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H A R V E S T

Published: Fri 15 September 2017

Wind energy used to mine cryptocurrency to fund climate research

HARVEST is a work of critical engineering and computational climate art. It uses wind-energy to mine cryptocurrency, the earnings of which are used as a source of funding for climate-change research.

Taking the form of a 2m wind turbine with environmental sensors, weatherproof computer and 4G uplink, HARVEST 'feeds' from two primary symptoms of our changing climate: wind gusts and storms. It does this by transforming wind energy into the electricity required to meet the demanding task of mining cryptocurrency (here Zcash), a decentralised process where computers are financially rewarded for their work maintaining and verifying a public transaction ledger known as the blockchain. Rather than filling the digital wallet of the artist, all rewards earned by the HARVEST mining machine are paid out as donations to non-profit climate change research organisations such that they can better study this planetary-scale challenge.

Acting as a fully functional prototype beyond a media-art context, it is envisaged hundreds of such HARVEST nodes could be deployed in the windiest parts of the world, together generating large sums of supplementary funding for climate-change NGOs in a time where climate science itself is under siege from the fossil-fuelled interests of governments and corporations.

Technical inventory

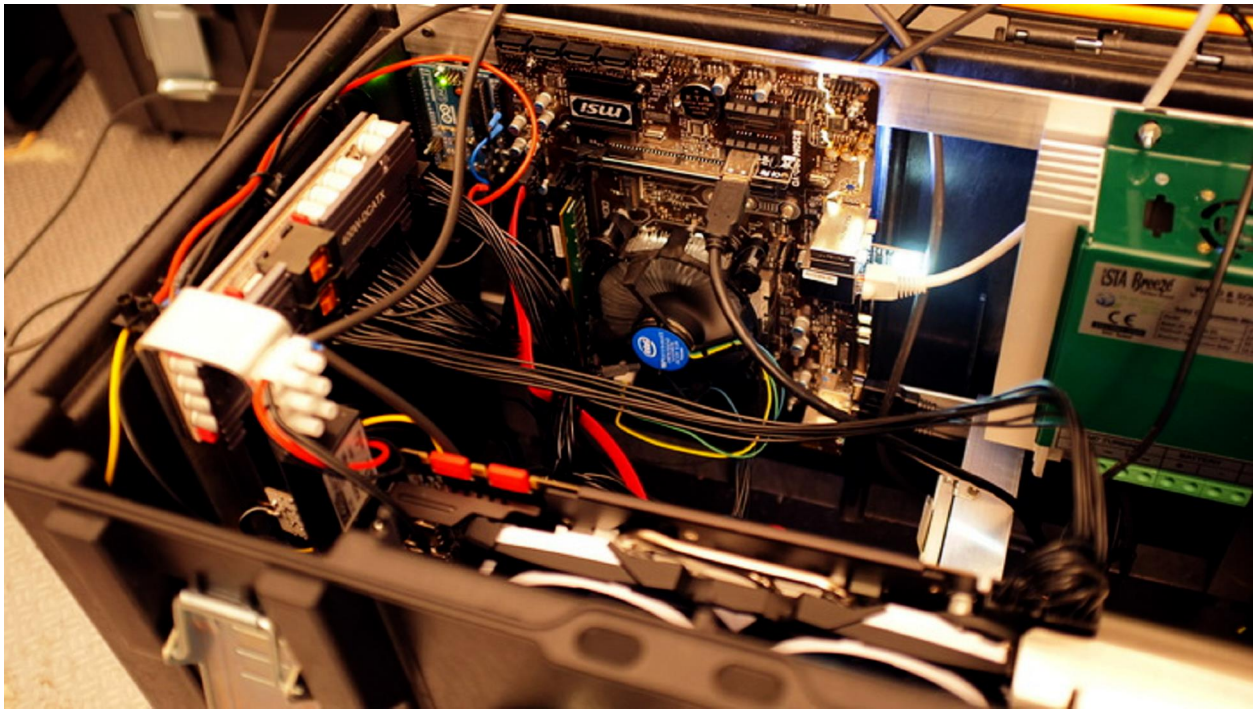
Turbine

- 700W 24V horizontal axis wind turbine
- Speaker tripod
- 3mm wound steel guy ropes, slip-proof rings and 35cm aluminium ground stakes

