, either against a tax or the price observed in the market.

Thus, from the point of view of efficiency, both instruments are equivalent, because when generating the same price, they also generate the same social cost to reach a certain environmental control goal.

Whatever the instrument type, a price instrument cost-effectiveness is greater as (i) the more accurate the measurement of the emission priced is, to ensure that the incentive is economically justifiable, (ii) the greater the heterogeneity of control costs, which increases the likelihood of containing the lower cost options and (iii) the lower are the transaction costs of regulated and regulator entities.

This equivalence, however, ceases to exist when there is uncertainty in cost of control estimates and transaction costs differ.

Uncertainty

When there is uncertainty, the preference of one type of instrument will depend on where this uncertainty is most valuable. If it is in price, a tax instrument should be used. If it is in the reach of the goal, a market instrument is recommended. This dilemma, however, is somewhat surpassed by solutions that introduce adjustments in tax rates and price control mechanisms in market approaches. In tax mechanisms, the tax (price of pollution) can be periodically adjusted to generate the desired control. Market systems can adopt a price variability goal (an interval) that is guaranteed with floor and ceiling prices for transactions and / or through a reserve of emission allowances that would be transacted to regulate this interval.

Thus, all recommendations proposed here for market creation already incorporate rate adjustments and price control mechanisms, which will be discussed later.

Transaction Costs

One of the main transaction costs is the regulatory costs associated with the legal and institutional arrangements required to implement the instrument. In this case, there are advantages and disadvantages.

Regulatory Barriers to Taxation

Most tax pricing versions have the potential to present lower regulatory costs because they benefit from current tax institutions and statutes, which generally makes their implementation simpler, therefore, more cost-effective. In the pricing of externalities, however, when it is intended to change the

[9] Note that the marginal abatement cost (MAC) curve is restricted to the technological options to reduce emissions. The marginal control cost curve also includes the cost of not producing in order not to emit, that is, the variation surplus of the producer or profit margin. For the consumer, the marginal cost of control represents the variation of the consumer surplus on account of a substitute product with a higher relative price and / or due to consumption reduction.

consumption and production pattern, the tax must have an extra-fiscal objective, that is, one of incentive and not only of collection.

The Brazilian tax system restricts levies ("*tributos"*) to four types (or tributary species), namely: taxes ("*impostos*"), fees ("*taxas*"), contributions and compulsory loans.

Fees ("*taxas"*) can only be used to finance the provision of specific and divisible public services, therefore its application is not recommended for GHG[10] emissions.

Taxes ("*impostos*"), alternatively, can be applied on pollution (GHG emission). However, its main purpose is fiscal, that is, to generate revenue that is necessarily destined to the public coffers, therefore, cannot be destined to some specific expense[11]. This limitation on revenue binding makes more difficult to publicly accept a carbon tax, since it does not generate direct benefits to its triggering event, such as financing for environmental expenditures. In addition, there is also the concern that the revenue may end up being directed to subsidize carbon intensive activities[12].

The use of variable rates of value-added taxes would have limited application, because they act with credit and debt differences along the chain, thus, when they affect intermediate goods, such as fuels and energy, their impact would be reduced in cost and selling price of the products and services that are used according to the differentiation of taxes throughout each chain.

Nor would **compulsory loans** be adequate to promote GHG emissions reduction, given the need for restitution (hence a loan) and the framing of specific purposes (public calamity, external war or its imminence or urgent and relevant public investment of national interest).

More suitable for carbon emissions are the **cumulative taxes of an extra-fiscal nature** in which the taxable event may be associated with the use of the revenues. In the Brazilian case, it would be the Intervention Contributions in the Economic Domain ("*Contribuições de Intervenção no Domínio Econômico"*,CIDE, in Portuguese) that could be associated with environmental objectives in both collection and use of revenue[13].

When levies ("*tributos*") are adequate for environmental purposes, its collection is easily incorporated at a low cost in the treasury administration, either of the Union or of the states. On the other hand, these tax and fiscal structures, in addition to being less transparent and participatory, tend to accommodate countercyclical or collection economic concerns that may influence levels of carbon taxation, rather than their mitigation objectives. In addition, the legal frameworks of taxation may hinder the application of the tax on carbon for extra taxation purposes of internalization of externalities.

Regulatory Barriers in Market Systems

[10] Amaral, P. H. (2007).

[11] Ibid.

[12] Milne e Andersen (2012).

[13] Seroa da Motta et al. (2000), Amaral (2007), Fortes (2010), Grau Neto (2012) and Appy, B. (2013).

In market approaches, it is crucial to ensure the liquidity and the fungibility of emission allowances and, therefore, its taxation and legal nature as well as the credibility of its trading institutions and registries should be free from controversies.

Therefore, the creation of a market requires the construction of an arrangement that guarantees the emission allowances security, providing trust in the transactions and contracts, which, on the other hand, can be an opportunity to guarantee autonomy, transparency and credibility to the management of the price incentives.

This regulatory framework for market creation would include:

(i) the principles and general guidelines to guide the emission allowances allocation with price control criteria and measures to protect competitiveness;

(ii) the periodicity of the revision of rules, with criteria that contemplate national mitigation objectives;

(iii) marketing practices, penalties, registration of emission rights, financial and carbon accounting rules, standards for measurement, reporting and verification (MRV) and the use of financial derivatives;

(iv) the identification of the executive government agency, at federal level, to implement and coordinate the regulatory framework; and

(v) the accreditation rules of private market management institutions, such as: stock market, agents, operators and MRV entities.

From a legal and institutional point of view, there is a clear trade-off in implementation costs between taxes and market systems. Mechanisms of carbon taxation almost always benefit from existing legal and institutional frameworks, but are more restrictive and affected by other economic issues, while market approaches may require new institutional structures and, therefore, more autonomy of management over the application of these mechanisms for environmental control purposes and with greater flexibility to design measures to protect competitiveness.

This report only indicates these possibilities, recognizing that these cost differences are difficult to measure (and hence, they should be included in economic modeling), although they can be assessed qualitatively by taking into account current regulatory milestones and their necessary adjustments.

3.1 Design Elements

Below are highlighted the design elements of taxes and market approaches[14].

[14] The Main Report briefly reviews the parameters of these elements in existing pricing experiences.

3.1.1 COMMITMENT PERIODS

For either tax or market approaches, the time aspect of the pricing commitment period is important to (i) enable the incorporation of relative price change into the decisions of regulated companies; (ii) allow periodic review of targets and operating rules in market approaches; and (iii) make feasible the revision of scope, marketing rules and other design elements.

For taxation, for example, the commitment period dictates mainly the frequency with which the value of the tax will be revised, and in the market approach, how the emission allowances will be adjusted over time[15]. Most of the existing systems present pricing phases, organized by different commitment periods. The initial phase is usually 3 to 5 years with smaller scope, expandng in the following phases, with longer periods.

In the Brazilian case, it is recommended an initial phase of three years - both for tax and for market system – and, from then on, it is suggested to adjust these periods to the national commitments in the Climate Convention so that the pricing can be an instrument in NDC implementation.

3.1.2 PRICE LEVELS

A total of 51 carbon pricing initiatives are active or planned for implementation around the world. The carbon price range in these experiments varies widely - between cents of dollars and US$ 139/tCO_2e - but in 46% of the emissions covered, prices are less than US$ 10/tCO_2e[16].

Most economic modeling studies[17] of the impacts of a carbon pricing on the Brazilian economy indicate that a carbon price of around US$ 10/tCO_2e would generate insignificant macroeconomic effects, especially when there are recycling of the collected revenues.

As a recommendation for the initial pricing phase in which, as discussed earlier, a learning process would be objectively suggested, it is suggested a more conservative price level in terms of effects on competitiveness and, therefore, one that generates the least degree of uncertainty to regulated agents. Accordingly, it is recommended the adoption of the constant value of R$ 30/tCO_2e (equivalent to US$ 10/tCO_2e), annually adjusted by the IPCA. Additionally, it is also recommended that, at this early stage, it should be indicated that in the next phase, in addition to the annual adjustments by the IPCA, there

[15]These are not adjustments aimed at equalizing social costs and marginal social benefits to achieve an optimum carbon price or the social cost of carbon. No pricing experience has explicitly assumed this assumption. The goal of gradual implementation is important for the learning of regulators and regulators and to enable adjustments that accommodate concerns about competitiveness and the impacts on consumption. See, for example, Withana et al. (2013).

[16] See World Bank, Ecofys and Vivid Economics. (2018).

[17] See Ver Margulis et al. (2010), La Rovere et al. (2016), Rathmann (2017) and Gramkow. (2017).

should be a real readjustment factor whose magnitude would be discussed at the time, in the light of NDC's goals in the period[18].

In the case of the market approach, it is suggested that the economic modeling should indicate a total emission limit (cap) corresponding to the marginal control cost of R$ 30/tCO_2e and that this price should be pursued for price control, as will be discussed later .

3.1.3 ADJUSTMENTS FOR INTERNATIONAL TRADE

The economic literature indicates that one way of protecting competitiveness is to adopt the same incidence of the tax or the need for emission rights on imports that compete with the domestic production of regulated sectors. This is known as border adjustment. This egalitarian tax treatment has more effect when emissions of these imports are measured in the average domestic emissions parity of the same national product. Another adjustment is the tax exemption or a supportive distribution of emission allowances for exported products of regulated sectors.

Another possibility is to reduce the tax base on carbon tax or to allocate free emission allowances to sectors exposed to international trade. The tax base can be reduced with the same criteria of favorable allocation when part of the generated emissions, instead of having free emission rights, is deducted from the tax base.

The literature recognizes that border adjustments can be more efficient because free allocations or reductions in the tax base require parameters that end up being negotiated for overcompensation. On the other hand, because of the possibility of hiding purely trade protectionist objectives that would affect least developed countries, border adjustment measures are still not free from controversy in the Climate Convention and in the World Trade Organization, and are generally restricted in Multilateral Trade Agreements[19].

Given these difficulties, it is initially suggested to adopt a reduction in the taxable base or a favorable allocation of emission rights for sectors exposed to international trade, as discussed below.

3.1.4 IDENTIFICATION OF SECTORS WITH COMPETITIVENESS RISKS

There are no established parameters for the identification of these sectors, but they are those intensive in emissions and exposed to international trade (emissions-intensive, trade-exposed - EITE). Such discrimination generally combines indicators of carbon intensity, additional mitigation cost, and international trade. These sectors are generally protected with free allocation or reduction of the tax base of emissions.

