



European
Commission |



PREPARATORY ACTION ON
Smart Rural Areas
in the 21st Century



Stanz Token

Examining opportunities to combine a digital local currency with a renewable energy community in Stanz im Mürztal.

Final Version

Agentur SCAN
Caliber Consult GmbH
ABC Research GmbH

Stanz im Mürztal / Vienna

29th June 2022

This publication has been produced under a contract (No AGRI-2019-409) with the Union and the opinions expressed are those of the contractor only and do not represent the contracting authorities official position.

Contacts:

Agentur SCAN e.U. office@scan.co.at

Caliber Consult GmbH hello@caliberco.at

ABC Research GmbH office@abc-research.at

Authors in alphabetical order: Alexander Baldele, Mirella Bärnthaler, Rainer Rosegger, Lisa Schatz, Lukas Sparer, Vinzenz Treytl.

The current document contains extracts from the report entitled

‘Stanz Token’: Examining opportunities to combine a digital local currency with a renewable energy community in Stanz im Mürztal

Missing pages

6. Status quo of Stanz Ecosystem

Stanz im Mürztal is a small local community in Styria. Covering an area of approximately 8000ha (80% of which are forests), it has more than 1800 citizens living in 800 households. As a Rural Pioneers Community, Stanz is actively pursuing new ways to organize energy generation, distribution and consumption.

The focus of this project is to evaluate how existing initiatives in Stanz can be leveraged and integrated by blockchain technology. This happens in alignment with the vision of becoming energy independent as well as fostering regional value chains and increasing the share of local value added in the region.

As a first step, existing ecosystems within the Stanz that underlie a potential token economic system are described. Subsequently the foundation of potential token economic systems are analyzed.

6.1. Stanz Gutschein

The “Stanz Gutschein” (hereafter named Stanz voucher) is a voucher-based local currency that is issued by the municipality (“Gemeinde”), and can be used for payment of goods and services at local businesses. All major businesses (e.g. pubs, the local gas station, etc.) in Stanz accept the voucher.

Having been established some 15 years ago, it was relaunched in 2015/2016, in order to streamline administrative processes. However, the goal of the Stanz voucher remains the same. It is a tool that aims to strengthen the local economy and the support of local businesses.

On a yearly basis around 30-40 people are purchasers of the Stanz voucher. Buyers of the voucher are varied including private individuals, businesses and the community, buying on average EUR 50 to EUR 100 worth of vouchers in a single transaction. These buyers mainly use the voucher for gifting purposes (eg. as a gift for a birthday or at the company Christmas party). Recipients of these gifts can use the voucher at local businesses.

The voucher is accepted by all main businesses in the community Stanz im Mürztal. The acceptance of the voucher is officially limited to Stanz.

Between 2019 and 2021 the average amount outstanding was EUR 13.000. An increase in the amount outstanding was observed in this timeframe. This is due to the opening of a supermarket in the community where people can pay with the vouchers.

From a design perspective, the Stanz voucher is issued in increments of EUR 10 and there is no minimum or maximum purchase among. The voucher has a constant value, a serial number and no date of expiry. Transactions in the voucher (issuance, redemption, use) carry no transaction fees.

The vouchers are exclusively issued at the Gemeindeamt Stanz im Mürztal (local authority of Stanz im Mürztal). Buyers receive the vouchers by paying the nominal value in cash. From an administrative perspective, for each purchase transaction an invoice is issued containing the number of sold vouchers as well as their serial numbers.

Holders of the voucher can then use the voucher much like cash. When purchasing goods and services they simply hand over the voucher instead of cash.

Vouchers are normally returned to the municipality by local businesses. (a redemption by private individuals practically never occurs). When a voucher is returned, the holder of the voucher is reimbursed the nominal value of the vouchers in cash or via bank transfer. The vouchers are subsequently invalidated and the invalidation of the specific serial numbers recorded.

The information available points to a limited circulation of the voucher. Normally, after having bought the vouchers from the local authority, buyers gift the vouchers to private individuals, who use them at a business to buy goods and services. The business then returns the vouchers to the local authority. Normally, businesses redeem the vouchers after a certain amount of them has accumulated.

6.2. REC Stanzertal

The REC Stanzertal was incorporated as an association (Verein) in 2022 and currently has 60 members at the time of writing, with many more citizens interested in joining the REC. Members include prosumers, net-consumers as well as net-producers.

From an organizational perspective, the REC main tasks lie in the organization of the community, in the management of the infrastructure and the future development of the initiative. To this end the REC operates four working groups (PV, wind, small hydro power stations, communication) that drive the future development of the REC. It is not planned that the REC itself owns significant generation assets.

Vision and Goals

Within the bigger Stanz context the goals of the REC are not so much energy autarky but rather to foster the individual feeling of responsibility and the higher level of autonomy, while at the same time to strengthen the already existing feeling of community. In this sense, the vision for the REC is to increase the visibility of energy and energy consumption within the community and increase the engagement of citizens with this topic.

From a more practical perspective, participating consumers of the REC benefit from cheaper energy tariffs from the REC (see below). Additionally, existing prosumers in the Stanz area are able to feed in their surplus energy to the REC at beneficial rates.

From a more operational perspective, the REC Stanzertal aims to optimize its supply and demand to be as self-sufficient as possible. This means that in an ideal case electricity is

generated, stored and consumed mostly locally. Only a marginal part of the energy being supplied to or demanded from the local utility (E-Werk Kindberg). Various innovative ideas and sub-initiatives are pursued to reach this operational goal (e.g. use of E-vehicles as batteries, integration with local heating and cooling system, etc.)

Current Infrastructure and Initiatives

Local utility and local grid: From the perspective of the traditional electricity grid, E-Werk Kindberg is the relevant electric utility for Stanz im Mürztal. E-Werk Kindberg is responsible for balancing any supply and demand imbalances within the REC. Being tied to the utility, the geographic scope of the REC is not the municipal boundary of Stanz but rather the areas supplied by E-Werk Kindberg.

At the time of writing, the REC and the community of Stanz were in negotiation with E-Werk Kindberg for a special tariff for REC members (“Stanz Tarif”). This local tariff enables them to purchase energy from the utility at slightly reduced rates. This rate reduction is made possible by channeling the network subsidies for sustainable energy directly to consumers. Although the monetary benefits are only a light reduction in rates, from a social perspective the special rate for the region fosters the community feeling within Stanz.

