

# HOW ABOUT A HOUSING AND TRANSPORTATION AFFORDABILITY INDEX IN GHANA? - A SYSTEMATIC REVIEW

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## Abstract

**Purpose** - Although the largest proportion of the household budget is spent on housing and transportation (H+T), housing affordability estimates in Ghana have over the years treated housing as a mutually exclusive expenditure, thereby excluding the effects of transportation costs. This can result in under-reporting of the household burden, which ultimately affects planning and policymaking. To curtail under-reporting, the H+T affordability index incorporates transportation costs into the assessment of housing affordability. However, the H+T affordability index is yet to be explored in the real estate literature from Ghana. This study contributes a novel discussion of the H+T affordability index and how it can be applied in Ghana.

**Approach** - Based on a systematic review of 9 peer-reviewed papers on the H+T affordability index, the main variables employed, the lessons, and policy implications have been discussed towards having a modified H+T affordability index that is suitable for Ghana.

**Findings** - Generally, the addition of transportation costs to the housing burden significantly changes the dynamics of the housing burden. Besides, the H+T Affordability Index relies on accessible secondary H+T economic data. In cities where there is a low proportion of renters, the owners' equivalent rent is used as the rental value. The main variables and methodologies employed in past studies have been discussed.

**Research implications** - Our research calls for researchers and real estate professionals in Ghana to consider developing robust housing, trip, spatial, and neighborhood databases to foster future H+T studies.

**Practical implications** - This study contributes insights that can enhance debates on the H+T

affordability index toward improved measurement tools for the household burden in Ghana.

**Originality/Value of work** - This study is the first attempt to discuss how the H+T affordability index can be applied in Ghana's housing market.

**Keywords** - Affordable housing; Affordable transportation; Transportation spending; H+T affordability index; Housing burden; Ghana

**Paper Type** – Research paper

## 1.0. Introduction

Housing and transportation (H+T) is the largest household expenditure and essential factor in urban planning and policymaking. The H+T costs play a major role in decisions regarding residential location and choice of transport. Due to rapid population growth and urban sprawl, it is imperative to have robust policies and plans to ensure affordable H+T in cities. Housing, being the biggest consumer of household income, is considered affordable if it falls below 30% of annual income —"(Nepal et al., 2010; Agrawal et al., 2020; Aljoufie & Tiwari, 2020). On the other hand, transportation spending, consisting of all travel costs on private car usage and public transport is the second-highest household expenditure and accounts for 12-15% of total household income (Ferdous et al., 2010; Guerra et al., 2018). Thus, the joint H+T burden is an important measure of the quality of life. It is also strongly associated with the Sustainable Development Goals 3 (*Good Health and Wellbeing*), 8 (*Decent Work and Economic Growth*), and 11 (*Sustainable Cities and Communities*).

Generally, affordable housing has been measured by treating housing costs as mutually exclusive, thereby excluding the impact of transportation costs (Boamah, 2010; United Nation-Habitat, 2011; Akingbohunge & Baba, 2014; Awanyo, & Attua, 2016; Asante et al., 2018). However, several studies have proven that housing and transportation have a strong relationship. The cost of housing declines as residents stay further away from the nucleus of the city (Mattingly & Morrissey, 2014) and the transportation costs tend to increase for the same residents (Currie et al., 2010). Rahman et al. (2021) found in Khulna (Bangladesh) that the exclusion of transportation attributes from residential housing rental models, reduced the model performance by 3.1%. In Semarang and Kendal (Indonesia), it was found that the most influential factors influencing the community's selection of subsidized houses were accessibility and choice of transportation modes (Indriyanti et al., 2020). In Tehran, Iran, it was found that the operation of a new metro station resulted in an average 3.7 percent

increase in the prices of adjacent properties (Yazdanifard et al., 2021).

Consequently, several studies have voiced the need to discuss housing affordability in tandem with transportation spending (Jewkes & Delgadillo, 2010; Mattingly & Morrissey, 2014; Hamidi & Ewing, 2015; Hamidi et al., 2016). The H+T has been premised on the basis that a house available for a lower price is not affordable in reality if it is located in an area with less accessibility, and if the transportation costs are higher. These findings emphasize the need to rethink housing affordability estimation by adding transportation costs. Accordingly, the H+T Affordability Index was developed by the United State of America's Center for Neighborhood Technology in 2006 (Haas et al., 2006) and improved in 2012 (CNT, 2012) to serve as a blueprint for measuring H+T.

The H+T spending is very critical in Ghana, where the household size is large (Beaman & Dillon, 2012), salaries are relatively lower than in other parts of the world, and transportation spending keeps increasing (Primrose & Christopher, 2018). Besides, the formal sector is smaller compared to the informal sector and minimum wages are relatively lower than in developed economies et al., 2021). These conditions make H+T spending burdensome, ultimately affecting the quality of life, happiness, and subjective wellbeing (Diaz Olvera et al., 2008; Venter & Behrens, 2005). Consequently, households are likely to make little savings, unable to meet other household needs, and have a low standard of living. It is imperative to add transportation costs to housing affordability estimates to give policymakers a better understanding of the housing burden in Ghana.