In order to promote greater acceptance and reduce controversies over the graduation of parameters, it is suggested that in the initial phase of pricing in Brazil, sectors with a risk of competitiveness, without

[18] The value of the social carbon price recommended to meet the 2-degree target is between US$ 40 and US$ 80/tCO_2e in 2020 and US$ 50 to US$ 100/tCO_2e in 2030, see Stigiltz and Stern (2017).

[19] See, for example, Seroa da Motta (2011), Metcalf (2014) and Trachtman (2016).

gradation in the level of risk, should be identified using the EU ETS indicators, although with a less restrictive gradation, considering the initial pricing phase and the degree of competitiveness of the industry in Brazil.

Thus, the sectors considered at risk of competitiveness would be those that meet one of the following criteria:

- Cost of emissions control: increase in production costs of more than 15%, as a proportion of the added value; or
- Intensity of trade: intensity greater than 15%; or
- Combining carbon cost and trade intensity: if control costs increase by at least 5% of the industry added value and the international trade intensity of the sector is greater than 10%.

These sectors must be identified in economic modeling, which incorporates the marginal abatement cost trade intensities curves. In the regulatory analysis these percentages can be reevaluated.

A proposal for the next phases, with the adoption of benchmarking allocation, would be the Platform for Emissions Trading System of the Companies for the Climate (*Sistema de Comércio de Emissões da Plataforma Empresas pelo Clima,* SCE-EPC, in Portuguese) that classifies sectors as to the competitiveness risk in low, medium and high, considering the intensity (in kg CO_2e/R$) and exposure to foreign trade, as discussed in the following subsection.

3.1.5 Criteria for Allocation of Emission Rights

In the market system there is a reduction target (cap) or a total carbon budget to be distributed and sold. In most cases, there is a part allocated free of charge and another part allocated by auction. At the end of each commitment period, each regulated source must reconcile the total emitted with the total of free and purchased allowances.

Gratuitousness is also a way of progressively generating learning for regulated and regulators entities, adjusting regulatory costs by correcting imperfections, and building public support for the mechanism. The experience of the SCE-EPC[20] indicates that the free allocation of most emissions in the first phase of the market favors their acceptance by society, mainly by regulated entities.

Technically, the free allocation process begins with the identification of sectors with competitiveness risk, as described above, which will generally be favored with gratuity. Once identified, there is a free allocation of emission allowances for these sectors using two metrics: grandfathering and benchmarking.

In the grandfathering distribution, the emission right is allocated according to the share of the regulated entity in total emissions (historical share measured in a certain period prior to the pricing), reflecting,

[20] FGCes (2016).

therefore, the current stage of the emissions profile. This metric favors sectors that have made the least progress in controlling emissions.

When it is desired to recognize past control efforts, the metric should be benchmarking, where the initial free allocation level of each regulated entity is proportional to a product emission intensity indicator considered to be efficient. Thus an intra-sectorial benchmark is defined observing technological trajectories and these of different products within the same sector.

In grandfathering, the allocation would be estimated very simply:

Annual free allocation by grandfathering = historical emissions x emission reduction goal x protection factor

Historical emissions can be estimated as the average of the last years and the target would be the desired reduction in that market in that commitment period. The protection factor represents how much each regulated entity will receive free of charge.

The development of product-based benchmarks usually involves three steps[21]:

1. Select the industrial products that will be covered;
2. Examine emissions levels and trajectories and the mitigation costs of each product;
3. Establish a rigor criterion of the benchmark.

To estimate the emission intensity factors (emission by production), initially, it is used a measure of the intensities observed in the sector, generally in discussion with the regulated entities.

In general, the benchmarking allocation has been estimated as follows:

Annual free allocation by benchmarking = protection factor x physical production value x emission intensity factor x capacity adjustment factor x linear reduction factor.

The protection factor varies by jurisdiction. There is no common rule for estimating the periodicity of the quantity produced, ranging from a historical value of the last decade to the value of the previous year.

The capacity adjustment factor would be to account for errors in the allocations, caused by the variation of production during the year, the so-called "true up", which relates production observed in the year with estimated production for allocation of the rights[22].

The linear reduction factor represents the annual reduction rate of the reduction target of the carbon budget to be allocated.

[21] See CARB (2011).

[22] See IETA (2015a e b) and ICAP (2017).

Given the lack of data and its simplicity, it is recommended at this initial stage in Brazil the grandfathering criteria, with 50% free allocation for all sectors with competitiveness risk, as pointed out in the subsection above. For non-free emissions (of these sectors and others without gratuitousness) the allocation would be via auctions, reconciling emissions with the purchase of emission rights.

In the experience of the SCE-EPC[23] platform, the use of benchmark generated greater acceptability among regulated entities, since it was considered more effective and fairer than grandfathering. A proposal generated by the SCE-EPC platform that could be adopted in the following phases can be summarized as follows:

1. The benchmark production (with the lowest carbon intensity indicator) of each sector or subsector receives 50% of the estimated allowances free of charge, while the worst receives 30%.
2. Sectors with only one emitter receive 50% free of charge.
3. Producers with intermediate indicators receive proportional percentages.

In addition, sectors considered as having a high (medium) risk of competitiveness receive 10% (5%) of free extra allocation. Sectors with low competitiveness risk do not receive additional gratuity. For this risk classification it is suggested that the previous competitiveness risk criteria should be graded as follows:

Table 1 – Competitiveness Risk Level Classification

Risk Level	High	Medium	Low
Cost of Emission Control (% of added value)	Higher than 15%	Between 5 and 15%	Lower than 5%
Trade Intensity (% X and M of production value)	Higher than 15%	Between 5 and 15%	Lower than 5%
Sum of Control Cost and Trade Intensity	Higher than 20%	Between 8 and 20%	Lower than 8%

Source: Own elaboration.

There is also a suggestion that the market-wide reduction target should be defined in absolute terms relative to the 2013 base year, starting at 10% for the first year and growing by an additional 2% each year. It is also suggested a 5% reservation for new entrants.

For this application, it is believed that the MRV system of the initial phase can generate the necessary information for the calibration of this criterion. In this way, the market package will have an additional version where the benchmarking criterion is adopted with variations in the amount of free allocation for sectors with competitiveness risk.

[23] See FGVCes (2016).

3.1.6 REDUCTION OF THE TAX BASE

Competitiveness protection, as already discussed, also applies to taxes in the form of the tax base reduction (output based rebate).

It is recommended, in the initial phase of pricing in Brazil, that Sectors with Risks of Loss of Competitiveness, as discussed above, should be exempted at 50% of the tax base of the carbon tax.

In the following stages, the tax base of the emissions would be calculated as follows:

Taxable emissions = total emissions of the product - (product protection factor x product output value x product emission intensity factor)

The use of intensity factors creates additional complexity in the regulation and collection of the tax.

The parameters of the protection factors and emission intensity of the production value would be the same as the SCE-EPC platform proposal described in the previous subsection.

3.1.7 PRICE CONTROL IN MARKET APPROACHES

Price stabilization measures in market approaches may include:

1. Additional allocation of emission allowances to a specific reserve for this purpose.
2. Reduction or enlargement of the face volume (the emission unit may suffer a reduction) of the distributed or purchased allowances.
3. Reduction or expansion of banking, borrowing and offset mechanisms.
4. Establishment of a ceiling price or a minimum one.

It is recommended for the Brazilian case that the price ceiling in the initial phase of the market should be R$ 30/tCO_2e and a minimum price of R$ 20/tCO_2e. To do this, it should be created a Stability Reserve with 10% of annual emission rights to be sold at R$ 30/tCO_2e. If the use of the reserve is not sufficient for the desired control, there can be allowed changes in the banking and offset restrictions and, as a last resort, the face value of the emission rights could be modified.

3.1.8 THRESHOLDS

In order to avoid excessive MRV administrative costs of the regulated entities, minimum thresholds for participation in the scope of pricing are usually adopted, reducing the number of regulated entities. In the case of taxes, this limit can be used to estimate the taxable base when the tax is levied only on the amount of emissions that exceeds the threshold.

Despite the differences in production dimension and in Brazilian emission profile that could indicate a lower threshold compared to more advanced economies, it is recommended to adopt the internationally used threshold of 25 ktCO2e, avoiding harming the competitiveness of smaller establishments in the country. The risk of encouraging deployments of smaller plants in the industry is low, given the scale and time of investments. The threshold for reporting of uncertified establishments would be 15 $ktCO_2e$ without verification obligation.

In the case of taxation, it is suggested to adopt this threshold for the calculation of taxable emissions as follows:

taxable emissions = total emissions - threshold.

In the case of liquid fuel distributors, there are 154 companies and 271 distribution bases authorized by the National Oil Agency (*Agência Nacional do Petróleo*, ANP, in Portuguese). The concentration in the sector is large, where BR is dominant, followed by Raízen and Ipiranga, in the ethanol, gasoline, diesel, aviation kerosene and fuel oil market, which together represent at least 60% of sales. In LPG, Ultragás, Liquigás, Supergasbrás and Nacional cover more than 80% of sales. However, for these sources, a threshold is not recommended once the total number of entities is low and they are already regulated by the ANP[24]. In addition, the creation of units with lower capacity than the threshold is avoided, since, unlike the industry, in this sector, the size of investments and the economies of scale are lower.

In the case of slaughterhouses, according to Scot Consultoria study (2018), there are 1,146 in operation in the country. The concentration in the industry is also very large, as JBS dominates 30% of cattle slaughtering, followed by Marfrig Global Foods with 16% and Minerva Foods with 11%. According to the study, JBS had 37 plants active in Brazil, slaughtering on average approximately 33 thousand cattle per day. Marfrig had 14 plants with approximately 14.5 thousand cattle per day, and Minerva Foods, with 11 plants active in the country, had 11.8 thousand cattle per day. The Federal Inspection Service (*Serviço de Inspeção Federal*, SIF, in Portuguese) of the Ministry of Agriculture, Livestock and Food Supply (Ministério da Agricultura, Pecuária e Abastecimento, MAPA, in Portuguese) registered 584 establishments with federal inspection in 2017. Almost 50% of the slaughterhouses have only municipal operations with small daily slaughtering capacity, average of 13.3 head/day, producing only 6.5% of the national quantity of slaughtered animals.

