Rewarding Recycling Plastic Proof of Concept with Tokenization and Smartcontracts in Alastria

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Idea in Brief — This paper explains a Proof of Concept (PoC) of rewards for recycling plastic, drinking cans and bottles, and its development in Alastria for the tokenization and smartcontracts implementation. The novelty here is that rewards for recycling are leveraged by raffles and lotteries, using Reciclos as a non-fungible token for rewarding recycling for domestic usages. Differently from renown reward programmes for good that focus on waste tax discounts or even further on catalogues of presents, Reciclos is used for raffles and lotteries by purchasing tokens for the participation to the said raffles and tokenised lottery participations, and for donations and crowdfunding. The aim is to increase the effectiveness of the rewards and to make then sustainable in the long term. The trick is making the rewards user-friendly enough, socially well perceived, and attractive to al, seeking for a majority of people that are appealed for the following claims: "I made millions by simply recycling" and "I support social, good projects donating my recycling efforts without cash".

The point is that nobody had created a token as a sort of virtual currency for recycling leveraged by raffles and lotteries and as a Social Proof of Work for donations. So far in late 2018, there were few initiatives like *cash for trash* and *waste lotteries* in Australia and the US that went in a similar direction.

In this paper, we describe the design of the virtual currency,the lotteries as smart contracts and tokens, and how they were developed as a PoC in the Alastria platform.

A. Introduction: Issue at Hand

Reciclos is a reward token leveraged by social proofs of work in recycling that is powered by raffles and donations. It is a paradigm shift in the personal rewards for recycling scene, where people regularly participate in weekly and monthly donations, crowdfunding, and raffles, with jackpots, and special lotteries, among the state of the art incentives like discounts in local waste taxes and donations to ONG of the user's election or crowdfunding of popular initiatives in Reciclos.

I anticipate that the development of digital raffles in virtual currencies will continuously impact our societies as I advocate that recycling as a community will share sustainability and game changing values, with strong mutual sympathy and support.

Furthermore, creating Reciclos ₹ is an opportunity to store (social) proofs of work and commitment in recycling, that is key for the future of the communities of recyclers.

At the time, there was a double question that had to be answered in this PoC: "will a currency move people to recycling more for the very long term and for what reason for: discounts, donations or raffles?

Section II will show the hypothesis and precedents of our design. Section III discusses on the tokenisation of Reciclos. The section IV deploys a MVP design. Next, section V is a platform design, followed by further technical stuff of the development proposed for the PoC, while results are displayed in section VI. And finally, section VIII provides the conclusions.

B. Hypothesis and Precedents

The aiming context of the PoC is at contributing to raise the 2018 Spanish recycling rate of 29% up to a 55% as it is the EU (European Union) goal for 2025: the aim is to raise all EU countries well beyond that figure of 55%. The ultimate goal is to prepare the European citizens for a change

of paradigm towards a “pay for waste” or “pay as you throw” Folz and Giles (2002) service where any type of rewards scheme will turn obsolete because they will be transformed into discharge or bonus schemes for the *pay as you throw* taxes scheme, that might happen already in 2040.

Meanwhile, we will start experiencing with raffles in Blockchain, for a global market of recycling rewards, under the lemma “the luck of recycling” along with community lemmas like “the more we are (in Reciclos), the more we recycle”.

The raffles are a powerful game that are widely used for rewards in many B2C markets, and combined with virtual currencies they are great candidates for the gamification of rewards. Indeed, raffles are powerful gamification schemes per se, and an opportunity to set up a global market of recycling incentives. With the advent of Blockchain and other general Distributed Ledger Technologies (DLT), this approach of rewards might clearly go global, based on trust.

Thus the experiment we planned with Reciclos, in its PoC, was to check how users chose out of a catalogue of 5 options: This catalogue baseline choice was then of 20% uniform random options, as a baseline for comparing the real choice of several types of users. The options were: one, a waste tax discount bonus, second, the donation to a ONG, third, weekly and monthly raffles, forth, special lotteries, and fifth, the donation of the individually collected Reciclos to other users like the kids, parents, or friends.

The departing fact was that, anytime when citizens are asked, they claim they want further facilities for recycling and rewards by means of waste tax discounts. It seemed there was no room for any other type of rewards.

