Other than that, Y. Lai et al proved with experiments that active liquid cooling is an effective solution for high brightness LEDs in automotive headlights, outperforming air cooling and passive liquid cooling methods. [@lai2009]. [@lai2009]

[@hsieh2014]

— start-multi-column: Hsieh et al. microspray

number of columns: 2   
largest column: left

Hsieh et al. proposed a microspray-based cooling system for LEDs, realizing temperature drop up to 40 degrees for single LED that output 3W and 5 W of powers. [@hsieh2014]

— end-column —

![[microspray\_litrvw.jpg]]

— end-multi-column Deng et al presented an active liquid cooling solution that replace water to liquid metal, it is due to its high density (up to 7 times higher) and strong thermal conductivity (more than 20 times higher) compared to water, allowing it to dissipate heat more easily than water even though its heat capacity is around 10 times smaller than water. [@dengLiquidMetalCooling2010]

There numerous possible configurations when it comes to cooling LEDs. However, when implemented in plant factories, challenges such as transferring heat across multiple layers of growing racks and ensuring effective outdoor heat expulsion are ought to be overcomed.

Based on the above discussion, this paper proposes a novel cooling solution aiming to:

* Design and implement an efficient heat conduction mechanism for LED aluminum substrates, rapidly removing the generated heat.
* Transfer this heat to a sustainable heat storage pool designed for directional discharge to the outdoor environment.

The ultimate objectives envisioned are:

* Achieving zero-energy cooling of LED chips during cooling operations;
* Recouping and reusing waste heat generated by LEDs without compromising their light output performance under heating conditions.