Generation Facilities: Currently, the REC is building a PV-installation on top of the local primary school. For the future it is planned to integrate new as well as existing energy generation assets into the REC. These include smaller generation facilities owned by individuals (e.g. private, roof-top PV panels) as well as larger generation facilities owned by the community or investors (e.g. a small hydropower station and two biomass-plants (350 KW and 1 MW). Although there is a large wind farm with 75 mWp generation capacity in the region, this facility will not be included in the REC in the near future due to contractual obligations of the wind farm.

The addition of new generation facilities is dependent on general requirements for the new members of RECs⁹¹ as well as future regulatory developments.

MyPower Platform: In connection with the planned PV generation facility installed on the rooftop of the primary school, Stanz evaluates a cooperation with Riddle & Code. Riddle & Code’s Mypower Solution is a management system for the facility which enables the management of the data streams of the facility. The platform not only shows energy production but also can be used to create blockchain-based tokens based on the generated energy.

In addition, the platform can be used for the tokenization of the generation facility itself. Tokenizing the facility makes it possible to divide ownership of the facility into small shares. These can be bought by the general public. This way citizens can participate in production

⁹¹ Appendix A, Decentralized energy supply through energy communities

facilities as investors without having to invest large amounts of money. The project is planned to go online in Q3/Q4 2022.

While MyPower Platform currently only encompasses the school PV installation, it can form a good basic infrastructure for a larger REC.

Other energy related projects: In accordance with the general aim to balance supply and demand within the REC, Stanz currently participates in a project to better match supply and demand. To this end, supply and demand patterns of selected local participants are established. By better matching supply and demand, the REC as a whole requires less peak capacity. Adding to this, interlinking electricity with other forms of energy (e.g. via. Electrical heat-pumps for heating) can further shave peak-demand.

7. Tokenizing the Stanz Ecosystem

The basis for designing a token economic system is a general understanding of the underlying ecosystem, its vision, its stakeholders and potential use cases. This enables the design and description of economic mechanisms and value flows. While the preceding section has focused on the underlying economic systems already in place, this section analyzes the potential system from a perspective of goals, stakeholders and use cases. Additionally, it discusses the general requirements that are needed for such a system.

7.1. Vision of the Token Economic System

The envisioned token economic system combines the best aspects of a REC using a blockchain-based infrastructure with a blockchain-based digital local currency. This would create a DLC based on energy. The field research and participation process showed that, generally, a DLC would be well accepted by various stakeholder groups in Stanz.

Creating such a shared infrastructure and DLC could lead to greater engagement of citizens in the project of the REC, increase the visibility of energy and energy consumption within the community, while at the same time fostering the local economy by strengthening the existing voucher-based DLC and create a stronger identification with Stanz.

The flexibility offered by blockchain would make it possible to add additional processes of the local economic system to the infrastructure and further support the local economy.

7.2. Stakeholders

For the purposes of designing token economic systems, all parties that affect the system or are affected by it need to be analyzed. It is important to note that this analysis takes the status quo of the underlying economic system as a starting point to ultimately show the potential participants in the system.

The parties to such a future token economic system can be either directly or indirectly involved with the system. Normally, stakeholder groups that are central to the development effort of the system are also at the core of the ecosystem (e.g. the municipality of Stanz, hereafter referred to as Gemeinde Stanz). Other direct stakeholder groups directly interact with the system.

This can be either in the development phase (e.g. suppliers of important system components) or in the daily running of the system (e.g. various user groups). Finally, indirect stakeholders have to be considered, although this type of stakeholders does not directly interact with or profit from the system. They can have considerable impact on the system by defining the bigger environment in which the system operates (e.g. regulators).

Name	Characteristics	Examples	Member of REC	Participant in the system
EG Stanzertal	# system initiator # association (Verein)		no (is REC and has no direct energy consumption)	yes
Gemeinde Stanz	# municipality		yes	yes
E-Werk Kindberg	# mid-size utility, infrastructure provider		no	no
Commercial Energy Producers	# larger operations focused on energy generation	#biomass plants (350 kWp+1mWp, mainly heating, private ownership) # hydropower plant (privately owned, planned capacity 80kWp) # Windparks (privately owned, 70 mWp, contractual obligations)	potentially yes (subject to REC membership eligibility criteria)	potentially yes (subject to REC membership eligibility criteria)
Household (Prosumer)	# private household that has the possibility to act as prosumer (e.g. single family home)		potentially yes	yes
Household (Consumer)	# private household that doesn't have the possibility to act as prosumer (e.g. apartments, financial constraints)		potentially yes	yes
Associations, initiatives and voluntary work	# various associations (Vereine)	# Fire Brigade (FF Stanz im Mürztal) # Local associations (Vereine) # E-Taxi # AG Lebensqualität	potentially yes	yes
Individuals	# general public in Stanz	# youths/students	no	potentially yes
Local businesses (general)	# mostly SMEs	# due to different needs subcategorization might make sense: gastronomy, products & services # examples: Trixi's Dorfladen, local gas station etc. # a full list of businesses is available from Gemeinde Stanz	yes	yes
Local businesses (farmers)	# mostly SMEs		yes	yes
Contractors (various)	# companies that provide products and services to build energy-related assets	# Riddle & Code # Fladischer Elektrofachhandel	no	no
Regulators and supervisory bodies	# large organizations # public sector	# FMA # National Bank (OeNB) # Municipal Supervisory Board	no	no
Funding Agencies	# large organizations # public sector	# Energieagentur Steiermark # Federal funding Agencies (FFG Stanz+) # European Funding Agencies (e.g. Smart Rural)	no	no
Consultants & other service providers	# various	# Agentur Scan # Austrian Blockchain Center # CaliberCo # Tax consultant # Lawyer	no	no

Figure 7: Stakeholder Overview

Based on the results of the extensive field research and participation process, stakeholder groups were identified, described, and analyzed. In total 14 distinct stakeholders or stakeholder groups were identified and grouped into core, direct and indirect stakeholders.

