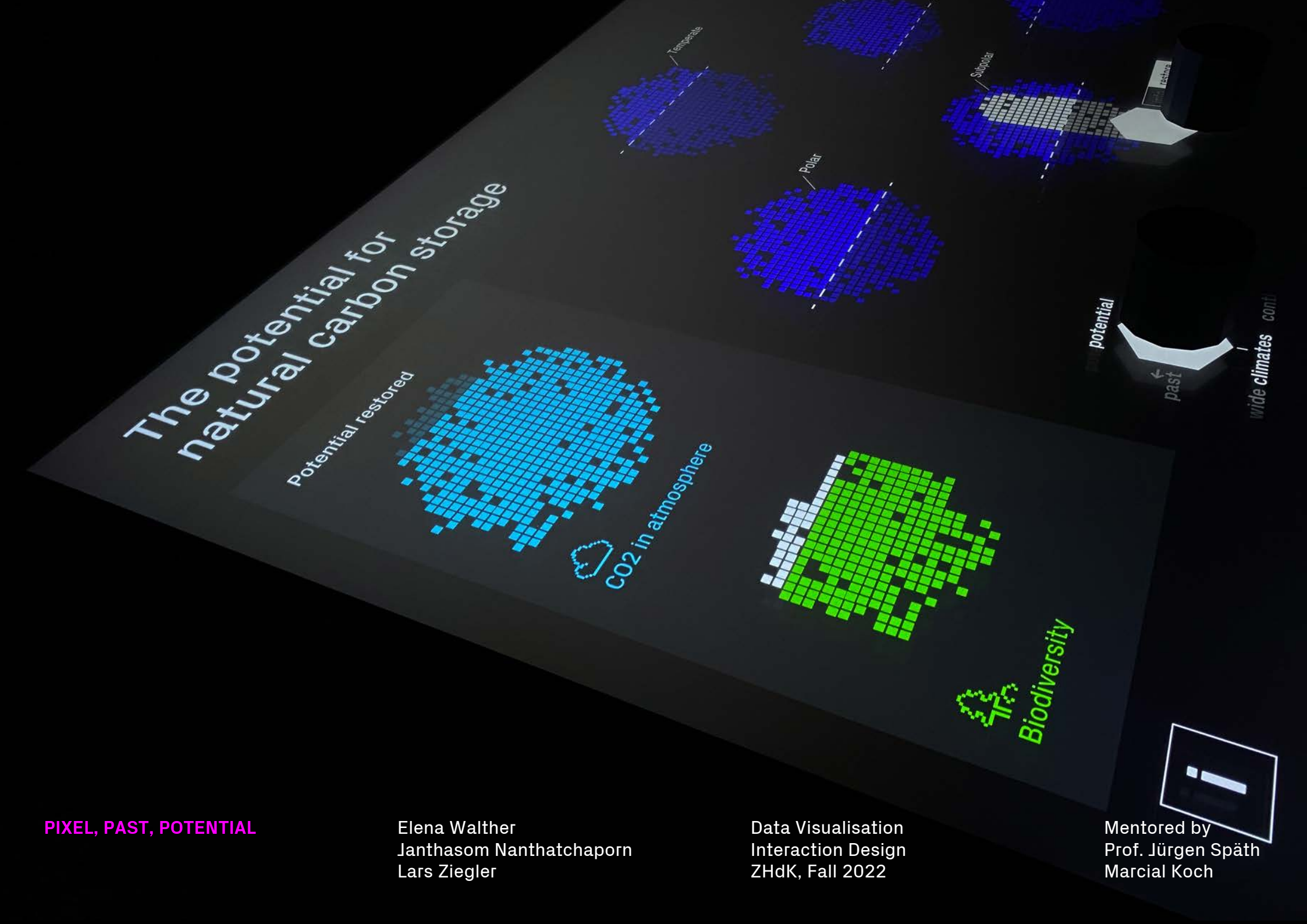

PIXEL, PAST, POTENTIAL

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Janthasom Nanthatchaporn
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Data Visualisation
Interaction Design
ZHdK, Fall 2022

Mentored by
Prof. Jürgen Späth
Marcial Koch

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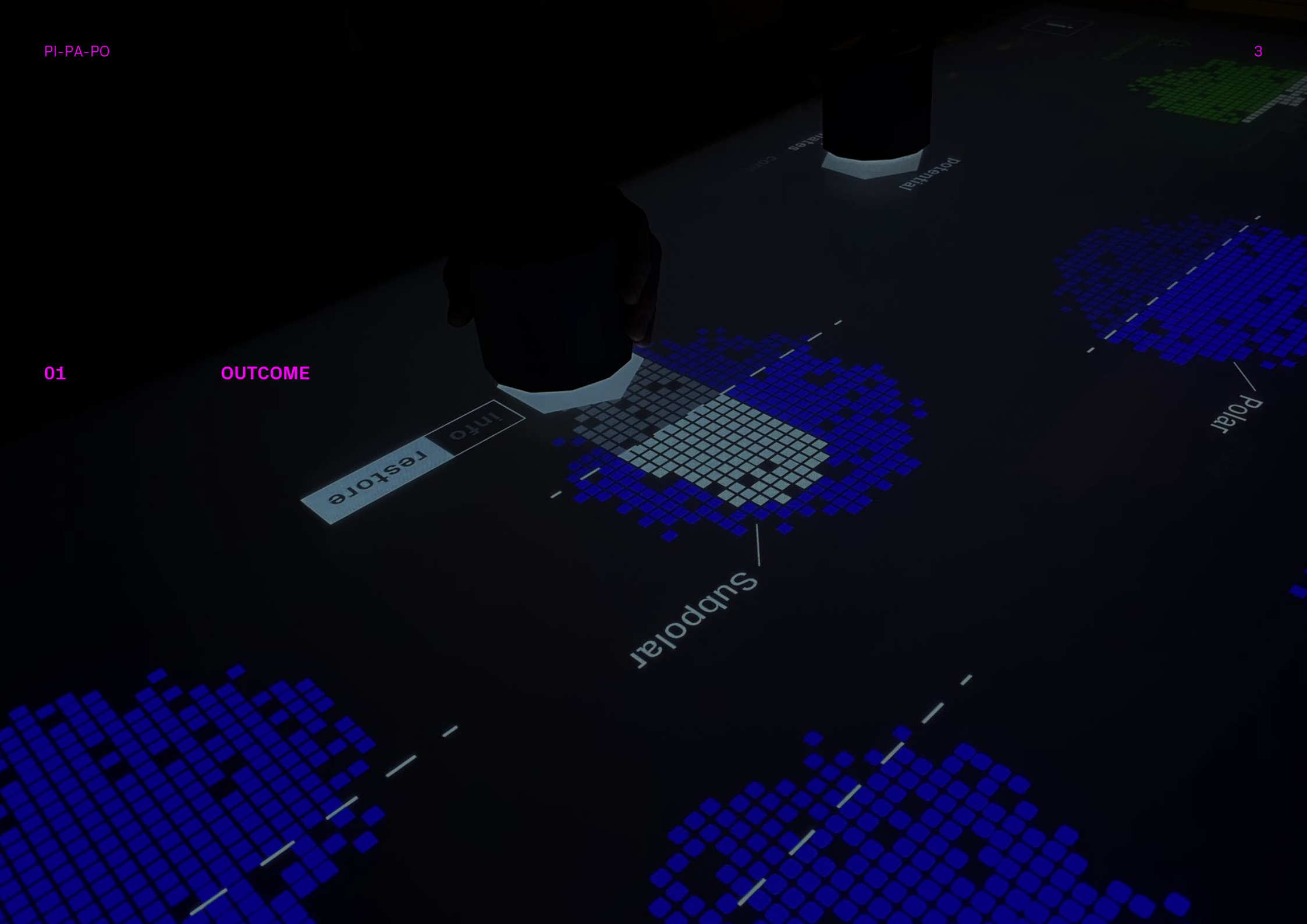
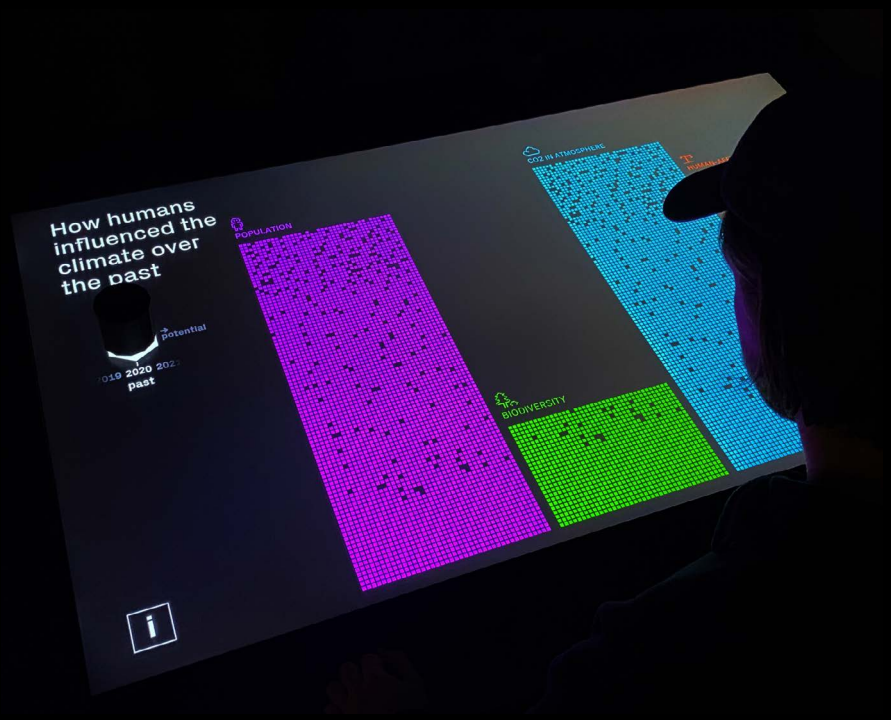
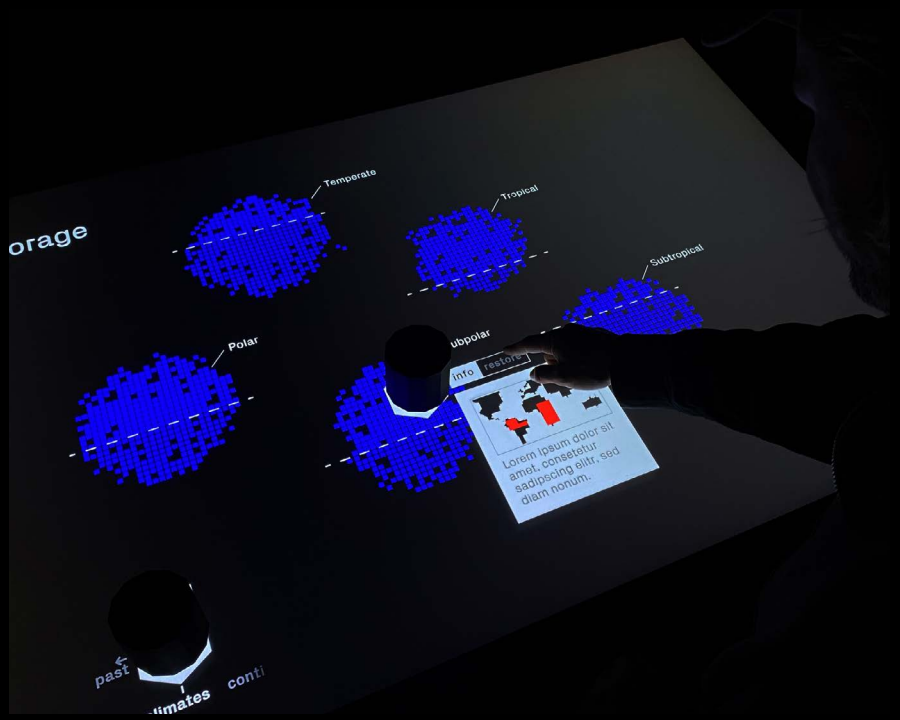


