Playing with Fire: Adjusting Bitcoin's Block Subsidy

Anthony Towns

Scaling Bitcoin, 2018

Apologies

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- Twitter feedback:
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  - "The Third Era Will Start With Civil War – The mathematics of this situation seem inevitable: The miners and businesses with large transaction volume will both decide to (re)introduce inflation."
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    - We should discuss whether it's a real problem, a real fix, and consider it.
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Does Bitcoin use too much energy?

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  - At least it's the *right* fiasco...
- Subsidising blocks with brand new money has two benefits:
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  - Mainstream news paying attention to the problem?
  - Industry profits centred around mining rather than other value adds?
  - 7x increase in PoW during a “bear” market?
  - Coins with less PoW not getting attacked?
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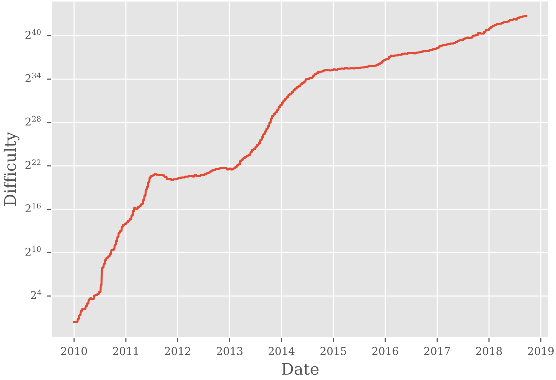

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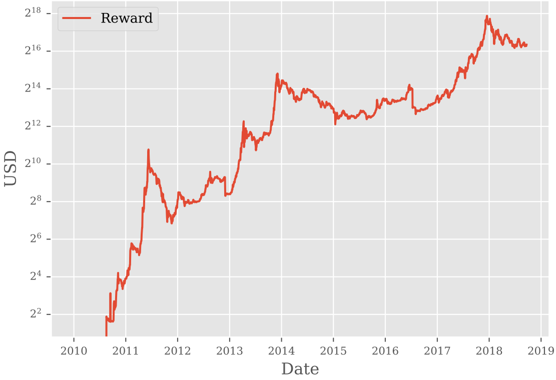

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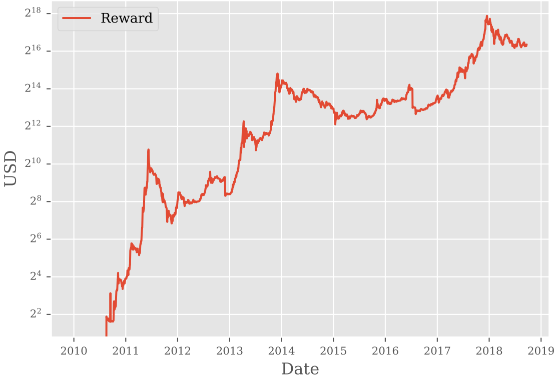

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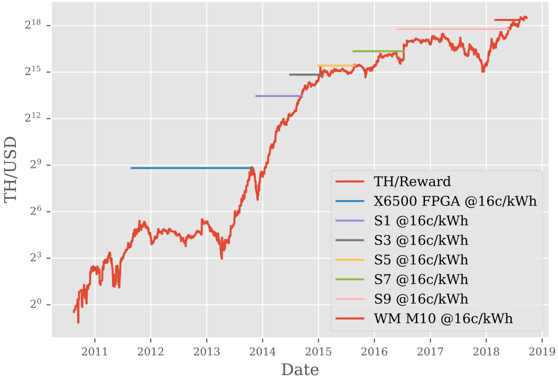
Hashrate vs Value