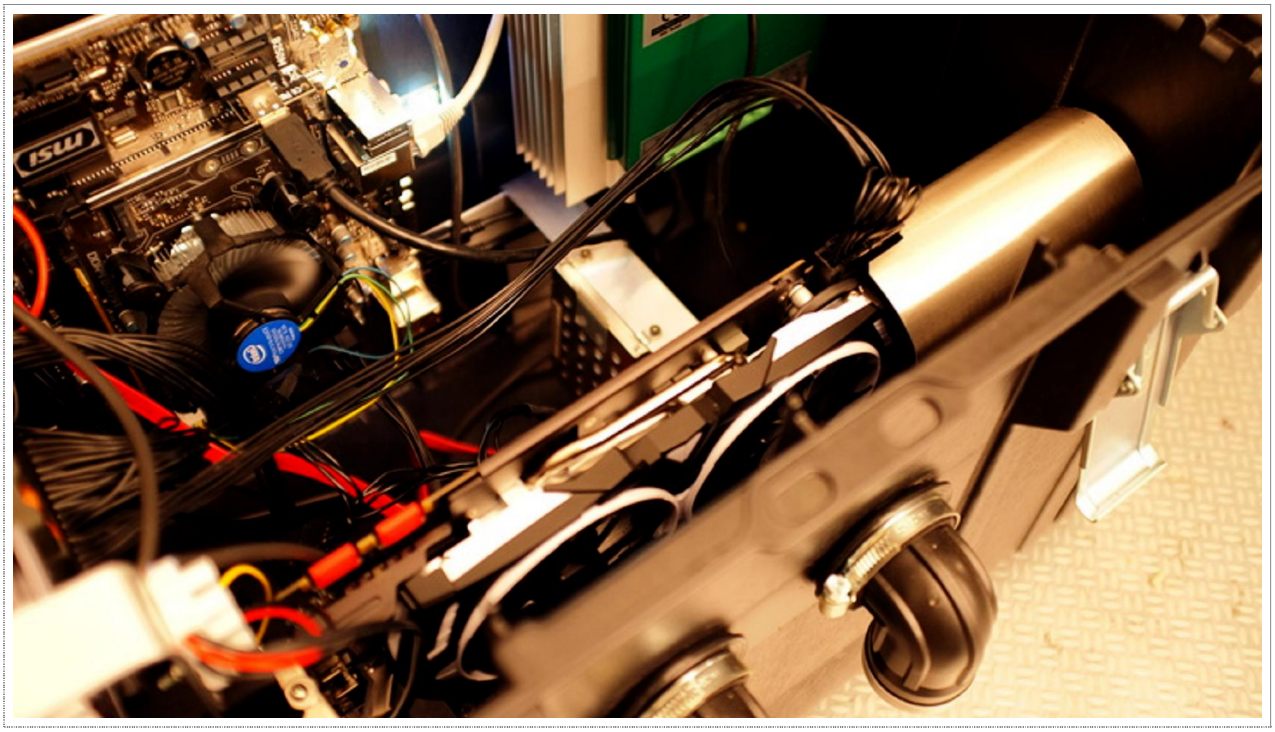
Energy storage

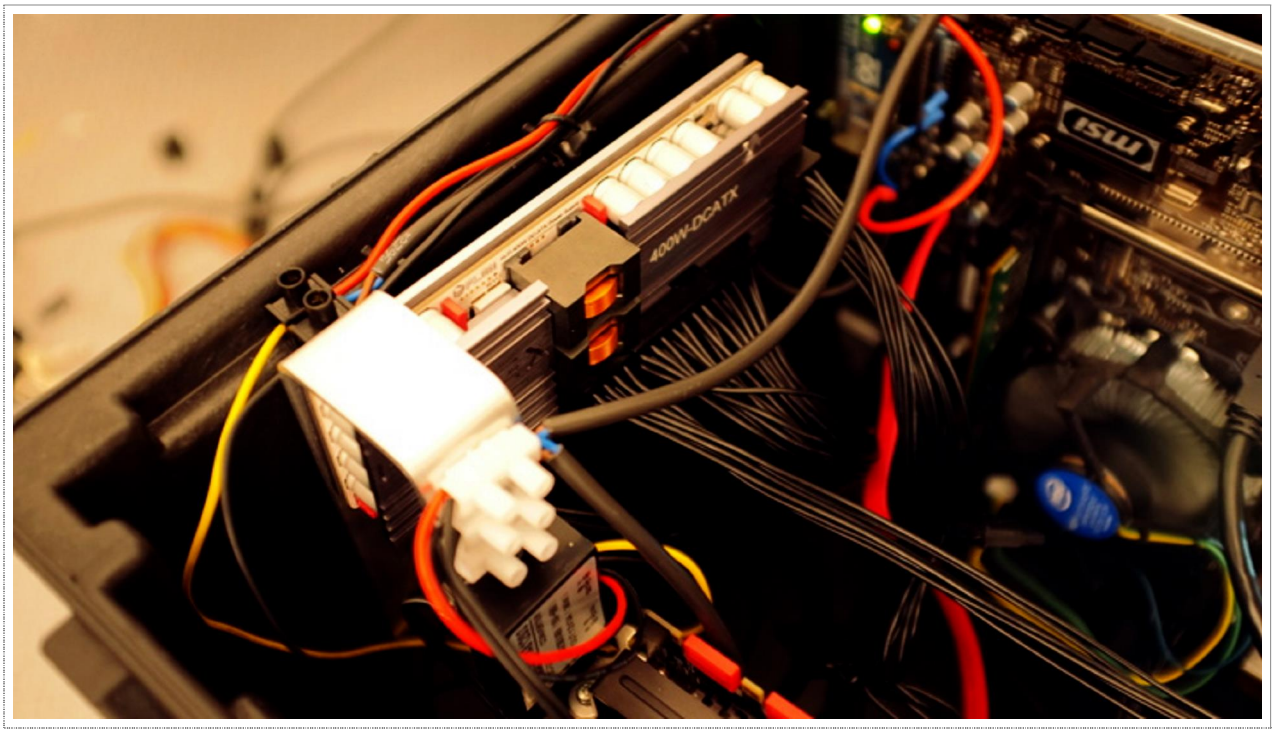
- 2x 12V 150Ah batteries connected in series (= 24V output). 43kg each.
- weatherproof case for each battery

Mining rig



- Battery charge controller (24V 3-phase in, 24V DC out)
- 400W wide input (6V-24V (28V max)) ATX PSU
- 6V-24V DC in, 12V 3A out converter/regulator
- Mini-ITX mainboard
- Intel i3 CPU (Sockel 1151)
- NVIDIA GTX 1080 ti GPU
- 250Gb SSD
- 4G USB dongle/'surfstick'
- Arduino
- 4Gb DDR 4 RAM
- Weather proof case modified with rain and insect-proof air intakes and GPU thermal exhaust





Software

- Ubuntu 16.04 LTS
- Shell scripts
- EWBF miner, mining on nanopool

Energy management is based on wind speed read from PWM signals from the anemometer like so:

```
#!/bin/bash

tty=/dev/ttyACM0
stty -F $tty 9600 ignbrk -brkint -icrnl -imaxbel -opost -onlcr -isig -icanon -iexten -echo \
    -echoe -echok -echoctl -echoke noflsh -ixon -crtscts -hupcl
#sleep 1
echo temp >$tty
```

```
read reply <$tty
echo "$reply"
stty -F $tty hupcl
```