01 OUTCOME

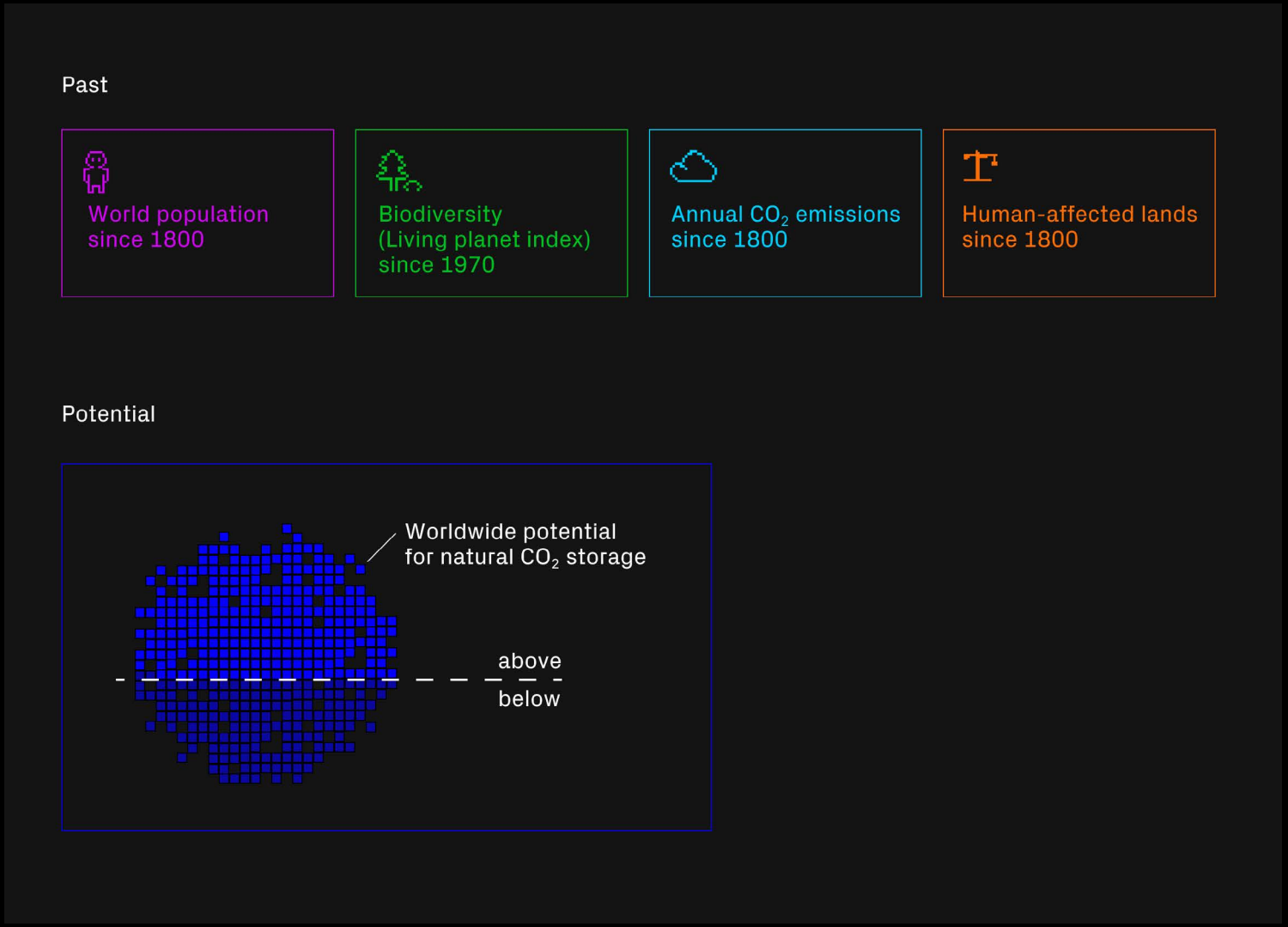
Pixel, Past, Potential is an interactive touch application that lets people explore natural-based solutions for CO2 storage. It was created in collaboration with ETH Crowther Lab and focusTerra. The application is parted in two modes, past and potential, where the former is giving the user an impression of how humans have affected the climate over the last two centuries. The potential mode on the other hand shows where the greatest potential for natural CO_2 storage lies. Additionally, people can manually exploit shown potentials and directly see its influence on the current CO_2 in atmosphere.
If selected, the project will be shown at the «Keep it CO_2OL» exhibition at focusTerra, the Earth & Science Discovery Center of ETH Zurich.



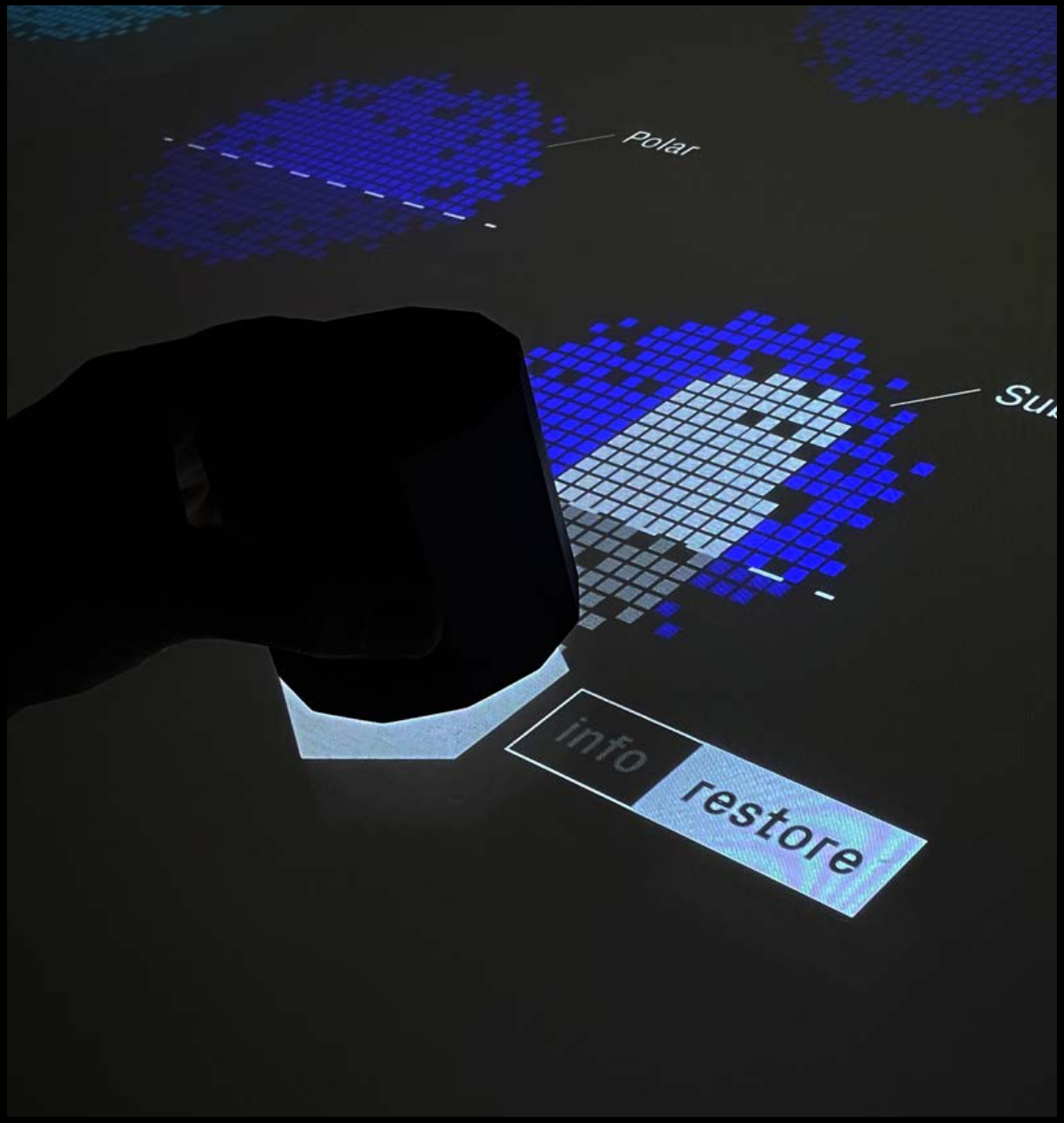


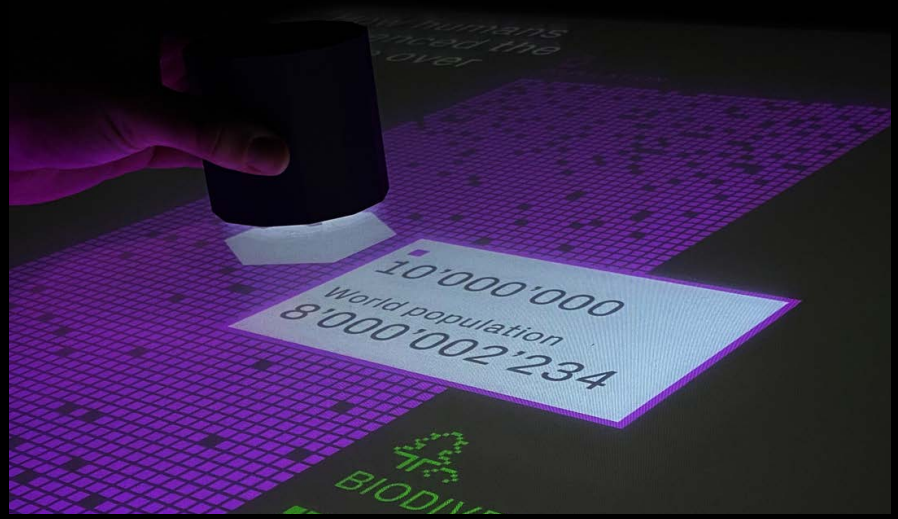
Our concept divides the experience into two different modes: “Past” and “Potential”. The former focuses on giving the user an impression of how humans have affected the climate over the last two centuries, while the ladder shows where the greatest potential for natural CO2 storage lies, divided into above and below ground. Users can additionally “restore” the potentials and see the influence it would have on biodiversity and CO2 in atmosphere.
It was important for us, to organise the product that way, because we believe, that this is the most effective way for the user to gain knowledge and do something about it in the future (Understand – Explore – Act).

We used various data to show users the CO2 storage situation. For the “past” mode, we compare world population, annual CO2 emissions and human influenced lands since 1800. Additionally, we compare this data to the Living Planet Index, which started to get measured in 1970, adding an additional layer of biodiversity to the comparison.
In the “potential” mode, we used the potential natural carbon storage, above and below the ground, divided into different views (Worldwide, Climate zones, Continents, Hotspots).