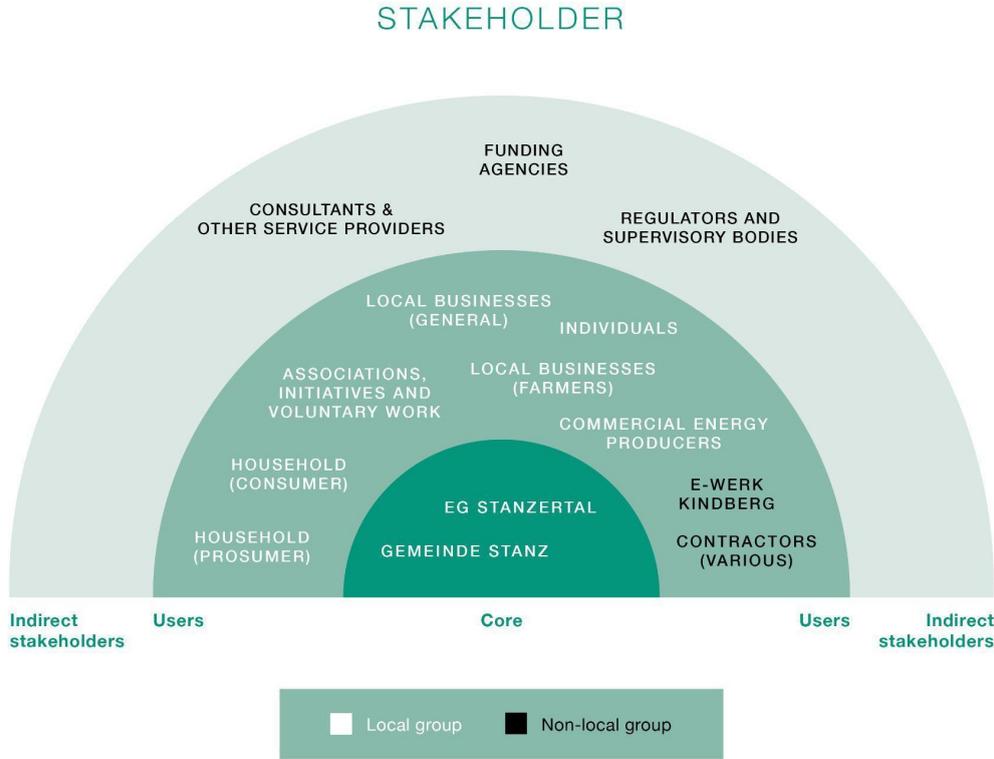


Figure 8: Stakeholder Map

Being driven by the REC Stanzertal and the Gemeinde Stanz, the system is largely catering to a diverse set of local user groups. These include households, businesses, local associations as well as the general public in Stanz. Non-local, direct stakeholders include the closest utility (“E-Werk Kindberg”) which provides the connection to the public electricity grid. Furthermore, outside contractors can play an important role in providing crucial technical components to the system (e.g. Riddle & Code). Figure 8 (see above) gives an overview of all involved stakeholder and stakeholder groups.

When analyzing single stakeholder groups, it is important to consider whether they are expected to be members of the REC and whether or not they actively use the system (see figure 7⁹²). Parties more deeply involved in the system by being a member of the REC and actively participating in the system, respectively, normally have stronger incentives and are

⁹² A more detailed analysis of the roles can be found in the table in Appendix C, Stakeholders within the Token Economic System.

more active in the development process of the system. Therefore, these stakeholders should be actively addressed in the design process of the system.

However, this doesn't mean that other stakeholder groups should be neglected as they also play important roles for the success of the system. For instance, funding agencies provide project finance for the implementation of planned concepts without which an implementation would not be possible.

Name	Valuable Assets	Incentive	Value created
EG Stanzertal	# infrastructure management system # expertise # network # generation assets	# mission is to operate the system and foster sustainable energy	# operation of infrastructure # central party for all stakeholders involved # support of members with know-how and expertise
Gemeinde Stanz	# network # generation assets	# public mission # guardian of the Stanzer Weg	# initiator of DLC # central party for all stakeholders involved # potentially large token issuer
E-Werk Kindberg	# public grid	# legal obligation to provide service to REC	# load balancing between public grid and REC
Commercial Energy Producers	# mid to large scale generation facilities	# regular line of business	# significant energy provider within the community
Household (Prosumer)	# small scale generation facilities # know-how & practical experience	# financial reward via producing and selling energy # caring about sustainability # Stanz community feeling # strengthening the local economy	# generate energy for REC # use DLC
Household (Consumer)	n/a	# financial reward via reduced rates for energy # caring about sustainability # Stanz community feeling # strengthening the local economy	# consume energy from REC # use DLC
Associations, initiatives and voluntary work	# potentially buildings and other premises (e.g. football pitch, fire brigade house) # large member-network (good multiplier)	# increase of community feeling # increase of regional social life	# acceptance of DLC increases usefulness for DLC users # as recipients of DLC -based subsidies, important distributor of DLC
Individuals	# time	# caring about sustainability	# users of DLC # carriers of change and innovation
Local businesses (general)	# rooftop space	# cost savings via more efficient use of energy # cost savings via cheaper energy # DLC strengthens local economy and local value creation	# acceptance of DLC increases usefulness for DLC users # Depending on the business, add functionality to the infrastructure (e.g. storage, peak shaving, roof-tops)
Local businesses (farmers)	# large areas for potential installation of generation assets # potential for small hydro-electric facilities # rooftop space on business installation # biomass	# cost savings via more efficient use of energy # cost savings via cheaper energy # DLC strengthens local economy and local value creation # DLC as opportunity to increase direct farm sales	# can operate larger generation facilities # can provide assets for generation facilities # acceptance of DLC increases usefulness for DLC users
Contractors (various)	# products, services for specific problems # expertise	# regular line of business	# turn-key solutions (e.g. management software, installation of PV-modules) # technical know-how
Regulators and supervisory bodies	# know how	# public mission (consumer protection, financial stability, public accounting etc.)	# prevention of misuse of public funds # consumer protection # financial stability # Create trust in supervised organizations and institutions
Funding Agencies	# know how # funds # network	# public mission (active contribution to energy transition) # Reputation	# funding of high impact projects
Consultants & other service providers	# specialized know how and expertise in selected fields # network	# regular line of business	# analysis and understanding of system # prototypical implementation of system # evaluation of system (business, technological, regulatory)

Figure 9: Stakeholders - Assets, Incentives and Value Creation

Name	Producer	Consumer	Prosumer	Manager	Operator of critical infrastructure	User of token
EG Stanzertal	X (potentially)			X	X	potentially no
Gemeinde Stanz	potentially X	X	X (potentially)	X		X
E-Werk Kindberg						
Commercial Energy Producers	X	X (but low)	X	X (potentially)	X	X
Household (Prosumer)	X	X	X			X
Household (Consumer)		X				X
Associations, initiatives and voluntary work	X (potentially)	X	X (potentially)			X
Individuals						X
Local businesses (general)	X	X	X (potentially)		X (potentially)	X
Local businesses (farmers)	X	X	X			X
Contractors (various)						
Regulators and supervisory bodies						
Funding Agencies						
Consultants & other service providers						

Figure 10: Stakeholders – Roles within the Token Economic System

7.3. Creating, Using and Obtaining Tokens

Based on the stakeholder analysis, in a next step of the token engineering process the token flows are defined. There are two aspects of particular importance: a) the creation and destruction of tokens and b) the scenarios under which they are used during their lifetime.