A pitiful problem was that waste tax discounts are rather unpopular to the local administrations responsible for the waste management as they are not at all willing to cut their incomes to pay costly recycling programmes (O’Leary et al.1999), claiming that less than 20% is the only tax discount they could afford. Thus we had to implement that discount by means of a bonus.

And, what is worse, a regular 20% discount or less is indeed *peanuts* for the most of the citizens as, for example in Spain, the yearly savings per household would be less than 40 euro, barely over 3 euro a month. For a majority of families 3 euro are ridiculous savings compared to their recycling burden they perceive they suffer.

The design of Reciclos PoC followed few assumptions as follows:

A.1. Discounts and Presents are not Working Enough

As said in the calculation of the former paragraph, for a majority of households, the burden of recycling is exceeding the benefits that whatever discounts and presents of any current incentive program offers. Examples of such incentives are the *Recyclebank* in Australia, or *terracycle.com*, and *wasteconnectionswichita.com* in the US, the “e-colones” in Costa Rica, *Pantapa.se* in Sweeden, and the *wasted.com* machines in Germany and similar versions in Spain with *Ganamos Reciclando* with their “segundos” currency.

They all work with the hypothesis that Recycling is for Profit, by Bidle (1993). However, the amounts they produce are attractive to only minorities while in our PoC we want to proof our reward scheme might attract large majorities.

A.2 Lotteries Redistribute the Individual Rewards

There are examples of redistributive raffles like the example of the traffic speed regulation in street of a Swedish city[1], standing at 25 km/h while the effective average was well over 30 km/h before the experiment. It proved highly effective as people kept lower than 30km/h sharp by simply

[1] https://medicalfuturist.com/swedish-speed-camera-lottery-healthy-living

changing the fines scheme applied to the speed violators: all fines were collected in a jackpot that was weekly given away by random among all the good drivers. The information of the jackpot was publicly announced with a public display, highly visible in that street.

This interesting approach enlightened us so that we came up with the idea of redistributing not fines but the tiny individual rewards that would be collected along with tiny recycling acts and gathered in a jackpot that is raffled among all good recyclers that might prove their effort by the Reciclos they got by recycling good.

Thus, instead of giving away an average of 3 euros a month per household, every 200 households in close neighbourhood could make a nice 500 euros first price, and a second price of 100 euros or a policy of 10% Reciclos reimbursement for engaging users for the next raffles as part of the gamification strategy of the recycling rewards system. And the prices could perfectly be materialised in cash or, what is preferred in the Reciclos communities, by products and services.

Examples like this are *Vermont Recycle and Win* in the US, and the *Australia cash for trash lottery*.

A.3 Lotteries and Rewards Programmes Need of Transparency

To keep up the reward impetus, there is need of total trust in the rewarding programme, and its transparency is key. Thus, DLT (Distributed Ledger Technologies) are necessary for providing the demanded transparency, traceability, auditability, in a distributed, compliant, and scalable way of such solutions among the very many local public administrations and companies involved in the waste management. We will talk about this need extensively on in this paper. The fact is that bringing DLT to bear in the digital asset space holds the promise of entirely new platforms for value storage, exchange, and preservation that traditional recycling and rewarding systems have so far not identified.

C. TOKENIZATION AS A TYPE OF CIRCULAR ECONOMY

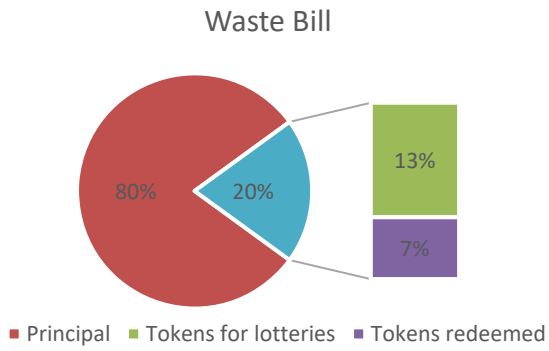
We advocate that recycling generates enough income to pay back the (waste) tax discounts a local public body might accept. Such it is that, in the end, extra income due to recycled stuff **compensates largely a 20% and whatever discount**.