As far as we are concerned, the H+T affordability index is yet to be explored in Ghana. Considering the benefits that it can bring to both research and practice by giving reliable housing burden estimates, it is imperative to develop an H+T affordability index for Ghana by modifying its applications to fit the Ghanaian housing market. This will largely depend on scientific evidence, especially given the relative difficulty in accessing secondary data in Ghana as pertains to other regions (Berg et al., 2017; Diaz Olvera et al., 2008). A systematic literature review would enable researchers and practitioners to learn some lessons for onward debate and policy in Ghana (De Vos & El-Geneidy, 2022).

Therefore, this study is a systematic review of selected papers that have used the H+T affordability index. This systematic review is guided by the following research questions. (1) What are the main variables employed in previous studies, their strengths and weaknesses? (2) What are the lessons and policy implications that can be employed to modify an H+T affordability index in Ghana? The findings are expected to enhance debates on housing affordability estimation and strengthen policymaking in Ghana.

## 2.0. H+t Affordability Index

Ferdous et al. (2010) proposed the need to treat housing and transportation affordability together. Subsequently, the H+T Affordability Index, developed by the United State of America's Center for Neighborhood Technology, provides comprehensive coverage of affordability that includes variables related to the cost of housing and the cost of transportation at the neighborhood level (CNT, 2012). Then, Mattingly and Morrissey (2014) made a strong case for H+T in their study from Auckland, New Zealand. Hamidi and Ewing (2015) followed the advocacy through their study from the USA. This index came about after criticisms of the previous housing affordability indices that neglected transportation costs (Mattingly & Morrissey, 2014; Saberi et al., 2017). According to the index, H+T is affordable when it is not more than 45% of household income.

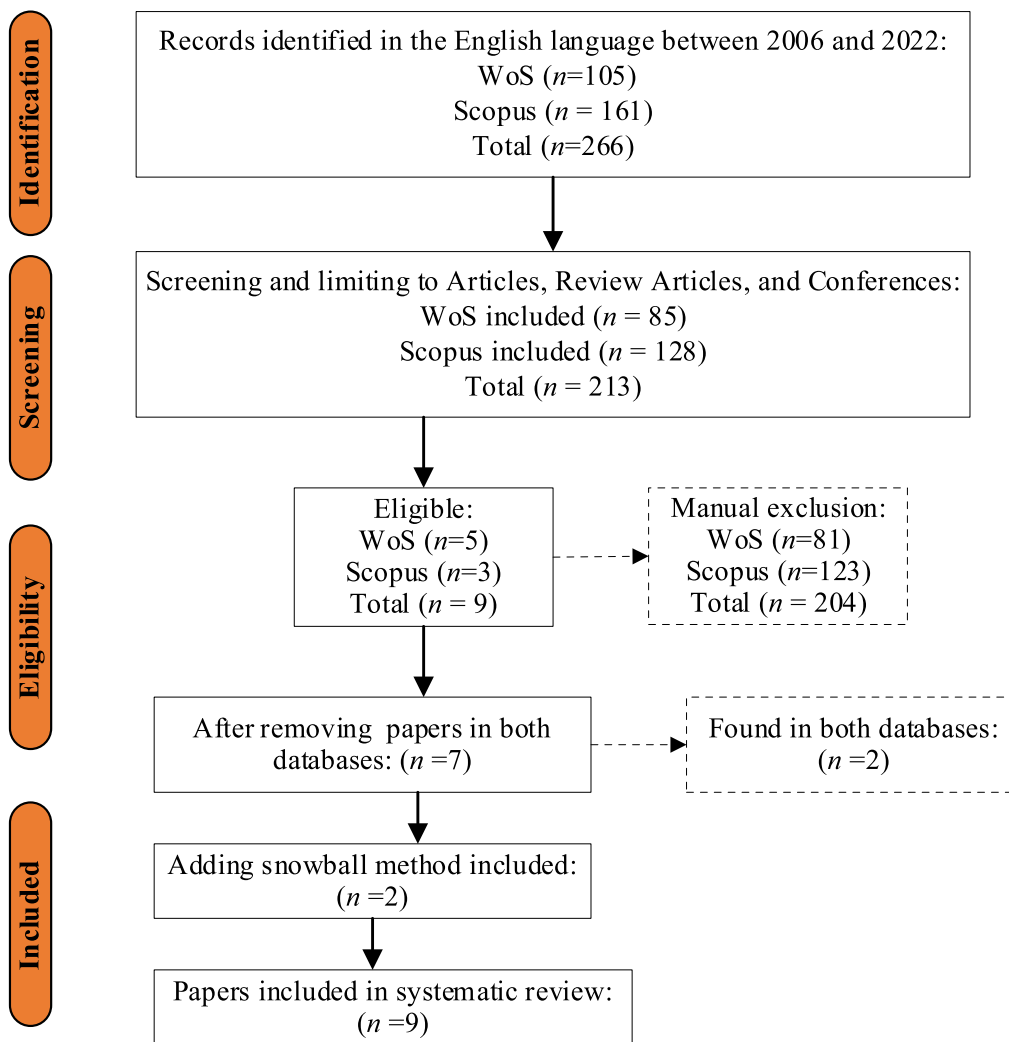
In Ghana, residents staying at the fringes rely more on private-owned transport services and paratransit. This results in increased travel costs, travel time, and trip distance. These factors ultimately affect the housing decisions of residents. Therefore, overlooking the cost of transportation and focusing on housing affordability can affect planning and policy-making. It is imperative to rethink housing affordability by adding transportation costs in Ghana.