Therefore, it is recommended that the threshold should be restricted to include only slaughterhouses with federal inspection. As the need for federal inspection is mandatory for the economic viability of medium and large slaughterhouses, there is no risk of creating a perverse incentive to disqualification. In the case of the market, only the 584 refrigerators with federal inspection would be required to participate. In the case of taxation in the slaughterhouses, it is suggested to adopt a reduction of 13 head / day in the calculation basis in order not to encourage small establishments to clandestine.

In the case of coal, the processing plants are around 20, so that all of them can be included without a threshold[25].

3.1.9 Emissions Accounting

As already discussed, the efficiency of any pricing system depends on the ability to price the actual realized and/or controlled emissions. Therefore, accurate, standardized and verified accounting,

[24] ANP (2017).

[25] DNPM (2017).

quantification and disclosure of these emissions information - procedures and guidelines called MRV - are crucial for the effectiveness of pricing systems. Internationally the experiences require annual reporting with verification by external audit.

A significant number of large Brazilian companies monitor, report and verify their GHG emissions voluntarily on platforms such as the Brazilian GHG Protocol Program and the CDP Climate Change, and there are also reports to mandatory or voluntary state systems. This MRV experience will be of great value for the standardization of accounting and reporting rules for Brazilian carbon pricing[26]..

It is recommended, based on the experience of the SCE-EPC[27] platform, the greatest possible disaggregation in the MRV bottom-up approach. That is, at the business unit or plant / facility level, as is the case with EU ETS and Californa & Quebec ETS.

In addition, a national database of standard emission factors should be created to ensure the uniformity of the emission factors used in the calculations, so that the basis is the same for all. Specific emission factors must be verified by a competent body. Ideally, the MRV system should be introduced before the market system, so as to collect data that will help to realistically calculate the compliance target.

This convergence is already being developed in the component of Emissions Report of the Policies on Climate Change Program (*Programa sobre Políticas em Mudança do Clima*, PoMuC, in Portuguese) coordinated by the Ministries of Finance and Environment.

For the Monitoring, Reporting and Verification (MRV) procedures, an annual report is suggested for all regulated entities with third party verification.

3.1.10 Subnational Policies

Subnational climate policies can generate emissions leakage and double regulation to control GHG emissions. This may occur when a sub-national target, whether by control or prices instruments, is different from that of the national pricing system. With this difference of goals, control efforts in the most restrictive subnational jurisdiction will be larger, increasing the supply of emission allowances for the domestic market and lowering the price compared to that practiced for regulated sources in other subnational jurisdictions. The result may be that the efforts of the subnational jurisdiction are nullified, with greater emissions in other jurisdictions.

In this way, pricing systems should ideally have national jurisdiction, possibly compatible with subnational systems, which may require sectoral subnational targets to be aligned with the national ones[28].

[26] See a review of these experiences in FGVces (2016).

[27] FGVces (2016).

[28] This is a suggestion also indicated in FGVces (2016).

3.1.11 MARKETING RULES IN MARKET SYSTEMS

The allocation of emission rights in market systems is performed by the purchase of rights in auctions. The regulated entities can carry out transactions between themselves by selling and buying allowances acquired or allocated where there are custody and registration rules to be obeyed.

In most carbon markets, the frequency of auctions is quarterly, to allow for continuous adjustments throughout the year. There are auctions for the year of commitment as well as for future years in order to facilitate planning[29].

Most often, auctions prices ascend, can be opened or closed, and the winning bid is the highest bid or second highest. There is always, however, the reserve or minimum price (Auction Reserve Price) that ensures that sales do not occur below this value.

Rights acquired or received free of charge in one year may, in most jurisdictions, be used in future years. This so-called "banking" option increases cost-effectiveness, although it can create over-allocation risks. Almost all markets accept banking within the commitment period, sometimes limited for one or two years, especially in the early stages. Other ones restrict banking between commitment periods. Another flexibilization, although very little adopted, is the use of future rights acquired to fulfill the goal of previous years, the so-called "borrowing"[30].

In the initial market phase in Brazil it is recommended:

(i) Quarterly auctions with minimum ascending and open prices, to allow for greater price discovery capacity.

(ii) Acceptance of banking without commitment period limitations, to ensure greater flexibility to the system and create experience with the mechanism.

3.1.12 PENALTIES

Penalties for non-compliance with targets are of three types:

- Obligation to purchase the number of units unfulfilled times a factor of penalty, always greater than one;
- Payment estimated by the number of unfulfilled times a fixed value per unit, always higher than the purchase market price;
- Payment of a fixed value penalty regardless of the unfulfilled quantity;
- Opening of criminal proceedings with penalty of imprisonment.

[29] ICAP (2018).

[30] See ICAP (2018).

There is also payment of fine and criminal prosecution for falsification of reporting information.

In the Brazilian case, it is recommended a fine of R$ 100,000 for non-compliance with the targets (or a maximum of 5% of annual turnover for the last two years of the company responsible for the regulated source), adjusted by the IPCA, doubling in the case of recidivism[31].

In addition to the fine, it is suggested that the obligation to buy the unfulfilled equivalent of the target should occur in the following gradual manner:

- First year: once the quantity unfulfilled;
- Second and third years: one and a half times the unfulfilled quantity;
- Subsequent phases: three times the unfulfilled quantity.

As the emissions report is crucial for the following phases, it should be set a fine of R$ 200 thousand, adjusted by the IPCA, for the falsity or non-observance of reporting rules, doubling in the case of recidivism. Also, in these cases of false reporting, there is the possibility of applying the Environmental Crime Law, in its Art. 60 "*To construct, renovate, expand, install or operate, anywhere in the national territory, establishments, works or services potentially polluters, without the permission or authorization of the competent environmental agencies, or contrary to the pertinent legal and regulatory rules. This crime provides for detention, from one to six months, or fine, or both penalties cumulatively*"[32].

For tax systems, tax legislation must be applied.

3.1.13 INTERNATIONAL INTEGRATION

In market approaches, there is the possibility of integrating the national emissions market with that of other countries. As a result, control goals can be achieved through the purchase and sale of emission allowances in jurisdictions outside the country, in the form of tradable units. This possibility of international tradable units can be adopted even in the case of a taxation system, when the calculation basis of the regulated entity emissions is adjusted according to the internationally acquired allowances.

Since this integration means broadening the opportunities to buy and sell mitigation efforts, it alters the heterogeneity of control costs and, consequently, the equilibrium price in the domestic market.

Therefore, the decision to promote international integration depends on how the effects on the demand and supply of the domestic market are estimated vis-à-vis the diversity of markets in other jurisdictions.

[31] This value was adopted, for example, in Renovabio (Decree 9.308 / 2018).

[32] In the experience of the SCE-EPC (FGVCes, 2016) a very soft penalty rule was adopted for a compulsory and comprehensive market. In the event that a participant issues GEE in addition to the amount of permits and offsets it has at the end of the compliance period, it would receive a negative balance of allowances in the subsequent period in a quantity equal to the overdraft. In addition, for each tonne of CO2e emitted and discovered, a fine equivalent to the average purchase value of an allowance was applied.

International integration presupposes harmonization of rules of almost all design features that can create competitive imbalances and leakage, from annual goals to regulation point, allocation criteria, penalties and, in particular, MRV rules.

Considering that there are still low-cost options in the country that minimize the economic impact of introducing a pricing system, it is recommended, as is done in other countries, that international integration should be postponed to later phases of greater maturity of the domestic market and greater diversity of international markets.

3.1.14 Offsets Mechanisms

Offsets are credits for certain quantities of emission reductions obtained by non-regulated sectors, ie in sectors not covered by the pricing mechanism.

Offsets can be of three categories, namely:

- International agreements governed by the Paris Agreement;
- International agreements resulting from the integration of climate pricing policies, through bilateral or multilateral agreements; and
- Generated by reductions in non-priced sectors.

In all of these categories, in order to prevent carbon prices from being reduced too much, damaging the incentive to decarbonize regulated sectors and sectoral technological innovation, and to minimize potential leakage effects, most jurisdictions introduce limits on the use of offsets by regulated entities and, sometimes, also restricts its use in the total aggregate. This limit varies, but, in most cases it is 20% in market approaches.

For the Brazilian case, given the wide availability of national offsets, the use of international offsets is not suggested. These national offsets opportunities would be used both in the case of taxation and in market systems. As a result, regulated entities could abate the equivalent emission reductions from these offsets from the calculation basis.

The offset limit would be of 20% per regulated agent in the initial period, and reduced to 10% in the following periods.

These possibilities of national offsets would be:

- Environmental Reserve Quotas (*Cotas de Reserva Ambiental*, CRA, in Portuguese);
- Clean Development Mechanism (and, in the future, Sustainable DM).

When the CRA market starts operating, it will be necessary to define robust criteria and methodologies for stock measurement for each type of biome and its conversion to flow. One possibility would be a normative act of the Brazilian Forest Service that should define these parameters and make them appear in the information of the CRA when it shall be issued.

It is suggested that, in the CDM project accreditation (or future SDM) together with the Brazilian National Authority, the project proponent would indicate that it would be for national destination and not for the

Climate Convention. In this case the project would not be sent for registration under the Climate Convention. It is worth noting that the CDM would include the possibility of offsets from uncertified sectors such as planted forests, solid waste and sewage treatment. What is being suggested here is the adoption of CDM MRV procedures for credits generation.

3.1.15 Revenue Use

The uses of carbon pricing revenues may be the item that most requires an economic and regulatory assessment to evaluate the best options.

The choice of destination and the magnitude of the allocated revenue are parameters that consider fiscal, macroeconomic, technological, competitiveness, and even political negotiation issues.

As carbon pricing generates additional distortions to existing taxes, particularly in markets of production factors, economic literature shows that tax recycling affects growth less when it reduces the equivalent tax collection of other taxes than by reducing fiscal deficits or by performing direct transfers to households. The use of revenues for environmental finance, with great political appeal, when not for R&D, correcting another externality, can increase distortions. Pricing distortions increase the distortions of the subsidies intended to be created with the pricing revenues, thus, generate less welfare gains than the option that includes the tax burden reduction. However, distortions of these subsidies for environmental financing are often preferable to the possibility of no recycling with the consequent increases in the price level due to carbon pricing[33].