Therefore, the *tokenisation of the discount* is just an advancement of the benefits that will come to the city precisely by the fact of boosted and enhanced recycling, Genestoux (2018). The mechanism is easy: offer the tokens to the citizens, and business in a future, as an acknowledgement of their proof of work and commitment to recycling, so that they can redeem them months or a year later, at the moment the dispose bill (ergo the waste tax) is charged or the recycling income for the city is due.

Tokenization is one of the promising features shipped in the DLT, Kapsammer et al. (2018) that is then worth exploring in the PoC.

Reciclos is then a token for discount of waste taxes (dispose or waste bills) that must not be purchased in advance but collected by individuals after their proof of work in recycling that, in the end, is used for a reduction of the bill or other usages, Greenhotelier (2009). Thus the circle is perfectly closed: generated Reciclos go back to the discount, and the local administration collects the 80% of taxes that had projected. This is a simple mechanism for the supply of Reciclos that can be complemented by many other sources of supply, like sponsors that contribute with fiat currency or with products and services that are, in the end, redeemed by the rewarded citizens on exchange of the Reciclos they had collected.

When the tokens are redeemed for other usages like donations, rewards or lotteries, then the process of creation and redemption of tokens change a little bit: as users wait for having enough tokens to get their option, both a present, or a significant donation, then the public body has time fairly enough to get the funds from recycling to back the said expenses. In the case of raffles, if the winners are rewarded in tokens then the token exchange for rewards could be again delayed to schedule of waste bills payments, or if paid in advance it goes well on accounting of the expected income by recycled stuff sold.



It will depend on the design of the raffles whether the public body would have to advance the most of the saved money from the recycling to back the tokens supply in Reciclos: if raffles are dimensioned regarding the amount of the waste bill (say 300 euro) then the winners will redeem their prices at the moment of the waste bill payments and the loop from the token-creation-as-bill-discount to its destruction at the moment of redemption is perfect. Otherwise, a fund backed by the expected income of the recycled stuff should be created to fulfil the redemptions as a bonus.

As one can see, our tokenisation, in most of the cases, has the advantage of null creation of virtual currency as all tokens are created (the supply) by the expected discount and then destroyed at the effective redemption: the creation of tokens limited to the amount of discount available, or funds available, that is easy to calculate and easily convertible to discount at the moment of the waste bill payments. In few cases, if the raffled rewards are planned to be more attractive and match well the average bill, then they are backed by the accounted benefits from recycling.

The discount token enables administrations, companies and next-generation associations for deployeing rewarding quite easily and sustainable. While the tokens allow transactions, capital formation, investment and speculation, the discount token model is an interesting way to incentivize the growth of a network with cryptographic technology. The discount token enhances loyalty to the growth of this adopting community, and gets rid of pure speculation because it has full sense as a utility token for the service. This creates an alignment between the client and the supplier that does not happen with security tokens.

This discount model is applicable to a wide range of business models. The companies that benefit the most are those that want and expect important long-term business from their customers through continuous subscriptions, recurring rates or frequent repeated purchases. For such dedicated customers, the discount offered by the token means real money for them, but for others who do not have a great interest or use of the network, the token will have limited value. In the case of public administrations, they seek long-term sustainable behaviour.

The Blockchain project from SweatBridge, Zargham et al. (2018) is one of the exponents of the discount token model, because using a discount token instead of a utility token must be in the framework to meet these requirements: encompass a wide range of organizations and decentralized networks; align the incentives between creators and consumers, and if possible,

investors; achieve long-term sustainability and thus turn distinct from Ponzi values and structures; and respect the existing regulatory framework.