Creation and destruction of tokens: An important consideration for any token economic system is the question of how tokens are created in the first place. The field research process as well as an analysis of the use cases identified several potential creation mechanisms. (see figures 9 and 10)

Use Cases	Description	Payor	Recipient	Characteristics
Production of Energy	- Tokens are automatically created for energy produced.	- System	- Prosumer, REC, (private) energy producer	- Point of token creation
Use of energy	- Token is used for the procurement of energy within the system. Tokens are automatically destroyed when the energy represented by the token is used.	- Users of Energy	- System	- Potential point of token destruction
Issuance	- Tokens are sold by Gemeinde Stanz against EUR	- Gemeinde Stanz	- All stakeholder groups (incl. businesses)	- Point of token creation
Redemptions	- Tokens are exchanged for EUR and subsequently destroyed or used by Gemeinde Stanz.	- All stakeholder groups (incl. businesses)	- Gemeinde Stanz	- Potential point of token destruction

Figure 11: Creation and Destruction of Tokens

Use Cases	Description	Payor	Recipient	Characteristics
Payment of subsidies to voluntary associations	<ul style="list-style-type: none"> - Gemeinde Stanz pays out part of existing subsidies in tokens 	<ul style="list-style-type: none"> - Gemeinde Stanz 	<ul style="list-style-type: none"> - Voluntary association 	<ul style="list-style-type: none"> - Potential point of token creation
Payment of social subsidies for energy or heating	<ul style="list-style-type: none"> - Gemeinde Stanz pays out part of existing subsidies in tokens 	<ul style="list-style-type: none"> - Gemeinde Stanz 	<ul style="list-style-type: none"> - Individuals / Household 	<ul style="list-style-type: none"> - Potential point of token creation
Payment of association membership fees	<ul style="list-style-type: none"> - Individuals pay membership fees of voluntary associations in tokens 	<ul style="list-style-type: none"> - Individual 	<ul style="list-style-type: none"> - Voluntary Association 	<ul style="list-style-type: none"> -
Payment of municipal taxes	<ul style="list-style-type: none"> - Individuals as well as businesses pay (part) of the municipal taxes in tokens. - For an average household, municipal taxes are between EUR 1000 to 1500 p.a. 	<ul style="list-style-type: none"> - Individuals, Businesses 	<ul style="list-style-type: none"> - Gemeinde Stanz 	<ul style="list-style-type: none"> -
Payments for goods and services	<ul style="list-style-type: none"> - Token holders can pay purchases of goods and services from businesses that accept Stanz token. These can include gastronomy, the supermarkets, the gas station or farms that directly sell their products to consumers. 	<ul style="list-style-type: none"> - All stakeholder groups (incl. businesses) 	<ul style="list-style-type: none"> - Businesses accepting tokens 	<ul style="list-style-type: none"> - Loosely energy related (for gas station)
Payment of suppliers (excluding energy)	<ul style="list-style-type: none"> - Token is used by a business to pay its suppliers. Examples include the purchase of wood from farmers by the biomass plant or the payment of suppliers by Trixi's Dorfladen. - Most businesses in the Stanz region already accept the tokens. Further 	<ul style="list-style-type: none"> - Businesses 	<ul style="list-style-type: none"> - Businesses (incl. agricultural businesses) accepting tokens 	<ul style="list-style-type: none"> -
Purchase of energy	<ul style="list-style-type: none"> - Tokens can be used to purchase energy. Depending on the implementation of the token economic system, energy trading can be P2P, P2B or centralized over the REC. While the purchase of energy doesn't necessary lead to the destruction of the token, the use of the underlying energy does. 	<ul style="list-style-type: none"> - All stakeholder groups (incl. businesses) 	<ul style="list-style-type: none"> - Prosumer, REC, (private) energy producer 	<ul style="list-style-type: none"> - Energy related - Potential point of token destruction
Investments	<ul style="list-style-type: none"> - Tokens are used as an investment into renewable energy generation facilities 	<ul style="list-style-type: none"> - All stakeholder groups (incl. businesses) 	<ul style="list-style-type: none"> - REC 	<ul style="list-style-type: none"> - Energy related
Gifting	<ul style="list-style-type: none"> - Tokens are used as a gift 	<ul style="list-style-type: none"> - Businesses, Individuals, Gemeinde Stanz 	<ul style="list-style-type: none"> - Individuals 	<ul style="list-style-type: none"> -

Figure 12: Using Tokens

In summary, tokens could be created via the generation of energy and destroyed by using this energy. Implicitly this would base tokens on the amount of energy used (e.g. 1 token per kWh). Additionally, tokens could also be issued by a central party – like Gemeinde Stanz. In this case a token would be issued by “Gemeinde Stanz” in a transaction against Euro. This explicitly pegs the token to Euro.

Using tokens: The field research process also yielded several scenarios in which tokens can be used (see figure 12 above). Co-developing these use cases with members of the wider Stanz community, participants ensured their practical relevance for citizens. While the table implicitly focuses on the user or payor in the transaction, it must be emphasized that recipients of tokens in most cases become payors themselves, the next time they use the token.

The discussion of the use cases yields additional insights for the design of a token economic system.

- *Additional creation mechanisms:* The analysis of the use cases identified an additional creation mechanism. Tokens can be issued by Gemeinde Stanz under various programs (subsidy programs for voluntary associations, social subsidies etc.). In this case the token would be issued against a budget of Gemeinde Stanz. This implicitly pegs the token to Euro.
- *Payment function dominates:* Most use cases identified focus on the use of the tokens for payment purposes (ie. as a DLC). Only a few selected use cases are integral to the energy sector. This suggests basing the token on Euro.
- *Accounting system integration:* Any use case that involves at least one party that has accounting requirements, requires a token economic system to be integrated into the existing book-keeping system.
- *Voluntary Work:* Remuneration of individuals for voluntary work with tokens was initially considered as a use case. However, discussions showed that extrinsic motivators were seen as very critical for voluntary work. This is in line with extant scientific literature.⁹³ Additionally, the measurement of the remuneration is a potential source of conflicts.

