

How do I become a Tezos baker

This is a step by step guide to being a Tezos baker for everyone.

You'll learn everything you need as well as some background to understand how things work.

You'll get impulses to dig deeper along the way if you are interested. Becoming a baker is a journey to understand how Tezos works!



What exactly does a baker do?

The blockchain runs on a network of worldwide **distributed nodes**. As baker you run such a node.

You **produce blocks** and control other bakers in the network to do their job correctly. All of that is done by Tezos software components. You don't have to manually do much except for keeping the software up to date.

For running a baker you get paid out **rewards** by the network.

You also participate in governing the development of the blockchains' protocol.
For that it is important that you **participate in regular votings**.



What equipment do I need?

To run a Tezos node you need a computer that is running and connected to the internet **24/7**.

Even though you could run a node on a cloud-computing-service which is running 24/7 by default, the better option for decentralisation is, to run it on a **tiny computer** like a Raspberry Pi **at home!**

How much tez do I need?

A baker on Tezos needs at least 6,000 tez.

But you can even be a baker with only **600 tez**
if you manage to get 5,400 tez from delegators!



How much do I earn?

You earn baking **rewards**

You earn **fees** from your delegators

You can earn transaction fees
embedded in blocks

Example: You own 600 tez

for simplicity let's assume:

- staking rewards are 5% per year (actually they are between 5-6%)
- bakers take a 10% fee (baking fee can range from 0-100%)
- you are fully delegated with 5,400 tez

If you delegate to a baker:

30 tez (600 x 5%)
minus 10% baking fee
27 tez per year

If you bake yourself:

30 tez for your own tez
plus 10% fee from 5,400 tez
delegations
57 tez per year



How do I find delegators?

Be active in the community, connect with artists and devs on Twitter, Telegram, Discord, Slack etc. Be around.

Be curious. Ask for help. Offer your help. Ask people to support you. Offer a benefit, like 0% fees for early supporters or special high quality NFTs. When you made real connections and ain't a dick, people come and delegate to you.

Some words you' ll come across all the time

Bakers are the **delegates** in the council of blockchain **governance**. Their voting power is given by the amount of tez they represent. Bakers are stakeholders of the blockchain. That's why this blockchain system is called **Proof of Stake (PoS)**

When you represent delegators, all their funds stay liquid (called **Liquid Proof of Stake LPoS**). It means not one delegated tez is locked or frozen! On other blockchains this is not always the case. For example if you stake Ethereum tokens, at the moment of writing, you cannot access them anymore.

To secure this whole mechanism, only you as baker have to freeze a **security deposit**, which is 10% of the funds you represent.

Hash a unique calculated string of numbers and letters to prove the integrity of any kind of data (text, code, images etc).

Is the data manipulated just the slightest bit, the hash would change completely. e.g. the first ever created block on Tezos has the hash:

BLSqrcLvFtqVCx8WSqkVJypW2kAVRM3eEj2BH-gBsB6kb24NqYev

Transactions All transactions on the blockchain. e.g. transferring money, minting/swapping/selling an artwork, swapping/farming DeFi tokens etc.

Blockchain You certainly use that word all the time. But do you know what it actually is? Very simply explained: A list of transactions is written in a „document“ called block. This block has it's unique hash. The hash of the first block is written into the next block and so on. This way all blocks are connected and any kind of manipulation is registered in all blocks because the hash in the manipulated block would change and with that all following blocks.

Gas A block can only store a certain amount of data. For every information that is stored in a block a fee has to be payed. That fee is called gas. It's like paying for fuel to drive the chain a bit further.

Block explorer The most versatile tools on the blockchain! You can find everything there is to know about the status of blocks, cycles, protocol, activity, governance, bakers etc. on a website. The most well known explorers are **tzkt.io**, **tzstats.com**, **arronax.io**

Mainnet The main blockchain

Testnet A test-version of the blockchain with fake tokens to test smart contracts, dApps, protocol upgrades etc.

Mempool Transactions go to the Mempool before they are integrated into a block.

Blocktime Currently every ~30 seconds a new block is produced.

Cycle A series of 8192 blocks. Given the block time a cycle currently is ~2.8 days.

Protocol The main set of rules and commands embedded into the base layer of Tezos. The protocol can be upgraded.