In any case, the international experience offers some indications. The recycling of these revenues in the economy varies greatly by purpose and degree of use among the various jurisdictions that use carbon pricing. Almost 3/4 of them combine different uses of revenue. The most common destination is for the general government budget. The main use is for tax purposes: 2/3 of the carbon pricing initiatives adopt this use exclusively (general budget) or in combination with other uses.

In the case of taxes, the financing of public expenditures, including environmental expenditures, was dominant in the Latin America experiences. Part of the revenue is also intended to reduce the tax burden of other taxes (tax shifting) and another part to finance public expenditures, mainly environmental[34].

In markets where there are auctions, the revenues generated are generally more geared towards climate change mitigation activities.

For the Brazilian case, as a first approximation, it is recommended the following composition of revenue uses for the initial phase:

(i) First Priority - Tax Compensation

[33] See recent review in Timilsinas (2018).

[34] World Bank (2017a).

When there is substitution or elimination of taxes, as in the case of transforming Fuels-CIDE into a Carbon-CIDE, the equivalent of the lost revenue of the eliminated tax should be allocated to the general budget of the Union and States. This equivalence can be estimated by the average revenue collected and its partition in the last three years before the replacement of the tax, which would be distributed in the same way as it is regulated by CIDE-Combustíveis. In the case of market approaches that do not require replacement or alteration of existing taxes, this destination would not exist.

(ii) Second priority: Distributive Compensation

When there is taxation on fuel and energy in household end use above the current level, part of the additional expenses should be allocated to low-income families. The amount to be distributed would be the equivalent of the collected revenue, discounted from the tax offsets described above. In this initial phase, when the tax is still small, it is suggested that the focus should be limited to the social transfers beneficiaries in the CadÚnico[35], which covers population in extreme poverty, that are beneficiaries of social programs and, therefore, are very sensitive to any prices variation of energy intensive goods. The additional expenditures would have to be estimated with parameters of the Family Budget Research for families with monthly per capita income of up to half a minimum wage.

The final constant value to be offset would be this estimate or the maximum possible amount in net revenue from tax offsets. It is suggested that this compensation should be an addition in the support granted by the *Bolsa Família* Program. The use of the *Bolsa Família* to mitigate the effects of fuel prices was already carried out at the time of the incorporation of the Gas-Voucher program (*Vale Gás*, in Portuguese) in 2003. This distributive compensation would not exist in the case of pricing without increasing the tax burden on fuel and energy in domestic final use above the current level.

(iii) Third Priority: Environmental Compensation

From net income discounted from tax and distributive compensation, half of it should be allocated as follows:

- An equivalent proportion of the total revenue collected from industrial sources should be allocated to the following Climate Fund subprograms: Efficient Machines and Equipment; Renewable energy; Carbon Management and Services; Charcoal; and Innovative Projects[36].
- An equivalent proportion of the total revenue collected from fuel distribution sources should be allocated to the following Climate Fund subprograms: Urban Mobility; Sustainable Cities and Climate Change; Solid Waste; and Native Forests.
- An equivalent proportion of the total revenue collected from agricultural sources should be allocated to credit lines in the ABC Plan, for assistance expenditures for sustainable practices,

[35] The Single Registry for Social Programs of the Federal Government (CadÚnico, from the Portuguese wording) is an instrument that identifies and characterizes low income families eligible for social programs and registers information such as: residence characteristics, identification of each person, schooling, work situation and income, among others.

[36] It should not be allocated in the subprogram Mineral coal.

such as technical assistance and rural extension services, purchase of genetic material and construction of fences, but which offers interest rates lower than the ABC credit.

From the net revenue discounted from tax and distributive compensation, the other half should be allocated to the Inovar Energia Program, equally distributed among the following purposes:

- development and dissemination of electronic devices, microelectronics, systems, integrated solutions and standards for the implementation of Smart Grids in Brazil;
- development and technological domain of the production chains of the following alternative renewable energies: solar photovoltaic, thermo-solar and wind power generation; and
- development of integrators and component chain densification in the production of hybrid / electric vehicles, preferably ethanol ones, and improving the energy efficiency of motor vehicles in the country;

In the following phases, this partition between compensations should be discussed based on:

- the needs of Union and State resources to finance adaptation plans;
- in the higher incidence of fuel prices, which could affect income classes outside the CadÚnico's coverage;
- in the neutrality of the carbon price, using the revenue for equivalent reduction of the tax burden;
- additional environmental funding needs with the determination of more ambitious NDC targets

Therefore, two additional versions of the taxation packages will be recommended, where revenue generation is broader, with a total revenue target for (i) public treasuries without reducing the tax burden and (ii) directly for social security, stimulating the generation of employment reducing the employer's contribution of the INSS.

For the additional version of the market package, where the potential to protect competitiveness with changes in the free allocation amount for sectors with a risk of competitiveness is reduced, it will be suggested that the total revenue allocation to be used to finance the sectors priced via *Fundo Clima* and *Inovar Energia*.

3.2 IDENTIFICATION OF THE PRICING INSTRUMENTS

Whatever the type of instrument, the cost-effectiveness of a price instrument is greater when (i) closer to the emitter agent and more accurate is the measurement of the priced emission, to ensure that the incentive is economically justifiable, (ii) higher the heterogeneity of control costs, which increases the likelihood of containing the lower cost options and (iii) lower the transaction cost of the regulated and regulator entities.

The choices of scope, point of regulation and emission calculation basis (defined below) are the design characteristics of an instrument that capture these cost-effectiveness factors. For these characteristics, economic theory and international experiences also help identify trade-offs between design options,

allowing the selection of the most appropriate ones for the productive structure of each source and sector[37].

Thus, the analysis of price instruments options considers the following aspects:

Scope: it identifies which emissions will be priced and, therefore, interferes with the price incentive focus. The broader the scope, the greater the cost heterogeneity, the more diverse the mitigation options that minimize the total mitigation cost. On the other hand, the larger the scope, the greater the regulation cost in terms of implementation and monitoring.

Point of Regulation: the closer the regulatory point is to the emission generator, the more flexibility there is for the emitter to decide the more cost-effective forms of mitigation. A regulatory point that is more upstream of the emitter point in the productive chain or consumption phase, can positively affect cost-effectiveness when it reduces the number of regulated entities.

Calculation Basis: The cost-effectiveness of the instrument depends on the precision of the emissions measurement, so the emissions calculation should be based on indicators that guarantee precise emission measurements. Diffuse sources may administratively impede direct measurements, requiring an indirect estimation via indicators which try to approximate emission measurements that, in addition to being less precise, create methodological controversies and ease of falsification. Therefore, the use of indirect measurements should be guided by the degree of access and availability of the information.

For the same instrument, combinations of scope, point of regulation and calculation basis can directly affect its cost-effectiveness.

These combinations for the tax, market, and hybrid packages are discussed below from these efficiency criteria.

3.2.1 CARBON TAX

Carbon-CIDE- in place of Fuels-CIDE, including emissions from combustion, industrial process and fugitive, and enteric fermentation.

Covered Gases: CO_2, CH_4, N_2O, SF_6, HFCs, PFCs, NF_3

3.2.1.1 FUEL

Scope: Emissions from fuel use in all sectors of the economy.

In the case of transports, the scope would include combustion emissions from gasoline, diesel, natural gas and aviation kerosene. The carbon content of ethanol and biodiesel could be considered neutral

[37] See guidance manuals for the design of pricing instruments such as OECD and World Bank (2015), CRP (2016) and World Bank (2016).

from the point of view of net emissions, thus, serve as a baseline for other fuels. The emissions differences in the production of biofuels would be treated within the scope of the *Renovabio*[38].

In the case of fuels for industrial use, the scope would also include fuel oil, coal, petroleum coke, waste, charcoal, and biomass, where biomass and charcoal with certified production could be considered neutral[39]. Petrochemical naphtha, destined to the elaboration of petrochemicals, that does not emit GEE, would not be included.

In the case of electricity generation, the emissions in the burning of fuel oil, coal, natural gas and biomass would be considered, but biomass would be considered neutral. In this case, it should be noted that the emissions from combustion in the industrial, commercial and residential sectors would also be included to avoid leakage resulting from the increase in the centrally produced energy price.

Point of Regulation: The carbon tax would be, as in Fuel-CIDE, for producers, formulators (refineries, petrochemical plants or formulators for oil derivatives, gas carriers and coal miners) and importers of fuels. Such upstream regulation simplifies and reduces the number of regulated entities, but restricts substitution flexibility and, therefore, cost-effectiveness.

In this way, producers and formulators of fuels would only be able to reduce emissions with energy efficiency and change of demand due to the variation of prices.

In the case of commercialization in the domestic market, the tax due will be calculated monthly and on importation on the date of registration of the Import Declaration (*Declaração de Importação*, DI, in Portuguese).

From the tax value on trade in the domestic market, the amount of the tax due in previous operation may be deducted: (a) paid by the taxpayer upon importation; or (b) paid by another taxpayer upon acquisition on the domestic market.

Calculation Basis: Emissions estimated directly from CO_2e content parameters of the fuels sales volume with Tier 1 of the National Inventory.

3.2.1.2 INDUSTRY

Scope: The scope of emissions would be process and fugitive emissions, generated throughout the manufacturing industry, including energy producers (refineries, coal, mining, distilleries, etc.).

Covered Sectors: Aluminum, Lime, Cement, Pig Iron and Steel, Pulp and Paper, Chemistry, Glass, Food and Beverages, Textiles, Ceramics, Ferroalloys and Mineral Extraction.

Point of Regulation: The collection would be in industrial establishments.

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[38] According to § 2 of Decree 9,308/2018: each decarbonization credit unit will correspond to one ton of carbon dioxide equivalent, obtained from the difference between the greenhouse gas emissions in the life cycle of a biofuel and the emissions in the life cycle of its substitute fossil fuel, estimated according to the procedures and criteria adopted for the Certification of Biofuels.

[39] Certificates, such as the Forest Stewardship Council (FSC).

Calculation Basis: The charge would be derived directly from CO_2e content parameters of process emissions and fugitive emissions, per quantity produced. It is suggested to use the same National Inventory parameters. For simplicity, the tax would be accounted for in conjunction with other taxes, to ensure a low additional accounting cost.

