

# Where should I bake bread? GIS-based planning of solar thermal bakeries and the socio-cultural dimension of energy transition

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## Abstract

We find ourselves in the midst of an energy transition, but not only energy supply will have to be modified or adapted to follow a sustainable path [1, 2]. The whole chain of supplying, transporting and consuming energy also implies social and cultural changes: we must transform our manner of living, that is to think about **why** we need specific types of energy, and **how** we may find corresponding sustainable alternatives. In the present case, heat energy is required to run bakeries on Reunion island. A classical technical, and limited, approach would only consider a change of *fuel tap*, that is looking for a sustainable source of energy that would replace the current supply satisfactorily. However, Reunion is a small isolated territory, where land-use pressure remains a significant issue. This constraint asks for a more systemic overview of the problem, where we consider the interdependence between land use, energy and food production as well as final consumption. In other words, which kind of bakery process and technology (i.e. *how*) would meet the dietary behavior of people communities (i.e. *why*) in a sustainable way? In this specific example, energy transition thus encompasses many possible social, cultural and technical changes towards sustainability: bread consumption profile, bread and grain type, craftsmanship process and bakery technology, or the energy resource used to bake bread, to name but a few. We believe that both the high efficiency and the *Low-Tech* philosophy [3][4] behind artisan bakeries based on solar thermal energy make them a potential match.

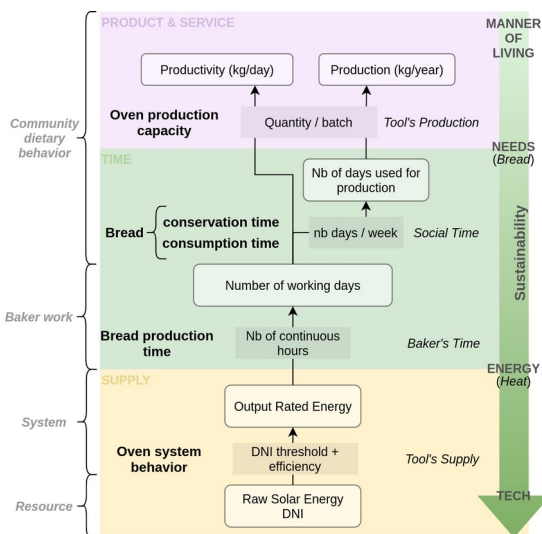


Figure 1: Research workflow. Tech used to harvest required energy addresses the population needs along a sustainable path.

This paper addresses the first question of our research: would solar-fueled bakeries match the requirements of the whole bread-supply chain as it is today? In other words, is the *solar resource* suited to both the *work configuration* of the baker and the *dietary behavior* of the community? In first instance, we analyze how direct solar radiation could *spatially* replace electric ovens on Reunion for running bakeries, with respect to 1) the work *timeline* of the baker and 2) the bread quantity that actually feeds the local population. Accordingly, we propose a methodological concept to guide this analysis, depicted in the workflow of Figure 1. We apply DNI values to a model based on a solar thermal oven currently used by an artisan baker in Normandy, France [4], and compute the final outputs of the workflow through Python GIS. The first cartographic results suggest high potential for solar bakery in the current context of bread consumption in Reunion. By including needs, community practices and a geographic approach to studying bakery transformation, our aim is to show how *transition* in the energy field must be apprehended holistically, beyond sole substitution of the supplying systems and resources.

[1] J. Köhler, F. W. Geels, F. Kern, et al., "An agenda for sustainability transitions research: State of the art and future directions," *Environmental Innovation and Societal Transitions*, vol. 31, pp. 1–32, Jun. 1, 2019, ISSN: 2210-4224. DOI: 10.1016/j.eist.2019.01.004.

[2] F. Kern and A. Smith, "Restructuring energy systems for sustainability? energy transition policy in the Netherlands," *Energy Policy, Transition towards Sustainable Energy Systems*, vol. 36, no. 11, pp. 4093–4103, Nov. 1, 2008, ISSN: 0301-4215. DOI: 10.1016/j.enpol.2008.06.018.

[3] G. Guimbretiere, S. Hodencq, and M. Balland, "Une Approche de la Low-tech dans l'Enseignement Supérieur et la Recherche", *La Pensee ecologique*, March, 6, 2022. <https://lapenseeecologique.com/une-approche-de-la-low-tech-dans-lenseignement-superieur-et-la-recherche/>

[4] <https://www.lowtechmagazine.com/>

[4] NeoLoco. "Artisanat solaire," *Graines NeoLoco*. [Online]. Available: <https://neoloco.fr> (visited on 01/21/2022). <https://solarfire.io/en>