
# Final Report: Nano Paint

DECEMBER 30, 2024

New Mobility
Strategic Planning and Policy
TransLink

# Executive Summary

- Nano paint, which is made of tiny particles at the nanometer scale (one billionth of a meter), has gained worldwide popularity, especially in Europe and North America for its eco-friendly and energy-efficient properties. Surfaces coated in nano paint offer unique benefits, including self-cleaning, anti-corrosion, and thermal insulation. Nano paint can reduce energy consumption by reflecting sunlight and improving insulation.
- While there are many known benefits of nano paint, this pilot focused on the effectiveness of nano paint in reducing surface heat and its thermal insulation capabilities, particularly in providing heat-reflective properties to maintain cooler temperatures and improve energy efficiency.
- The pilot was delivered in two phases in partnership between TransLink, the Low Carbon Business Association (LCBA), and the now decommissioned Vancouver Economic Commission (VEC) through Project Greenlight.
- The pilot results recommend factoring in annual sun exposure when evaluating the sustainability of nano paint applications. Currently, the high cost of the paint and lack of green incentives make widespread adoption impractical, particularly for buildings that do not experience significant heat outside the summer season. It is also worth looking into other potential benefits of the paint, such as self-cleaning, corrosion resistance, and durability.

# Project Overview:

Hotter summers and more frequent extreme heat due to climate change are putting Metro Vancouver's vulnerable populations at greater risk of heat-related illness[1].

The region is collectively looking for ways to reduce the negative impact of extreme heat on people and environment by adapting buildings to be able to withstand the extreme heat that is expected to become more common in the next 30 years.

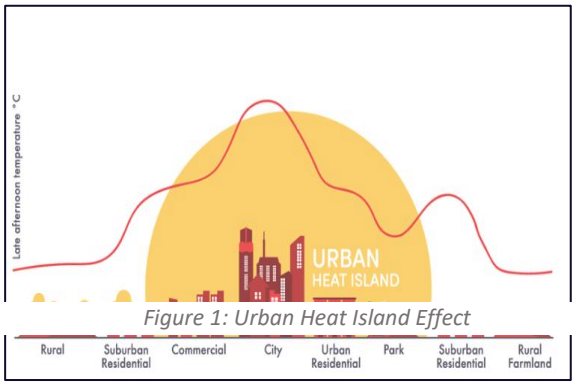


*Figure 1: Urban Heat Island Effect*

The application of nano paint is one way the region can prepare for extreme heat, particularly by addressing the Urban Heat Island (UHI) effect. This phenomenon occurs in large urban areas with significantly altered environments, which tend to experience higher temperatures than surrounding areas. The UHI effect can raise temperatures from five to 10 degrees Celsius amplifying the effect of heat waves. It is predicted that the number of days exceeding 30 degrees Celsius in Vancouver will increase from one to 13 over the next 30 years as a result of climate change[2].

[1] https://vancouver.ca/files/cov/vancouver-climate-change-adaptation-strategy-2024-25.pdf
[2] https://climateatlas.ca/urban-heat-island-effect

Nano paint can improve thermal management in buildings and exterior surfaces by reflecting a significant portion of solar radiation, preventing excess heat absorption. This reduces heat gain in buildings, lowers ambient temperature, and helps prevent the accumulation of heat.

Cities like Toronto[3], Los Angeles, New York, Melbourne, and Athens have launched cool roof programs to address the UHI effect and improve energy efficiency. These programs often include incentives like consumer rebates, requirements for cool roofs on municipal buildings, and promoting them as a tool for sustainability and climate change mitigation.

Due to time constraints and the limited scope of this pilot, the project team focused on nano paint's thermal insulation benefits, specifically in the properties that have the potential to combat the UHI effect. While here are other benefits of nano paint, as mentioned below, the team believes that its greatest advantage for transit infrastructure is reducing the UHI effect, which is the focus of this study.

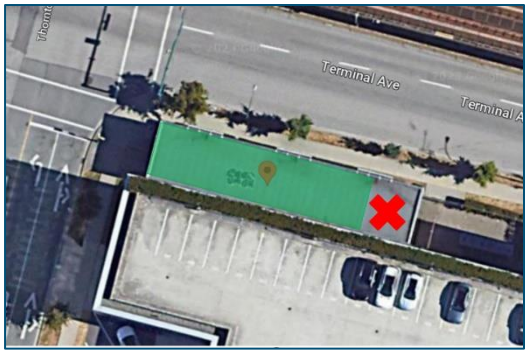
Benefits of using nano paint

- Thermal Insulation
- Energy savings
- Ease of application
- Durability
- Self-Cleaning
- Anti-bacterial
- Air purification
- Maintenance reduction


[3] https://www.toronto.ca/services-payments/water-environment/environmental-grants-incentives/green-your-roof/

# Project Design

Phase 1 (2023): BCRTC substation Thornton Street and Terminal Avenue, Vancouver BC

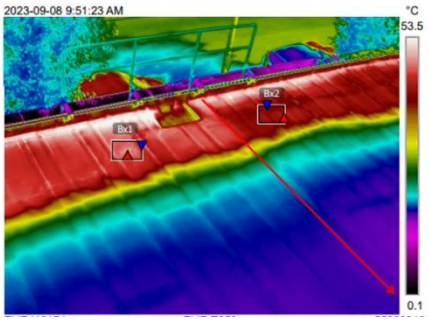




**Roof Material:** 2-ply SBS with granulated surface
**Roof measurement:** approximately 2,175 sq. ft.
**Address:** 540 Terminal Avenue Vancouver, BC

The effectiveness of nano paint was tested using comparative temperature data of a surface that is covered by the nano coating and a surface that is not. 80% of the building was covered with nano paint and the remaining 20% was left unpainted to allow a direct comparison to be made between the portion treated with the nano material and the portion that was untreated.