The tokenization formula is as follows. Being ***T*** the total waste bill and ***s*** the percentage of discount, then the total discounted waste bill ***D*** will be

$$D = s \cdot T \qquad \text{Eq. 1}$$

The number of households ***H***, the number of weekly disposals ***d***, and the acknowledgement factor ***f***, then the yearly supply of Reciclos #ℝ, supposing that a year is 52 weeks, will be

$$\#\mathbb{R} = H \cdot d \cdot 52 \cdot f \qquad \text{Eq. 2}$$

And the value of Reciclos in euros after the tokenization will be

$$\mathbb{R} = D / \#\mathbb{R} \qquad \text{Eq. 3}$$

D. Minimum Valuable Product (MVP) Design

The design of a MVP for the PoC Reciclos ℝ in Spain was applied to a Spanish county of 31,000 inhabitants scattered in seven villages. The implementation consisted of a webapp that the citizens used for scanning their tagged disposal bags to collect Reciclos and later browsed on the catalogue of bill discounts, donations, raffles, and lotteries. The goal was to register over 1,000 households, families, that accounted to 2,500-3,000 people.

D.1. The Proof of Work

The citizens proved they were recycling by scanning QR stickers that were attached to yellow disposal bags devoted to PET, cans and bricks. They used their own smartphones to do this. A collector company gathered all separated bags and dumped them on a sorting plant where few workers inspected the quality of the disposals and used the same app to rate in [*bad*, *ok*, and *really good*], so that extra rewards in Reciclos were given to the citizens who tagged them and did the selection of PET outstandingly well.

D.2. Tokenising the Tax Discount

As said in section III, the tokenisation of the tax account is by, first, calculating the total discount, and second, estimating the amount of disposals a year at a rate of 1 Reciclos per disposal, 1 extra Reciclos when the disposal is checked to be ok that is 60% of the cases, and the extra Reciclos to a 20% of the really well separated (well recycled) disposals, that make **f** = 160%*120% = 192%. As a household was estimated to dispose 2 times a week thus approximately 102 disposals a year that would be rewarded 102 Reciclos + 61 Reciclos of the ok disposals + 21 Reciclos to the really good ones that make 184 Reciclos, that might be rounded **up to 200** for the sake of simplicity accounting to extra Reciclos that might be given away by whatever other campaign.

On the other hand, knowing that the county's waste bill on average was of 150 euro a year, and taking into account they will to discount no more than 20% of the bill this gave 30 euro a year per household.

To calculate a value of the Reciclos was then 30 euro / 200 Reciclos = 0.15 euro/Reciclos. This meant that an average disposal was granted 2-3 Reciclos, that meant 0.3-0.45 euro. If we compared it to average rewarding per bottle, brick or can that is from 2 to 5 cents, then these rewards were worth 8-15 pieces (bottles, cans, and bricks).

And finally, 1,000 household's x 200 Reciclos/household = 200,000 **Reciclos a year (and 1/6 of them for the two months of the PoC timeframe) were created** to tokenise the 30 euro x 1,000 household = 30,000 euro of the waste bill discount for this pilot group. So summarizing:

₹ = 0.15 euro
#₹ = 200,000 / 6
D= 3,000 euro

As a general rule, a 20% discount will be split in 500 ₹, thus 1 ₹ = 0.04% of discount. As, at least in Europe, the disposal tax will grow from todays 150 euro in many places up to 600 euro in the next 20 years towards a *pay for trash* policy, 1 ₹ will range from 0.06 to 0.24, and therefore one Reciclos would be solid currency backed by growing costs in taxes that will push up its value 2-4 times in the following 20 years, that could be programmed to increased composed 5% in value € every year. This would make Reciclos greatly attractive for long term savings and further usages. The proposed mechanism will be calculated from the fresh supply of Reciclos in a year (that initially will be supplied with the 5% increase) compared to the existing mass of Reciclos pending to be redeemed that were generated with former prices, so that the larger mass of existing Reciclos the lower the increase.

D.3. Tokenising the Special Lotteries

As well as the raffles, special lotteries were organised so that prizes got the highest of all rewards, and yet differently to the raffles, donations, and discounts, the public body had not back them as they were leveraged by other organisations like the state lotteries organisations.

The tokenisation here was to divide the price P of a ticket of said lotteries by the value of 1 Reciclos, and thus we knew how many participations we had to create out of a number of tickets:

Number of tokens $N = P / ₹$ Eq. 4

For example, if the price P = 10 euro per ticket, and we used the same value in euros of our pilot, then the number of tokens would have been N = 10 / 0.15= 66 tokens, and a residual that would not be assigned to anybody. Thus the citizens might purchase participations of the said lottery with their balance of Reciclos. As prices are very important, like 200,000 euro per ticket, a participation with a single Reciclos will be worth 3,030.30 euro for the winner, that is a cool price for disposing a simple bag of recycled plastics.