- Combine the two measures of security: TH/USD



Hashrate vs Value

- TH/USD:
  - Goes up and to the right as technology improves
  - TH/Reward measures how hard you have to work to earn revenue
  - Miner values measure how much work you get at a given electricity price
  - Not subjective!
- Gives insight into market reaction:
  - Reward halvening makes TH/Reward double
  - Price increases makes TH/Reward drop
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- Why:
    - Includes other Opex costs (cooling, staffing, etc)
    - Includes Capex not just Opex
    - Includes expected profits
    - Needs to cover risk that difficulty will rise faster than expected
    - Mining isn't a completely efficient market
- My guess:
    - 4c/kWh electricity
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- Price model:
  - Assume Bitcoin succeeds (if it fails, energy use won't be an issue)
  - But try to be conservative
  - Log-log curve fit, scaled down to act as a lower support
  - Sub-exponential, but still gives huge price rises over time
    - Over \$10k by 2022, over \$20k by mid-2023
    - Over \$100k in 2028, over \$500k in 2034
    - Over \$1M in 2037, over \$2M in 2041
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  - Too conservative? “Support” as at 2018-10-06 is at \$1980 USD
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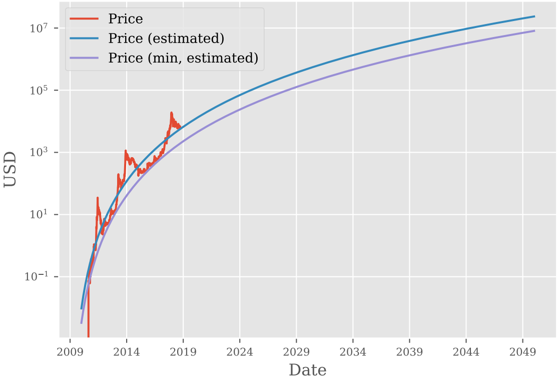

Assumptions - Miner efficiency / Energy costs

- Rough fit of TH/USD
- Split into miner efficiency improvements, and decreasing "electricity" costs
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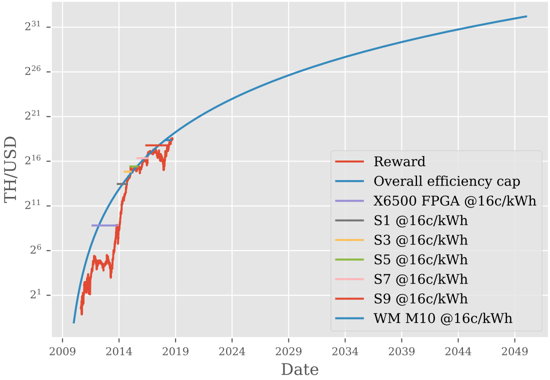

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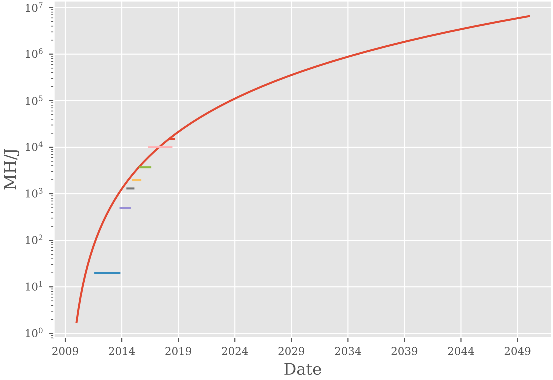

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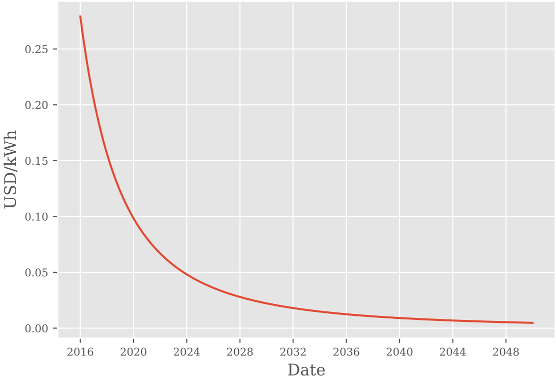
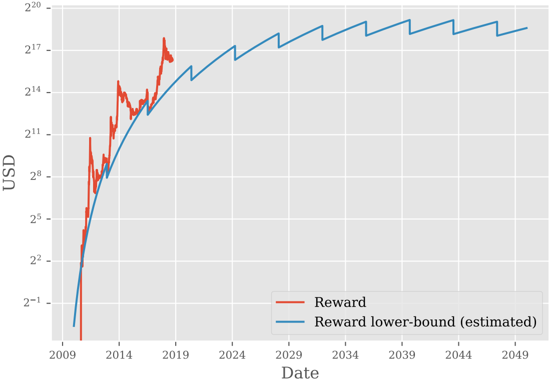


Predictions

- So we have some assumptions. What can we predict from them?