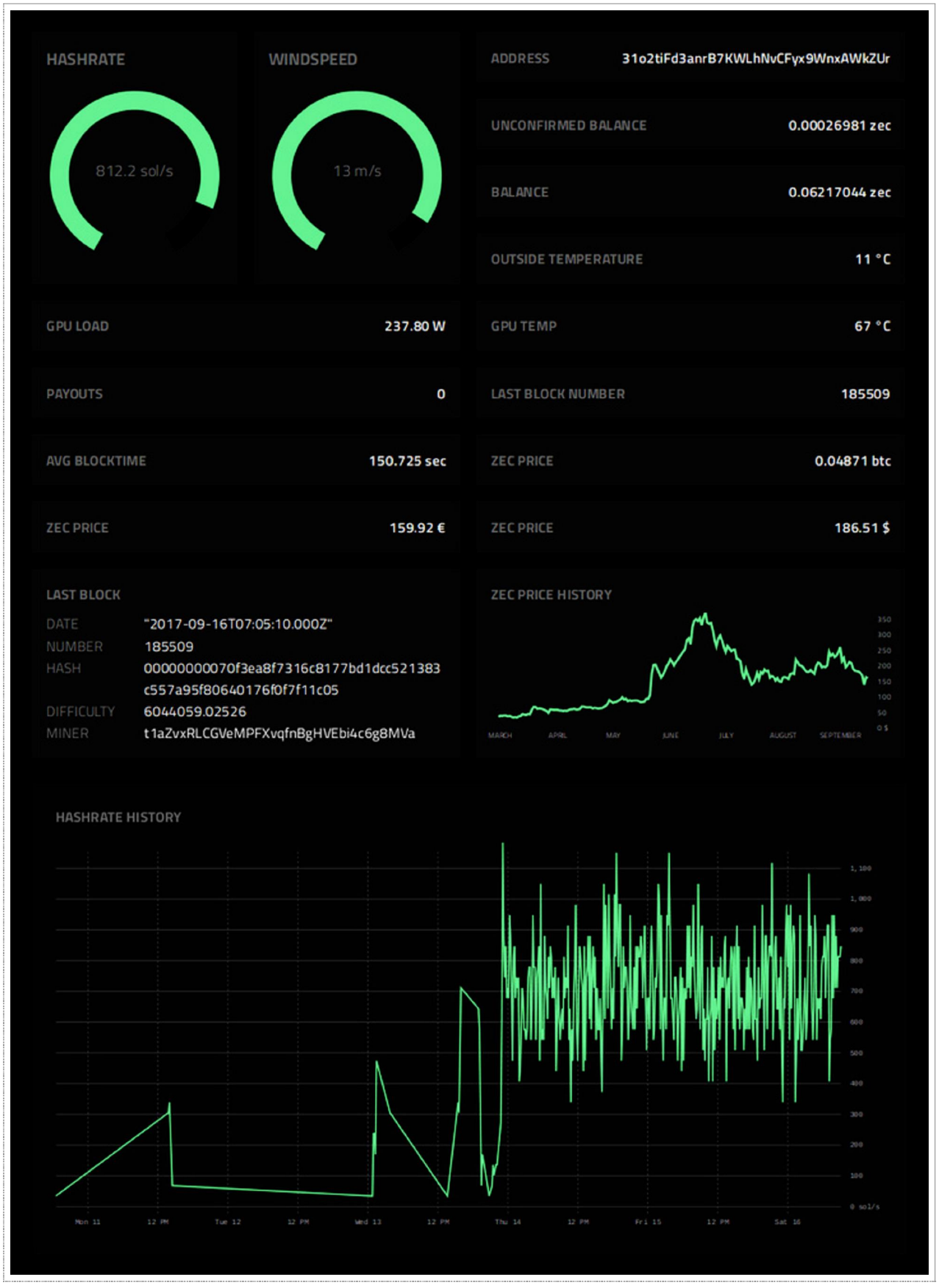
The mining process is then paused or resumed relative to a minimum wind speed (as watts yielded by the turbine at that minumum), saving battery. In a future version I may use *nvidia-smi -pl* to scale GPU consumption ceiling (in watts) against windspeed, but with 150Ah in the batteries chosen we have plenty enough room to simply toggle, as shown below:

```
#!/bin/bash

SCRIPTS=/root/scripts
MIN=5 # meters/second
POLL=60 # once a minute

while true;
    do
        fspeed=$($SCRIPTS/read-anemometer.sh | awk '{ print $9 }' | sed 's/\r//')
        echo "Current wind speed is: "$fspeed
        mpid=($(ps ax | grep [m]iner | awk '{ print $1 " " $3 }'))
        mstate=${mpid[1]}
        if [ $fspeed != "0.00\r" ]; then
            ispeed=$(/usr/bin/printf "%.*f\n" 0 $fspeed)
            if [[ $ispeed -lt $MIN && "$mstate" == Sl* ]]; then
                echo "Windspeed is too low. pausing miner"
                kill -STOP ${mpid[0]}
            elif [[ $ispeed -gt $MIN && "$mstate" == Tl* ]]; then
                echo "Windspeed is high enough. resuming miner"
                kill -CONT ${mpid[0]}
            else
                echo "State unchanged, leaving alone this round"
            fi
        fi
        sleep $POLL
    done
```