Ledger In its' original meaning the ledger is just a list of transactions. The most popular hardware wallet compny is called „Ledger“ as well. If you want to bake you will need e.g. a „Ledger Nano S“.

Tezos node The piece of Tezos software that stores a copy of the blockchain and is connecting you to the blockchain and to the network of other nodes.

Tezos baker Future you! A validator of the blockchain. Also that piece of Tezos software that is in charge of doing all the baking and endorsing for you.

Tezos accuser The piece of Tezos software that monitors if somebody is doing mischief on the blockchain and prevents / punishes it.

Baking a block Taking transactions from the mempool and integrate them into a block. All done automatically by the baker software.

Endorsing a block checking if the recently baked block from another baker is correct.

Bootstrapping Downloading a copy of the blockchain, connecting to the network and sync with it.

High Water Mark The latest produced block.

Slashing If a baked block is manipulated, the creator of that block gets punished by losing parts of their security deposit.

Double baking / double endorsing Block manipulation can happen accidentally by producing or endorsing the same block twice. The baker who happens to do so loses parts of their security deposit. Luckily if you are using a Ledger Nano S you are protected from double baking and double endorsing.

Governance

Tezos has the ability to adapt to market demands and new technology.

It is designed to evolve.

Upgrades are voted upon by the bakers in a five-step process. Each step has a duration of five cycles. Only if all steps are fulfilled, the update goes live on the mainnet.

As baker you are an important part in this process. So please participate in those votings!

For a vote on Tezos to be valid, the participation has to be higher than a certain automatically calculated percentage. This is called the **Quorum**.

Of all casted votes a **supermajority** of 80% has to vote „Yay“ for a vote to be successful.

Dig deeper
Tezos
Governance



Dig deeper
Voting with
BakeBuddy



Dig deeper
Voting with
TezGov.app



Dig deeper
Voting with
Tezocracy



The five steps of tezoz governance

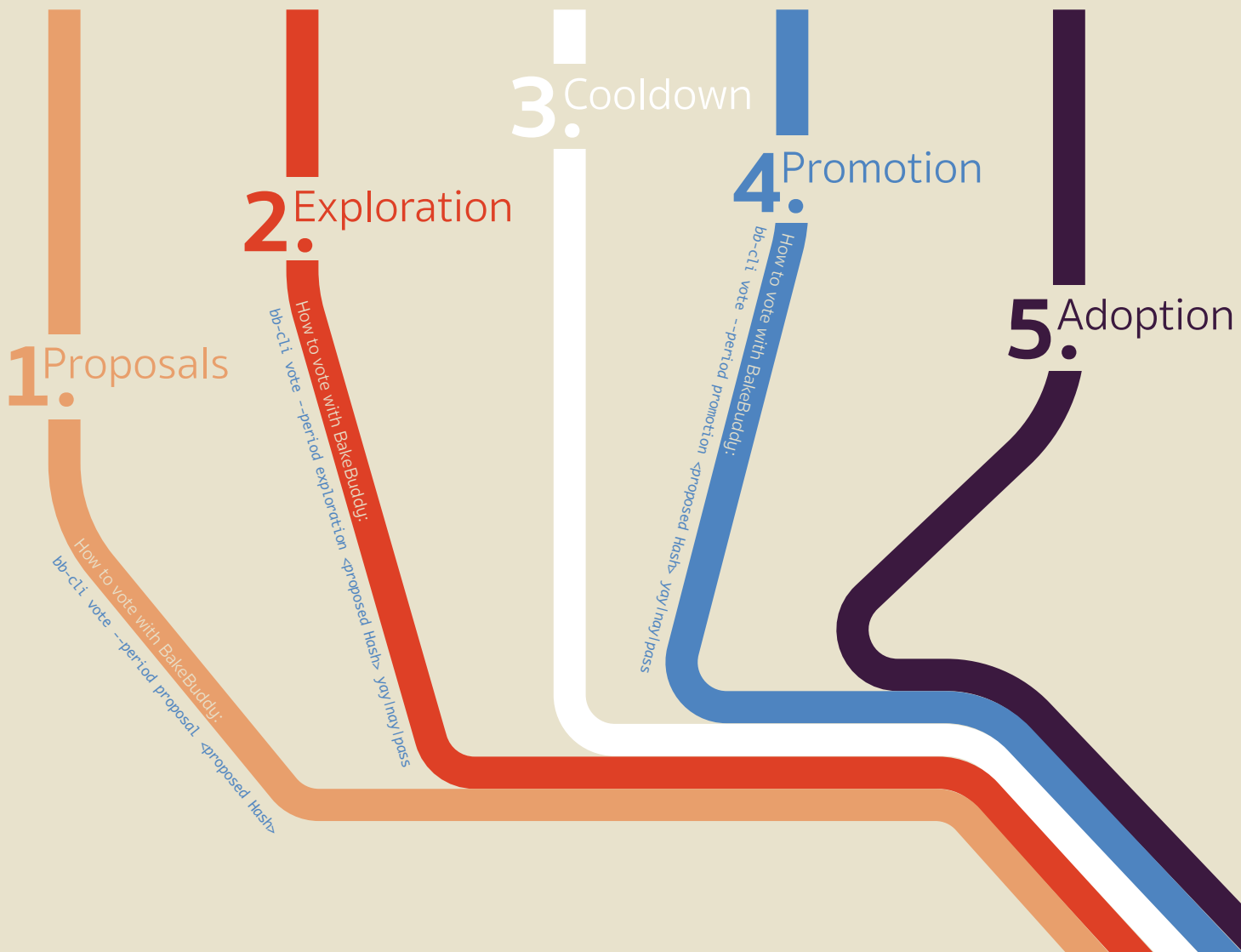
Proposals can be made by any baker but you need to have developers who can implement what you are proposing. The most serious proposals are joint efforts from the core development teams. The most voted on proposal goes to the next stage.