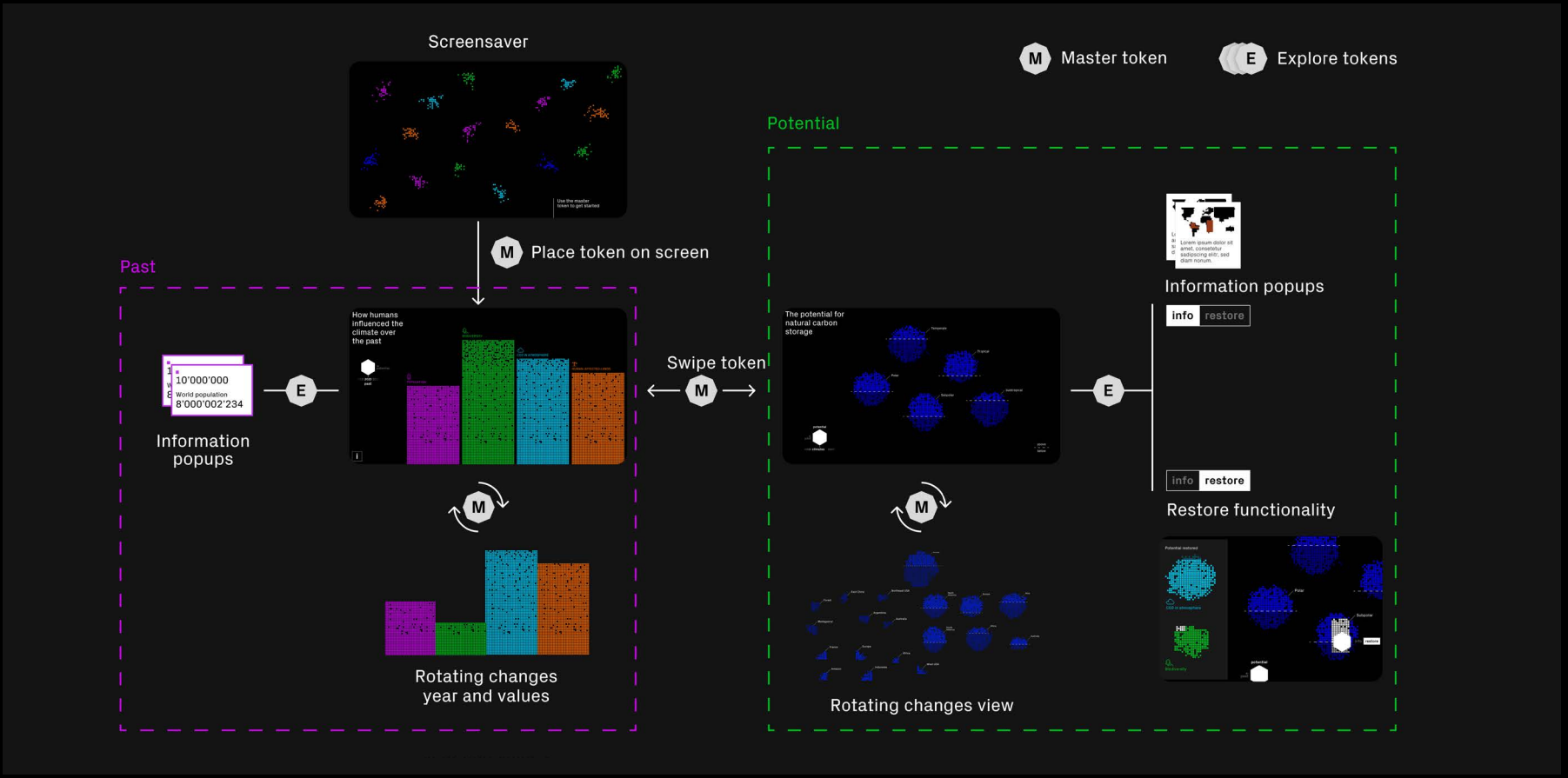


The audience uses the table with tokens. In our concept, there are two different kinds: One master token and two to three explore tokens. The former lets the audience chose, which mode (past or potential) is currently shown. The mode can be changed with swiping the token to the right or to the left. In the respective modes, the audience can rotate the token to either show different years (past) or different views like worldwide, climate zones, continental and hotspots (potential).

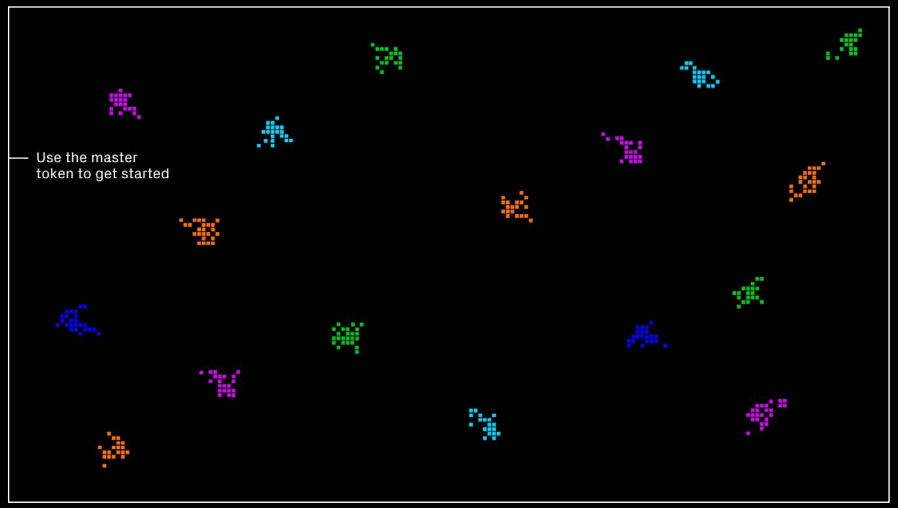




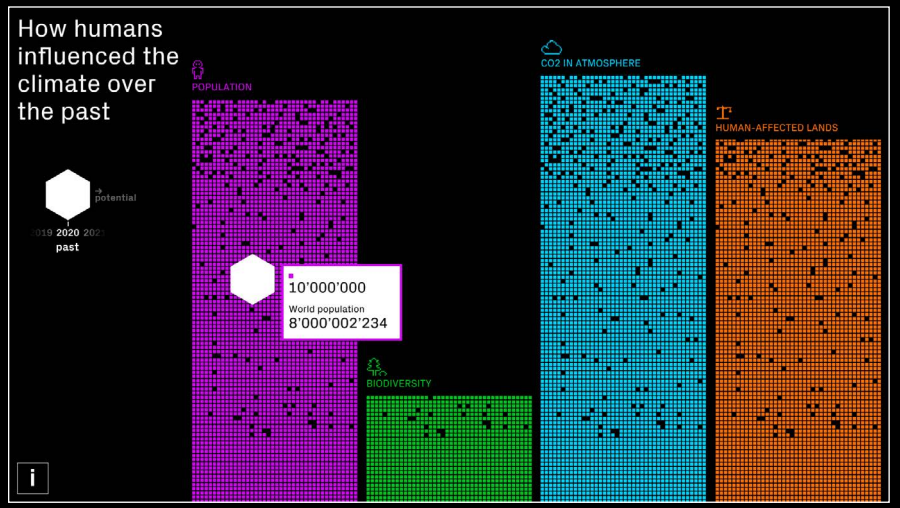
With the explore token, the audience can separately get more insights on the shown data. It can be placed on every element on the screen, where a popup with respective information appears. In the potential mode, explore tokens can also be changed from «info» to «restore» by touch. The restore functionality lets the audience move over data points and manually «restore» them. The influence of that to biodiversity and CO2 in atmosphere is then directly displayed.



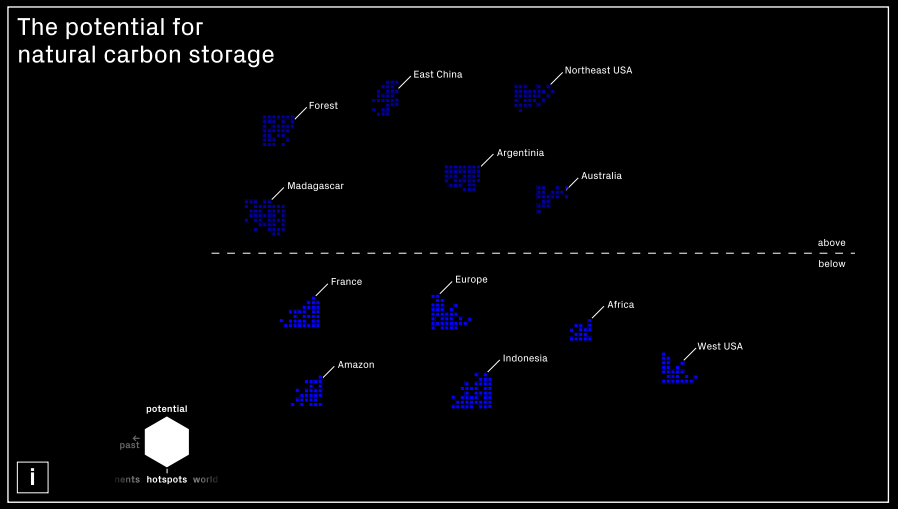
When the master token is not placed on the screen, there is a screensaver shown which encourages the audience to place it on the screen. Once that is done, the audience is put in the «past»-mode. By rotating the token, they can scroll through the years and see world population, CO2 emissions and human-affected lands going up, while biodiversity drastically descending. With the explore token, more information about the data is shown. When the master token is swiped to the right side, the audience gets into potential mode. By rotating the token, different views (worldwide, continental, climate zones and hotspots) are shown, showcasing natural carbon storage potential, divided into above and below the ground. With the explore token, more information can be gained or the audience can restore certain pixels and see the influence on the climate.