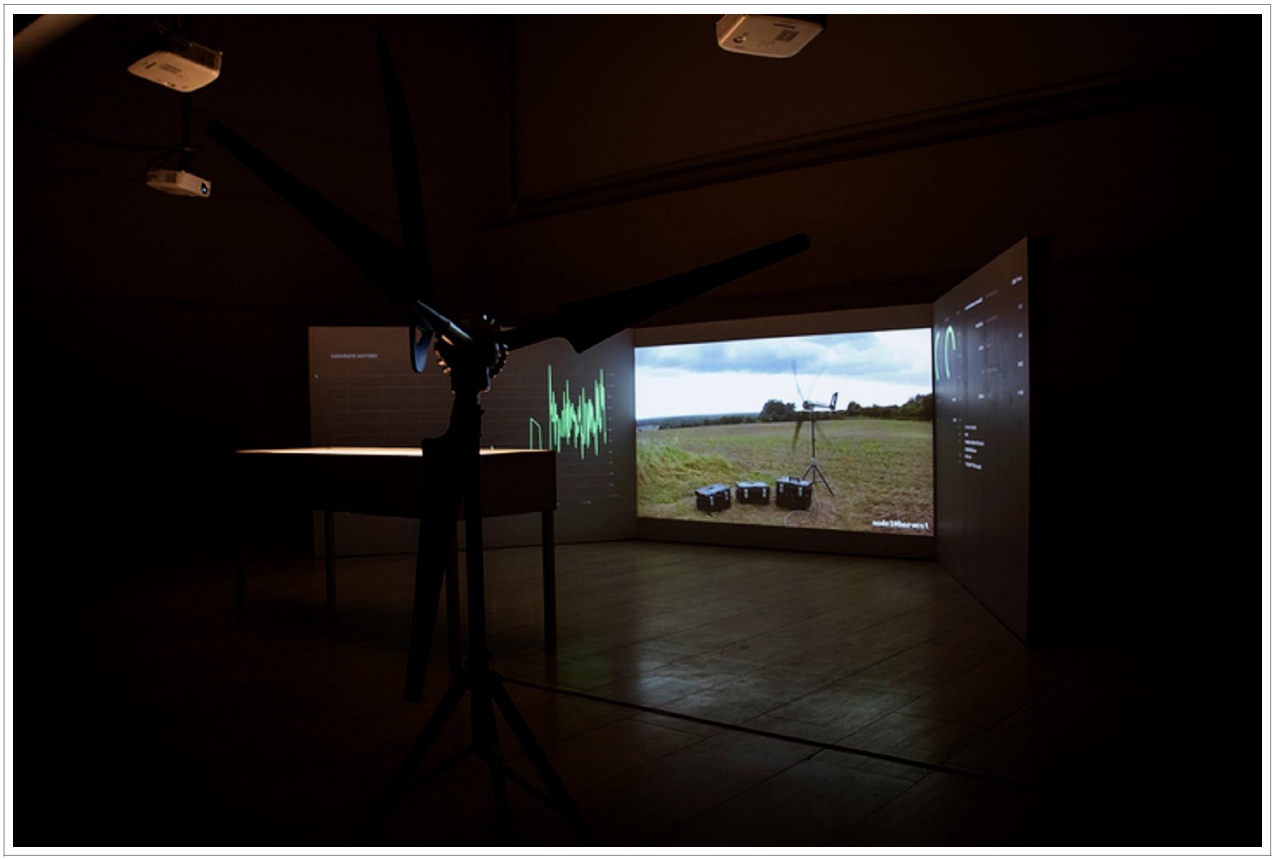
Exhibition

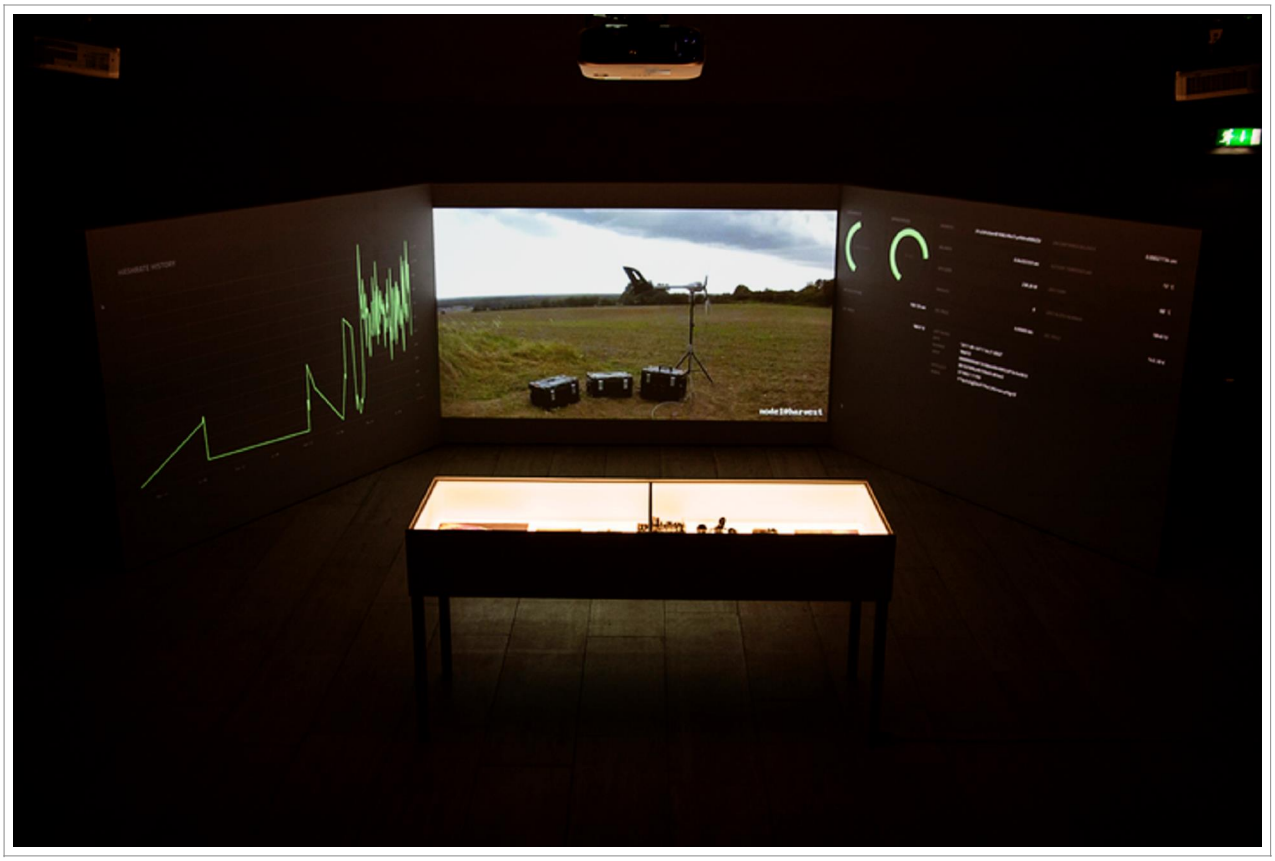
HARVEST was commissioned by the Konstmuseet i Skövde an exhibition of which was designed and launched on the 14th of September, 2017, running for two months in the museum.