Bakers vote on the proposal with the options **Yay, Nay or Pass**. There are usually a high amount of Pass-votes from Exchanges like kraken, coinbase etc. and the Tezos Foundation. They stay neutral for liability reasons. If quorum and supermajority are met, the next step starts. Otherwise the proposal period starts anew.

Nothing happens on chain. Time for testing.

With the knowledge from testing, another round of voting just like Exploration starts. If quorum and supermajority are met, the next step starts. Otherwise the proposal period starts anew.

Another five cycles time for bakers and developers to implement changes. **Usually here you will need to update and restart the baking software.**



Importance of Decentralisation

The Tezos network has to be as decentralised as possible so that no-one has the power to manipulate or stop the chain.

Imagine two scenarios:

- 1 Cloud computing service is switched off!
Imagine if more then 1/3 of all staked tezoz are on nodes on a cloud service like amazons AWS and amazon decides to switch off AWS, the blockchain would come to a halt.
- 2 The biggest Tezos bakers are crypto exchanges like kraken, coinbase, binance etc.
If these biggest bakers don't participate in a vote it's almost impossible to reach quorum. The development of the blockchain could be manipulated this way.

This is why two things are most important:

To run a node on hardware at home to get the network geographically distributed and failsafe.

Tezos holders need to get their coins off of exchanges to local wallets and delegate to an active baker or become a baker themselves.

Community

As baker you can join the Tezos baking-slack and certain discord or Telegram groups where everybody is very helpful and welcoming! You get information about updates and events, participate in discussions and get in contact with developers.

Tezos Baking Slack



Tezos Baking Telegram



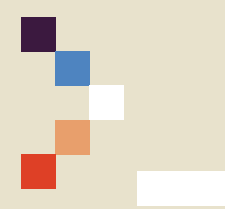
Tezos Baking Discord



BakeBuddy Discord



Do not fear the command line interface! A short field trip



Some of you have never used or seen a Linux Command Line Interface (**CLI** - also called „Terminal“ or „Shell“) let me assure you, it's not as frightening as you might think! You just need some patience and interest in what's going on. The rest is copy&paste.

What you usually see and know of your computer's Operating System is the Graphical User Interface (short GUI) where you open Windows, create and move Files&Folders and use Programs or Apps.

The GUI is build upon a huge amount of commands and subprograms. And there are even many more commands that are not accessible from the GUI. That's when you need to access them directly from the CLI.

