SolarSource:

A general framework for evaluating rooftop solar potential

Graham Turk

In a Tortoiseshell: *Excerpted from a computer science paper, this **abstract** successfully condenses the essential aspects of a lengthy paper into a potent, concise account. In clearly outlining an initial problem, the author's solution and his methodology, this abstract provides the reader with a comprehensive overview of the paper's core argumentative elements.*

Excerpt

Homeowners don't have a simple and accurate method to determine whether their homes are good candidates for a solar installation. This is problematic because a solar installation can both yield savings on electricity cost and reduce greenhouse gas emissions, recognized as the primary driver of global climate change. In this paper, we propose SolarSource, a universally applicable framework for evaluating rooftop solar potential. The framework is implemented as an Android mobile application and public RESTful API. The key insights are to provide homeowners with tools to construct a roof mapping themselves, to use a crowdsourcing platform (retrieving production statistics from actual solar arrays) to inform our analysis, and to implement the back end of the framework as a public API with an adaptable, open-source architecture. The main advantages of this approach are flexibility and adaptability: by providing tools for the homeowner to map her own roof, we enable universal coverage; a decoupled API provides software developers with access to our analysis tools; and an adaptable and open-source architecture enables the open-source community to augment the framework. Experimental results demonstrate that our framework produces reasonable estimates for solar potential compared to existing tools. A general-purpose and accurate framework helps uncover the financial benefits of solar for the widest audience possible, thereby facilitating the transition to a carbon-free energy future.

Author Commentary

Graham Turk

When I began this project, I knew I wanted to build a practically useful application at the intersection of software and renewable energy. Dr. Alan Kaplan, my advisor, explained to our "Apps for the Environmental" seminar that successful research fills gaps left by existing efforts. I turned my attention to residential solar energy, which still remains a largely untapped resource, capable of fully offsetting a home's electricity consumption from the grid. Complex modeling tools existed for simulating a solar panel, but if a homeowner hoped to get an estimate of their home's potential to generate rooftop solar electricity, the primary option was a professional appraisal from a solar installer.

This was the motivation for SolarSource, which is also how I began the abstract. The first two sentences grab the reader's attention—they concisely introduce the problem and the larger implications for both homeowners and the planet. These implications demonstrate why the problem is worth addressing. It is important to formulate the problem statement carefully, as it directly implies the project's goal.

From there I move on to the key insights, which describe *how* my approach differed from existing solutions in order to solve the problem posed. I felt strongly about stating these insights early in the abstract, as they constitute the contribution of my work. Each insight was born out of what we saw as a drawback in existing work. Many of the existing applications relied on aerial photos, which could be obscured by trees or were only available for certain regions. Other tools relied on fixed electricity generation estimates for panels, ignoring regional variability. Even the most accurate tools, like Google's Project Sunroof, were opaque about their computational methods.

It is not immediately clear how each key insight relates to the larger goal of creating an accurate, general-purpose tool for estimating rooftop solar potential. This is achieved by listing the advantages of my unique approach. To avoid any ambiguity, I restate the insight followed by the specific advantage it provided. The keywords "flexibility" and "adaptability" summarize the advantages for the reader and contrast my approach to existing tools.

We wanted our tool to be available to anyone with a rooftop and an Internet connection, so we leveraged the capabilities of smartphone cameras to enable homeowners to map their own roofs. We secured an agreement with a solar provider to collect electricity generation data from actual rooftop solar panels (with the consent of the homeowners). These data allowed us to compute a more realistic estimate of panel production than would have been possible using static parameters. The decision to implement that back end of the framework as a public, open-source API provides transparent access to the data and allows other software developers to improve the framework's accuracy, for example with a custom module to forecast grid electricity prices, or to use the data flexibly in a separate application.

The penultimate sentence summarizes our results, an important factor in determining the contribution of the work. The final sentence is meant to tie the research back to its broader implications and remind the reader of the motivation for undertaking the project in the first place.

Fellow Commentary
Ryan Vinh

In the abstract for his group's independent work project, Graham clearly establishes the context and relevance of his work in relation to the consumer solar space. He does so by succinctly stating the initial problem at hand: "Homeowners don't have a simple and accurate method to determine whether their homes are good candidates for solar installation." He then goes on to explain why this problem needed to be solved. According to Graham, not only are solar installations a boon to the environment, but they can also improve consumer savings. By demonstrating this gap in consumer solar options and its subsequent harms, he clearly establishes the motive for his paper; there was a clear problem at hand that needed to be solved. Thus, he immediately establishes the context and necessity for his project.

Next, Graham describes the particular components of his "SolarSource" project that directly addresses this initial gap in the consumer solar space. He emphasizes SolarSource's flexible, open-source nature that provided users with a convenient and adaptable tool for estimating solar potential. In this way, he demonstrates how he explicitly worked to solve the initial problem as outlined. In an abstract, it is also important to mention the relevant insights gained from a particular project or investigation, which Graham achieves in hinting further at the success of initial experimental results.

In examining Graham's abstract in closer detail, we attain a better sense of the trajectory of his paper: he outlines the initial problem, the steps he has taken to solve this problem, and the results or insights he drew from this solution. To conclude, Graham's abstract captures the essence of his paper, establishing its relevance and inviting the reader to investigate the workings of SolarSource in more detail, an ideal example for which all abstract-wielding papers can strive.

Bios

Graham Turk '17 is a computer science major pursuing a certificate in sustainable energy. He is the founding president of the Sustainable Software Initiative, a student group committed to addressing campus sustainability challenges through software applications. His current research focuses on optimizing computational methods for studying molecules with applications in renewable energy, under the supervision of Dean Emily A. Carter. Next year he will conduct research in shared solar microgrids at the Royal Institute of Technology in Stockholm, Sweden, with the support of a Fulbright grant. He wrote this as a senior.

Ryan B. Vinh '19 is one of *Tortoise's* new editors this year. He is currently trying to escape the College of Engineering to major in Philosophy. Outside of *Tortoise*, he organizes the Princeton Social Impact Competition and heads the Careers Team of the Entrepreneurship Club. He doesn't have much else to say. He wrote this as a sophomore.