3.2.1.3 AGRICULTURE

Scope: The number of properties emitting is in the order of millions, spread throughout the national territory. In addition, they are diffused emission sources and conditioned to different productive characteristics, which makes emissions identification and measurement costly and complex.

However, the reduction in the production cycle of beef cattle is an interesting strategy to reduce the emission of GHG in Brazilian livestock, which is the main source of the sector's emission. In this case, it would be necessary to approximate the enteric fermentation emissions of bovine livestock by a combination of the slaughter age and productive techniques, which can be calculated, or reasonably estimated, in the slaughterhouses production.

Taxation would be restricted to an approximation of CH_4 emissions from enteric fermentation of beef cattle.

Point of Regulation: The slaughterhouses, on the downstream of the chain, are in much smaller number and already have experience with systems for identifying their purchases, including data on weight, sex, race, food. In the aggregate, this regulatory point would drastically reduce emissions accounting and monitoring costs, being one of the few options to implement pricing in the industry. It could generate an incentive for the slaughterhouses to differentiate their cattle purchase prices by age and productive technique, as it is currently done by the quality of the meat, and thus induce changes in the cutting profile.

It should be noted, however, that in addition to the approximate measurement of emissions by adopted slaughter and technology indicators, this regulation point in the slaughterhouses would reduce the pricing effectiveness, since it is far from the segment of the chain that is the effective emitter[40].

Calculation Basis: Enteric fermentation, measured indirectly by the combination of meat production and age of slaughter (beef cattle), combined with the adopted practices that affect these emissions. It is suggested that by the age of slaughter of 36 months, the level of emissions for tax or market is considered zero. For the ages of 37-40, 41-48 and above 48, the emission accounting would follow, for each interval, a scale with a fixed emissions value on which would apply reducers according to the emission indicators of the productive technique.

[40] In addition, it can increase the market power of these slaughterhouses relative to producers by reducing their profit margins in order to minimize the effects on demand through the consumer price. Although this possibility is desirable to control the price level of the economy, it may not generate demand effects for substitution of consumer items.

The accounting of the enteric fermentation emissions, measured by the combination of production volume and slaughter age, can take advantage of the current systems already adopted for the slaughterhouses that already consider these characteristics.

In the case of including productive techniques, an alternative would be to allow producers who have proven sustainable techniques to present a certification, on top of which an emission reducer could be applied.

3.2.1.4 *Shadow Price at the Electricity Dispatch*

Taxing coal and natural gas fuels, as described above, will affect the marginal cost of thermoelectric generation, thus the bid price in auctions and the generation in the free market. Taxation would also raise the unit variable cost (*Custo Variável Unitário*, CVU, in Portuguese) of the dispatched thermoelectric energy and the settlement price of the differences (*Preço de Liquidação das Diferenças*, PLD, in Portuguese) that compensates for the mismatch of supply resulting from orders dispatched from other sources.

In the dispatch, as intermittent renewable sources already have priority in the merit order, the effects of fuel taxation at this point of the chain would be restricted to changing the order of gas and coal sources; which is positive, since it signals carbonization of intermittence by reserve sources and, in addition, induces energy efficiency.

If it is desired to avoid these price effects, an option would be to use a carbon shadow price in the dispatch for the energy already contracted and in the auctions for new energy to be contracted. With this mechanism, the shadow carbon price would enter into the accounting for Variable Unit Costs (CVU) and, therefore, in the dispacth Marginal Operating Costs (*Custo Marginal de Operação*, CMO, in Portuguese), only for the merit order of the coal and gas thermoelectric plants, without, however, generating payment obligation. Similarly, this shadow price would change the bid for new energy auctions, and, therefore, the order of hiring, without, however, affecting hiring prices.

In this case, the shadow price will have to be included in the scope of the CVU according to technical parameters approved by ANEEL, and then calculated in the CCEE, according to the verified generation value.

3.2.2 Carbon Market

Covered Gases: CO_2, CH_4, N_2O, SF_6, HFCs, PFCs, NF_3

Scope: emissions of (i) the use of fuels, (ii) industrial processes and fugitive ones, and (iii) enteric fermentation of livestock.

In the case of transports, the scope would consist of the combustion emissions from gasoline, diesel, natural gas and aviation kerosene. The carbon content of ethanol and biodiesel could be considered neutral from the point of view of net emissions and serves as a baseline for other fuels.

In the electric energy generation, emissions would be the combustion of fuel oil, coal, natural gas and biomass, and biomass would be considered neutral. In this case, it should be noted that the emission

of burning from self-generation in industry and homes would also be included to avoid leakage resulting from the increase in the price of energy centrally produced.

In industry, the scope would include emissions from the combustion of fuel oil, biomass, waste, charcoal, coal, coke and coke oven gas, where certified biomass and charcoal could be considered neutral. In the industry, there would still be covered process and fugitive emissions, including non-energy uses of fuels. In addition to the greater ease of accounting in MRV, the inclusion of fuel emissions is also justified as the emissions of non-CO_2 gases depend on the technology used in combustion.

In agriculture, the pricing would be restricted to an approximation of the CH_4 emissions of enteric fermentation of livestock.

Point of Regulation:

- Fuels for non-industrial purposes: distributors of diesel, gasoline, fuel oil, LPG, aviation kerosene and natural gas; coal-fired power plants; and coking plants;
- Industry: industrial establishments;
- Agriculture: cattle slaughterhouses.

A market system for industrial emissions will be more cost-effective if regulated entities can manage mitigation with greater heterogeneity of options. Therefore, for the industrial emissions of combustion, process and fugitives ones, the point of regulation would be the industrial establishment.

For fuels, the regulation point would be in the distributors of liquid fuels and those of LPG, natural gas and coal, although with emission restrictions only for transports and electric generation fuels.

In agriculture, the recommendation would be to have slaughterhouses as a regulation point.

Allocation Criteria:

Free allocation of 50% of emission allowances by the criterion of grandfathering for all sectors with competitiveness risk and allocation by auctions for the other sectors in the first phase of the market, of three years, as explained above.

It would also be desirable to progressively vary the allocation criteria with a distribution of allowances with a more categorized competitive risk rating, reduced total free allocation and benchmarking[41].

3.2.2.1 CARBON CREDITS MARKET IN THE ELECTRICITY GENERATION SECTOR

The dispatch centralization of the electric power makes difficult to allocate emission rights in the thermoelectric plants in an emission allowances market approach, since the emitters do not control their production. The decision about quantities to be dispatched is exogenous to the producer, restricting the incentive to plan the reconciliation of emissions with the acquisition of allowances.

[41] One possibility would be the allocation proposal adopted in the SCE-EPC.

Alternatively, there would be the possibility of a baseline and credit system for the free market of electric power. Thus, when emissions reach carbon intensity levels below the baseline limit of a generating source contracted in that market, it generates credits that can be sold to the consumers of that market that also have a target of carbon intensity in the consumption to be reached. This possibility will be adopted in one of the versions of the market package.

3.2.2.2 *CARBON CREDITS MARKET IN THE LIVESTOCK SECTOR*

Another possibility in the livestock sector would be the creation of a carbon credit market with sector-specific baseline and credits, operating independently of the carbon pricing of other sectors. With this system, targets for the intensity of enteric fermentation emissions per ton of beef would be defined for the production of bovine meat, as well as baselines for livestock enteric fermentation emissions per hectare. The goals of the slaughterhouses would be met with credits generated by emission reductions in livestock.

Emissions from cattle raising would be measured using the same metric as the proposed for the tax system. To that end, emission measurements per hectare, measured on the basis of the combination of slaughter age and production technique, should be certified by accredited third parties.

This possibility will be adopted in one of the versions of the market package.

3.2.3 HYBRID PRICING

The hybrid package combines tax with market system.

Taxation for the burning of fuels (except in industry) and also for livestock, and market for industry (including fuel burning), as presented above for the tax instrument in Section 3.2.1.

The market system, as presented above in Section 3.2.2, would be the most adequate for the industrial sector, because of its highest sensitivity to leakage and because it allows more flexibility in the mechanisms of protection against competitiveness risk, greater participation in the activities of mitigation and better transparency in control targets. In addition, it has been the approach most used internationally to price the industry and is indicated in Brazil as preferred by the Brazilian industrial sector.

In other sectors, the taxation of Section 3.2.1 is recommended, in view of the ease of adjusting Fuels-CIDE for carbon intensity parameters vis-à-vis the integration of fuel distributors and upstream slaughterhouses in a market system .

Taxation on fuels in the industry whose emissions are in the market system would be exempted to avoid double pricing.

4 CARBON PRICING PACKAGES

As discussed above, there are possibilities for designing each pricing instrument with different cost-effectiveness gains and losses that can be equivalent, such as scope, point of regulation and emissions accounting. In addition, the mechanisms of competitiveness protection can vary by instrument and in its form and scale. Revenue uses, although not associated with the typicity of the instrument, can combine different destinations.

The packages presented here were proposed based on sector reports and review of international experience.

The differentiation of the packages also sought to emphasize these aspects of design so that the economic and regulatory modeling could exploit its economic and cost-effectiveness impacts. For this, the packages were modulated as follows:

- **Taxation: pricing only with a carbon tax**

Emphasis on the use of revenues and design variations regarding scope, regulation point and accounting of emissions.

Three versions of tax packages are proposed. The Taxation Package A is the most comprehensive in scope and coverage. As this package presents the greatest potential for revenue generation, its versions seek to adopt different destinations for its uses.

Version B simplifies version A by including different possibilities of taxation on electricity, exemption for LPG and variation in the calculation basis of agriculture. In addition, it includes reductions in the taxable base in sectors with a risk of competitiveness and, finally, proposes the full use of the revenues for the public coffers.

Version C only modifies Version A by making carbon tax revenue neutral.

- **Market: Carbon market pricing only**

Emphasis on mechanisms of competitiveness protection in variations of emission allowances allocation criteria and emissions trading format.

Market packages have the same scope and coverage. However, there are two versions that seek to address distinct choices in the allocation of emission rights and destination of revenues. Option A adopts grandfathering allocation, with 50% free allocation for sectors with high competitiveness risk, with revenue split between fiscal, distributive and environmental ends.

Option B reduces competitiveness protection by changing the Competitiveness Risk rating, also diminishes the total free allocation with the benchmarking criterion, and reduces the offset limit. Given this change in the competitiveness protection, the destination of revenues is also modified, with its entirety allocated to the priced sectors.