The CLI is basically exactly doing what it's called. You write (or copy&paste) a line of command, press enter and that command is executed.

If you need a series of commands very often, you can even put them one line after the other into a text-file. Then you can use another command to make that plain text-file executable and voila, you have a script. That script itself can be used as a command. Like this you can execute a whole series of commands automatically.

Folder structure / Superuser

You navigate folders (called **directories**) along a path you can imagine as a **tree**. Every folder inside another folder is a **branch** and they all stem in the **“root”** folder which is the folder where your Operating System has its base. **“root”** is protected to prevent hacking and accidental changes that could damage the system.

Usually you work inside your user profile / home folder. But sometimes installing programs or running commands need to be done on the root level. Here you'll need to verify yourself as the **superuser**. When you install a program in your GUI you are asked to enter your admin password. That is comparable, except with the superuser you can do even more. But be aware you can also do more damage!

So, whenever you are in superuser mode:

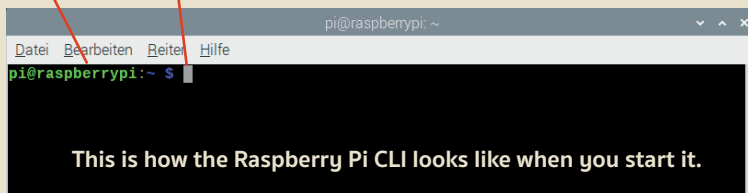
Be 100% sure the command you are running comes from a reliable source!

When you need to run a command as superuser you write **“sudo”** before the command, which means: **“superuser do”**. Then you are asked to enter the password where the cursor is at. And don't be surprised. When typing a password, the cursor is not moving. It looks like you are not typing at all. But when you hit **“enter”** your password will be accepted and the command executed. Or not if you get it wrong ;)

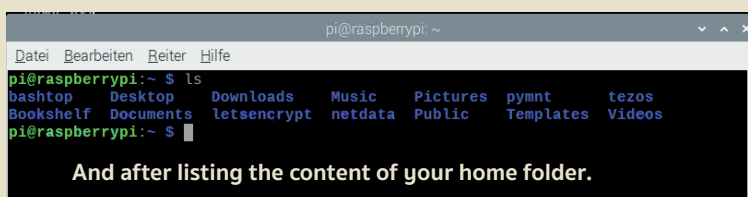


This is the folder you are currently in

Here you write your commands



This is how the Raspberry Pi CLI looks like when you start it.



And after listing the content of your home folder.

In the CLI every command you write produces at least a new line where you can write your next command. It could also produce an ongoing flow of lines of text, one after the other. The original command stays written in the row above. The more you execute in the CLI the longer the list of lines. The position you are currently at is always where the cursor is. You can move the cursor with left and right arrow keys and use delete or backspace if you want to correct a part, but only in the current command.

Commands, like starting a program, can only be executed from inside the folder that program is located. That's why you need to know how to **navigate folders in the CLI**.

When you start the CLI you are usually inside your home folder.

These are some very basic commands you might use:

cd means change directory

ls means list all files and folders inside the folder you are currently in

cd myfolder enter folder with the name "myfolder"

cd .. brings you outside the current folder to the next higher folder hierarchy

mkdir means make directory

mkdir myfolder means make folder with the name "myfolder"

cp source destination copy a file from source to destination

mv source destination move a file from source to destination

Tipp: With „arrow up“ you can skip through the latest commands you executed

Some more advanced commands you will come in touch with (Just so you have seen them before and get an idea what they do)

apt-get installation of linux packages (Advanced Package Tool)

wget a tool for downloading stuff from the internet

chmod setting permission for a file e.g. to make it executable with **chmod +x**

Home baking with a Raspberry Pi

My top reasons for using a Raspberry Pi:

- It consumes the **least amount of energy**
- It can run 24/7 without being cooled by a fan, so it is absolutely **silent** and can even sit in your living room
- It already comes equipped with **useful tools** like Real VNC server so you can connect to your Raspberry Pi from any computer over the internet
- at the time of writing the Raspberry Pi 4 B is often out of stock and pretty expensive, even on second hand market. It is still much cheaper than baking in the cloud. Normally you can get the whole baking setup for ~250€ whereas cloud computing can cost several 100€ per year.

