# BIOMASS HARVESTING FROM HOUSING DISMANTLEMENT IN URBAN FRINGE AREA, JAPAN

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## ABSTRACT

Currently Growing number of vacant houses is an emerging issue in Japan. According to the government statistics, the vacant house rate is about 13.5% nationwide in the year 2013. Vacant houses are not simply aesthetically unappealing to a community, it also poses health and safety threats, such as becoming hotbeds for mosquitos or collapsing during earthquake. From social sustainability point of view, vacant houses show a community is indifferent to their living environment, and thus potentially invites criminal activities; this is widely known as the broken window theory.

A driving force for the emergence of vacant houses is the new housing development projects that often motivate people moving into urban core area for a better quality of life. Particularly, the Japanese government is promoting the Compact City Policy as a recent urban planning strategy. Compact city, in general, emphasizes a relatively dense residential area in urban core with a mixed of other land-use, such as commercial and services industries. The compactness of human activities will result in a more environmentally friendly lifestyle, such as a more efficient transportation, energy recycling system, and others. Compact City Policy will benefit the urban core, but not necessary the urban fringe area. A prospective change is, vacant houses will emerge when the population migrants from urban fringe to urban core areas. Meanwhile, vacant houses are hard to repopulate as Japan is entering a depopulation society.

To solve the vacant house issue, vacant house dismantlement in urban fringe area for urban regeneration is the key. A fundamental problem is, the cost of house dismantlement in Japan is very costly, and thus demotivate house owners to demolish the old houses. This research is therefore aiming to propose an innovative policy suggestion to incentivize house owners in dismantling the vacant houses. The proposal is about designing a biomass harvesting system by reutilizing waste wood from housing construction and dismantlement. Since most housing materials in Japan are wood based, the implementation of biomass energy system is most likely feasible. In addition, by supplying waste wood as feedstock to biomass energy system, fossil fuel can be substituted. Therefore, cost can be saved and compensate to house owner, to incentivize vacant house dismantlement. From environment perspective, using waste wood, a renewable energy source, can reduce greenhouse gases emission thus mitigating global warming.

To examine the proposed solution, the objective of this study is to estimate the biomass potential from an urban fringe area, Nanbu Community. The case study is located in the South Kashiwa.

Three main analysis is conducted in this study.

1. Study site selection: To identify a target area that potentially being affected by the compact city policy based on the government development plans; and to quantify the current available houses in the site for further analysis.

2. Housing analysis: To estimate the potential biomass generating from the waste wood of dismantled and newly-built houses in the study site. For simulating the prospective population changes, five housing development scenarios are designed and analyzed.

3. Energy analysis: To estimate the potential energy yielding from biomass energy system, in terms of electricity and heat generation; and to evaluate the potential cost recovery and $CO_2$ reduction by substituting fossil fuel with biomass.

The development plans of Kashiwa City were reviewed to show the expansion pattern of a city, specifically in the population density distribution over times. Then, the current house density was analyzed and mapped using the ArcGIS, a geographic information software. Nanbu Community was eventually selected as the case study area, as this urban fringe area was expected to reduce population density from 59 people per hectare to 31-40 people per hectare based on the Urban Promotion Area policy, promoted by the Kashiwa City government.

Based on the current available houses in the study area, five scenarios were designed to estimate the house density, number of newly-built houses, and dismantled houses, from the year 2010 to 2040: (Scenario 1) restriction of building new houses, (Scenario 2) housing expansion following current trend, (Scenario 3a, 3b, 3c) policy to achieved 31, 36, and 40 people per hectare, respectively.

Waste woods from new housing construction and housing dismantlement were quantified to estimate the potential biomass available for heat energy generation. Scenarios with higher housing density will have a higher energy potential. This study estimated the revenue that created from selling waste wood as biomass feedstocks. Also, the $CO_2$ reduction potential for each scenario was estimated.

For policy recommendation, to incentivize house owners to dismantle vacant houses, this study estimate a revenue potentially created from harvesting the waste woods. Benefit of $CO_2$ reduction was also converted to a monetary value. The total revenue, combining waste wood

revenue and $CO_2$ reduction benefits, was able to compensate around 6-8% of housing dismantlement fee depending on the scenarios. Therefore, a subsidy policy was possible to encourage old house dismantlement.

Vacant house can be converted into vacant lands for other purposes, if housing dismantlement is no longer a problem. In short, urban regeneration or redesign is possible, by utilizing the vacant lands appropriately, such as converting into parking lots or urban farmlands, would not just prevent the vacant house problems, but also improve the quality of life for the community.

*Key words*: Vacant house, Compact city policy, Biomass recovery, House dismantlement, Urban fringe area