



What is Minting?

The act of registering a new asset to a blockchain, fungible or non-fungible, is called minting.

In the digital space, this is how unique pieces of artwork, collectibles, and even new forms of currency are brought into existence and authenticated. For creators and developers alike, understanding the minting process is essential.

Whether you are an artist looking to immortalize your digital artwork or a developer eager to innovate within the Cardano ecosystem, understanding the minting process is a foundational step. This chapter will guide you through the minting process on Cardano, from the necessary preparations to the final step of seeing your asset live on the blockchain.



Minting on Cardano

Cardano's approach to minting is distinct from other blockchains. On Cardano minting assets **does not require a smart contract**, unlike on almost all other blockchains. Instead, Cardano's protocol allows for **direct registration of assets onto the blockchain**. The information about the newly created asset is stored natively on the chain in the data included in the mint transaction (in the CIP-25 standard, the most common). This streamlined process not only ensures that each asset is immediately part of the Cardano ledger but also simplifies the minting

process, offering a level of security and reliability that creators and collectors value.

From the point of view of the ledger, a mint transaction is a base transaction like any other. The data in the mint transaction is a form of metadata that is read by wallets, marketplaces, and blockchain explorers to display information about the token(s). The token metadata on Cardano is formatted in JSON, JavaScript Object Notation, a standard data format.

In practice this means that NFTs on Cardano are on the base layer of the blockchain from the moment they are created and don't rely on a third party entity (a smart contract).

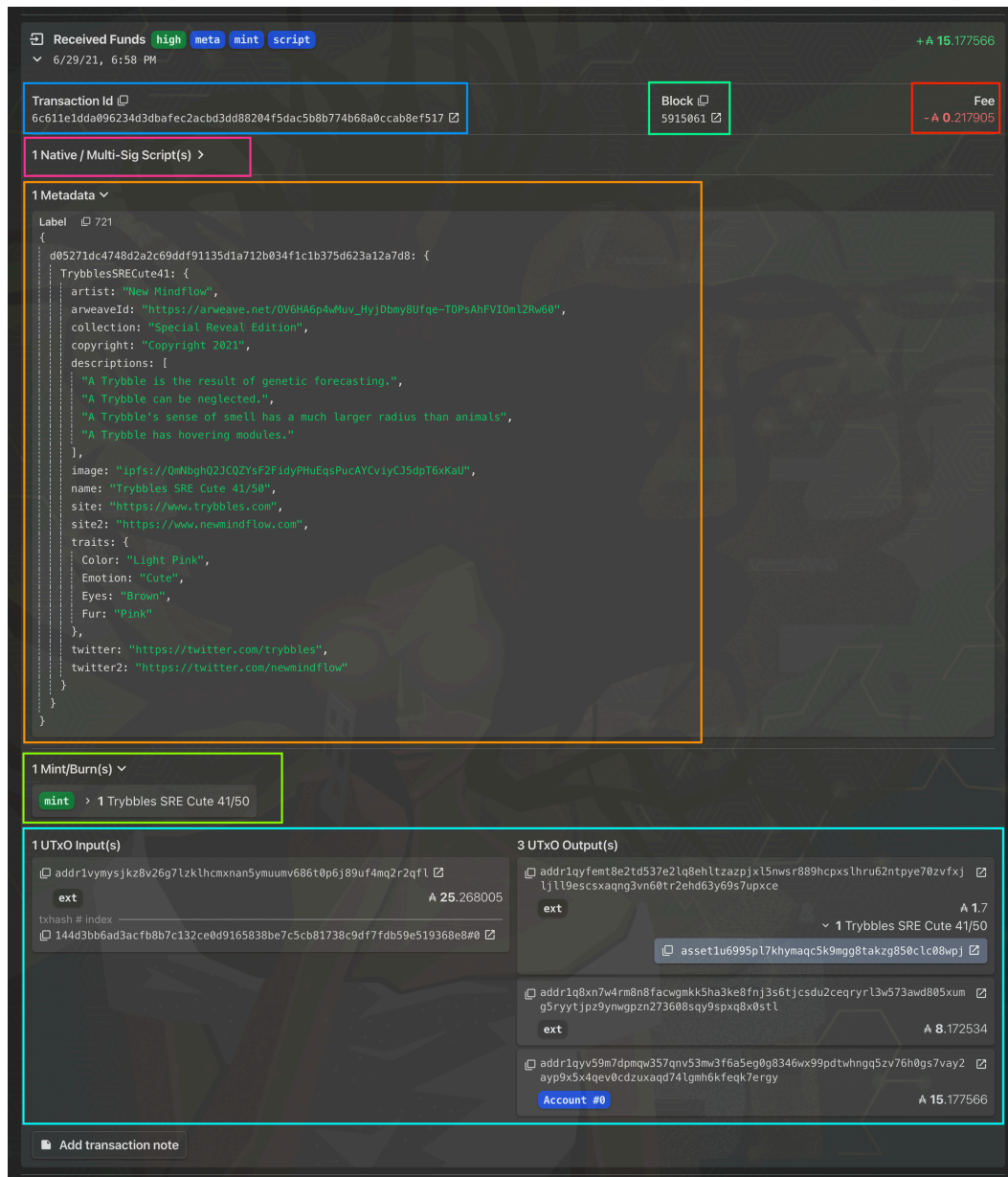
Additional Resources:

1. *Cardano Developer Portal - Minting NFTs* [<https://developers.cardano.org/docs/native-tokens/minting-nfts>]
2. *Introducing JSON* [<https://www.json.org/json-en.html>]



Breakdown of a Cardano Mint Transaction

Pictured below is an example of a typical minting transaction on Cardano. It includes the minting of an NFT under a specific policy ID, using a script that controls the minting permissions, and it is accompanied by metadata that provides detailed information about the NFT. The metadata is stored on-chain, and it adheres to the standards set out by CIP-25, ensuring that it is compatible with wallets and marketplaces that support these standards.



Let's break down the components of the mint transaction.

- 1. Transaction ID:** At the top, you have the unique identifier of the transaction (TxHash). It's like a receipt number that can be used to track the transaction on the blockchain.
- 2. Block:** This indicates the block number in which this transaction was included.
- 3. Fee:** The total transaction fee that was paid to process this transaction, including writing the metadata necessary to mint this token to the blockchain.
- 4. Native/Multi-Sig Script(s):** This section lists the script(s) used to control the minting process. The script ensures that the minting complies with the rules

set out in the token's policy.

5. **Metadata (Label 721)**: This is the metadata associated with the minted token according to CIP-25. The structure under the 721 label contains several fields:
 - Policy ID: The unique identifier for the policy under which the token is minted.
 - Asset Information: Within the policy ID, we have a nested JSON object that describes the minted asset. In this case this includes (will vary based on the preferences and desires of the artist/creator):
 - artist: The creator of the NFT artwork.
 - arweaveld: A link to an Arweave storage location where the back-up of the asset is stored (optional).
 - collection: The name of the collection to which the NFT belongs.
 - copyright: Copyright notice for the NFT.
 - description: A general description for the NFT.
 - image: A link to the main image of the NFT, stored on IPFS (InterPlanetary File System).
 - name: The name of the NFT.
 - traits: Various other characteristics of the NFT, color, emotion, eyes, and fur in this case.
 - links (site; site2; twitter; twitter2): Links to related websites & social media.
6. **Mint/Burn**: This shows what was minted or burned in the transaction. In this case, *1 Trybbles SRE Cute 41/50* indicates that one unit of the "Trybbles SRE Cute" token, specifically number 41 out of 50, was created.
7. **UTxO Breakdown - Inputs & Outputs**: The UTxO (Unspent Transaction Output) model is how Cardano tracks ownership of ADA and tokens. This field describes all parties involved in the transaction, their addresses and corresponding UTxO. The Input is where the ADA required for the transaction came from, in this case the minter of the NFT. The Outputs are where the ADA and any minted tokens are sent after the transaction. In this case there are 3 Outputs: one going to the wallet that initiated the mint, with the newly minted token, the second going to the minting service provider fee wallet and the third going to the artist/creator.