Downside:

If there are so many transaction included in one block that the block gets full, the RPi might not be fast enough to process it. In that case to you can miss assignments and possibly loose rewards. In my own experience for now that does not happen often.

What's the alternative?

Many bakers use an Intel NUC computer. They are much more powerful than a RPi but they are more expensive, consume more energy and they have a fan that makes noise. That are the main reasons I personally would not use them. A promising option could be the "Radxa Rock 5" single board computer. It is similar to the RPi but with more CPU Power and up to 16GB of RAM. My aim is to someday get one and try it out!

Your shopping list

Raspberry Pi 4 Model B with 8GB RAM
16 or 32 GB Micro SD Card
Micro SD-Card Adapter
Micro HDMI Adapter
USB-C Power supply
Metal armour case for the Raspberry Pi
Hardware wallet (e.g. Ledger Nano S)
min 256 GB SSD (Samsung T5, T7)
LAN Cable to connect to your router

On top you'll need

another PC/Mac with SD card-reader
Monitor
Keyboard
Mouse

Setting up the RPi

1 Go to <https://www.raspberrypi.com/software/> and download the Raspberry Pi Imager

2 Put the micro SD card in the SD Adapter and that one in your computer

3 In Raspberry Pi Imager:
CHOOSE OS -> Raspberry Pi OS 32 bit
CHOOSE STORAGE -> locate the SD Card
Click **Write**

4 After the process has finished put the SD Card in the Raspberry Pi. Connect Mouse, Keyboard, Monitor and at last the power supply.
As soon as the RPi is connected to power it starts running.

5 You'll be asked to setup the Operating System: ←
Set your location and language
Stick with the user named „pi“ and set a password that is not too easy but that you remember
Connect to wifi
After the configuration the RPi reboots automatically

6 After the startup process you see the GUI of the RPi. Click on the Raspberry Icon in the top left corner, then on Accessories, then on Terminal or LXTerminal.

7 Congratulations, you successfully started the CLI

8 Write or copy&paste this command to open the configuration of the RPi and hit enter

9 The sudo command asks you for the password you just entered in the setup

10 In the raspi-config window you can navigate with arrow up/down and enter.
Go to **Advanced Options** —> **Boot order** —> **USB Boot** —> **Hit Enter**

Everything we did to this point was necessary to enable this **USB Boot Option**. Usually the RPi runs just with that SD card but Tezos can't be run from the SD Card because it is too slow and too small. This setting tells the RPi to look for an Operating System on a disk connected via USB. You need to install the 64 bit version of the operating system on your SSD. Continue like this on your PC.

11 Plug in your SSD and start Raspberry Pi Imager again if it's not still open.

12 In Raspberry Pi Imager:
CHOOSE OS -> Raspberry Pi other -> Raspberry Pi OS (64 bit)
CHOOSE STORAGE -> locate the SSD Drive
Click **Write**

13 After the process has finished, plug the SSD into one of the blue USB ports of the RPi (USB 3)

14 Reboot the RPi - you now have to go through the setup process again. Repeat just **Step 5**

After your RPi has rebooted it runs the 64 bit operating system on the SSD.

You don't really need the SD Card but you also can't remove it because the RPi would not start without it.

Setting up the Ledger Nano S

- 1 Download the Ledger Live App to your PC
- 2 Connect your Ledger Nano S to your PC
- 3 Follow the guide of your Ledger Nano S. You'll need to setup a **PIN** and note down a **passphrase**. **Attention: This piece of paper with the passphrase is your holy grail. Never lose it, under no circumstance let anybody see or copy it! You might lose all your funds!**
- 4 Make sure your Ledger Nano S runs on the latest firmware! You'll find a guide to do so on their website.
- 5 In Ledger Live go to **settings**, then **experimental features**, then **enable developer mode**
- 6 Install the two apps **tezos wallet** and **tezos baking** You need both apps because the wallet and baking are separated. That is a security measure. As long as

you are running the baking app your ledger can not make outgoing transactions. If you need to send tez from the Ledger you first have to quit baking and switch to the wallet app.

7 In Ledger Live, create a new Account, chose tezos and give it a name. The name you enter here is only relevant to identify the account in this app. For consistency you might want to name it like you want to name your baker. The generated tezos address will be you bakers address.