The analysis also yields insights into which types of tokens could be potentially relevant for the system.

⁹³ cf. e.g. Ryan & Deci (2000)

- **Utility token:** Once purchased, utility tokens are stored in a crypto wallet. They are associated with the buyer and can be used to access services of a blockchain project. In the case of Stanz, energy tokens can act as utility tokens that are transferable, exchangeable and fungible for users to enable peer to peer energy trading within the energy community.
- **Payment token:** Payment tokens represent a certain value that can be used to purchase goods or services from persons other than the issuer. This can be based on tokens from peer-to-peer energy trading systems, where one energy token equals 1 kWh of energy generated. Alternatively it can also be based on a Euro denomination.
- **Security token:** Security tokens are very similar to traditional debt or equities. They give a right of payment against an issuer. In the case of Stanz security tokens could represent an ownership for photovoltaic systems. In this way it is also possible for individuals to participate in the energy community and own a share of the photovoltaic system without spending all the money that is needed for a whole photovoltaic system.

7.4. Other Functional and Non-functional Requirements

From the field research phase, several general functional as well as non-functional requirements emerged that should be considered when designing a blockchain-based system.

From a perspective of general functional requirements three requirements were identified that are important for potential users in Stanz.

- **Exchangeability:** There is a strong preference that any token should be exchangeable into Euro. Furthermore, tokens were not seen as an object of speculation. That means that there was a preference for a fixed exchange rate to Euro. Especially when tokens were considered for payment related use cases.
- **Analog option:** There were strong preferences that any digital system should have an analog option. This desire was partly due to the wish of making the system as inclusive as possible for people who are not digital natives. Another reason given, was the better look and feel of having and using physical representation of the token.
- **Accounting system integration:** An important functionality for businesses and, more generally, organizations that have to keep accounts, was the compatibility of the system with accounting systems.

From the perspective of non-functional requirements several features were identified that are of particular importance for potential users in Stanz. The requirements identified can be typically expected from any IT-system and included:

- *User friendliness*: From a user perspective, the participation should be as easy as possible. That includes easy to understand processes and well designed front-end components
- *Security*: System security and prevention of hacker attacks were an important aspect for potential users.
- *Local Participation only*: The field research showed that participants would prefer a system that is regionally limited to Stanz.

8. Concept for a Token Economic System

Based on the analysis in the preceding section, this section conceptualizes token economic systems for the existing economic systems. The ultimate goal of the analysis is to evaluate the feasibility of creating a DLC based on tokenized energy produced within the local REC. To this end this chapter drafts and analyzes, on the one hand, a token economic system optimized for the REC and, on the other hand, a system optimized for a DLC. This enables us to compare and analyze a potential integration of these two systems in a subsequent step.

8.1. The Stanz Energy Token as a Cornerstone of the REC

8.1.1. Basic Idea

The Stanz Energy Token rests on a simple principle. When members of the REC (i.e. producers or prosumers) generate energy and feed it into the local REC grid, a Stanz Energy Token is created. This token represents the energy generated (e.g. 1 token = 1 kWh). This process is automatically handled by the envisioned system via a trusted gateway that connects the generation facility to the blockchain system.

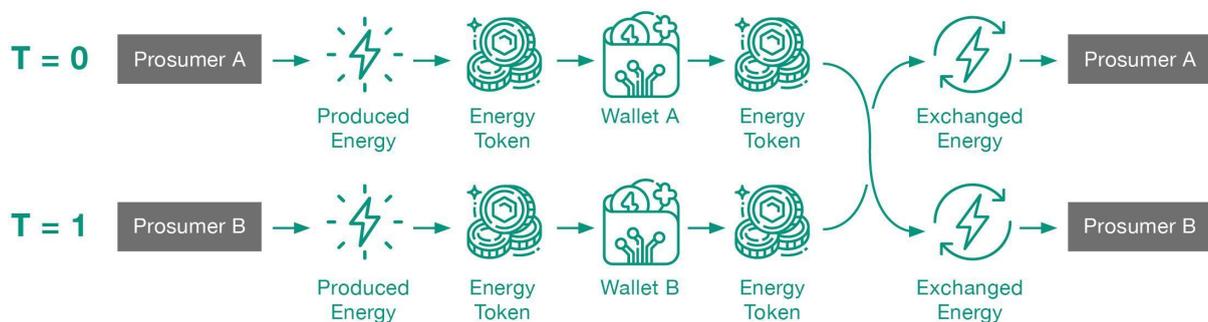


Figure 13: Stanz Energy Token - Basic principle

The holder of the token can then either use the energy (in which case the token is destroyed), or store it for later use, or sell it to other participants of the REC. The sale of Stanz Energy Tokens is handled in a peer-to-peer marketplace directly between sellers and buyers via the blockchain system. A consumer will ask for energy from a smart contract on the blockchain. The smart contract automatically checks if the requested amount of energy is currently available at one or more producers. If this is the case, it will fulfill the consumer's request. The remuneration for the token (and energy received) can be transferred in Euro in Stanz Energy Tokens. In the first case a fixed as well as a dynamically negotiated price is possible. This is an option for energy transfers between producers and consumers. In the second case, it is agreed that for every Stanz Energy Token received at a certain moment,

the buyer will return a token in the future. This is an option for two prosumers with energy needs at different times during the day (e.g. a household and a small business or school).

8.1.2. Token Types Involved

The Stanz Energy Token as described above mainly fulfills a utility function with certain payment aspects. Therefore, it can be assumed that it can be classified either as a utility token or a hybrid token. The Stanz Energy Token could be further developed into a DLC. For example, this could be done by giving prosumers and producers the possibility to pay municipal taxes with excess Stanz energy tokens. However, this would mean that the payment aspects of the token would be more dominant. This needs to be considered in any legal evaluation.

Although it is quite common for local currencies to have special features (e.g. decreasing value over time, redemption fees), the field research and participation process showed a strong preference for a simple, easy to understand design.

The objectives and needs of the energy system and its users are thus competing with this preference for simplicity. For example, users might prefer to store tokens generated in summer for later use in winter. This could lead to several problems (e.g. price differences for energy supplied by E-Werk Kindberg over time) and also counteract objectives of the REC (e.g. achieve load balancing within the REC). Therefore it seems advisable to introduce features that incentivise the immediate use of the Stanz Energy Token (e.g. decaying value, storage fee, pricing at the time of use etc.) It is recommended to simulate and test such features, in order to establish the exact impact on the system.