Additional Resources:

Cardanoscan Transaction Details [<https://cardanoscan.io/transaction/6c611e1dda096234d3dbafec2acbd3dd88204f5dac5b8b774b68a0ccab8ef>]



Minting Fees

The network fee paid for minting NFTs on Cardano is very small. This is why, for instance, most minting services don't even bother to add additional calculations for minting fees. Because minting NFTs on Cardano is done by registering additional metadata to a transaction, multiple assets can be minted in the same transaction. The exact number depends on the metadata size of each asset, but as a rule of thumb, minting 20 to 25 NFTs in one transaction should not be a problem. In most cases, when minting multiple NFTs in a single transaction, you could even consider that the fee for minting one NFT is smaller than that of a simple transaction. For example the fees for a standard transaction on Cardano are approximately 0.17 ADA, a mint transaction that minted 10 NFTs with relatively large metadata, similar to the one pictured in the previous lesson, had transaction fees of 0.492 ADA - meaning that the minting fee for each individual NFT was just 0.049 ADA.

In conclusion, because the minting of a token is treated by the network as a transaction, the actual "minting fee" is just the slightly larger transaction fee that needs to be paid in order to add the token metadata to the transaction. This is because the network fees are determined by the size of the transaction in bytes and the metadata of the token is additional information that is stored on the blockchain. You can get a comprehensive explanation of this [here](#).

The relatively low fees, apply not only to the minting of the tokens but to all other transactions throughout its life cycle, be it a transfer, a sale or other interactions with a smart contract on Cardano.

The Cardano roadmap even includes a feature called "[Babel Fees](#)" that would

allow for network fees to be paid in tokens other than ADA.

Additional Resources:

1. *Understanding Cardano Fees* [<https://cexplorer.io/article/understanding-cardano-fees>]
2. *Babel fees - denominating transaction costs in native tokens* [<https://iohk.io/en/blog/posts/2021/02/25/babel-fees/>]



Minting Services

There are numerous services and platforms that enable you to mint both **fungible** and **non-fungible tokens** on Cardano. For simplicity, we shall refer to these as **minting providers**.

Minting providers can be broken down into two major categories: “self-service” web apps/platforms and “On-demand” services.

“Self-service” Minting Services

Self-service web apps/platforms enable you to build an NFT collection by yourself, using a set of pre-built tools. These can vary greatly in complexity of the features and customisation options they offer. The best known and the most feature complete self-service NFT minting platform on Cardano is **NMKR**, but there are numerous services available and even mobile wallets with minting functionality built in, such as the Mantium wallet (iOS only for now).

A few of the self-service minting platforms:

NMKR - <https://www.nmkr.io> - The most complex minting service on Cardano, with a myriad of features and an easy to use dashboard. Responsible for minting over a

quarter of all Cardano NFTs. Find out more about their full list of features in their documentation: <https://docs.nmkr.io>

Saturn - <https://saturnnft.io> - A minting platform specializing in CIP-68 mints, including upgradable NFTs and “wormhole” conversions, that allow existing CIP-25 NFT collections to migrate to CIP-68.

MintMatrix - <https://www.mintmatrix.io> - A unique platform that offers both a Cardano NFT minting studio and an identity management solution. The minting studio has prebuilt templates for a wide array of NFT use cases, from documents and tickets to vehicle ownership registration. The templates include categories for both digital and physical art. To mint physical art tokens you will first need to register and mint an identity token.

Cardano Studio - <https://www.cardano-studio.app/> - A comprehensive service capable of complex collection creation and batch minting. Not as user friendly as NMKR, and missing several of its features, however the service is extremely affordable - as low as 0.06 ADA/NFT compared to the minimum of 2ADA/NFT NMKR charges.

The Ars Magna Transaction Editor - <https://arsmagna.xyz/apps/web-tx-editor/> - A complex transaction editor that allows for wallet connection, and offers a simple token minter. Suitable for small collections with minimal metadata - the fields for each asset need to be inputted manually and each asset only supports 3 metadata fields - name, description and media URI (IPFS upload must be done before mint).

Cardano Native Token and NFT Builder - <https://cardano-native-token.com> - Basic minter with a clean UI, offers options to mint both fungible and non-fungible tokens.

Mantium Wallet (iOS only) - <https://apps.apple.com/pl/app/mantium-wallet/id6443788134> - The minting feature of this mobile wallet can be useful if you want to mint directly from your phone’s gallery or on the go. Wouldn’t recommend using it for more complex projects, but it’s great that the ability to mint from mobile exists.