In option C, competitiveness protection is carried out with border adjustments, including targets on imports and target exemption of exports, so all rights will have to be acquired through auctions, with no free allocation to any sector.

- **Hybrid: pricing combines carbon market with tribute**

Finally, the hybrid package presents a combination of the tax with the market system previously presented.

Taxation for fuels and livestock, and market for industry. The market system is indicated for the industrial sector due to it higher sensitivity to leakage and because this approach allows greater flexibility in the mechanisms of protection against competitiveness risk, greater participation in mitigation activities and better transparency in control goals. In addition, it has been the most used international approach to price the industry and has been pointed to as preferred by segments of the Brazilian industrial sector.

In other sectors, taxation is recommended in order to adjust Fuels-CIDE to carbon intensity parameters vis-à-vis the integration of fuel distributors and upstream slaughterhouses in a market system.

To avoid double pricing, it is proposed to exempt this tax on fuel for industrial purposes. To this end, the tax adjustment point is in the distributors, in order to allow discrimination of the incidence of the tax. To further minimize double pricing, we suggest considering in the impacts analysis a scenario in which the Renovabio would be discontinued.

The following is a summary of these packages described in detail below.

Chart 1 - Summary of recommendations for pricing packages

	Tax (Complete, Simplified and Neutral Packages)	Market (Grandfathering, Benchmarking e Segmented Packages)	Hybrid
Sectors	Transport; Thermoelectric Generation; Industry (Aluminum, Lime, Cement, Pig-Iron and Steel, Paper and Cellulose, Chemistry, Glass, Food and Beverages, Textile, Ceramics, Ferroalloys and Mineral Extraction); Agriculture		
Gases	CO_2, CH_4, N_2O, SF_6, HFCs, PFCs, NF_3		
Scope	Emissions from: (i) fuels, (ii) industrial processes (iii) figitives; (iv) enteric fermentation on cutting livestock		
Commitment Period	Initial period: three years. Following periods: to adjust with NDC review periods.		
MRV (to be revised by PoMuC project)	Annual report for all regulated entities, with third party verification, and for the economic agents of the industry with emission above 15 $ktCO_2e$, without the need for third party verification. In the Hybrid package, fuel distributors must identify end-use sales so as not to tax industrial purposes.		
Pricing instrument	Tax: Carbon-CIDE replaces Fuel-CIDE Modification in the **Simplified Package:** To use a shadow carbon price in the dispacth for energy already contracted and in the auctions for new energy contracted from thermoelectric plants.	Emission Rights Market: Grandfathering and Benchmarking **Segmented Package**: emission allowances and credits The carbon credit markets would be: •National Biofuel Policy (RenovaBio) • Carbon Credits Market in the Electricity Generation Sector (Consumer x Generator in the Free Market) • Carbon Credit Market in the Livestock Sector (Cattle Raiser vs. Slaughterhouses)	Tax: Carbon-CIDE replaces Fuel-CIDE in the sectors of transports, thermoelectric generation and agriculture Market: in the industrial sector for combustion emissions, industrial processes and fugitives ones
Point of Regulation	Fuels: **producers, formulators and importers of the following fuels:** diesel, gasoline, fuel oil, LPG, aviation kerosene, natural gas and coal. Industry: industrial establishments Agriculture: cattle slaughterhouses	Fuels: **distributors** of diesel, gasoline, fuel oil, LPG, aviation kerosene, natural gas, coal and coke mills Industry: industrial establishments Agriculture: cattle slaughterhouses	Industry: industrial establishments Agriculture: cattle slaughterhouses Fuels for non-industrial purposes: distributors and importers of gasoline, ethanol and diesel, LPG, fuel oil, natural gas and coal-fired power plants

For Market: Sectors with Competitiveness Risk Grandfathering Initial Phase	• Cost of emission control: the increase in production costs is higher than 15%, as a proportion of the added value; or • Intensity of trade: the intensity is greater than 15%; or • Combining carbon cost and trade intensity: if control costs increase by at least 5% of the industry added value and the international trade intensity of the sector is greater than 10%.		
For Market: Sectors with Competitiveness Risk Benchmarking Phase	High Risck: Cost of Control or Trade Intensity greater than 15% or Sum of Cost and Intensity greater than 20%.	Medium Risk: Cost of Control or Trade Intensity between 5 and 15% or Sum of Cost and Intensity between 8 and 20%.	Low Risk: Cost of Control or Trade Intensity lower than 5% or Sum of Cost and Intensity lower than 8%
Permission allocation criteria	N/A	In the **Grandfathering Package:** Initial Period: grandfathering criterion with 50% free allocation for all sectors with a high competitiveness risk. For the other sectors, the allocation would be via auctions. In the **Benchmarking Package:** Initial Period:benchmarking criterion, as follows: 1. The benchmark production (with the lowest indicator of carbon intensity) of each sector or subsector with high and medium risk of competitiveness receives 50% of the estimated allowances free of charge, while the worst receives 30%; 2. Sectors with only one emitter with high and medium risk of competitiveness, this one receives 100% of the allowances for free; 3.Producers with high and medium risk of competitiveness with intermediate indicators receive proportional percentages; 4. If it belongs to an industry with high (or medium) competitiveness risk, it receives another 10% (or 5%) free of charge; 5. Sectors with low competitiveness risk do not receive gratuity. In the **Segmented Package:** identical to the Benchmarking package, except in the industry, in which there would be 100% emission auction, with border adjustment, as follows: 1.The emissions of exported production in the year are accounted for as free allowances in the following year; 2. Importers will have their emissions estimated by the average carbon intensity used in the benchmarking process of the equivalent domestic sector, and will be acquired via auctions.	Only for the industrial sectors: Initial Period: grandfathering criterion with 50% free allocation for all sectors with risk of competitiveness.

	Tax (Complete, Simplified and Neutral Packages)	Market (Grandfathering, Benchmarking e Segmented Packages)	Hybrid
Thresholds (to be revised by PoMuC project)	Industry: establishments with an emissions higher than 25 ktCO2e Other sectors: all establishments Slaughterhouses: only slaughterhouses with federal inspection		
Calculation Basis	Fuels: Emissions estimated directly from parameters of equivalent carbon content (Tier 1 of the National Inventory) of fuel sales volume. Industry: Emissions estimated directly from parameters of equivalent carbon content, Tier 3 of the National Inventory, of process emissions and fugitive by quantity produced. Agriculture: In **Complete and Neutral packages**: Enteric fermentation indirectly measured by the combination of the total meat production, the **age of slaughter (beef cattle) combined with production practices** that affect these emissions by slaughter age. It is suggested that by the age of slaughter of 36 months the level of emissions is considered zero. For the ages 37-40, 41-48 and above 48, the emissions would follow, for each interval, a fixed scale of taxable base, on which would apply reducers according to emission indicators of the productive technique. In the **Simplified package**, enteric fermentation emissions measured based on the volume of production and age of slaughter, with the same parameters described above.	Fuels: Emissions estimated directly from parameters of equivalent carbon content (Tier 1 of the National Inventory) of fuel sales volume. Industry: Emissions estimated directly from parameters of equivalent carbon content, Tier 3 of the National Inventory, of process emissions and fugitive by quantity produced. Agriculture: Enteric fermentation indirectly measured by the combination of the total meat production, the age of slaughter (beef cattle) combined with production practices that affect these emissions by slaughter age. It is suggested that by the age of slaughter of 36 months the level of emissions is considered zero. For the ages 37-40, 41-48 and above 48, the emissions would follow, for each interval, a fixed scale of taxable base, on which would apply reducers according to emission indicators of the productive technique. In the following periods, the basis of calculations with factors estimated more directly with plant and product data ("bottom-up") will be developed.	Fuels: Emissions estimated directly from parameters of equivalent carbon content (Tier 1 of the National Inventory) of fuel sales volume. Industry: Emissions estimated directly from parameters of equivalent carbon content, Tiers 1 and 3 of the National Inventory, of process emissions and fugitive emissions by quantity produced and of **combustion by quantity purchased**. Agriculture: Enteric fermentation indirectly measured by the combination of the total meat production, the age of slaughter (beef cattle) combined with production practices that affect these emissions by slaughter age. It is suggested that by the age of slaughter of 36 months the level of emissions is considered zero. For the ages 37-40, 41-48 and above 48, the emissions would follow, for each interval, a fixed scale of taxable base, on which would apply reducers according to emission indicators of the productive technique. In the following periods, the basis of calculations with factors estimated more directly with plant and product data ("bottom-up") will be developed.
Exemption Criteria	For the initial phase it is proposed that: •The sectors considered as Competitiveness Risk are exempted at 50% of the tax base of the carbon tax; • Naphtha destined for the production of petrochemicals that do not emit carbon would not be taxed. •Municipal and state slaughterhouses would not be taxed. **Simplified Package** Modification: exemption from LPG due to distributional impacts.	Petrochemical naphtha, destined to the elaboration of petrochemicals, would not be included. Municipal and state slaughterhouses would not be included in the pricing. In the Segmented package, fuels, cattle raising and thermoelectric generation can generate carbon credits.	Petrochemical naphtha, destined to the elaboration of petrochemicals, would not be included. Municipal and state slaughterhouses would not be included in the pricing. Renovabio would be disabled. Industry sectors that are covered in the market system would have their fuel purchases exempted from Carbon-CIDE.