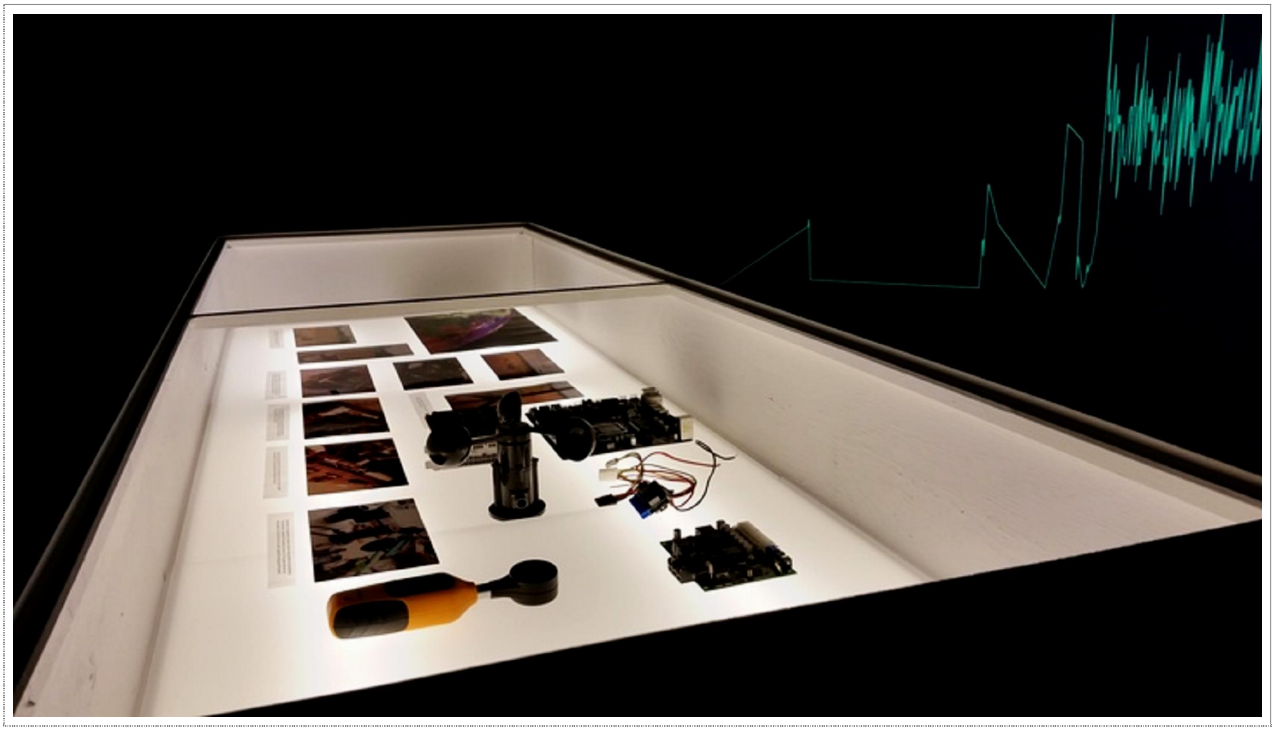
The exhibition comprises a live feed directly from the miner, conveying data relevant to the mining process. This data was visualised by Christopher Pietsch and can be seen in the two projections in the exhibition. Chris has kindly provided a public version of his work on this project here.