“On-demand” Minting Services

On-demand services enable you to launch an NFT collection better customised to your needs. Some of the established operations (not intended to be a comprehensive list):

Anvil - <https://ada-anvil.io/> - Anvil is a one stop shop for everything Cardano NFT related. They offer multi-sig minting by default through their SDK, but depending on the contract you sign with them, they can set up a mint with complex custom rules, build a customised mint website, a staking platform and more.

Buffy Bot Publishing - <https://buffybot.io> - One of the first minting service providers on Cardano, brought to you by the same people behind the NFTxLV conference.

Canucks Publishing - <https://canucks-publishing.com> - Launching NFT projects on Cardano since 2021, they are a team with a proven track record.

A Dedicated Minting Platform - Contract Developers

If you are looking for a highly customised mint offering, that fully brings to life your unique vision, your best option may be to contract a dedicated developer to build it for you. Such customization might include unique minting logic, specialized smart contracts, or integrations with third-party platforms or services. If your project requires smart contract development, for example, you'll need someone with expertise in [Plutus](#), the smart contract language of Cardano, or one of its equivalents, [Aiken](#), [OpShin](#) or [Helios](#) . In short, the skills that the developer will need to have will depend on the requirements of your project, and whether or not you will need smart contracts developed. Some of the on-demand minting services may also be willing to accommodate the development work required for your mint, however, if not, a good place to start your search is the technical section of the [Cardano Forum](#), [IOG's Technical Community](#) or the [Gimbalabs Community](#) .

Marketplaces

Another minting option creators can make use of, is launching their project directly on one of the several Cardano NFT marketplaces that offer minting directly through their platform via a self-service style app. These usually include basic minting capabilities and automated listing on the marketplace. One of the benefits

of using marketplace platforms is the added visibility they provide. Should your project be featured on the marketplace's homepage, it can significantly increase the exposure of your NFTs to potential buyers and collectors. Additionally, marketplaces often have built-in audiences and promotional tools that can help amplify your project's reach.

Some of the marketplaces that offer minting options are:

Kreate.Art - <https://kreate.art/new/collection> - Catering more to individual artists Kreate is a platform that aims to bring an art focused experience to Cardano collectors and artists. Their minting service offerings are somewhat basic, but should be sufficient for most artists looking to mint simple image based NFTs or NFT collections.

jpg.store - <https://help.jpg.store/jpg-studio> - Is a self-service NFT generator tool. JPG Studio helps you create and generate entire NFT collections without any coding knowledge.

Grabbit - <https://grabbit.market/nfts/mint> - Is a newcomer to the cardano NFT marketplace scene. It's set apart by its fully on-chain auctions, that offer a unique way of trading NFTs. Its minter is bare-bones, and doesn't support collections yet, but it offers a royalty customisation feature, that creators might find useful.

Note: A more exhaustive list of Cardano NFT minting services can be found on Cardano Cube, in the NFT Tools section: <https://www.cardanocube.com/cardano-ecosystem-nft-map> .

Additional Resources:

1. *Cardano Forum Technical Support* [<https://forum.cardano.org/c/english/communitytechnicalsupport/7>]
2. *IOG's Technical Community Discord* [<https://discord.com/invite/gsvZ4tafPJ>]
3. *Gimbalabs Discord* [<https://discord.com/invite/BPFs46nwrS>]
4. *Cardano Cube - NFT Ecosystem Map* [<https://www.cardanocube.com/cardano-ecosystem-nft-map>]