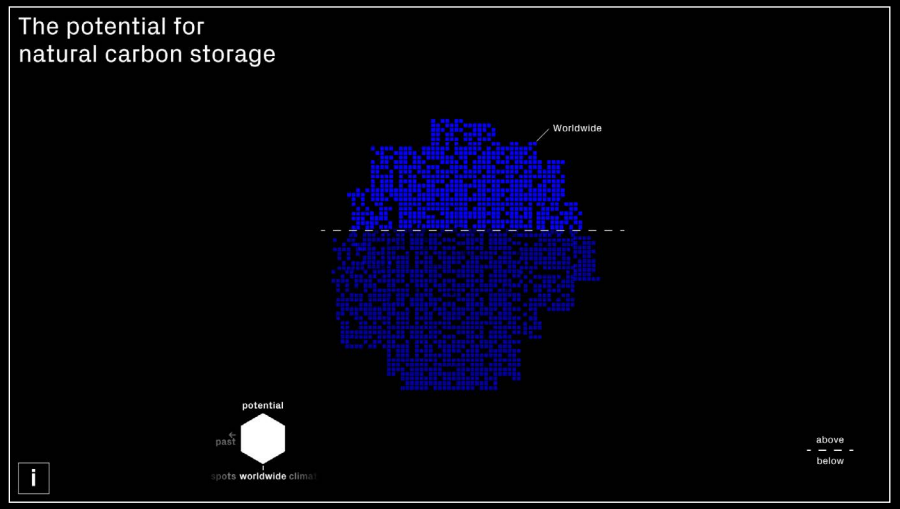
Screensaver



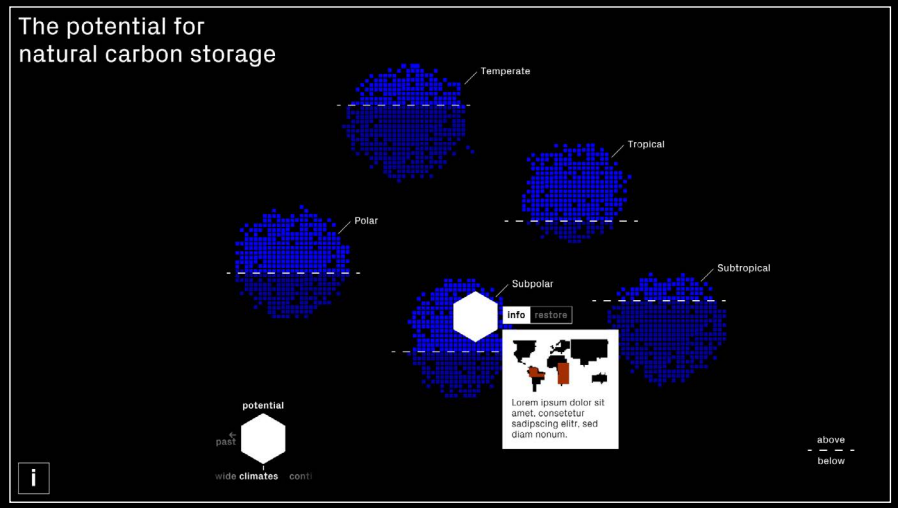
Past mode with info popup



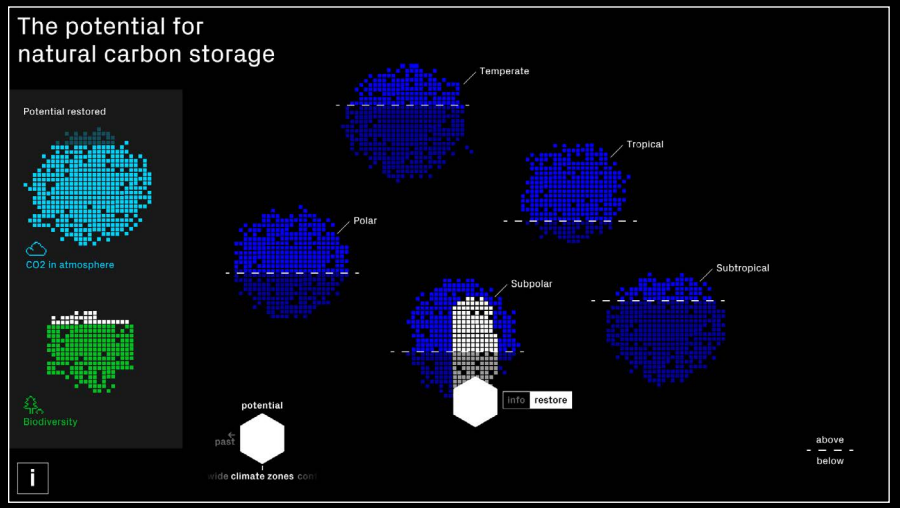
Potential mode: Hotspots



Potential mode: Worldwide

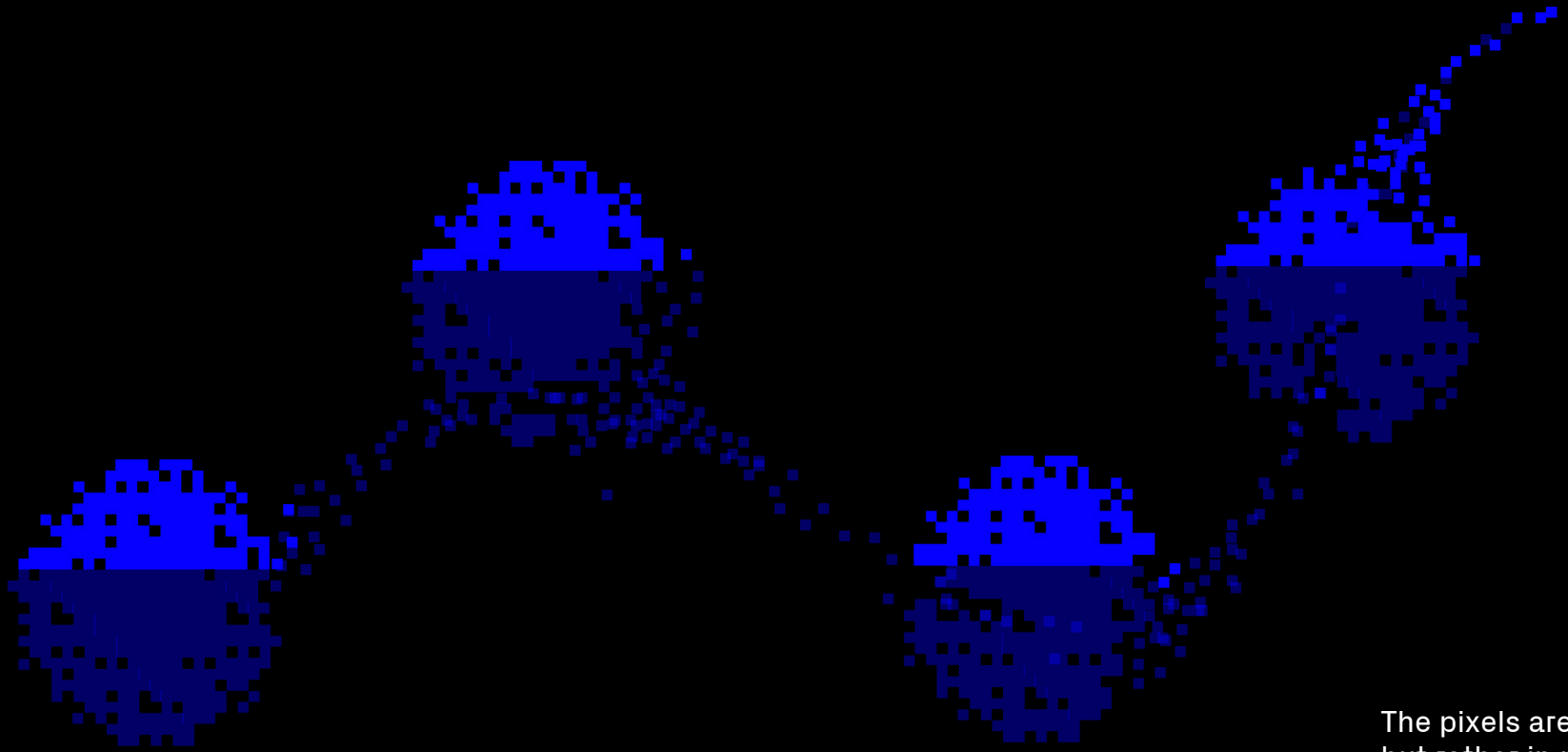


Potential mode with info popup



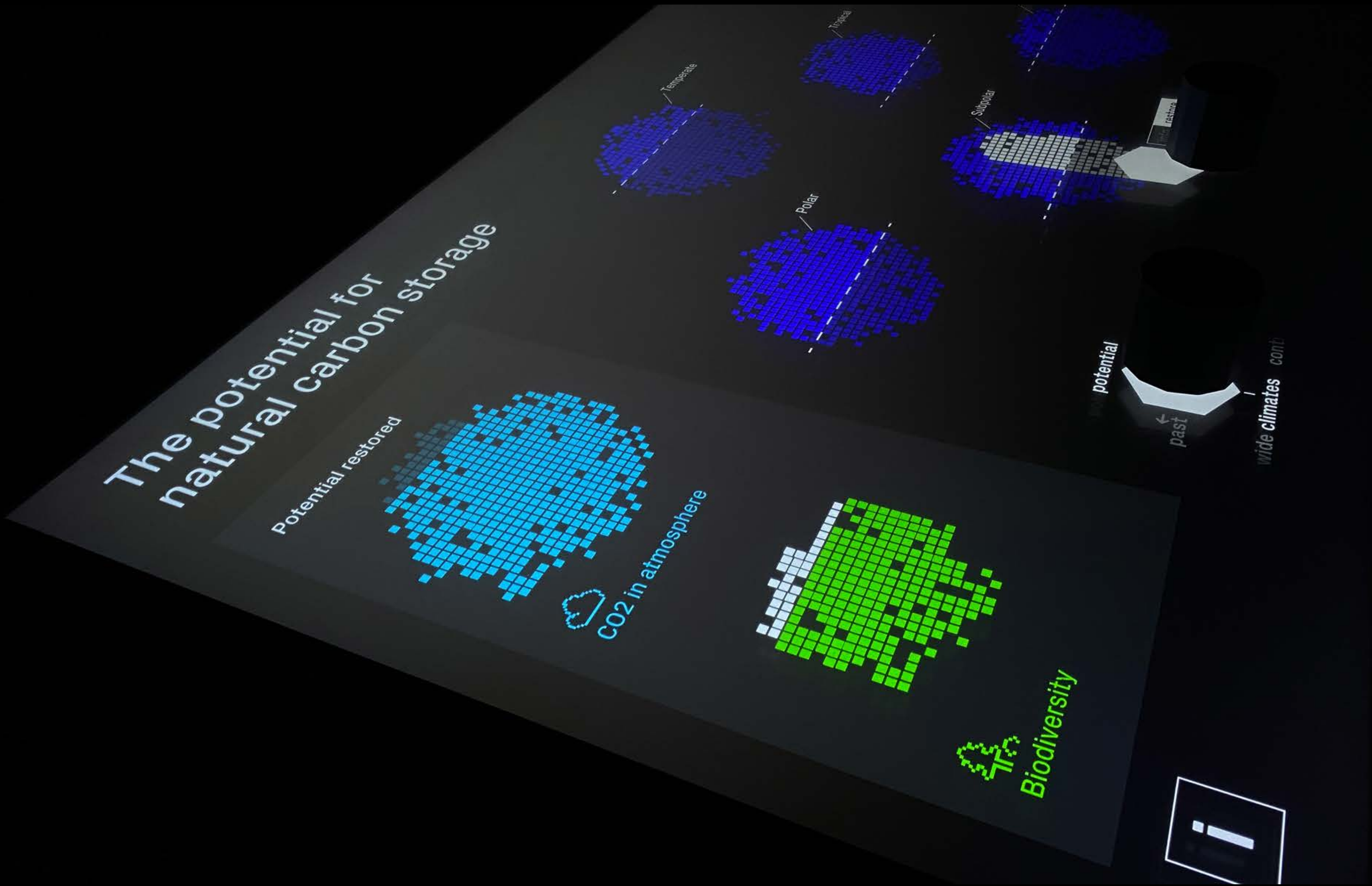
Potential mode while restoring

We decided to go with a pixelated design, as we think it is a great way to give the people an idea on how big a specific amount is. In our application, one pixel always equals a specific amount of something (for example 10 Million people). The audience can find out about how big this amount is by using the explore tokens. We also think that the simple look of the pixel design makes it easier for people to understand, what we want to tell them.
The application is designed in dark mode, with neon colors giving it a big contrast and a «old-school»-vibe. The font «PX Grotesk» has little pixelated details while mantaining a modern look with great readability.

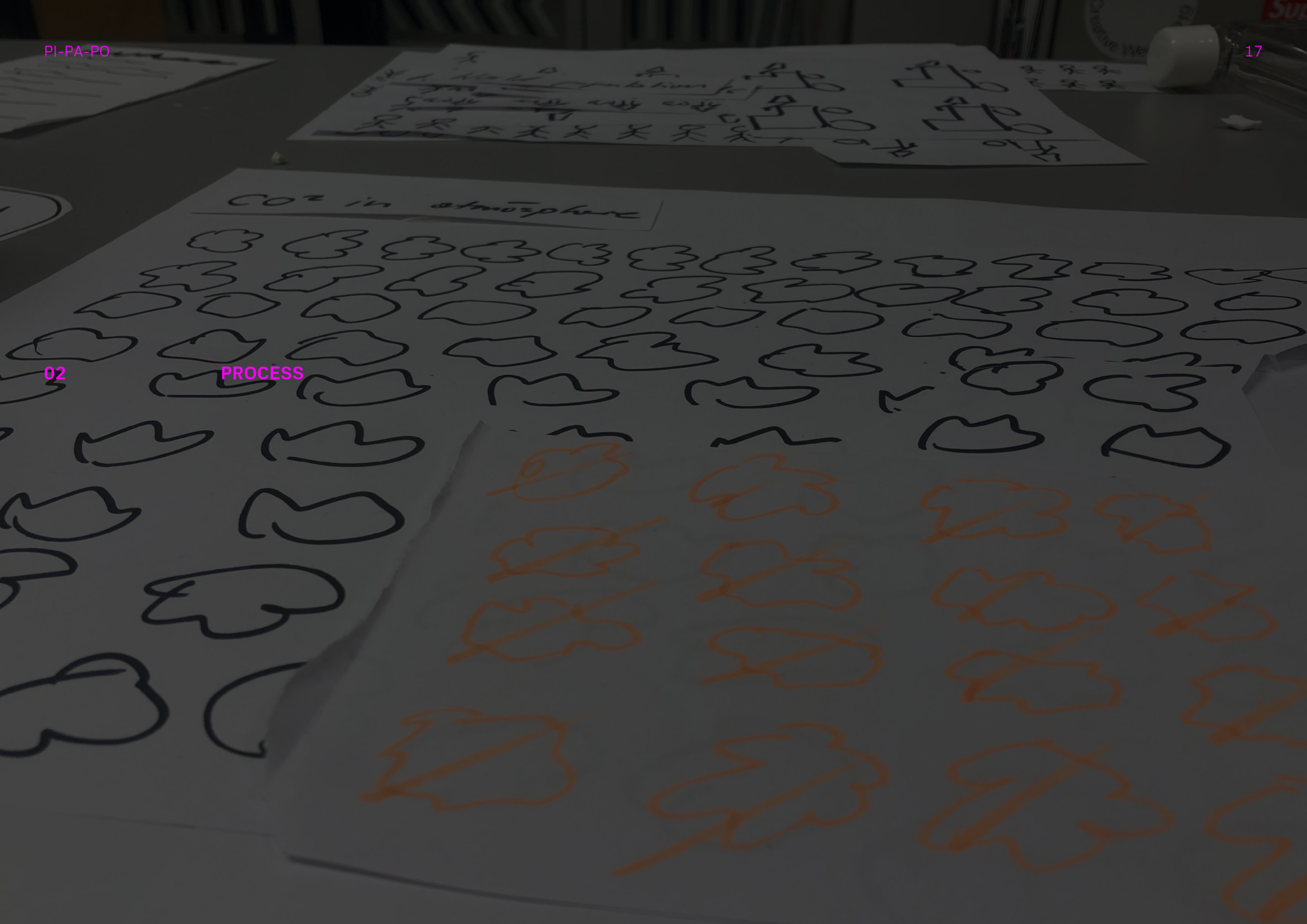


The pixels are not meant to be static, but rather in movement, representing the aliveness of our planet. This effect could be achieved by constantly fading in and out certain pixels. If people touch into the pixels or wipe through them, pixels should behave accordingly, moving away from the touches and back at the previous position after a few milliseconds (Particle behaviour). This playful interaction could also be engaging for a younger audience at the exhibition.