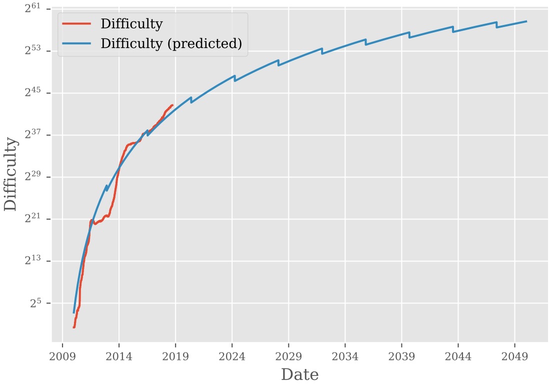
Predictions - Reward in USD



Predictions - Reward in USD

- Things to note:
  - Only relies on the price assumption
  - Even over a 30 year timeline (2019-2049), decreasing reward in BTC is mostly compensated for by growth in BTC price
  - This is a simple result of the price doubling faster than the block reward halves
  - Those little shocks at halvenings look a lot worse when you don't use a log scale

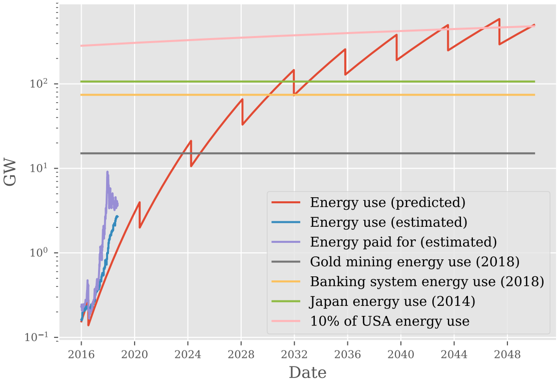
Predictions - Difficulty



Predictions - Difficulty

- Relies on assumptions about price and TH/USD
- Assumes that difficulty immediately responds to price/technology changes
  - (Not economically unreasonable, given they're assumed to be perfectly predictable)
  - (Technically unreasonable, given difficulty only adjusts every two weeks though
- Assumes the mining market is efficient and there's no profit/rents
  - (Beyond what's implicit in the "electricity" price)

Predictions - Electricity Usage



Predictions - Electricity Usage

- Relies on all the assumptions: price, efficiency, and energy cost.
- Electricity usage increases even though reward in USD does not – because we assumed “electricity” prices decrease

Predictions - Summary

- Garbage in / Garbage out
- We started from shakey assumptions, so should not have huge confidence in the predictions
- We don't get to "Bitcoin Mining on Track to Consume All of the World's Energy by 2020"
    - http://www.newsweek.com/bitcoin-mining-track-consume-worlds-energy-2020-744036
- But we do get to levels that seem high enough to justify thinking about reducing them.

Reducing Energy Usage

- The talk title is an obvious give away about how to go about reducing energy usage:
- When the price of BTC goes up, lower the reward to compensate.
- Because the overall reward in real terms does not go up as much, there's less incentive to deploy lots of new mining hardware.
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- But! It can detect rises in price indirectly, because people deploy more hardware and the difficulty rises.
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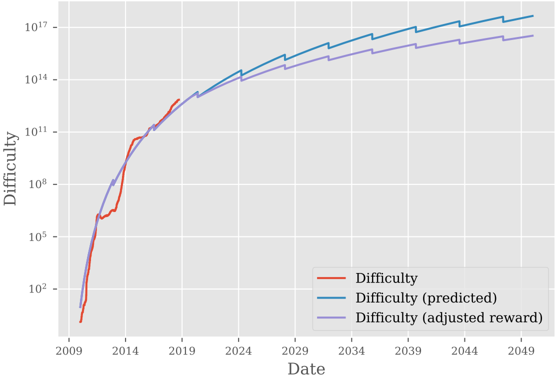
Reducing Energy Usage

- A concrete example: Cut the reward by 20% everytime difficulty doubles
  - Easy to calculate reward given block height and difficulty
  - Consistent behaviour no matter when the rule gets put in place
  - Exponential formula makes the math work out fairly nicely
  - Only applies once difficulty is above 10e12