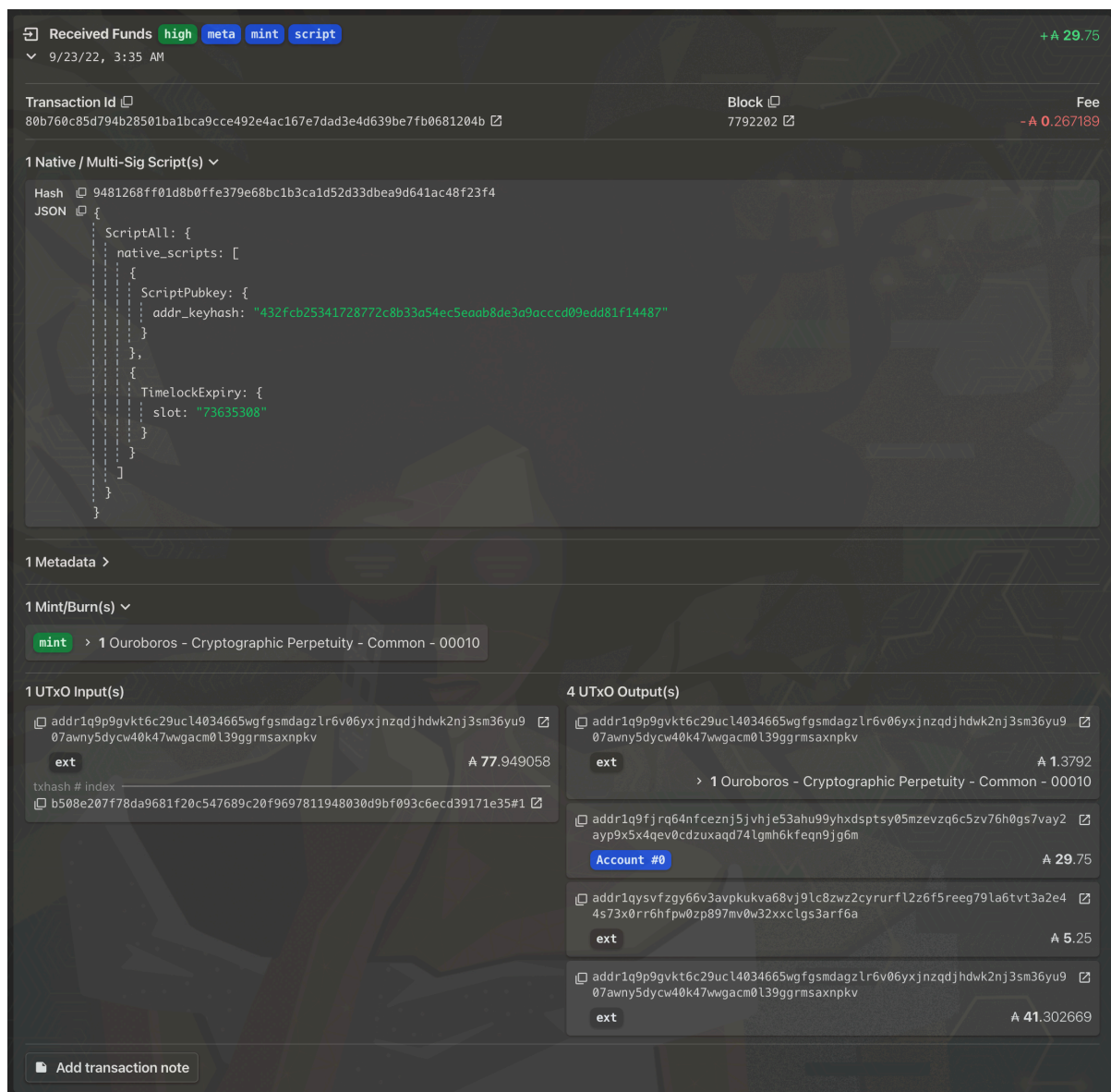
Multi-sig Minting

In the early days of Cardano NFTs, following the Mary Hardfork in 2021, all mint transactions were done in two steps - the person minting the NFT would send the ADA required to mint the NFT in one transaction and the NFT would be minted and sent back to your wallet in a second transaction. While this option is still sometimes used, multi-sig minting is now the preferred option. With multi-sig mints (short for multi-signature), two transactions are no longer required because the minting script is set up in such a way that the minting costs are paid for, the NFTs are minted and the proceeds of the transaction are distributed to all relevant parties in one transaction.

Multi-sig minting has many advantages:

- **Enhances buyer trust:** Allows buyers to see and confirm the NFT they're acquiring before signing the payment transaction.
- **Increased speed:** At least twice as fast as two-step minting due to fewer transactions being processed.
- **Potentially improved revenue for creators:** Eliminates the need to send the min ADA UTXO along with the minted NFT. This can influence your price calculations, as this cost is no longer needed.
- **Reduced blockchain traffic:** Combines minting, payments and distribution into a single transaction, significantly cutting down blockchain load. This is further enhanced by the fact that multi-sig minting also eliminates the need for potential refunds, which can be needed in two-step minting.

The only downside of multi-sig minting is that it must be performed through a wallet that supports the wallet connector standard. In practice this means that minting will be impossible from the Cardano full node wallet, Daedalus, or for people that don't want to connect to your minting website.