8 Send at least 600 tez to the ledgers wallet.

9 Connect the ledger with your baking machine and start the baking app.

Dig deeper
Setup Ledger Nano S



Setting up the baking software with BakeBuddy

- 1 Open the CLI Terminal
- 2 Copy&paste the following command to download the latest version of BakeBuddy
- 3 Hit Enter and wait for the command to finish. It downloads the tezos software from the internet and moves it to the folder /usr/bin/bb-cli
- 4 Copy&paste the following command and wait for it to finish
- 5 Now you need to bootstrap your node. That means you download a copy of the blockchain. This can take some time. The terminal shows you the progress. You will see when it's finished. Copy and paste the following command
- 6 Start your node and wait until it is synchronised
- 7 From time to time run the following command and look at the status. Watch out for "level"
- 8 On your PC open a block-explorer like tzkt.io or tzstats.com and observe the latest block that is added to the blockchain. Compare it with the "level" displayed when check "bb-cli info" on your Machine.
- 9 When „level“ shows the same as the blockexplorer everything is in sync, connect your Ledger Nano S
- 10 Import your ledger's address into BakeBuddy
- 11 Authorise your ledger to bake. The **HWM (High Water Mark)** indicates the most recent created block. This setting protects you from double baking and double endorsing. If you setup a new Ledger Nano S you can leave the HWM setting at „1“. If you are unsure go to a block explorer like tzkt.io and find the number of the "latest block" copy and paste this number instead of the "1"
- 12 Register your ledgers' tezos address on the blockchain as baker

Dig deeper
BakeBuddy Wiki



Upgrading your baking software with BakeBuddy

To be ready for protocol upgrades, new tezos software-releases or new BakeBuddy releases you need to update like this:

- 1 Download the latest BakeBuddy version, exactly like you learned above
- 2 Check if everything is running fine before initiating the upgrade:
- 3 Upgrade your baker:
- 4 Check again if everything is running fine:

Setting a maximum security bond

You might want to set a maximum to the amount of tez that can be frozen for security. This can be adjusted any time. If you don't set it and you get more than 10x delegations, all your funds will be frozen and you are less flexible in making payouts. You can set this with the following command. Just fill in the tez you want to set it to where it says „<tez>“.

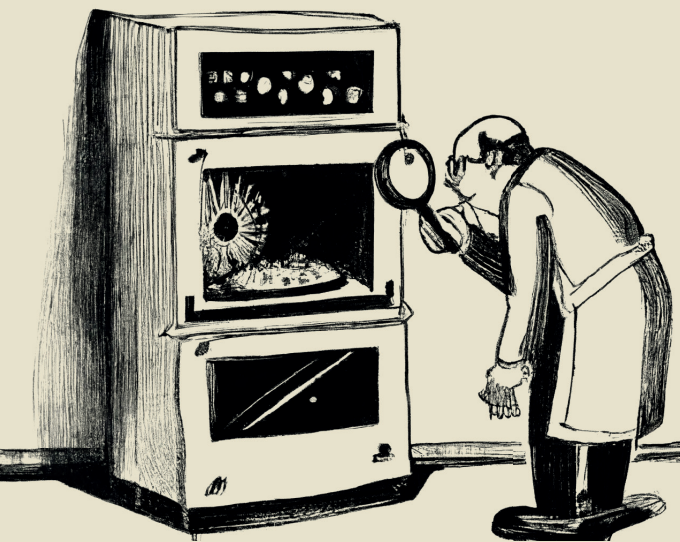
Overdelegation

Block explorers show how much space for delegations you have left. If you get more than 10x delegations of your maximum security bond you are „**overdelegated**“.

The distributed rewards will become less for everybody. In that case you need to either:

- increase your security bond,
- convince delegators to leave
- set the fee of delegators that exceed your limit to 100%.

The payout tools Breadcrumbs and TEZPAY implemented mechanisms for this case.



Monitoring your baker

There are multiple reasons why you want to monitor your baker. There are also multiple ways to do so.

Reason

What are my bakers' assignments, how many delegators do I have, how much have I earned?

Go to a blockexplorer and enter your bakers' tezos address. You'll get infos on your assignments, delegators, earnings etc.