D.4 Smartcontracts for Lotteries

Nearly all new projects of virtual currencies and tokens were working with the ERC-20 specification, and we did so for our tokens for Reciclos in a first fungible implementation (despite of its future non-fungible implementation with ERC-721 or higher standards) and for the participations in the special lotteries. The random choice of the lucky winners was developed in smartcontracts to contribute with transparency and equality the lotteries and raffles process, as well as track all transactions among users.

The advantage of using smartcontracts is that they contribute strongly to the trust and confidence by citizens into the necessary belief that the rules are fairly applied to ALL. As well, in the moment this recycling programme will scale, the said transparency will calm the concerns of any local administration that its discounts are going to the benefit of their citizens, and not citizens of other administrations or sponsors. So no worries, with the smartcontracts citizens might trust their public bodies, and the public bodies will trust each other that nobody will be overlaying or ruling the programme for their particular benefit, nor on purpose not by error.

There was a role in the PoC, the notary, who was in charge of creating the raffles and checking the process of selecting the participants and winners and the rewards delivery, and audited the program to decide whether it was fulfilling the *rewards programme bases* that she had in escrow. Her conclusions were that this totally digital mechanism was reliable and notarization was potentially reducible to just audit the smartcontracts because their execution was impeccable.

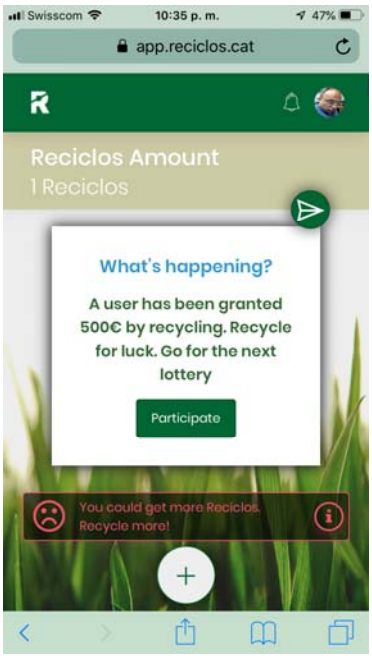
D.5. Illustrative Use Case

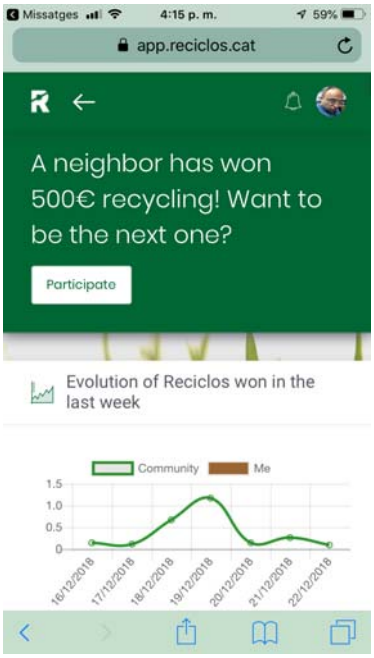
Joana is 44 years old and had no virtual currency so far. She was working as engineer in a big firm with one 2-year-old kid. She had signed for several dental, health, car, housing, and loan insurance policies. Every day, after the long journey, she still found time to spend with her kid and storm her partner to recycle. She considered the following. “We do our best despite the city has

not provided the best equipment for recycling and we don't have room for several bins at home". When she heard of a neighbour had won 1000 ₹ , that were 250 euro worth discount in waste taxes, by participating in a rewards program she got interested and found out it was Reciclos.cat. Months passed, after she signed and collected the ₹ in her account that then she decided to participate in the weekly raffles with part of her balance while other part was devoted to a local ONG, and the little remain for the tax discount. She thought, "what the hell, better having an important price than peanuts: We are lucky anyway, it is worth indeed recycling". Weeks later she was awarded with refunds in Reciclos and kept trying, and 12 months later she got a secondary price worth of 100 euro that definitely rewarded all her efforts and made her and her family proud of recycling and spreaded the luck of recycling word to her acquaintances.