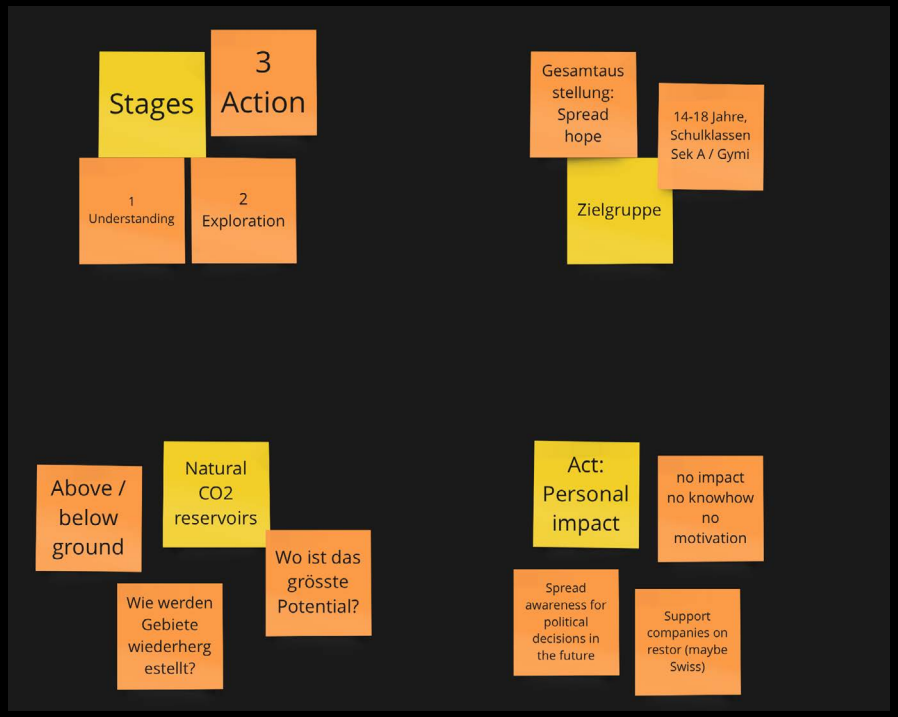

Use the master
token to get started


The potential for
natural carbon storage
Potential restored
CO2 in atmosphere
Biodiversity
Temperate
Tropical
Polar
Subpolar
potential
past
wide climates