Reason

Is my baker bootstrapped, is it synced, how is the peer-2-peer connection?

On your CLI enter

You'll get info on the status of your baker



Reason

I want to get informed immediately when I miss an assignment or get a new delegator?

Use the Tezos Notifier Bot on Telegram



Reason

I'm missing blocks or something else is wrong with my hardware! Is the RPi powerful enough, is RAM or CPU exceeded?

Use netdata
Attention: this gets pretty technical!



Remote control your baker

In most cases it is not convenient to have the RPi connected to a monitor, keyboard and mouse all the time. And it does not need that to run. That is called running „Headless“. But how do you check if everything is running or make an update?

You can use VNC (Virtual Network Computing):

VNC is like Screensharing and handing over control of mouse and keyboard to another computer. You might know similar tools, like Teamviewer. The Raspberry Pi comes with Real VNC Server. You need to make an account at their website, Configure the server, install The Real VNC Viewer on your other Computer and just like that you can log in to your RPi from your Laptop from anywhere in the world.

You can use SSH (Secure Shell):

You can use the CLI of your RPi through the CLI of another computer. This is a bit more advanced and I won't explain every step. You'll need to know the IP address of the RPi and enable SSH in the RPi preferences. For security I strongly advice you to set a username other than the standard „pi“. Also choose a strong password.

Then you can login to your RPi's CLI like this:

enter your password

Becoming a public baker

The difference between a private and a public baker is simply the fact, that a public baker provided info about their baker to the blockexplorers.

Contact them and they'll let you know what info exactly to provide.

You'll need to define e.g. the following points.
What you do here is complete up to you:

Name of your baker

Tezos address of your baker

Percentage fee you'll take from your delegators

Geographical location

Minimum delegation amount that gets payed out

Contact handles

Payout address

A logo file

For a start contact these two:

<https://tzstats.com/docs/gui-de/howto/#add-your-baker-on-tzstats>

<https://twitter.com/TezosBakingBad/>

Paying out delegators

As soon as you are public you might want people to delegate to you. In that case you need to payout their share of the rewards. This can not be done automatically by the baking software. And it is way too complex to do it manually. Luckily there are many genius people in the tezos ecosystem who developed solutions for this. I know of four solutions with different pro and con.

A general topic with paying out rewards is the fact that making payouts directly from you bakers tz address is a pain in the ass because every 2.8 days you will have to quit the baking app, switch to the wallet app, confirm the outgoing transfer manually and switch back.

Instead, it is common practice that you have another software wallet in kukai, temple etc. for making the payouts. This "Hot wallet" is not as secure as your ledger wallet which is why you should only have a balance on it that's enough for a few cycles to pay out. In the meantime you accumulate rewards on the ledger and only if the "Hot Wallet" runs dry you have to transfer new funds from the Ledger or from somewhere else. I will do a detailed tutorial on payouts later.

TAPS Lite

This is absolutely beginner friendly. You just go to their website tztaps.io

Connect with your payout wallet

Go to settings

Enter your bakers address, Fee and Min delegation and you are good to go

Only downside is: you have to make payouts manually after every cycle. You cannot automate anything (yet)

Dig deeper
Medium Article
about TAPS



TRD – Tezos Reward Distributor

You can automate payouts, you can setup Telegram and Twitter Bots to inform your community.

The setup is a little intimidating so maybe go with TAPS Lite for the start and when you feel a little more comfortable with the CLI you setup one of the others.

TRD has a support community on the baking Slack

Dig deeper
TRD
Documentation



Breadcrumbs

Is as powerful as TRD.
I have not used it myself by now.

Dig deeper
Breadcrumbs
Wiki



TEZPAY

The wonderful developers of BakeBuddy also developed an easy to use yet powerful payout tool.

At the time of writing automation is not yet implemented but planned.

Dig deeper
TEZPAY
Project page





Welcome to the club

Sources

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baking-bad.org/docs/tezos-staking-for-beginners/

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www.tezosagora.org/learn

Sites to dig in deeper

Tezos documentation
tezos.gitlab.io

Open Tezos
opentezos.com

Tezos Agora
www.tezosagora.org

All Illustrations were made with Open AI Dall-E 2