The study measured the temperature of the roof over a period of five weeks. There were broad temperature recordings of the entire roof as well as spot recordings.

An independent third-party vendor was tapped to use thermal scanners at certain times of the day to measure the effectiveness of the product, allowing the team to gather data relating to the product's efficacy. The thermal readings provided temperature gradient data that allowed direct comparison between the coated and uncoated parts of the roof. With this temperature gradient data, the solar reflectance was compared to that from the Cool Roof Rating Council trials.




| Including Outside Temp. | Nano coated | Uncoated | Difference |
|---|---|---|---|
| 1st Reading (27.0 C) | 54.8 C | 58.9 C | **-4.1 C** |
| 2nd Reading (26.3 C) | 51.5 C | 57.6 C | **-6.1 C** |
| 3rd Reading (25.3 C) | 45.7 C | 50.4 C | **-4.7 C** |
| 4th Reading (24.2 C) | *NA* | *NA* | *NA* |
| 5th reading (22.1 C) | 47.0 C | 52.3 C | **-5.3 C** |

The result showed that surfaces coated in nano paint were at least 10% cooler compared to untreated surfaces.

Phase 2 (2024): BCRTC substation: geographic coordinates: 49.2200650°N, 122.8923881°W


**Roof Material:** 2-ply SBS with granulated surface
**Roof measurement:** approximately 2,580 sq. ft.
**Wall Material:** Clay Sediment (Brick)
**Wall Measurement:** 3,944 sq. ft.

The second phase of the pilot focused on thermal emittance, or the ability to cool the interior of the building by deflecting the heat from the sun and preventing it from penetrating the surface. If successful, this can lead to improving occupant comfort and energy savings.

For this phase, the team identified a building that is exposed to the sun during the summer. The building that was selected is a substation under the SkyTrain with no adjacent buildings located next to it. It is located on the Brunette-Fraser Regional Greenway in New Westminster, between Sapperton and Columbia SkyTrain stations.

Thermometers were installed inside and outside of the building and temperatures were tracked on an hourly basis before and after the paint was applied to measure effectiveness of the paint in cooling the interior of the building.

*Figure 2: After nano paint application*

### Result of second phase

The results from the second phase proved challenging to assess due to the inability to directly compare the data side by side. Analyzing all the data points did not show a significant impact of the paint in terms of cooling the substation's interior. However, by comparing the readings from July 10 to August 17 – on days with similar ambient temperatures and sunlight exposure - it was observed that the interior of the treated surface on August 17 was cooler by a few degrees. This trend was also noticed on other days with similar outside temperatures.

## Lessons Learned and Recommendations

### Application

- Surface preparation is critical. The effectiveness of nano paint relies heavily on proper surface preparation. An uneven or poorly prepared surface can compromise the effectiveness of nano paint and lead to a waste of paint.

- The manufacturer's estimates on the amount of paint required was significantly understated. It is crucial to account for additional paint when creating a budget or business case.

### Performance

- **Consider the winter heating impact during application**. On colder days, the surface will absorb less sunlight, reducing heat conduction into the building and increasing the need for heating in the winter.

- **Carefully consider where to use nano paint**. Due to its high thermal emittance properties, nano paint can heat the surrounding area where it is applied. While it is effective in protecting a building's interior from heat, it may cause the heat to dissipate into the surrounding environment.

- **The second phase yielded mixed results**. Analyzing the data without accounting for times when the sun isn't shining produced different results compared to analyzing the data during peak sunlight hours. This suggests that to maximize the benefits of the paint, it should be applied to areas exposed to the most sunlight and where reduced temperatures would provide the greatest advantage.

### Cost

- If the paint is to be adopted for widespread usage, consider manufacturers in North America to minimize costs. The Cool Roof Rating Council publishes all certified paint manufacturers worldwide.

- Lack of government rebates in Metro Vancouver makes the paint more expensive.

# RECOMMENDATIONS

- The pilot confirmed the effectiveness of nano paint in solar reflectance and thermal emittance. However, the cost of the nano paint is significantly higher than the cost of a regular paint. If this technology is to be considered for future implementation, consider an in-depth cost-benefit analysis as to where the paint will be applied and the potential savings that can be achieved at that location, as there will be areas where the cost of the product will outweigh its potential benefits.

- Other benefits of the paint, such as the prevention of graffiti and filtration of pollution, can be explored further. Nano paint can be used strategically on high-traffic areas, vandalism prone areas, or surfaces that directly face the sun.

- Explore comparable technology offered in North America. The nano paint used for this pilot was procured from Czechia. If the TransLink enterprise were to adopt this technology for widespread use, the cost of adaption can be reduced by looking for nano paint providers in North America that are certified by the Cool Roof Rating Council (CRRC).

- Collaboration with Metro Vancouver and municipalities to investigate cool roof program for houses and commercial infrastructures combined with an effort to retrofit existing infrastructure to use nano paint can help make a concentrated