The Stanz Energy Token is a transactional token meant to represent energy and should not be confused with a token meant to represent ownership in a generation facility. An idea discussed during the field research and participation process was to enable participation in renewable energy facilities for little money. Tokenizing a generation facility into small shares, would make it possible to purchase only parts of an expensive facility. The type of token used in that case is a security token.

8.1.3. Technical Components

Infrastructure: Since the Stanz Energy Token acts as a token for low value transactions, low fees are the major factor for selecting an appropriate blockchain protocol to serve as the backbone infrastructure. Furthermore, stability, security, and energy efficiency should be deciding factors. Additionally, as it could become important for the future development of the system (e.g. cross-regional energy trade) blockchain interoperability should be considered. For the system at hand, it is recommended to focus on private blockchains. Nodes for the network can be established at key stakeholders in the community (e.g. Gemeinde Stanz, Commercial Energy Producers etc.). From a technical perspective these nodes could run on local computers or on cloud-based service.

Smart Contracts: A smart contract is basically a written code/computer program that is stored on a blockchain and runs when specific predetermined conditions are met.

From the required business logic that needs to be implemented in the system, the Stanz Energy Token system requires several smart contracts. First, a program for creating tokens based on the energy generated is needed. The system also requires a contract for destroying tokens once the energy is used. Both contracts need to be able to communicate with the energy infrastructure via a trusted gateway as an oracle. Additionally, contracts for the transfer of energy exchange are needed that match buyers and sellers and determine the transaction price. Lastly, a smart contract is needed to update the system when load balancing transactions with E-Werk Kindberg take place.

Wallets: Wallets allow users to hold and transfer digital assets. These wallets hold the private keys to access the digital asset held on the blockchain. There are various types of wallets that can be considered. So-called software wallets are applications running on a device of the user (e.g. smartphone). Hardware wallets are stand-alone devices that exclusively run the wallet software. Another important distinction is between custodial wallets and non-custodial wallets. Custodial wallets offer wallet services offered at a trusted third party. In contrast, non-custodial wallets are hosted by users themselves. While this gives users greater control over their wallets, it also means that if the wallet is lost or destroyed, or if the user forgets the access data to the wallet, the assets stored in the wallet become stranded.

Due to the high cost of hardware wallets, and the limited usability of non-custodial wallets, it is recommended that the Stanz Energy Token is based on custodial, software wallets.

User-side applications: Several user-side applications are required for the system. First, a smart phone app is required. The app should show users basic information about the status of their generation facility (e.g. output, tokens created etc.). It should also allow users to access their wallets in order to see their balance as well as initiate transactions. Lastly, it should enable users to set parameters for the automatic trading of surplus energy.

Second, businesses need a solution that can read transactional data from the blockchain system and translate it to a data format that can be processed by their accounting software. Third, for the manager of the ecosystem (i.e. REC Stanzertal) a backend solution is needed for documenting transactions, managing balances and periodic payments. Lastly, in order to make participants as well as non-participants more aware of the activities of the REC, a user-side front end showing the status of the whole system to the general public could be beneficial.

8.1.4. Governance

In the context of blockchain-based infrastructures, governance refers to the mechanisms for changing the rules of the system itself. There are two basic ways to implement these “change rules”. So-called on-chain governance directly encodes the rules for changing the system into the system. In other words, the system is ruled by rules encoded in the system. This enables the automation and auto-execution of rules and in turn increases the predictability of the system. However, it also leads to inflexibility when unexpected situations arise. In contrast, so-called off-chain governance completely separates the rules for changing the system and places them outside the system.

For the system at hand, it is recommended that governance should be handled off-chain for two reasons. First, as an innovative project it is more likely than not that there will be an experimental phase in which different design variants have to be tested. Second, with the REC there already exists an organizational structure with established decision processes. It is therefore recommended to use this existing structure for government purposes. This also leaves open the possibility of migrating some governance rules on-chain at a later stage (e.g. voting processes of the REC).

8.2. The Stanz Voucher Token as a Digital Solution for the Stanz Gutschein

8.2.1. Basic Idea

The basic idea behind the Stanz Voucher Token is to digitalize the existing Stanz voucher (hereafter referred to as “Stanz Gutschein”). The basic processes underlying the Stanz Gutschein are not conceptually changed but rather put on a blockchain-based system. In this scenario, the municipality of Stanz creates Stanz Voucher Tokens which are transferred to the municipality’s wallet and stored on the blockchain. The municipality of Stanz then is able to transfer the voucher tokens from the municipality’s wallet to Stanz citizens. This transfer can have several underlying business cases. For example, the municipality can use the voucher tokens for existing transfer programs (e.g. subsidies to associations). As with the Stanz Gutschein today, it is also possible for citizens to buy the voucher token for cash.

Once holding voucher tokens in their wallets, owners can then use the token to purchase local goods and services.

