

Warming Planet, Cool Ideas

By Trees by Degrees°

The problem is the world is getting warmer, and cities (where most people are) are increasing at a greater rate.

Solution? Drop icebergs into the ocean!!



The causes of the problem are well understood. The issue is referred to as an **urban heat island (UHI)** (is an urban area or metropolitan area that is significantly warmer than its surrounding rural areas due to human activities).

- 1) Too many people in a small area generates a lot of heat.
- 2) Cooling buildings generates heat outside.
- 3) Tall buildings to house the people cause a Canyon Effect trapping the heat.

- 4) The builds are made from materials that absorb heat and then radiate heat back at night.
- 5) The roads required for the people to commute absorb a lot of heat during the day.

Our pain points are:

- 1) health effect on the vulnerable (young/old/sick)
- 2) cost of cooling

We came up with as many different techniques for reducing temperature in cities as we could think off and then started to eliminate them based on the following criteria:

- 1) Must meet Sustainable Development Goals from the United Nations ie [GOAL 11: Sustainable Cities and Communities](#)
- 2) Cost: how much?
- 3) Speed: how quickly can we start? Is there anything holding it back for a launch within the year? Time is running out and while long term solutions are preferred, the lead time might make them useless.
- 4) Buy-in: can we get the people behind the solution as if there is no public support then the solution will never be implemented.
- 5) Other benefits: will there be other benefits due to the solution?
- 6) Other negatives: what are the drawbacks?

Possible solutions:

- 1) Ice blocks storage
- 2) No driving/work from home day
- 3) Plant trees - air pollution filter + shade
- 4) Paint buildings
- 5) Solar panels on roofs
- 6) Water bodies to store heat
- 7) Solar windows for skyscrapers?

We quickly investigated and evaluated the above solutions from brainstorming.

- 1) Ice blocks to store 'coldness':
The idea here was to use solar power to create ice blocks during sunny days, and then using the ice to cool the building at night when buildings are hotter than they would normally be.
As this uses 'free' energy to cool and then 'cheap' energy to it's cost effective and business love that! But it's not sustainable.
- 2) No driving - work from home day:
This would have a great effect on reducing traffic and associated heat generated by commuting, but the home is using more energy while people are there.
- 3) Plant trees:

Trees provide shade and absorb CO₂. they also encourage wildlife. They also have a filtering effect on pollution.

But they take time to grow and can damage buildings and other structures.

4) Paint buildings:

We could paint tarmac/concrete with a heat reflective paint to reduce the amount of energy absorbed during daylight hours. This is a cost heavy solution

5) Solar panels on roofs:

More solar panels on the roofs for more free energy! There are already a large amount of grants for this, and retrofitting houses will mainly save energy for the building user, but not reduce the temperature of the surrounding area.

6) Water bodies to store heat:

Water is a great for cooling, spraying building with water to reduce heat, having lakes/streams to catch and move heat out of the city. Expensive and requires a lot of construction work.

7) Solar windows for skyscrapers

-<https://www.seeker.com/earth/energy/clear-liquid-coating-turns-windows-into-solar-panels>

Spraying all the windows is a time heavy process and quite expensive.

We want people to get behind the solution, so that it will actually be implemented. The least amount of red tape involved (planning permission/regulations), the quick it can be implemented.

Since our solution needs social buy in and needs to reduce the temperature in cities we believe that planting trees in key locations will reduce the UHI effect.

The science:

Tree corridors are better than single trees, the shade provided can be utilised by people as a shaded pathway while the tree canopies also remove toxic pollutants from the air.

There are case studies where by addign tree corridors, the overall temperature has decreased by 2deg in a city.

https://www.linkedin.com/posts/world-economic-forum_colombia-environment-activity-6589902545752207360-BI2z

The solution:

Technology can be leveraged into helping us decide the best tree for the best location.

Using satellite data and computer vision, we can quickly ascertain where there is a lack of trees, the space between building/roads.