Reducing Energy Usage - Comparison



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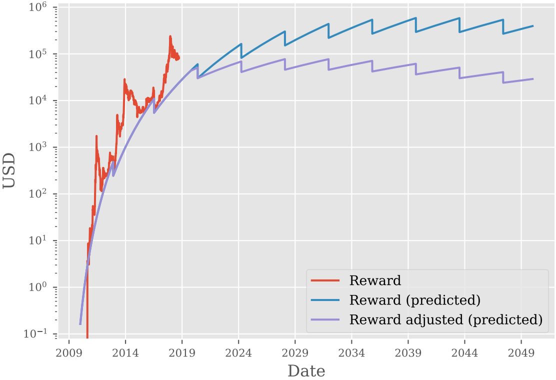

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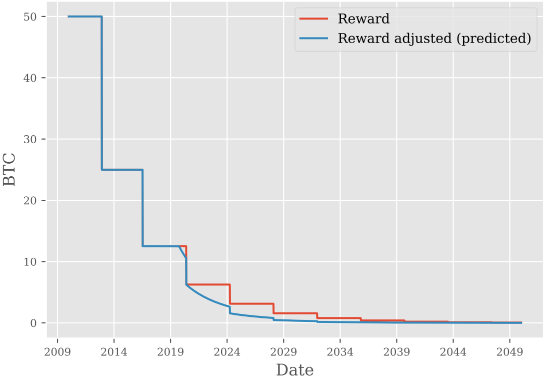

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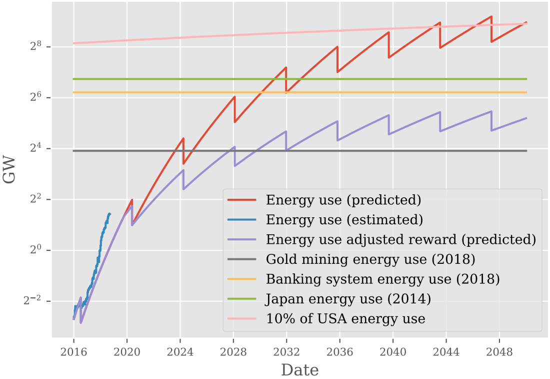

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- Reducing block reward is a soft-fork:
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- "Burned" rewards from coinbase pay into it
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Implementation - Rules

- Each coinbase spends burned rewards to a scriptPubkey "100 OP_CSV"
- Each block contains a "savings" transaction:
  - Single output: "1 OP_CSV"
  - Inputs are (1) previous block's savings tx's output, (2) coinbase burn output from 100 blocks ago
- Consensus rules validate:
  - Coinbase burn is (at least) some appropriate value (soft-forkable up)
  - Savings fees are (no more than) some appropriate value (soft-forkable down)
- Nodes validating these rules need to only track an additional 100 UTXOs (one for each coinbase burn for the past 100 blocks) at any given point in time.

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Other approaches

- Even if these are real problems, there are other approaches to dealing with (some of) them.
- For instance, perhaps the invisible hand of the market will already solve all these problems naturally:
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  - Maybe electricity will get more expensive
  - Maybe 10% of US eletricity usage just means all mining is done by hot water systems and there is no problem
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Other Benefits

- Some people claim that halving the reward will force the price to double, as a result of supply/demand
- Even if it doesn't exactly double, less supply with the same demand seems like it would force the price to rise.
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Other Costs

- This is probably not a win-win-win scenario.
- Some people will lose out:
    - Less energy use by miners means less mining hardware means less growth opportunities for miner manufacturers
    - Lowering rewards as difficulty increases means equilibrium will be hit faster, reducing excess profits for miners
- Maybe those losses are compensated by reducing the risk of black swan catastrophes such as:
    - Bitcoin economy deciding to switch to a different PoW
    - Governments legislating against mining in order to reduce energy usage

Conclusion

- Open questions:
  - Are there reasonable ways of making better assumptions than the ones I made?
  - How robust are the predictions with different assumptions?
  - What is the likely impact on parts of the industry in real terms?
  - Is there a reasonable way to define the "burn" and "fee" formulas for pay-it-forward savings, that remains simple with future soft-forks?
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