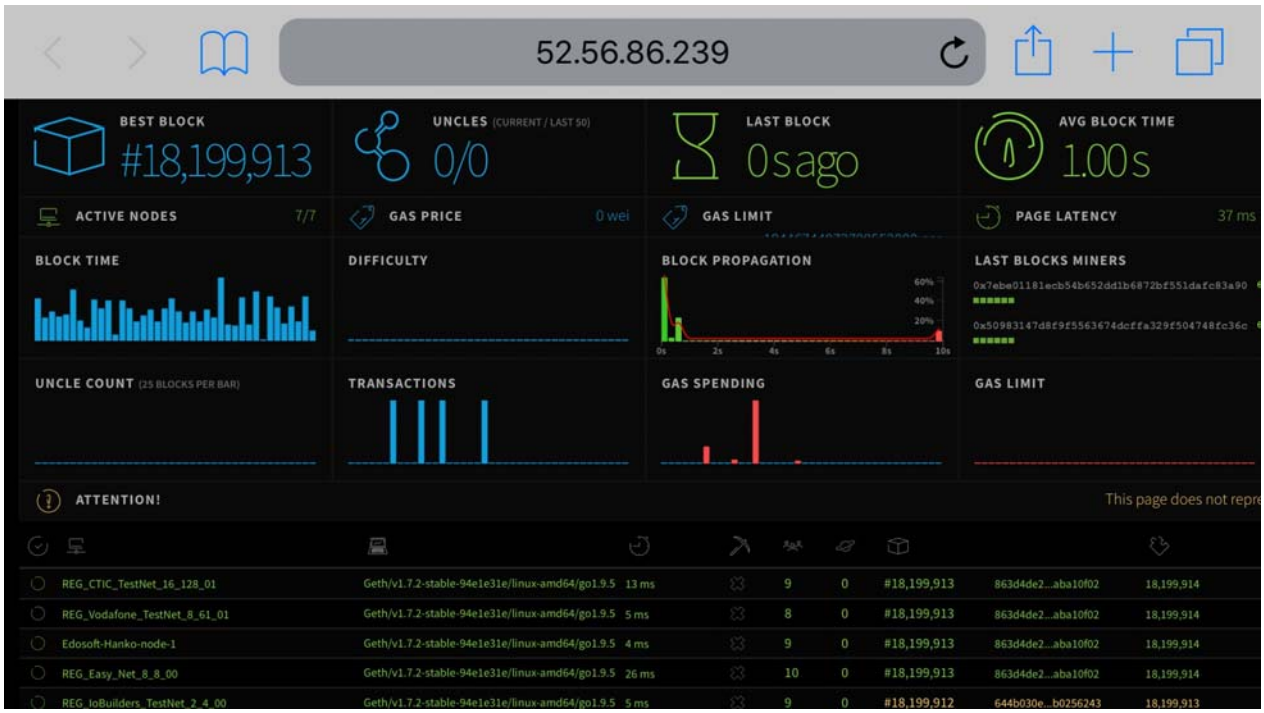
E. The Platform Approach and implementation

We have chosen a webapp, or mobile web. This is because it helps getting new users, yet an Android/IOS app will be developed in a future to deploy loyalty among the recyclers. The look and feel of the webapp is modest and focused on getting Reciclos, for trying with luck, and sharing luck.





The webapp connects to Alastria for the management of the raffles and lotteries.
We worked it out on the Alastria Red T, that is a fork of Ethereum but with Proof of Authority instead of Proof of Work, with 11 nodes as of Dec 22, 2018, that run fast enough for the pilot, even when we were dealing with 400 concurrent accesses to the webapp from 18h to 21h Monday to Saturday. This solution provided immediate technology ready to grow the MVP into a full service for all Spain in the following 1-2 years where a main net open solution will be then, perhaps, more advisable.



Here follows where the smartcontracts are located and how we can monitor and transact with them.

Network: **Alastria**

Principal Smart Contract of Reciclos:
0xfbb4a779aa6c9ae0a8ac095d7d576aac4073ad01

This contract is in charge of creating and executing the raffles which in their turn are an independent smartcontract each one, as they are created dynamically one by one from this smartcontract.

