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A Detailed Introduction of Ethereum Gas Fees

A gas fee is a fee that all users must pay in order to perform any function on the Ethereum blockchain.

There are no free lunches and certainly no free transactions. If spending \$5 to receive \$20 at an ATM can be frustrating, imagine spending \$100 to send \$500 or receiving a PNG of a penguin.

While it might seem a steep example, that can sometimes be the case in order to send a transaction or perform a function on [Ethereum](#)'s network. And unlike the case with ATM fees, there's no way the Ethereum network will refund you for your gas fees at the end of the month.

Definition

Gas is the term for the amount of ether (ETH) – the native cryptocurrency of Ethereum – required by the network for a user to interact with the network. These fees are used to compensate Ethereum miners for the energy required to verify a transaction and for providing a layer of security to the Ethereum network by making it too expensive for malicious users to spam the network.

Even though they are an effective means of incentivizing miners to keep verifying transactions and maintain network security, gas fees are nonetheless every user's most hated part about Ethereum. People hate gas fees not only for a general disdain toward fees, but because they can be absurdly expensive when the network is congested.

So, let's dive into what can make gas fees so expensive and what simple steps you can take to save money when interacting with Ethereum's ecosystem.

Gas Fees Calculation

In order to get an understanding of why gas fees cost so much and how you can save on them, it's important to understand how they are calculated.

Because fees on Ethereum are usually much less than 1 ETH (although sometimes it doesn't feel like it), Ethereum employs a metric system of denominated units called "wei," where 1 ETH is equal to 1 quintillion wei. (A quintillion is a number with 18 zeros after it.) One of the most common wei denominations, and the one used to represent gas fees, is gigawei (gwei), or 1 billion wei. Therefore, when you check on a gas tracker and see that the average gas for a transaction is 100 gwei, that means you should expect to pay a base fee of 0.0000001 ETH for a given transaction.

If you have ever minted a [non-fungible token](#) or purchased one on a secondary market like OpenSea, then you might be thinking that 100 gwei sounds like a steal for an NFT transfer. That is because the base fees are just one part of the total fee structure. Following the readjusted gas fee structures brought in by Ethereum's London upgrade, the total fee is now calculated as:

Total Fee = Gas unit (limits) * (Base fee + Tip)

- **Gas units (limits):** This refers to the maximum amount of gas you are willing to spend on a transaction. While you are able to adjust how much gas your transaction will cost, it's important to do so carefully. That is because different types of interactions with the Ethereum blockchain will require different amounts of gas to complete.
- **Base fee:** This refers to the minimum amount of gas required to include a transaction on the Ethereum blockchain. The amount of gas required for a base fee is determined by the demand for a transaction to be included, regardless of what type of transaction it is. Because base fees are a factor of demand, they are dynamically adjusted based on the number of users interacting with the network at any given time.
- **Tips:** Also known as a priority fee, tips are an additional fee made to have your transaction completed faster. This fee is better known as a tip because it provides an economic incentive for Ethereum miners to confirm your transaction before others. When a miner verifies a transaction with a priority fee attached, they receive that fee as a tip for doing so. Because miners are able to see what transactions include tips, they will prioritize completing a transaction with the highest tips attached to make the most money they can.

It's important to note that if you set your gas unit limit below the amount of gas needed to complete your interaction, your transaction will be reverted but you wouldn't receive your gas fee back. That is because the miner has already done the equivalent amount of work to process your transaction and they receive the fees for doing so even if the transaction doesn't go through.

To illustrate the total fee formula, let's say that I am looking to send you 1 ETH and the average

amount of gas required to transfer ETH on the Ethereum network is 23,000 gwei. I would set that as my gas limit. The minimum amount of gas required to send the transaction at the time (base fee) is 150 gwei, but I want it to get to you faster so I add a tip of 20 gwei to the transaction. In this case, our formula for a total fee would look like this:

Total Fee to send you 1 ETH = 23,000 gwei * (150 gwei + 20 gwei)

Following, the total fee would be equal to 3910000 gwei, or 0.00391 ETH (about \$13, at press time). This means that I would send 1.00231 ETH to the Ethereum blockchain and you would receive 1 ETH to go buy some cool JPGs.

Why Are Gas Fees So High?

With an understanding of how total gas fees are calculated, we can get a better idea on why gas fees cost so much. Mainly, the two biggest factors that have caused gas fees to soar recently are:

- Gas fees denomination in gwei.
- Ethereum's variable total fee formula.