We get the temperature from various datasets.

Building heights can be calculated from satellite photography thus allowing us to calculate the canyon effect as per this website.

We can then use Skynet (AI) we can determine the locations for the trees, and help decide the maximum length of the tree corridors to optimise coverage for shade and minimise the obstruction and interference caused.

Our tech stack:

Eventually we'll leverage cloud based solutions such as AWS to host the database and provide APIs to upload data. The database will have GIS extensions natively enabled to help speed up location computations.

Using the API connection to pull data from the many open source datasets (open street maps) and making a connection with our database will mean that the dataset will be kept up to date and that the ML process will only need to be run against changes.

The machine learning component will calculate whether a tree corridor will fit and if there are no planning restrictions or any physical obstructions.

Based on how close to the city centre, how close to the road, space, height of buildings (to ensure it has sunlight)

The feedback metric will need to be human based at first, to properly gauge the visual amenity.

It can also then recommend green roofs vertical garden locations.

Front end will be a serverless solution, enabling the customer/client/user to display the data (maps + aerial satellite + temperature) and overlay problem areas, and possible solutions.

We will eventually have an Augmented reality app which will project the trees onto open spaces (data available from various cities, dublin docklands has an open set) to show the citizens what the trees will look like.

A commercial application of tree placement AR is this ad from Ikea:

https://www.youtube.com/watch?time_continue=09&v=n-5N0X14qFk

This will allow us to have people vote on where to plant a tree based on their real-time location and allow the local government to act based on citizens feedback which reduces opposition as this will be factored in via the negative voting.

Product Vision:

Public buy into planting trees to reduce temperatures of cities with health and monetary gains.

Conclusion:

Data:

The idea is worth nothing if there is no data available.

For our solution, we are using previously computed data, where available, and then using ML to process satellite photography from nasa/copernicus/etc.

Open street maps and local planning maps will help give more context to the suggested solutions.

Census data would be incorporated to determine age populations and their densities, which help determine commute patterns that will emerge in the future.

Cost:

The tech stack and data are already available, and the science has been well established.

Using semantic segmentation to pull data from the satellite photos is a proven concept and allows the latest data to be used to plan the future.

Mature trees are expensive and limited. The best time to plant a tree was twenty years ago, the next best time is now.

Speed:

The time taken for trees to fully develop varies from tree to tree, but regardless of this, trees are long lasting and

Buy-in:

By having a website, key stakeholders can base their decisions with key visualizations using real data which is updated and accurate.

The mobile app would be used by people to nominate areas for installation of tree corridors to be reviewed by local gov. It would also allow local gov to see how many people are for or against a specific installation. But using the app to demonstrate the visual effect on amenity, we can help people to buy into the finished vision of the street and their living areas.

Other benefits:

From trees/green roofs there are a few other benefits other than reducing temperature:

- 1) Trees provide food and shelter to bees, as well as providing them a route to travel to the hive. <https://www.urbanbees.co.uk/trees/trees.htm>
- 2) Trees hold water and stop flash flooding when local drainage infrastructure is overwhelmed. <https://www.charteredforesters.org/2017/06/trees-can-reduce-floods/>

From the website/app:

- 1) Highlighting the problem areas and showing gains to the key stakeholders in local gov.
- 2) Active participation by citizens - feedback on where the trees will be planted and what they will look like.

Other negatives:

Trees block traffic views, so care has to be taken where to plant trees.

The roots can damage infrastructure.

The leaves and other debris require cleanup and maintenance.

The health benefits of a cooler environment has well been established as the various heatwaves in the cities have shown. Cleaner air will help the vulnerable, by removing and hindering air particles and pollution.

Remember the best time to plant a tree was twenty years ago, the next best time is now.

And regardless if this project succeeds or not, I trust that you will join us and plant trees when and where you can (in a socially responsible manner).

References

Automatic Building Footprint Extraction: <https://www.mdpi.com/2220-9964/8/4/191/pdf>