Transactions scan of that smartcontract is:
https://alastria-explorer.councilbox.com/account/0xfbb4a779aa6c9ae0a8ac095d7d576aac4073ad01/transactions

Example of Smart Contract for a Raffle is in **0x99DeFB5aF09537F7A9cb08B27c1d9F254b79159C**

Transactions scan in Alastria of that Raffle is:
https://alastria-explorer.councilbox.com/account/0x99DeFB5aF09537F7A9cb08B27c1d9F254b79159C

F. RESULTS

Finally 1,050 families participated in the PoC and they behaved as follows:

# Waste Disposals (bags)	6,749	
Supplied Reciclos	13,060	100%
Balance (in Reciclos)	5,613	43%
Used Reciclos for Rewards	7,247	56%

Polling users before the PoC gave us the following insights: the 75% of them said they wanted to convert their Reciclos into waste tax discounts. However, they behaved differently in the PoC,

as a 30% only did it, compared to the more than 60% that used the raffles option. The remaining 10% of their Reciclos went for donations.

As well, 60% of the user families were recyclers before the PoC while this figure soared up to 85% in the end of the PoC. The impact of the PoC was a 10 points improvement of the quality of disposals and a net increase of 25 points in the percentage of recycled PET.

Users spend nearly 4 minutes a day with their app.

The several roles involved in the PoC gave positive feedback: users, civil servants, recycling staff, the notary, and officers of the county, they all appreciated they could trust the app, the system, and the rewards transparency and efficiency for a fine recycling program developed on top of it, that was named Reciclos after the name of the token.

And the supply of Reciclos was sufficient, less than 50% of the provision, thus the tokenization was successful: the PoC fulfilled the objectives and got green light for scaling it up.

G. Conclusions

The novelties that I had contributed here are as follows:

- Novel incentive mechanisms with raffles to boost the impact and appeal of the rewards.
- Introduction of “luck of recycling” as a motto for a community for recycling.
- Non-fungible token: Reciclos.
- Tokenisation of waste bill discounts.
- Smart contracts for the raffles management.

Its implementation in a pilot of 1,050 families collects the qualitative perception of the potential users to the incentive capability of the raffles and other benefits of the token Reciclos. So far, I have developed and deployed a Blockchain and smart contracts powered webapp with strong focus on the citizens’ usability and the complicity of the civil servants.

And definitely, this is a proof that citizens can get easily to a concept of recycling that they trust when they perceive strong incentive to recycle, and that they prefer raffles, as a personal reward, despite they claim they want waste bill discounts and donations only, as a collective reward.

The development of the PoC in Alastria has been smooth and compliant. Scalability issues followed, but this will be matter of discussion for future papers.

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About Us

Peplluis de la Rosa is full professor at the University of Girona (UdG) Spain from 2010, visiting professor at Rensselaer Polytechnic Institute (RPI) New York, USA 2008, and to the ETH Zurich, Switzerland 2019, with h-index=23. Director of the Technology Research TECNIO Easy Centre www.centreeasy.com and of the Official Master in Smart Cities of the UdG. He is MBA of the UdG, PhD in Computer Science from the Autonomous University of Barcelona (UAB). De la Rosa is specialist in intelligent agents, virtual currencies, and digital preservation and their applications. +200 international publications along with +20 PhD thesis supervised are part of his contributions. He is a researcher with entrepreneurial vision that has created several spin-off companies starting with the first world robotic soccer team as early as 1996, customer intelligence in 2000, virtual currencies in 2010, and several blockchain initiatives from 2017. His research on complementary and virtual currencies started in 2006 and later he got fascinated by the disruption of the Blockchain and SmartContracts technologies and their advantages. From then, he has been working on this topic to design new types of money suitable for the Internet, scanning for its applications in general

and in IP and open innovation in particular. Today he is advising several blockchain projects, as for example licens3d.com, taboow.org, welicense.io, nir-vana.eu, and Reciclos.cat.

@peplluis7, CV in Google https://scholar.google.es/citations?user=QXLp1RgAAAAJ and in the LinkedIn here https://es.linkedin.com/in/peplluis

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