	Tax (Complete, Simplified and Neutral Packages)	Market (Grandfathering, Benchmarking e Segmented Packages)	Hybrid
Rate value	• Initial Period: constant value of R$30/tCO$_2$e (equivalent to US$ 10/tCO$_2$e) annually adjusted by the IPCA. • Following Periods: a real readjustment factor whose magnitude will be discussed at the time and in the light of NDC's goals.	N/A	<u>Only transports, thermoelectric generation and agriculture:</u> • Initial period: constant value of R$ 30/tCO$_2$e (equivalent to US$ 10/tCO$_2$e) annually adjusted by the IPCA. • Next periods: real readjustment factor whose magnitude will be discussed at the time and in light of the NDC targets.
Mechanisms of price control	N/A	Initial phase: ceiling price of R$ 30/tCO$_2$e and minimum price of R$ 20/tCO$_2$e. Instruments: • Stability Reserve with 10% of the annual allowances to be sold at prices of R$ 30/tCO$_2$e and a New Entrants Reserve of 5%. • Allow changes in banking and offset constraints.	
Total limit (*cap*)	N/A	Initial period: Economic modeling indicates total emission limit (cap) corresponding to the value of a tax of R$ 30/tCO$_2$e. Next periods: annual emission limit reducing factor whose magnitude would be discussed at the time in the light of the NDC targets.	
Offset	Only national offsets will be accepted. In the initial period the offset limit would be 20% per regulated agent. In subsequent periods, the ceiling would be reduced gradually to 10%. The possibilities of national offsets would be: • Quotas of Environmental Reserve, when regulated • Projects with MRV of Clean and Sustainable Development Mechanisms		
Penalty	In accordance with the tax legislation.	In the initial period, a fine of R $ 100,000 (or, at the most, 5% of the average of the annual turnover of the last two years of the company responsible for the regulated source), adjusted by the IPCA. The obligation to buy the equivalent of the unfulfilled target in the following gradual manner: Initial phase • First and second year: once the quantity not met • Third year on: one and a half times the unfulfilled quantity Subsequent phases: three times the unfulfilled quantity Fine of R $ 200 thousand, adjusted by the IPCA, for the falsity or non-observance of the reporting rules, doubling in case of recurrence. And the possibility of applying the Environmental Crime Law.	<u>In the case of market (industry):</u> In the initial period, a fine of R $ 100,000 (or, at the most, 5% of the average of the annual turnover of the last two years of the company responsible for the regulated source), adjusted by the IPCA. The obligation to buy the equivalent of the unfulfilled target in the following gradual manner: Initial phase • First and second year: once the quantity not met • Third year on: one and a half times the unfulfilled quantity Subsequent phases: three times the unfulfilled quantity Fine of R $ 200 thousand, adjusted by the IPCA, for the falsity or non-observance of the reporting rules, doubling in case of recurrence. And the possibility of applying the Environmental Crime Law. <u>In the case of tribute (transportation, thermoelectric generation and agriculture):</u> In accordance with the tax legislation.

	Tax (Complete, Simplified and Neutral Packages)	Market (Grandfathering, Benchmarking e Segmented Packages)	Hybrid
Revenue Use (subject to the restrictions of Constitutional Amendment 95/2016)	For the **Complete package**: (i) Initial Period: a. First Priority - Tax Compensation b. Second priority: Distributive Compensation c. Third Priority: Environmental Compensation (ii) Following Periods In the following phases, this partition between compensations would be rediscuited based on: • the fiscal needs of the Union and the Member Stated • the higher incidence of fuel prices that could affect income classes outside the CadÚnico's coverage • the neutrality of the carbon price using the revenue for equivalent reduction of the tax burden • (probably) the increased funding needs with the determination of more ambitious NDC targets. For the **Simplified Package**: Same as the expected revenue use in the current Fuels-CIDE For the Neutral package: INSS tax reduction	For the **Grandfathering package:** (i) Initial Period: a. First Priority - Tax Compensation b. Second priority: Distributive Compensation c. Third Priority: Environmental Compensation (ii) Following Periods In the following phases, this partition between compensations would be rediscuited based on: • the fiscal needs of the Union and the Member Stated • the higher incidence of fuel prices that could affect income classes outside the CadÚnico's coverage • the neutrality of the carbon price using the revenue for equivalent reduction of the tax burden • (probably) the increased funding needs with the determination of more ambitious NDC targets. For the **Benchmarking e Segmented packages:** All revenues allocated to the Climate Fund with 100% application in the sectors priced.	(i) Initial Period: a. First Priority - Tax Compensation b. Second priority: Distributive Compensation c. Third Priority: Environmental Compensation (ii) Following Periods In the following phases, this partition between compensations would be rediscuited based on: • the fiscal needs of the Union and the Member Stated • the higher incidence of fuel prices that could affect income classes outside the CadÚnico's coverage • the neutrality of the carbon price using the revenue for equivalent reduction of the tax burden • (probably) the increased funding needs with the determination of more ambitious NDC targets.

Fonte: Elaboração própria.

5 ADJUSTMENTS TO SECTORAL INSTRUMENTS

Sectoral policies and programs offer market reserve instruments, credit and tax subsidies, and technological standards with the objective of encouraging the expansion of the sectoral product. The instruments of these policies and programs, when directed to the expansion of sectors and activities with high carbon intensity, generate an opposite effect to the one of the carbon pricing. Therefore, if these sectoral instruments are not realigned, the carbon price incentives to decarbonization will be reduced.

Even the instruments of current sectoral policies and programs directed at low carbon products and activities may have conflicts of overlapping objectives or targets with pricing instruments. In such cases, they may require adjustments to avoid additional unnecessary mitigation costs to meet mitigation targets.

However, sector policy instruments and programs that seek to correct market failures associated with climate externalities, such as technological ones that are corrected through the promotion of R&D and technological diffusion, increase the effectiveness of carbon pricing. However, these instruments may also need focusing adjustments to amplify complementary effects.

The sectoral instruments presented below point out the adjustment needs and how these could be analyzed in the economic modeling and in the regulatory impact assessment. These adjustments to the existing instruments can be combined with any pricing packages, since changes do not affect the pricing instrument choice *a priori*.

5.1 FUELS

5.1.1 CARBON PRICING

There are already in Brazil some instruments that indirectly price the carbon emissions of fuels or could serve for this purpose - notably Fuels-CIDE- and Renovabio.

5.1.1.1 FUELS-CIDE

In the case of pricing the carbon through a tax mechanism, there is the opportunity to transform Fuels-CIDE in a Carbon-CIDE, through an amendment project to the Constitution. The migration of taxes on energy to a carbon tax was a trajectory used in many countries.

Conversion to a Carbon-CIDE would result in three (or four) changes, namely:

(i) to explicitly add the criterion of adjusting the rate values in proportion to the fuels carbon content;

(ii) to change the revenue destination for the activities with GHG emissions reductions motivation, such as distributive compensations and financing of environmental and control activities; and

(iii) depending on the scope of pricing, to include other fuels, such as coal and natural gas.

5.1.1.2 RENOVABIO

Although Renovabio has similarities to a proposed carbon trading regime, there are important differences between them in the criteria of targets and MRV.

Its scope is thus limited to the carbonic relationship between biofuel production and the sale of fossil fuels. Renovabio resembles a credit and baseline system, in which emissions below the baseline limit of one source generate credits that can be sold to other sources that emit above their target. Thus, "Cbio" would be a form of offset restricted to the carbon intensity ratio between biofuels and those fossil fuels that can be mixed with biofuels.

In addition, the accounting of emissions in Renovabio covers the product life cycle. That is, Renovabio is a market system with restricted scope and marketing criteria, and with its own emissions accounting.

Therefore, it would be very complex to create fungibility mechanisms between the "CBios" and the emission rights of a carbon market (cap & trade), such as those proposed here, so that the target achievement of a system would be allowed with the credits of another[42].

Coexistence between the two non-fungible systems may affect the value of the credits of each carbon market whenever the carbon intensity targets are different[43]. It is also proposed that when there is a tax or carbon market for fuels (i) Renovabio should not be included in the tax and market pricing packages or (ii) Renovabio should replace the pricing of the liquid fossil fuels of the tax or market scheme.

5.1.2 PROGRAMS

5.1.2.1 ENERGY EFFICIENCY

Add the GHG emission indicator labels in the Brazilian Vehicle Labeling Program (*Programa Brasileiro de Etiquetagem Veicular,* in Portuguese), linked to CONPET[44].

[42] That is, to create tradable units that are fungible mechanisms between two markets that have decided to integrate.

[43] The Renovabio was inspired by California's Low Carbon Fuel Standard (LCFS), although there is a wider spectrum of clean fuels, such as compressed natural gas, liquefied biogas, hydrogen, and electricity for electric vehicles, and targets are imposed on producers and importers of fuels. In California, however, given the difficulties of fungibility, it was chosen to keep the LCFS as an independent system of the California ETS without fungibility.

[44] Federal Government Program created in 1991 to promote the development of an anti-waste culture in the use of non-renewable natural resources in Brazil.

5.1.2.2 *Regulatory Improvement*

No subsidies should be created to compensate for the pricing in the three programs, namely: Gas to Grow[45], Fuel Brazil[46], Fuel Quality Monitoring (PMQC)[47].

5.1.2.3 *Financing*

The pricing revenue could increase the amount of these credit lines and/or reduce interest rates on the lines that foment the decarbonization, such as Climate Fund, FINEM-BNDES (transportation, distribution and production of biofuels) and Support to Innovation in the sugarcane for energy and chemicals sectors (*Apoio à Inovação dos Setores Sucroenergético e Sucroquímico*. PAISS, in Portuguese).

5.1.2.4 *Subsidies*

There are varied subsidies to the activities of development, extraction, refining and distribution of fossil energy in Brazil[48]. Special mention should be made of the Special Customs Regime for the Export and Import of Assets Destined for the Research and Development Activities of the Oil and Natural Gas Reserves (REPETRO)[49], the Special Regime for Incentives for the Development of Infrastructure for the Oil Industry in North, Northeast and Midwest Regions (REPENEC)[50] and the Special Customs Regime for Importation of Crude Oil and its By-Products (REPEX)[51].

Therefore, the following removal planning of these subsidies is suggested:

(i) To reduce REPENEC and REPEX subsidies in 10 years at a rate of 10% per annum; and

(ii) To redirect the annual decreasing amount of subsidies for direct investments in R&D in the removal of emissions from domestic refineries with carbon capture and storage technologies.

Subsidies for domestic LPG consumption that were incorporated into the *Bolsa Família* in 2011, in addition to the distributive impact, encourage its use to the detriment of the use of other more carbon

[45] In Portuguese: *Gás para crescer*.

[46] In Portuguese: *Combustível Brasil*.

[47] In Portuguese: *Programa de Monitoramento da Qualidade dos Combustíveis*.

[48] In Brazil see INESC (2018) and in the world at large, see, for example, recent review in Coady et al. (2017).

[49] *Regime Aduaneiro Especial de Exportação e de Importação de Bens Destinados às Atividades de Pesquisa e de Lavra das Jazidas de Petróleo e de Gás Natural* (REPETRO), in Portuguese.