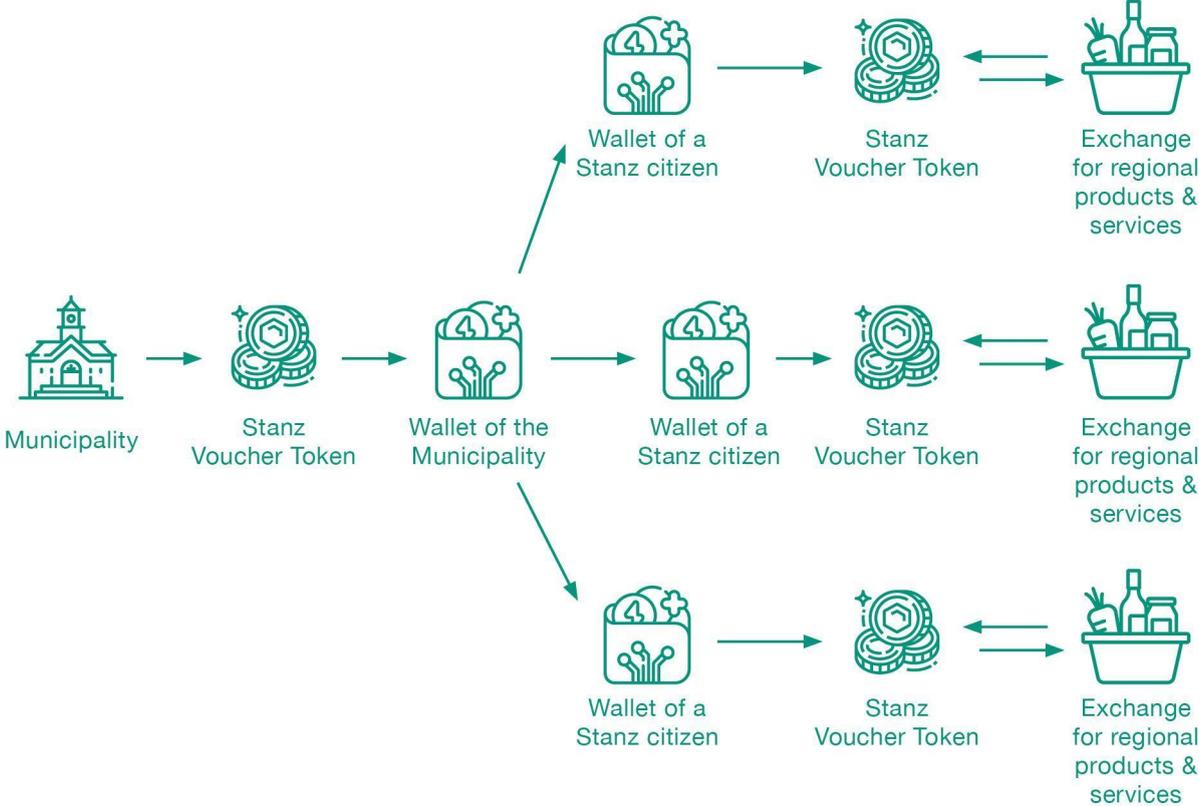


Figure 14: Stanz Voucher Token - Basic principle

8.2.2. Token Types Involved

The Stanz Voucher Token is a payment token. Payment tokens represent a certain value that can be used to purchase goods or services from persons other than the issuer. The Stanz voucher token acts as a payment token, because the only use case is to purchase goods or services.

Although it is quite common for local currencies to have special features (e.g. decreasing value over time, redemption fees), the field research and participation process showed a strong preference for a simple, easy to understand design.

Therefore, it is recommended to design the Stanz Voucher Token with as few special features as possible. More specifically it should

- represent Euro (e.g. 1 Stanz Voucher Token = 1 Euro)
- not decay over time
- not incur fees for obtaining or using it

One potential feature that could be advisable to introduce is some kind of hurdle with regards to the redemption of tokens. The impact of local currencies increases with an increased circulation of the local currency. The more often a local currency is used before being redeemed at the issuer the better. With the current system of the paper based Stanz Gutschein there are no cases of immediate redemption (e.g. some receiving the voucher as a gift, immediately exchanging it in at the municipality). One reason for this could be that cashing in comes at a cost (ie. going to the local authority). In a digital version of the Stanz Gutschein this cost is reduced to zero which could lead to not only immediate redemption but also high frequency redemptions of small sums.

In order to prevent this risk, some hurdle to redemption seems advisable. Possible solutions could be a minimum redemption amount (e.g. EUR 100) or a small redemption fee. The height of any redemption fee should be decided in comparison to other payment fees a redeemer has (e.g. credit card fees for merchants).

8.2.3. Technical Components

Infrastructure: Since the Stanz Voucher Token acts as a payment token, low fees, high transaction speeds, stability and security are the major key factors for choosing a technology. Due to the regional character of the Stanz Voucher Token blockchain, interoperability is of minor importance for technology selection. Overall, a private blockchain infrastructure is recommended, as this would satisfy the technical requirements of the system. Nodes for the network can be established at key stakeholders in the community (e.g. Gemeinde Stanz, larger businesses etc.). From a technical perspective these nodes could run on local computers or on cloud-based service.

Smart Contracts: From the required business logic that needs to be implemented in the system, the Stanz Voucher Token is rather simple, requiring only smart contracts for the creation and destruction of tokens.

Wallets: As with the Stanz Energy Voucher, in the setting of Stanz hosted custodial wallets are recommended, as this type of wallet combines an acceptable level of security with greatly increased usability.

User-side applications: Several user-side applications are required for the system. First, a smart phone app with basic payment functionality is required. The app should allow users to access their wallets in order to see their balance as well as initiate transactions. For a transaction the app would generate a QR-code that can be scanned by the recipient of the transfer. Working with QR-codes has the advantage that it can bridge the gap in a digital/non-digital transaction (e.g. a physical voucher that has the QR-code printed on it can be scanned by a transaction recipient with a smartphone). Second, businesses need a

solution that can read transactional data from the blockchain system and translate it to a data format that can be processed by their accounting software. Third, for the issuer of the tokens (i.e. Gemeinde Stanz) a simple backend solution is needed for creating and destroying tokens. This solution should also be compatible with existing accounting systems.

8.2.4. Governance

For the system at hand, it is recommended that governance should be handled off-chain by the municipality. Besides the added flexibility for experimenting in the initial stages of the project, this best reflects the existing governance structure of the “Stanz Gutschein”. This also leaves open the possibility of migrating some governance rules on-chain at a later stage.

8.3. Potential Merger of Energy and Voucher Tokens

Having described the Stanz Energy Voucher and the Stanz Token voucher in a preceding section, this chapter focuses on the comparison of these to token economic systems. This forms the basis for an evaluation whether a potential integration of these two into a system that creates a DLC based on the tokenized energy of the REC is feasible and advisable.

When analyzing the two systems some obvious differences stand out. For instance, the two systems use different mechanisms for the creation and destruction of the tokens. On the one hand, Stanz Voucher Tokens are centralized, issued by Gemeinde Stanz against Euro. This happens either via the sale of vouchers to the general public against cash or via issuing of vouchers to pay out subsidies currently payable in Euro. On the other hand, the Stanz Energy Token is generated in a decentralized manner, when producers of energy or prosumers generate renewable energy with the generation facilities. Additionally, there are differences in the technical set up of the systems (e.g. required smart contracts) and in the concrete implementation of the governance structures of the systems.

However, on a more fundamental level, there are two major differences between these two systems, namely, the goal structures and the value references.

The analysis shows that the goal structures of the Stanz Voucher Token and the Stanz Energy Token differ significantly.

From a systemic perspective, the ultimate goal of a DLC is to foster the regional economy by keeping value creation within a region. This is achieved by introducing a means of payment that is bound to a region. In order to foster this goal a main factor is a high circulation of the DLC. From an individual perspective, the main goal of the Stanz Voucher Token is to have an alternative means of payment which also fosters the local community.