Pictured above is a multi-sig transaction, as displayed in the Eternl wallet. What's important to note is the **Multi-Sig Script** that contains information about the public keys required to validate the transaction, and the **UTxO Inputs/Outputs**. The input (i1) provides the source of ADA funding the transaction - it covers the transaction fees and the cost of minting the NFT, with the remaining balance returned to the sender. This includes the address from which the ADA is sent and the amount of ADA used. Notice how the address is the same as the first address in the outputs field, receiving the minted NFT.

The outputs detail where the ADA and the newly minted token go in the transaction. In this particular transaction, there are four outputs:

1. **o1**. Newly minted NFT;
2. **o2**. Artist's cut;

3. [o3](#).Minting service cut;
4. [o4](#).Change UTxO (returned to the sender's address).

The outputs will depend on the needs of each project, typically it will include the recipient of the minted tokens, any change returned to the sender ([o4](#) in this case), and possibly payments to other parties involved in the transaction (collaborators, minting platform fees, etc.).

Additional Resources:

[Cardanoscan Transaction Details](#)



At Mint Best Practices & Considerations

Minting your NFT collection is more than just a transaction on the blockchain; it's the culmination of creativity, planning, and execution. In this section, we'll provide some steps that we think are essential for a smooth NFT launch.

1. The first thing that you will need to consider before mint, is what type of policy you want for your collection. In short, open policies offer more flexibility and the option to make changes or additions to your collection indefinitely, accommodating future growth or changes in plan. On the other hand, closed policies offer certainty to your buyers and collectors that the NFTs can't be changed after the policy lock date, while also guaranteeing a fixed supply, which can be an important factor for a wide range of buyers. More info on Policy IDs in the *Understanding Policy IDs* section of the guide.
2. If you opt for a closed Policy ID for your on-demand collection, take into account the fact that the minting process can take from a couple of hours to a couple of months and any errors in metadata or images can only be fixed while the policy is open.
3. Double-check all artwork files and metadata for accuracy. Ensure that image resolutions, file formats, and metadata descriptions are consistent and of

- high quality and load correctly from IPFS.
4. Consider image optimization. Prepare your image or media files for the web to minimize minting costs and ensure smooth display across platforms.
 5. Uploading images to IPFS - whether you're using Blockfrost or another service - can take a considerable amount of time, so have everything ready well in advance of the scheduled mint date. Depending on the minting service provider you opt for, this step may be done for you.
 6. A test mint on the Preprod network is highly recommended to ensure your collection looks and behaves as intended. Depending on how and where you decide to mint your collections, this option can be available. For instance NMKR offers a full version of their minting Studio app for the Preprod network, allowing you to fine-tune your collection before the official launch. [<https://studio.preprod.nmkr.io>]
 7. Review all legal aspects, including copyright, licensing, and terms of service. Ensure that you have the rights to all elements of your NFTs and that buyers understand their rights upon purchase.
 8. Ensure that all aspects of the minting process are secure. This includes ensuring that your minting page is protected against common web vulnerabilities, potentially auditing multisig setups or smart contracts if used, and even securing your own wallet - pro tip: it's best to use a hardware wallet if you're expecting significant amounts to be generated by the mint.
 9. Consider steps to secure your Policy ID keys, especially if you opt for an open policy. Make sure you ask your minting provider for the policy keys - even an open policy can only be edited if you are in possession of them.
 10. Have backups of all critical assets and data. This can apply both to the NFT itself and your own storage solutions. For instance in the case of our *Trybbles* collection we chose to backup the IPFS data with Arweave [<https://www.arweave.org>]. For your storage needs, consider using multiple storage solutions to ensure that your data is retrievable in case of any single point of failure.
 11. Consider the timing of your launch. Analyze trends and aim for a period when you can maximize visibility and interest.
 12. Estimate the total cost of minting, including transaction fees, storage fees for IPFS, and any additional services. This helps in setting the right price for your NFTs and understanding the financial implications of the mint.
 13. Plan for the post-mint period. Consider verifications on secondary marketplaces in advance to ensure that your buyers can trade your NFTs shortly after the mint.

14. If you are launching a community oriented project, engage with the Cardano community early on. Share progress and set clear expectations about your project to foster trust with your audience.