[50] *Regime Especial de Incentivos para o Desenvolvimento de Infraestrutura da Indústria Petrolífera nas Regiões Norte, Nordeste e Centro-Oeste* (REPENEC), in Portuguese.

[51] *Regime Aduaneiro Especial de Importação de Petróleo bruto e seus Derivados* (REPEX), in Portuguese.

intensive fuels or pressure on native forests. Therefore, such compensation to low-income households should be expanded if pricing is to increase the price of LPG.

Direct subsidies for coal and natural gas for thermoelectric generation will be discussed later.

Thus, for economic modeling it is suggested to estimate scenarios:

- with the creation of Carbon-CIDE;
- with or without the Renovabio;
- of productive impacts in the removal of REPENEC and REPEX subsidies; and
- with the current allocation of CIDE's revenues in the current composition and others with destination changes.

For the regulatory impact assessment it is suggested to analyze legal and political viability:

- of the creation of a Carbon-CIDE as indicated here, including analyzing the legal diploma (PL or PEC);
- of the coexistence of Renovabio with the carbon pricing on fuel, whether by tax or market, including analyzing legal double taxation barriers; and
- the removal of REPENEC and REPEX subsidies, including analyzing barriers to compliance with contracts.

5.2 ELECTRICITY

5.2.1 PROGRAMS

The INMETRO Energy Efficiency Label program and the Procel Energy Saving Seal program could also include GHG emission indicators.

5.2.2 SUBSIDIES

5.2.2.1 MICROGENERATION

Monomial tariffs do not generate micro and mini-generation incentives for residential customers, or smaller ones, where this offer would have the potential to be developed. With these tariffs the distributors are indifferent to the level of consumption and therefore, without interest in the promotion of micro and mini generation. This situation also reduces the incentive to modernize the distribution networks with the replacement of meters and the functions of command, control and data processing. For this reason, it is essential to revise the tariff structure with the introduction of binomial rates (decoupling).

5.2.2.2 MINERAL COAL AND NATURAL GAS

The tax exemption on the sale of mineral coal destined to thermoelectricity - Energy Development Account (CDE)[52] - National Mineral Coal - has already received R$ 5.3 billion in the 2013-2017 period and exemption from taxes on the sale of natural gas - Priority Thermoelectricity Program (PPT)[53] – are an amount of R$ 2.5 billion over the same period.

The incentives for national coal and natural gas (CDE) - National Mineral Coal and Priority Thermoelectricity Program (PPT) -, are in conflict with the objectives of reducing emissions, because they are fossil fuels, thus these incentives should be gradually eliminated. The immediate withdrawal of the incentives is not recommended because it could make generators unfeasible, leave the electricity system vulnerable and result in serious economic effects in coal producing regions. In addition, natural gas plants have much lower carbon intensity than short-cycle and fast-building coal, which are desirable characteristics for dealing with intermittent renewable sources (wind and solar). Therefore, there is no differentiation of phasing out mechanisms between the two sources.

For these reasons, it is important to establish a transitional period for the complete withdrawal of these tax benefits and subsidies, observing the following criteria:

(i) only to finance new coal-fired plants with public resources if they take GHG removal with carbon capture technologies by at least 50% and plants of natural gas if they adopt combined cycle technology;

(ii) to reduce subsidies to each coal and natural gas plant at the rate of 10% per year, beginning ten years before the end of the concession contract; and

(iii) to deduct from this decrease in item (ii) the proportion of the emission removal degree carried out with carbon capture technologies.

5.2.3 FINANCING

The use of pricing revenue to increase this credit and/or to reduce interest rates would be desirable in the promotion of credit lines such as Climate Fund in the subprogram Renewable Energies, BNDES Finem - Generation of Energy and *Inova Energia* Plan.

5.2.4 REGULATORY IMPROVEMENT

Improving the market environment is essential to enhance the effects of carbon pricing in the electricity sector. In order for emission price signals to be perceived and provoke agents reactions to reduce emissions, the following improvements in the sector model should be considered:

[52] In Portuguese: *Conta de Desenvolvimento Energético* (CDE).

[53] In Portuguese: *Programa Prioritário de Termoeletricidade* (PPT).

- **Opening of the captive market** - to reduce or eliminate the limits regarding the size of the consumer unit so that it is possible freely to choose the electric energy supplier.
- **Revision of tariff structure in low voltage** - Segregation of wire tariffs and energy consumption tariffs, with the implementation of binomial tariffs.
- **Dynamic rates in the captive market** - change of the price signal in the regulated energy tariff, in frequency compatible with changes in the dispatch cost. Ideally, this frequency should be the same as that considered in the establishment of short-term market prices.
- **Modernization of distribution networks** - create incentives for distribution companies to invest in replacing meters and expand command, control and data processing capabilities.
- **Dispatch by price offer** - Dispatch of energy resources based on water and fuel values determined by the generators themselves, involving a considerable degree of self-dispatch, where the role of the central operator is coordination and control. As a result, short-term market prices would be established based on generator offerings.

Thus, it is suggested that the economic modeling should estimate the following impacts:

- of the gradual elimination of subsidies to coal and natural gas in the price of electricity and, in the case of coal, in the generation of employment and income in the mining areas; and
- of the gradual limitation of the TUSD and TUST tariff rebates and the adoption of the binomial tariff for producers and consumers of energy from the promoted sources;

In the regulatory impact assessment, it is suggested to analyze the legal and regulatory changes necessary to:

- gradual elimination of subsidies for coal and natural gas for thermoelectricity;
- gradual reduction of TUSD and TUST rebates;
- compatibility of the proposed carbon market in the Draft Law for the Modernization and Expansion of the Free Market for Electric Energy, resulting from Public Consultation No. 33/2017; and
- opening of the captive market, adoption of the binomial tariff, adoption of dynamic tariffs, modernization of the distribution networks, dispatch by price offer.

5.3 INDUSTRY

5.3.1 FINANCING

In the credit lines of public banks and in the fiscal subsidies, there is no explicit differentiation favorable to low-carbon activities. Therefore, it is suggested that, in the lines that are not directly associated with low carbon investments, more favorable credit conditions should be offered in accordance with the compliance of the companies financed with performance indicators in the control of emissions.

In addition, it is recommended that part of the proceeds from the pricing should be used for these financing lines, in order to contribute to broadening the scope and/or credit conditions of them.

5.3.2 SUBSIDIES

5.3.2.1 ROTA 2030

An adjustment is suggested in granting this exemption from “ROTA 2030’ to the format known as "feebate"[54]. In this instrument, the tax rate levied on the sale of vehicles (IPI in the Brazilian case) is proportionally reduced the closer to a desired efficiency goal is the efficiency of a vehicle model. The rate is zero when the homologated emission is the same as the standard one, and from there, the tax increases proportionally the higher the homologated emission is above the standard. This tax variation for exemption is more effective when it comes to the model of the vehicle sold and not the aggregate sale[55].

Thus, in economic modeling it is suggested to estimate scenarios that simulate how a feebate system would affect the composition of vehicle sales for energy efficiency.

The regulatory assessment, on the other hand, could analyze the legal and regulatory changes for the introduction of a feebate system in Rota2030.

5.4 AGRICULTURE

As previously discussed, agricultural pricing is challenging, both due to technical constraints and to the cost of accounting and monitoring. Therefore, in order to encourage the reduction of carbon emissions in this sector, it is suggested to maintain the existing subsidy and control instruments with changes and adjustments in relation to their objectives, magnitude and level of engagement.

5.4.1 RURAL CREDIT AND INSURANCE

To maintain and strengthen decarbonization credit lines, such as the ABC Program, Pronaf Floresta and Pronaf Eco.

The current efforts of the Agriculture Ministry with *Banco do Brasil* and BNDES to establish a standardized roadmap to simplify and expedite the collection of credit should be maintained and

[54] See, for example, an Inovar-Auto analysis with feebate experiments in Oliveira et al. (2014). In Chile, for example, this system is adopted for NOx emissions with fees of US$ 500 and US$ 1000 and rebates of US$ 500, US$ 1000 and US$ 1500, see Lopez (2014).

[55] As it was adopted in Inovar-Auto, where the goal achievement is calculated by the average production of each assembler. In Rota 2030 this metric only keeps differentiating the models in cars, light commercials ones (only with gasoline) and SUVs.

improved with monitoring techniques, including with the support of SICAR[56] – Rural Environmental Registry System.

Another possibility would be the granting of a complementary credit line to the ABC credit borrowers, for assistance expenses linked to sustainable practices, such as technical assistance and rural extension services, purchase of genetic material and construction of fences, but offering lower interest rates than the ABC credit.

Although the sustainable practices funded under the ABC Program promote the resilience of production to climatic events, they are technologically more sophisticated than traditional practices or less widespread, therefore, are considered by the producer to be riskier at the onset of their adoption. In this way, it is suggested that there should be offered more attractive payment conditions of premium and of indemnity of rural insurance to these borrowers.

The proceeds from the pricing could be partly directed toward these purposes of additional support to the ABC Plan.

The same would apply to rural insurance by offering greater subsidy to the premium for producers who adopt sustainable emissions mitigation techniques. Emphasizing the creation of new specific products for mitigation and emissions in the livestock sector that is not currently fully inserted in the rural insurance policy.

5.4.2 Rural Territorial Tax (ITR)[57]

The ITR could carry additional incentives for more sustainable land use, with minimum productivity parameters of livestock and agricultural activities that include sustainable good practice criteria with GHG emission indicators. Additionally, it is suggested to extend the concept of productive area to include native forests that are part of integrated management with farming and livestock[58].

Thus, in economic modeling, it is suggested to estimate scenarios that simulate how interest rate changes, in the lines for assistance expenditures to sustainable rural insurance practices and at the ITR rates, would encourage the adoption of sustainable practices.

In the regulatory impact assessment, it should be analyzed regulatory adjustments in:

- the creation of the credit line for assistance expenses in sustainable practices and greater subsidy to the preferential rural insurance premium for the ABC credit borrowers; and
- the change of the technical parameters of good practices productivity and of carbon in the ITR.

[56] In Portuguese: *Sistema de Cadastro Ambiental Rural* (SICAR).

[57] In Portuguese: *Imposto Territorial Rural* (ITR).

[58] The same adjustments are not postulated in the calculation of the Ecological ICMS distribution because such adjustments alter the municipal tax revenue, which would have a restricted influence on the private actions of the rural owners.

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