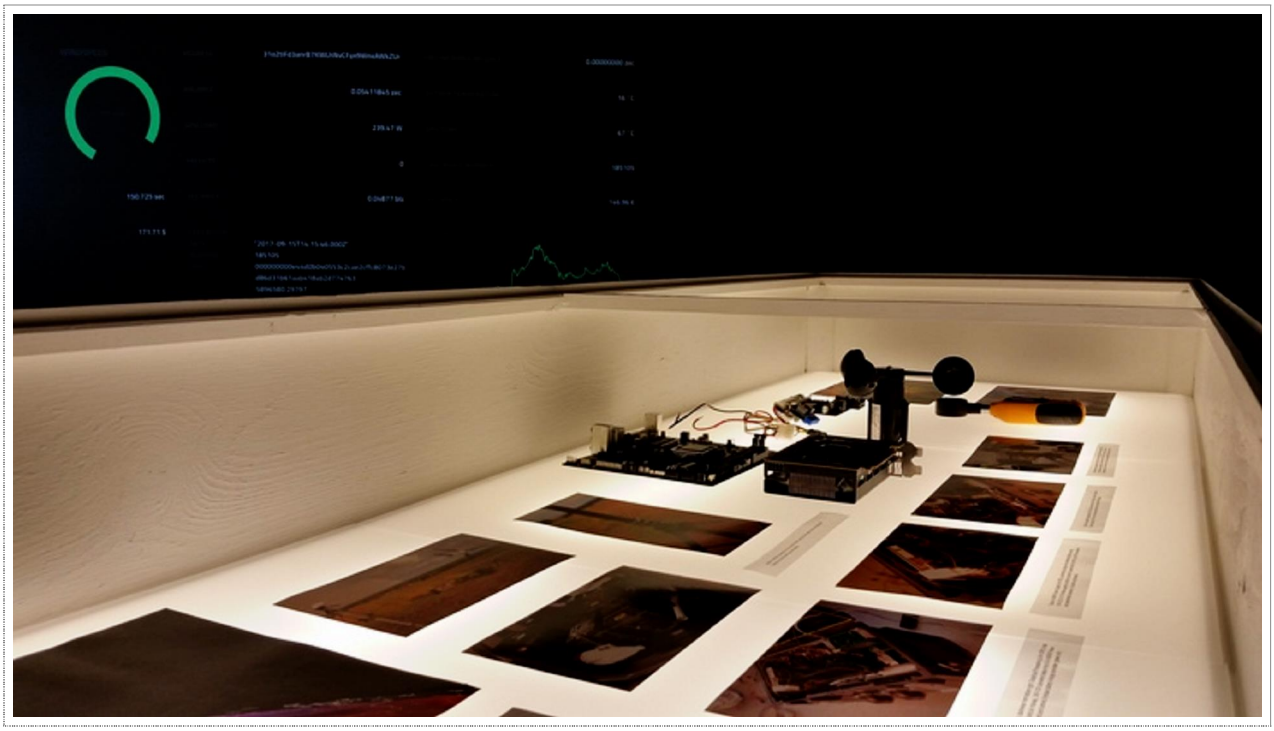


The below photos are by Alexandra Magnusson.









Payouts

Three non-profit climate change research and/or public awareness organisations will be selected to receive the funding at the close of the exhibition. The results of that outcome will be posted here.

Writing on HARVEST

Dave Youssef: Thoughts on “HARVEST”

HARVEST was generously funded by the Konstmuseet i Skövde

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