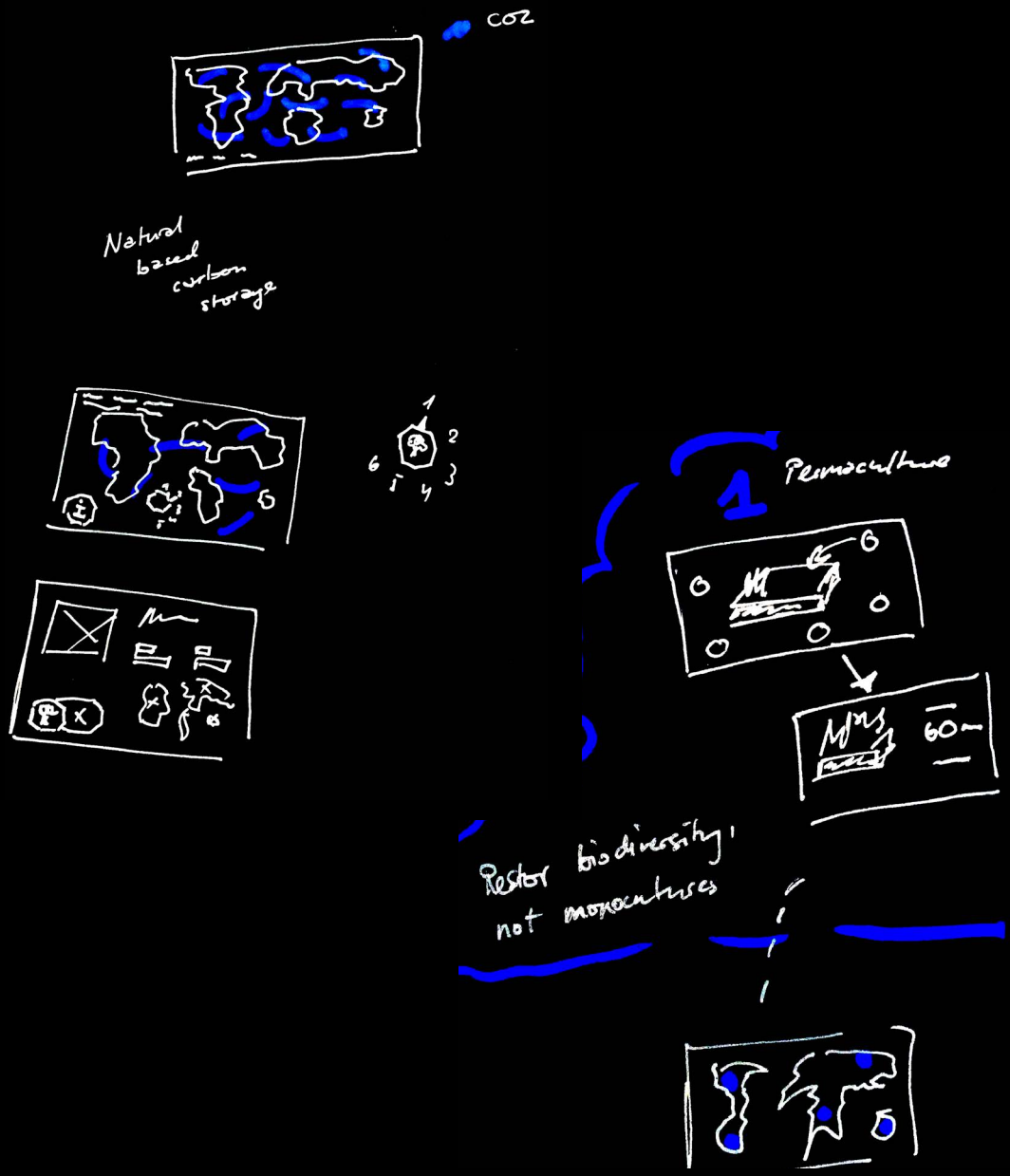

How humans
influenced
the climate
over the past

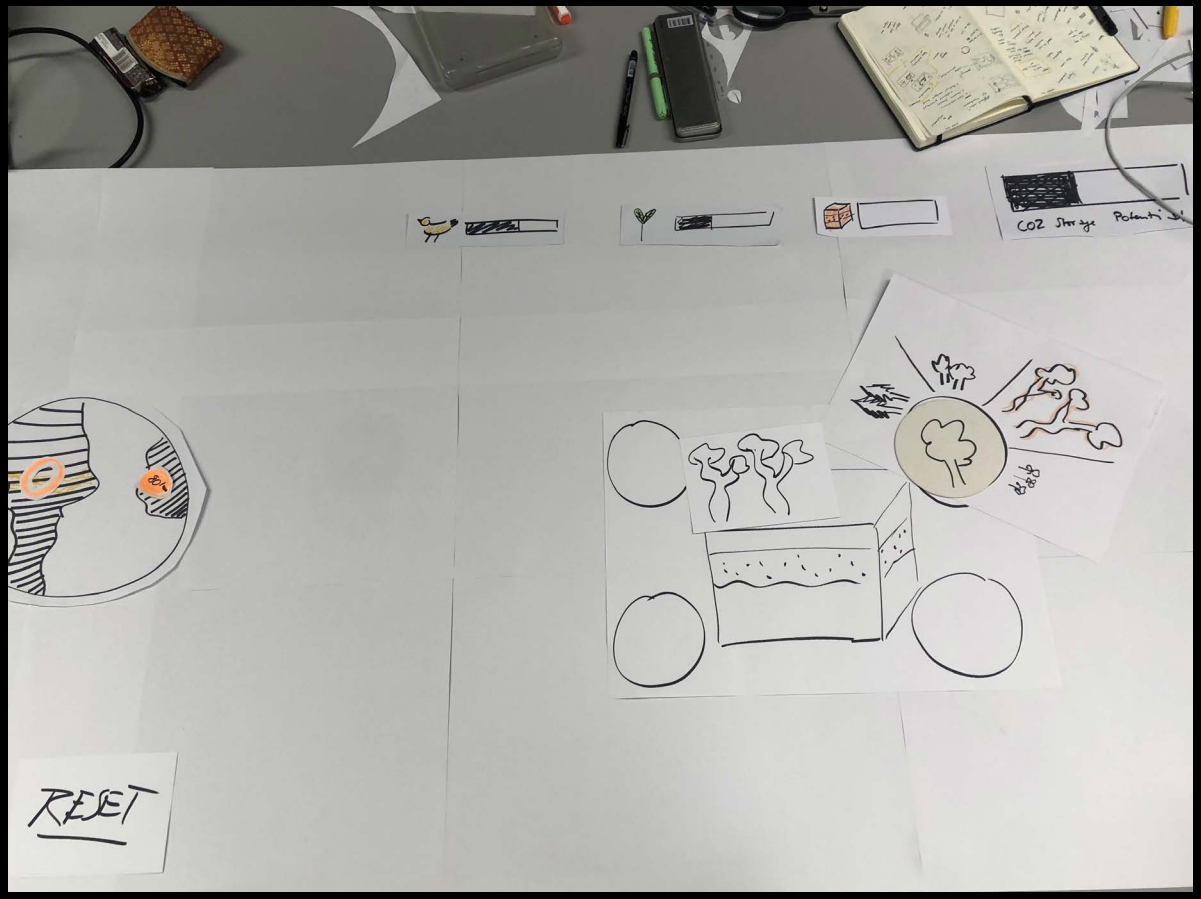


02 PROCESS

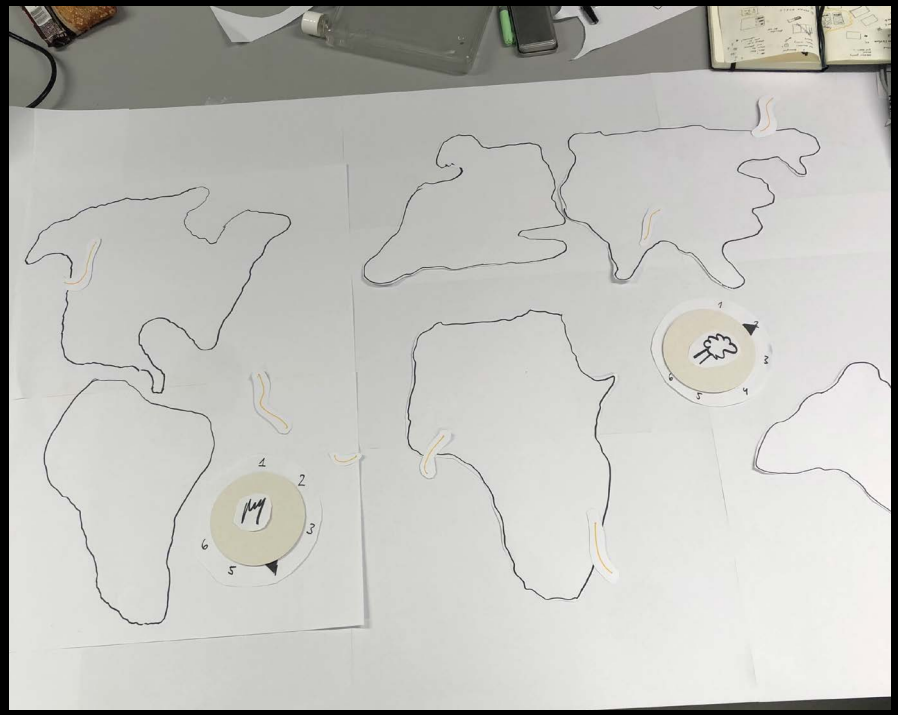


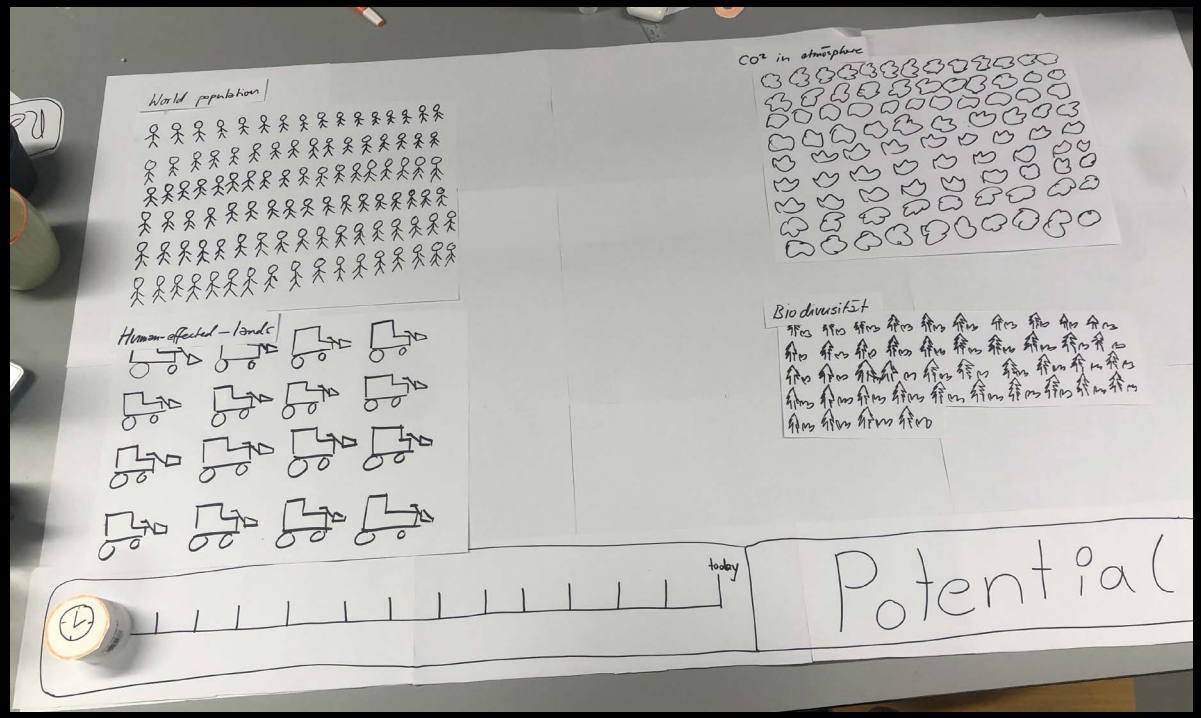
After an intense research phase, we narrowed down, what we really wanted show our audience. We all found the topic of biodiversity very interesting. Our first sketches therefore went into the direction of some sort of a block builder, where the audience can put together their own “earth block” with different plants, funghi, etc. Depending on the compilation of the block, there would be more biodiversity and therefore more carbon storage potential.

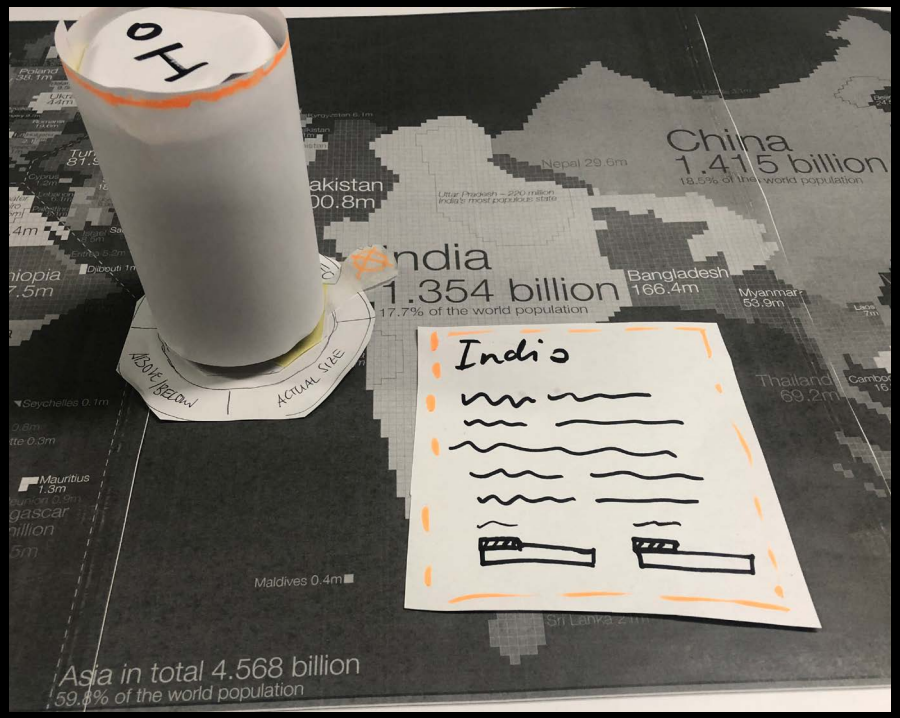


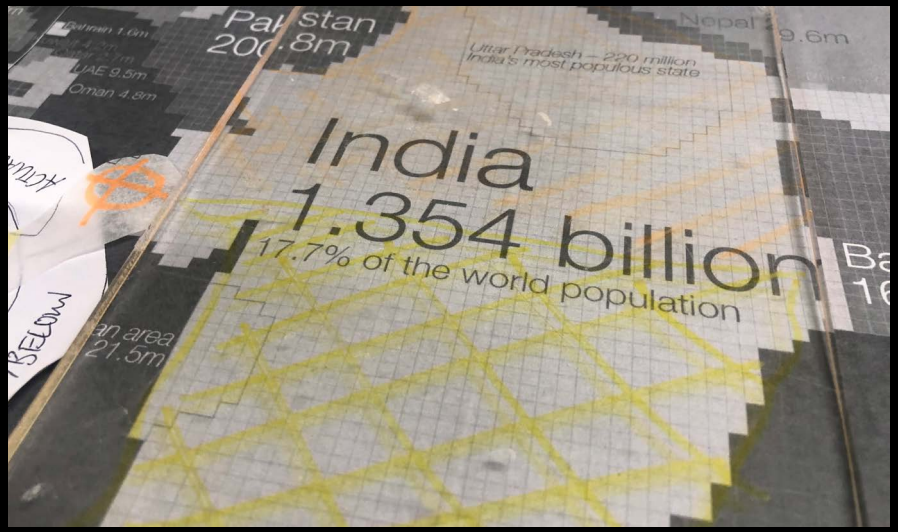


We continued working with paper prototypes, creating our earth block idea and also another idea, focusing more on the worldwide view and the impact for example wetlands would have if restored.
In the mentoring, we got advised to focus more on the given briefing and also keep in mind the data we would need for creating the project. We therefore changed our concept radically, going more in a very simple data visualisation approach, where one entity stands for one specific amount of something.
We also stumbled over an interesting, pixelated world map, which visualised the size of every country not by its land size, but rather its population amount in pixels. This was later also the first inspiration to go with our pixel look.



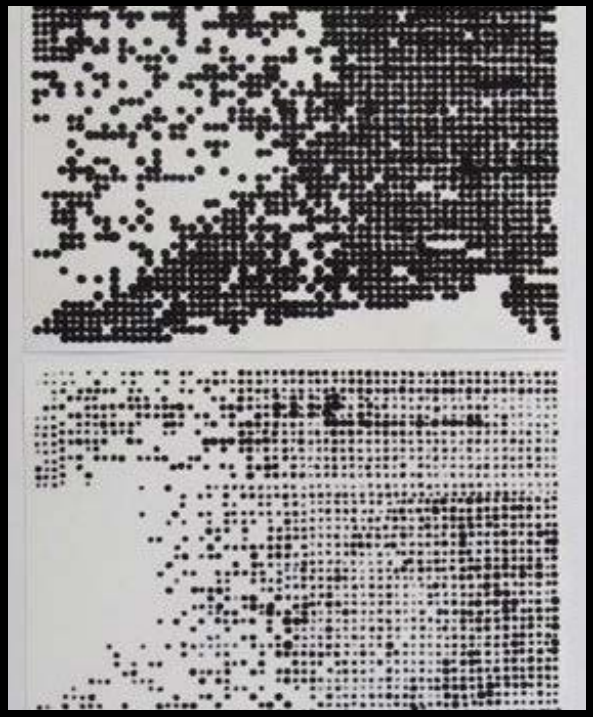


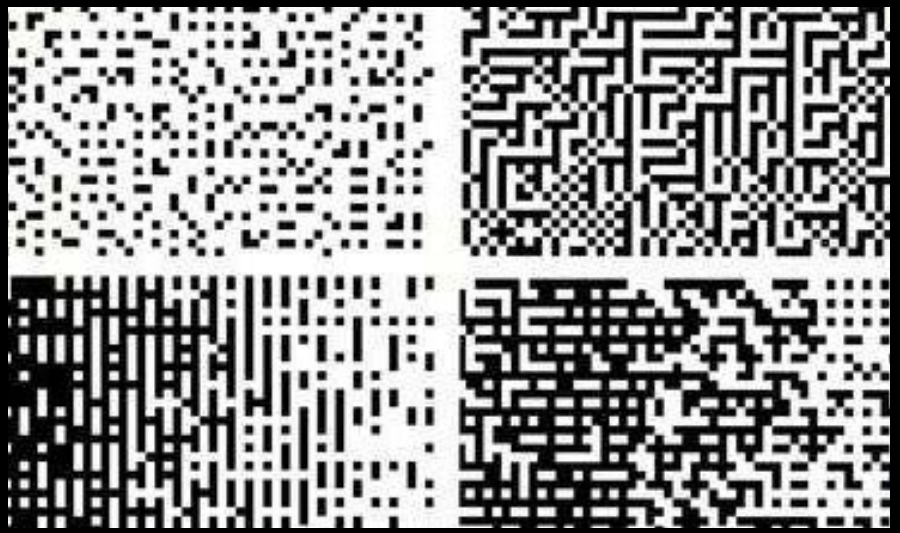


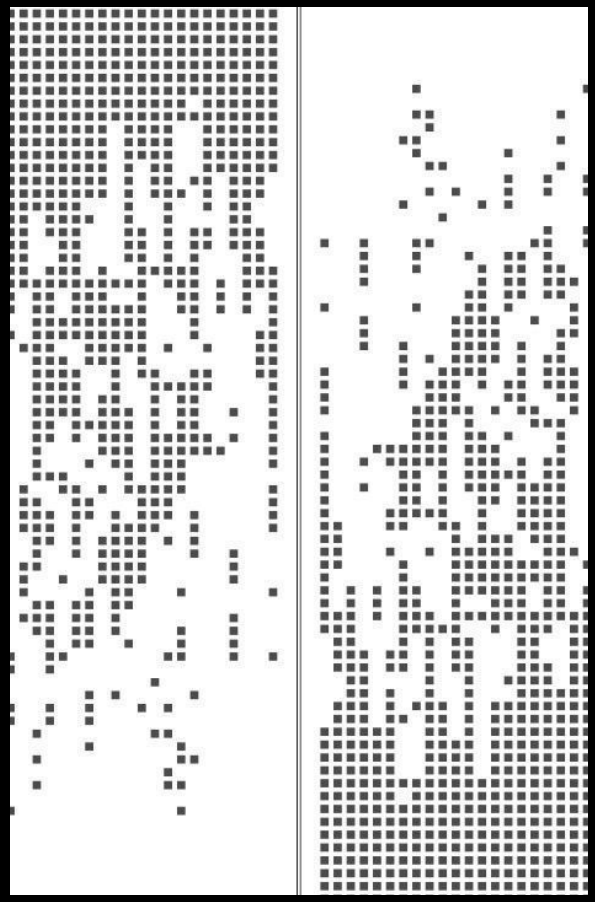


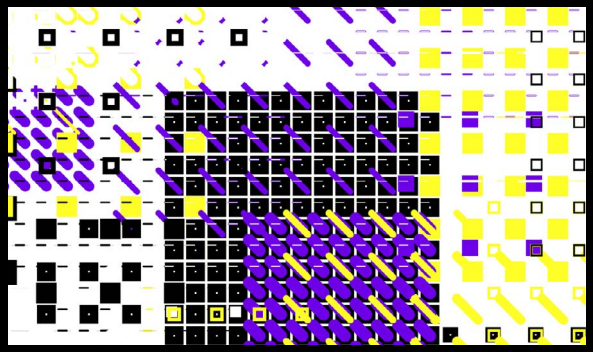
For this new concept we also produced a paper prototyping, giving an easier understanding and common ground for the functionalities we though about.