In comparison the goals of the Stanz Energy Token are more complex. On a system level, there are several goals. First, the blockchain-based infrastructure is meant as a tool to document and manage energy flows within the REC. To this end, automation and a full digitization of processes is much more important than with the Stanz Voucher Token. Second, by enabling users of the system to take more responsibility for their energy usage, it also wants to increase the awareness of the general public for renewable energy and highlight the benefits of local energy production and consumption. Lastly, from a value exchange perspective, the token is primarily meant to be a means of exchange for energy. Ideally, a more transparent management of energy flows with a high involvement of users and the possibility to directly exchange energy between users, leads to a better balance of supply and demand within the REC over the longer term. Also from a user perspective, the goals for using the Stanz Energy Token are more complex. While financial goals such as cost savings and potential protection against inflation play a role, the more important considerations for using the system lie in non-financial goals such as optimizing the users own energy profile. This is done in order to achieve a higher level of autonomy and sustainability. In other words, especially for prosumers, selling surplus energy is an additional but secondary benefit.

Also, with regards to the value reference of the systems, fundamental differences stand out. The value reference of the Stanz Voucher Token is explicitly linked to the Euro. This value reference is long term and stable. In terms of a DLC, this makes sense as users intend to use it as a means of payments in lieu of Euro. As the field research and participation process has shown, there also is a strong preference for a simple design with a fixed exchange rate to Euro from users of a Stanz Voucher Token.

In contrast, the Stanz Energy Token is only indirectly linked to the Euro. The main reference unit is Kilowatt hours (kWh). This makes sense in relation to the system's goals of managing energy flows and making them more visible to users. However, although kWh can be priced in Euro, this pricing fluctuates over time, and for the system at hand ultimately depends on the tariffs obtainable from E-Werk Kindberg.

These fundamental differences make an integration of the two systems difficult. In addition, several practical issues for the system design have to be highlighted when considering an integration.

First, from the discussion of the two systems, it becomes apparent that one key operational goal when developing the Stanz Energy Token is the high grade of automation. This requires the system to be digitized to a large extent. In contrast, a DLC like the Stanz Voucher Token

aims to reach a high circulation as well as a high adoption rate in the population. This makes offering a physical version important.

Second, the legal implications of energy tokens as well as DLCs are fairly well understood. A combination of these two concepts would add legal uncertainty and would require a completely new legal evaluation and subsequent approval by the relevant regulators.

Lastly, another aspect that should be taken into account is that a combination of the systems will most likely decrease the flexibility for the future development of each system. The complexity of combining the systems at hand requires a tailor-made solution. This reduces the flexibility to add innovative functionality to the system at a later stage when compared to two less complex stand-alone systems. For example, from a regulatory perspective a DLC like the Stanz Voucher token rests on the assumption of regional use. A combined voucher and energy token would therefore most likely encounter limits for cross-regional energy exchanges between different RECs. This aspect is especially relevant as the Stanz Energy Token system currently is in a very early phase of development. Having been newly formed this year, REC Stanzertal is currently in the phase of organizing the association, building first generation assets and recruiting members. Many important strategic as well as operational questions are still under discussion.

Due to the issues outlined above an integration of the systems, while feasible, does not seem advisable at the current development stage of the REC.

9. Conclusion and Outlook

Before proceeding with the project, a decision on the scope and content of the future development needs to be made. Overall, there are several options for future initiatives.

First, it is possible to still focus on a co-development of Stanz Energy Token and Stanz Voucher Token. The discussion in the preceding section clearly shows that a co-development and integration of a fully functional DLC based on energy tokens created within an REC, adds large amounts of complexity to the design process and can lead to challenges due to competing goals, different fundamental design features and practical considerations. While certainly feasible, it doesn't seem advisable considering the current stage of development of both systems.

Another option lies in the parallel development of the Stanz Energy Token and the Stanz Voucher Token. While this is certainly possible, it is not recommended for two reasons. Developing two projects at the same time might strain existing resources in terms of financial as well as personal resources. Furthermore, system development requires making decisions on concrete technical implementations. Once these decisions are made, a certain lock-in is created, reducing the flexibility for a potential future integration of the two systems.

A third option is to focus on the development and implementation of one system. The project team recommends this option with a focus on the development of the Stanz Energy Token. There are several reasons for this. The analog version of the Stanz Voucher Token is a well-established system that is running smoothly with low overhead costs. As the analog version of the system will be continued in any case, a digitalization of this system is expected to add only marginal value. Especially, when considering the costs of system development. In contrast, the REC Stanzertal can immediately benefit from a flexible solution for documenting and managing the assets of the REC and its members.

With regards to the design, technical specification and implementation of the token economic system, it is recommended to follow established procedures. After having gained a clearer picture of the envisaged functioning of the system, next steps consist of a formal specification of the economy and the translation of business requirements into more formal language.

A formal, mathematical specification of the economy allows an analytical analysis as well as an analysis based on simulations. These types of analysis are important for complex, multi-stakeholder systems. Normally, in such systems unexpected behavior emerges leading to unexpected system states. Simulations can help discover and counteract such aberrations. Also, systemwide behavior can be shown and analyzed.

In addition to these analytical aspects, a translation of the business logic of the system into more formal, technical requirements forms the basis for the actual implementation of the system. This includes decision on and prioritization of concrete functional requirements of the system as well as detailed non-functional requirements for the system. Based on this work a first prototype with core functionality can be implemented.

It is strongly recommended that this work has a very narrow focus (e.g. energy flows in connection with the PV-installation on the roof of the primary school) in order to make fast progress and increase learning rates. Once a limited prototypical system is established and deployed this can form the basis for adding further functionality. Furthermore, a system with limited scope can be used to experiment with different mechanism design, parameter values of the system and policy choices without having a negative impact on the larger community in Stanz.

Parallel to the technical design of the system described above, conversations with relevant parties from the legal field should be started. This includes lawyers for a legal evaluation of the system and a translation into concrete legal questions. These questions can be used to initiate a dialogue with relevant regulators such as the Austrian Financial Market Authority (FMA) for information purposes.

Needless to say, the communication with the general public in Stanz is crucial for the adoption and therefore success of the project. Generally, the communication with regards to the project has been exceptionally good. One additional improvement could be to create a dedicated webspace for interested parties to access as well as store information relevant to the project at hand and the topic of sustainable energy in general. This would give the citizens of Stanz an additional touch point and enable everyone to actively participate in the energy transition process.