Gas Fees Cost More As ETH Costs More

The first major reason why gas fees are costing more is simply that ETH costs more. Recall that gas fees are denominated in gwei, which is a different way to represent an amount of ETH. The main catalyst for this rising demand is the booming decentralized finance (DeFi) and NFT sectors, which continue to attract new users to Ethereum's ecosystem.

Gas Fees Cost More As Base Fees Costs More

Also, gas fees cost so much now because Ethereum's total fee formula is dynamic. Remember, base fees are the minimum amount of gas required to include a transaction on the Ethereum blockchain and are adjusted by the demand for transaction inclusion. As a result, base fees have consistently increased as a result of increasing demand for the Ethereum blockchain.

There are more than 3,000 decentralized applications (also known as "dapps") running on the Ethereum blockchain, all of which are looking to have their transactions included alongside other Ethereum network users. Dapps alone account for more than 100,000 daily active users on Ethereum, executing a total of around 250,000 transactions a day.

The widespread adoption of Ethereum has not only led to higher base fees but also has made the gas for base fees much more volatile. In an effort to try to make gas fees more consistent,

Ethereum's EIP 1559 upgrade adjusted the calculation of base fees to be determined by the transaction before it. While the real impacts of EIP 1559 are debated, base fees continue to drive the total cost of gas fees up due to the increased demand for Ethereum.

Ethereum 2.0 is a major upgrade to the Ethereum network that will see the transition of Ethereum's consensus algorithm go from proof-of-work (PoW) to proof-of-stake (PoS). Among the many benefits this will bring to the network, the upgrade promises to reduce Ethereum fees in line with other market competitors by significantly improving transaction-processing capabilities and doing away with miners.

How to Reduce Gas Fees

While it is impossible to avoid paying for gas when using the Ethereum blockchain, there are at least some ways to make them less burdensome.

Choose the Right Time with Patience

Unfortunately, there is no way for you to directly reduce the impact of the gas unit, but there are ways that you can reduce your total fee by lowering the base fee and tip.

To reduce the cost of your total gas fee through a lower base fee, you could make your transaction on the network at a time when fewer people are using the blockchain. This is because, in a way, base fees are a representation of demand for using Ethereum. Gas fees are higher when more work is required to interact with the Ethereum network. More work is required when there are more people trying to interact with the network. Therefore, if you can find a time where there is less demand to interact with the Ethereum network, you could spend less on gas by reducing the base fee of your transaction. Weekends are usually the best time for that.

Another method of reducing your total gas fee cost is by reducing your tip. Remember that our tip, or priority fee, is an additional cost that we can give to miners in exchange for a faster transaction time. If your transaction isn't time-sensitive and you are willing to be patient, reducing your tip can be an additional way to spend less on gas.

Set a Maximum Fee Limit for Your Transactions

Another way to spend less on gas fees is to set a maximum gas fee limit on your transaction. Setting a max fee for gas is a way of telling the Ethereum blockchain that X gwei is the most you are willing to spend by sending X gwei as your total gas fee. Once the transaction is completed, the Ethereum network will refund the remainder of the max fee that wasn't used as part of your total gas fee.

Setting max fees can not only help you spend less on gas, but it can also provide you with peace of mind that you will not be paying more than you need to on a particular transaction. It's important to remember, however, that like with setting your gas limits, a max fee below the amount of the total gas needed to make your transaction will result in you losing your gas fee and having the transaction reverted.

Ethereum “Layer 2 Scaling Solutions”

Finally, you can spend less on gas by interacting with the Ethereum blockchain with an Ethereum “layer 2 scaling solution.” Scaling tools are extensions of the Ethereum network that aim to increase the speed of transactions and the number of transactions that can be processed per second. Some popular examples include Arbitrum, Loopring and dYdX.

Layer 2 scaling solutions are off-chain, meaning they handle transactions separately from the Ethereum blockchain. Though there are different implementations of layer 2 scaling solutions, they all act in a similar way. Layer 2 transactions occur off-chain and then are verified by the Ethereum network and recorded on-chain.

Again reviewing our total fee formula, the layer 2 scaling solution provides a way to save gas fees by reducing the number of units of gas needed to complete a transaction. Since this method only interacts with Ether when verifying transactions, less gas is required for Ether miners to process the interaction. The layer 2 solution also reduces overall base fees for all users by alleviating congestion in the Ether network. In doing so, the Layer 2 scaling solution can help you significantly reduce gas fees.