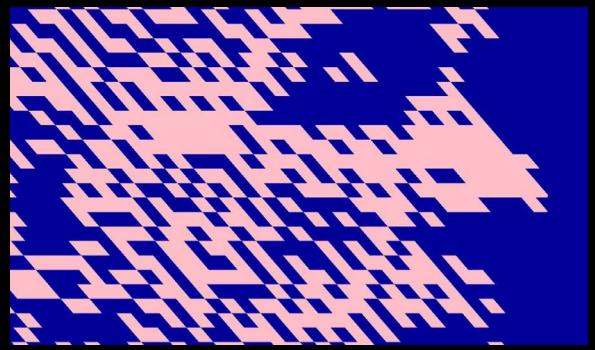
The moodboard research was important for us to get a common understanding on which direction we want to go aesthetically.



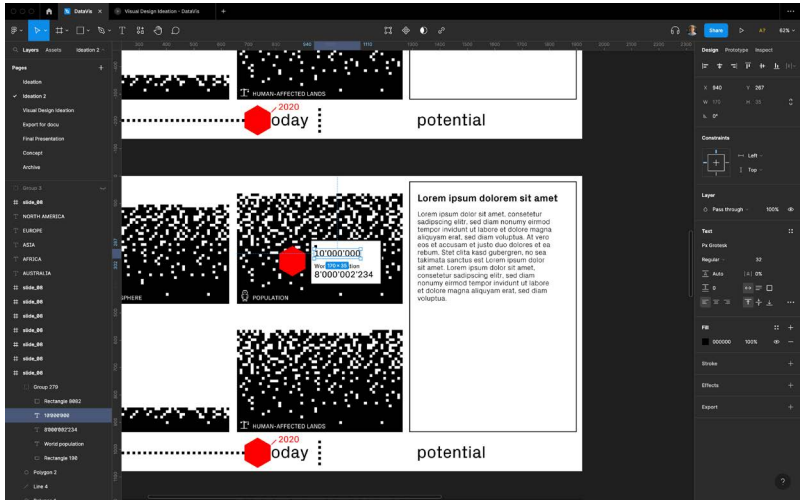


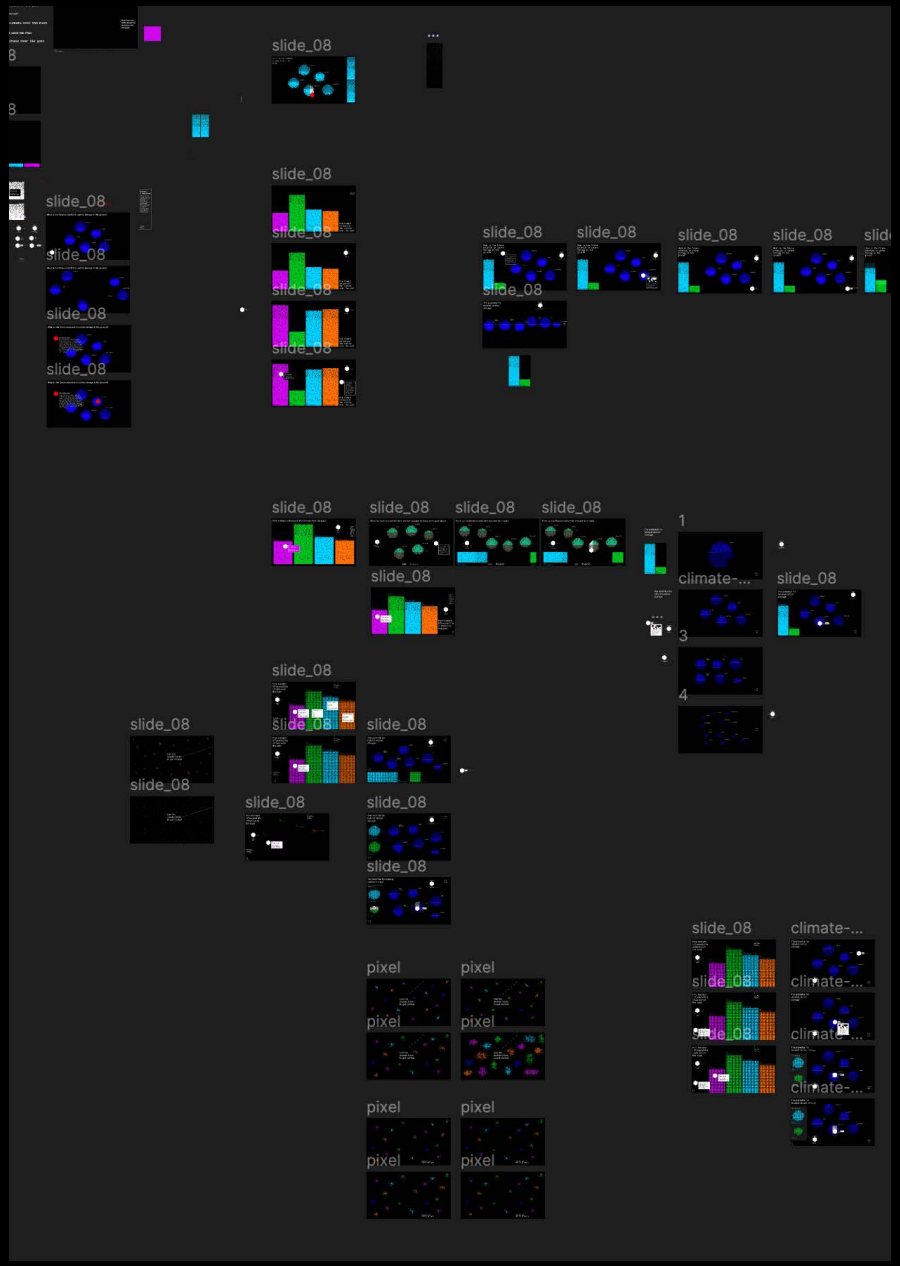


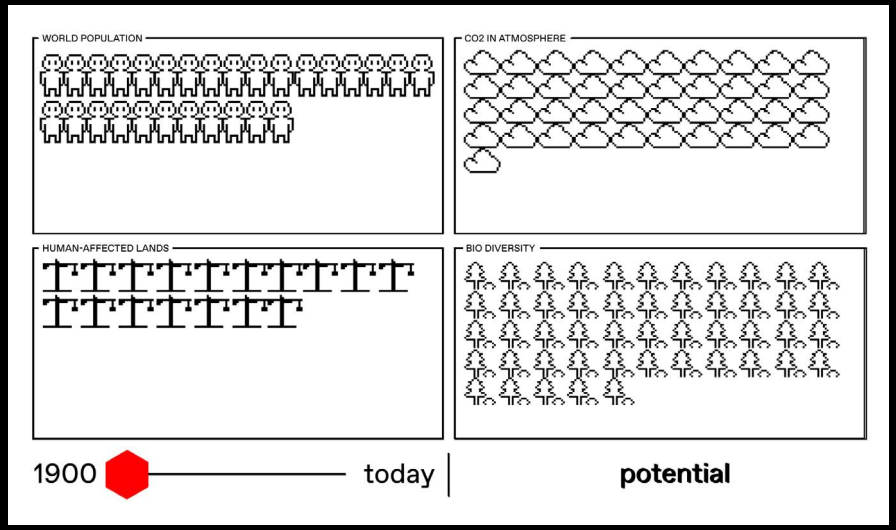


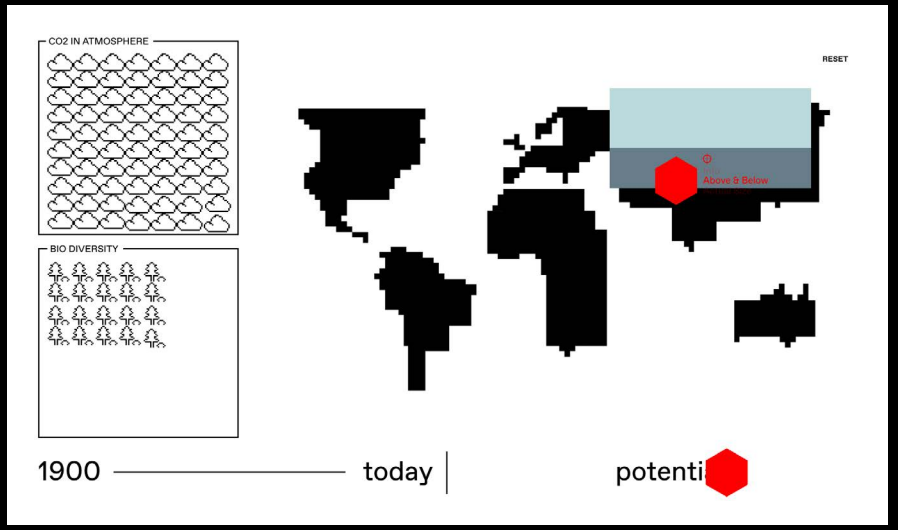


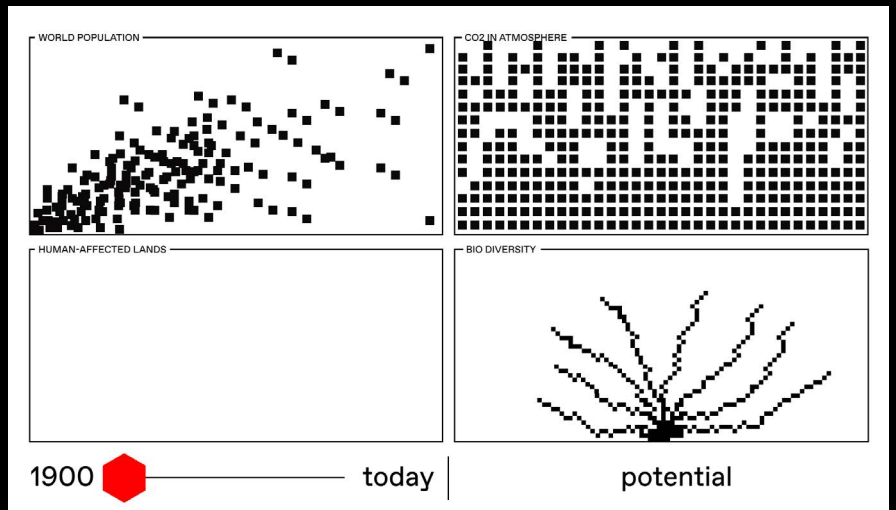
We created the wire-frames in Figma. It helped us get a first view on how big things would appear on the touch table. After another mentoring, we got advised by Jür-gen to go with a dark mode, which made absolutely sense to us, as the light of the white screen was to bright on the big touchtable.

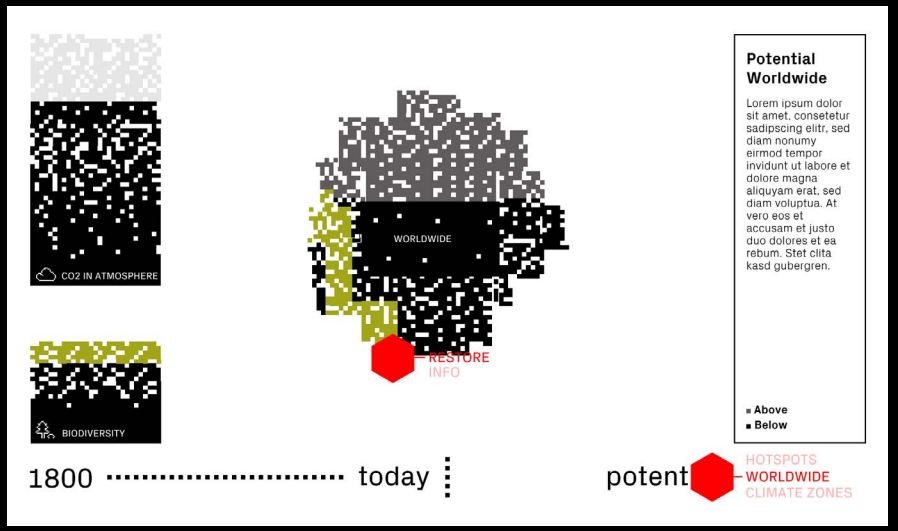






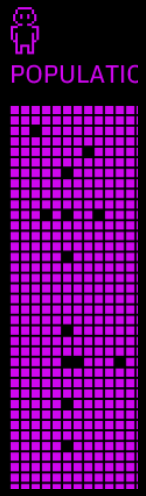




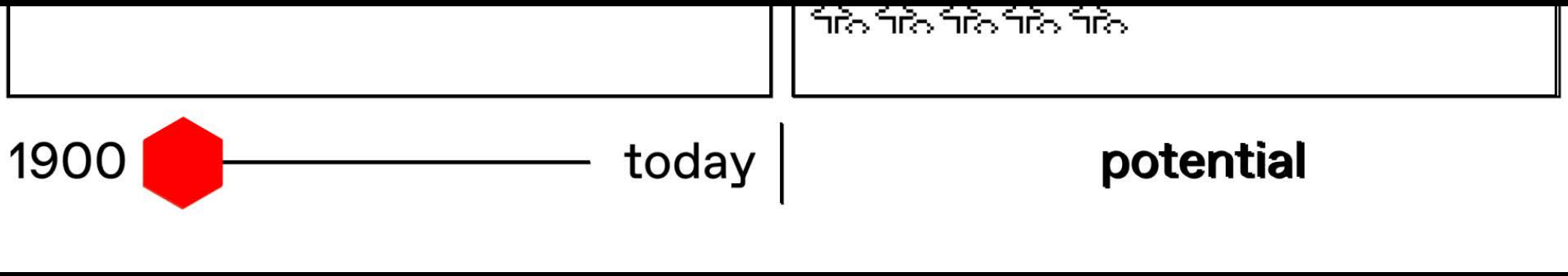


Different wireframe iterations.

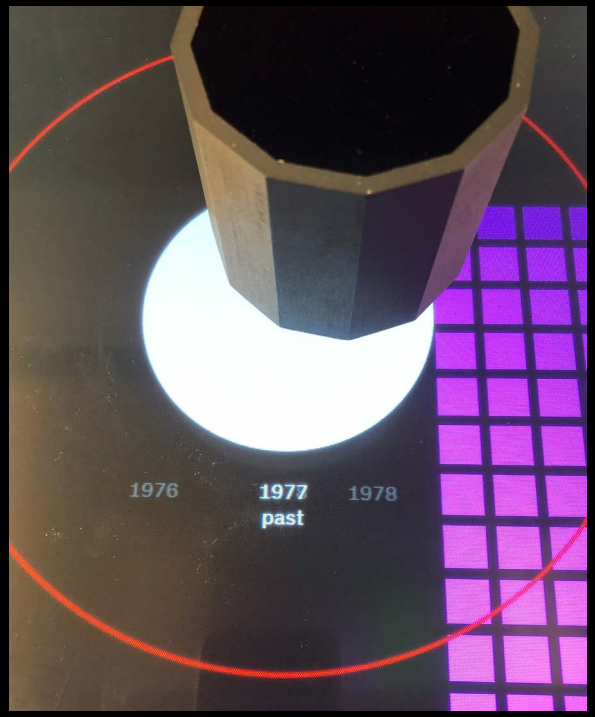
influenced the
climate over
the past



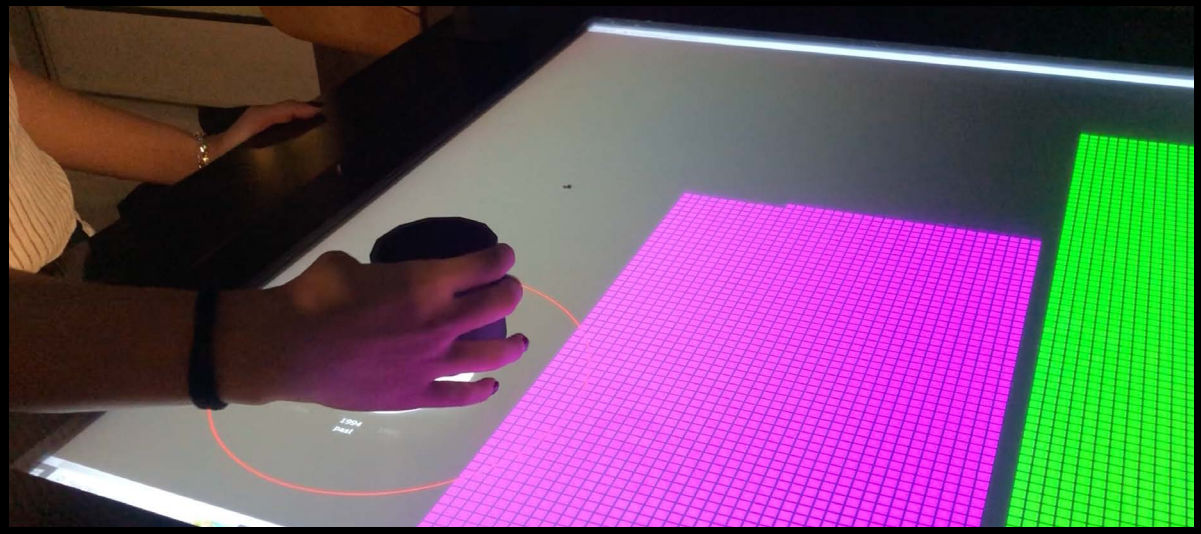
We had many iterations on specific details. The «scrolling-trought-the-years»-function for example was at first just a timeline, where a token on a specific year could be placed to set the year. On the one hand it was not really a clever usage of the token and on the other hand it used a lot of space on the screen and also let the past mode appear not equal to the potential mode in terms of importance. Over iterations, we managed to prevent that.



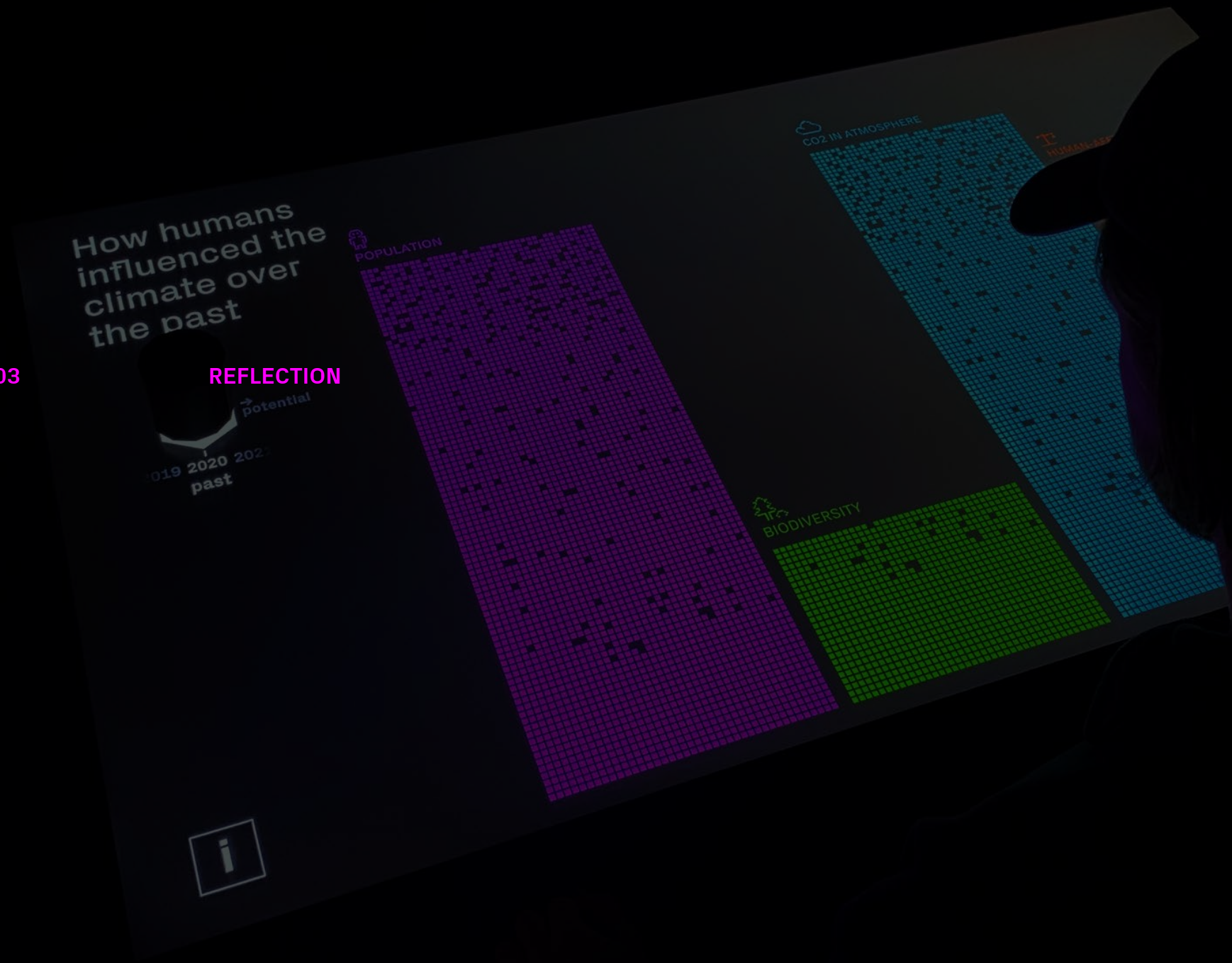
```
            .transition()
            .duration(50)
            .ease(d3.easeLinear)
            .attr("r", rotation);
    }


    function mapValue(number, inMin, inMax, outMin, outMax) {
        return (number - inMin) * (outMax - outMin) / (inMax - inMin) + outMin
    }

    // CHANGE AMOUNT OF PIXELS
    function changeAmount(){
        activePopulation = Math.round(mapValue(pValues[years],0,8000000000,0,a
        activeBiodiversity = Math.round(mapValue(bValues[years],0,100,0,amount
        activeCO2 = Math.round(mapValue(cValues[years],0,37123850000,0,amountP
        activeLands = Math.round(mapValue(lValues[years],0,1605000000,0,amount
        //console.log(activePopulation);

        for(let i=0;i<activePopulation;i++){
            const popamountcolored = d3
                .select("#p"+(i+(amountPixelColums*amountPixelRows-activePopu
                .transition()
                .duration(50)
                .ease(d3.easeLinear)
                .style("fill", pink);
        }
        for(let j=0;j<(amountPixelColums*amountPixelRows-activePopulation);j+
            const popamountempty = d3
                .select("#p"+j)
                .transition()
                .duration(50)
                .ease(d3.easeLinear)
                .style("fill", "black");
        }

        const moveTextPop = d3
            .select("#poptext")
            .transition()
            .duration(100)
            .ease(d3.easeLinear)
            .attr("transform", () => 'translate(0, '+ ((amountAllPixels-active


        for(let i=0;i<activeBiodiversity;i++){
            const bioamountcolored = d3
                .select("#b"+(i+(amountPixelColums*amountPixelRows-activeBiod
```



One challenge we had, was that Figma was struggling with the amount of pixels we were using and was also limited in showcasing our token interactions. This made it impossible to prototype a realistic view of the past mode, as we also would not have wanted to create over 200 screens (one for each year) and also could not show the rotation interaction. We therefore decided to code these elements in D3.js. It was quite a challenge, as we all never worked with D3.js before, but were really happy, that – with over 500 lines of code – we were successful with it in the end. The master token and pixels in the past mode were working fine. Additionally, the data used for the past mode is real. We see our coding part as a valuable proof of concept.



03 **REFLECTION**



We had some challenges throughout the process, our first mentoring for example really left us frustrated. At this point, we were not really sure, if we could create something valuable. Also we had to deal with some absences due to sickness in our group. The time we lost there sadly prevented us from investing more effort in to the animation and haptics of the pixel design, where we would have wanted to iterate more and visualise, how it should look like in the end. As much as we love Figma, we also realised that our pixel design was not really optimal for the web-based application and we struggled with performance issues. Coding-wise we had to work with a technology (D3.js) we never used before.

But, despite all these challenges, we are really happy with our outcome. We think our pixel design stands out from many other scientific visualisations and is also easy to understand. Furthermore, we managed to have creative integration of the tokens, which was an important goal for us. Lastly, our coding part really proved our concept and gave us a chance to showcase our approach nicely during the live-demonstration. It felt so good to really see how it is technologically working on the screen, and explore how the different values would change, which was only possible because we used real data. We now really hope to get the chance to show our product at the exhibition!