## 3.0. Methodology

To put forward a policy agenda, we did a systematic literature review of previous H+T studies. The procedures and reporting for this study followed the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) guidelines (Moher et al., 2009). In the first step, paper inclusion and exclusion criteria were developed. The second step was paper identification in the Web of Science (WoS) and Scopus. All the top transportation and urban planning journals are indexed in these databases ""(Mongeon & Paul-Hus, 2016). Other databases such as Google Scholar and ProQuest were searched.

Selected papers met the following inclusion and exclusion criteria. The scope of the study was restricted to peer-reviewed Journal Articles, Review Articles, and Conference papers written in the English language. Selected papers had at least one of the following keywords in their titles: housing and transportation\*, housing and transportation spending\*, housing and transportation index\*, and housing and transportation affordability\*. Thus, papers merely covering housing burden, housing affordability, and housing rents without the transportation nexus were excluded. All selected papers explicitly included an H+T model, and not just

housing or transportation variables were estimated. In addition, papers were restricted to publications covering 2006 and 2022 because the development of H+T has evolved within this period. Paper identification was done in the WoS and Scopus using the search criteria as shown in Figure 1.



**Figure 1:** PRISMA flow chart for the data collection

After searching both WoS and Scopus, the datasets were retrieved in excel format followed by manual exclusion of duplicate papers. Overall, 9 papers were eligible but two duplicates were deleted giving an output of 7 papers. The snowball method was employed whereby the bibliographies of the selected papers were searched to find papers that met the selection criteria but were excluded ( $n=2$ ). Thus, the total number of selected papers was 9.

## 4.0. Results

### 4.1 Overview of selected papers

Table 1 gives an overview of the nine papers found in the data collection. Geographically, there were two papers from South America, Oceania, the Middle East, and North America, and one from the Asia Pacific. The data composition of studies was mainly household surveys, national census data, and secondary institutional data. Additionally, these H+T studies focused largely on large cities, indicating that the H+T burden is perceived to be more critical in these urban areas than in other smaller cities with relatively lower population sizes. The main methods used in case studies included modified H+T affordability indices, the global Moran's index, owners' equivalent rent model, interval data envelopment analysis, ordinary least squares, and the linear mixed-effects models.

Coulombel (2018) proposed a monocentric household utility maximization model which in addition to the H+T affordability estimation, compares the relationship between H+T and the welfare of households. It makes a bold assumption that all jobs are located in the Central Business District. Thus households commute to the CBD or the same neighborhood, and their commuting cost increases as they stay farther from the CBD. This is however yet to be tested with a case study dataset.

**Table 1:** Overview of H+T studies

Reference	Country	City	Method	Data (sample size)
Isalou <i>et al.</i> , 2014	Iran	Masoumyeh and Pardisan New Town, Qom	A simplified H+T affordability index	Household survey (900)
Mattingly and Morrissey, 2014	New Zealand	Auckland	The Combined H+T affordability index	New Zealand census and other open data sources
Saberi <i>et al.</i> , 2017	Australia	Melbourne	H+T Affordability Index	Open data sources
Acolin and Green, 2017	Brazil	São Paulo	Owners' Equivalent Rent (OER) Model	Annual population survey (8000) housing units
Guerra, 2018	Argentina	Greater Buenos Aires	Ordinary Least Squares (OLS)	Household travel survey (22,170)
Coulombel, 2018	United States of America	none	Proposed a household utility maximization model	No data was tested

## 4.2 Income, housing, and transportation variables

The first objective of this systematic review is to identify the main variables that studies have used to measure the joint H+T burden. The H+T affordability index assumes the simplified equation below. It simply adds the housing plus transportation costs of households (means or medians) as a percentage of the household income. To solve this model, the main sources of data identified are household surveys, census data (open source), and secondary institutional data.

$$H + T_{ai} = \left[ \frac{(HC+TC)}{I} \right] \times 100 \dots\dots\dots (1)$$

Where:  $H + T_{ai}$  is the housing and transportation Affordability Index,  $HC$  is monthly housing costs,  $TC$  is monthly transportation costs, and  $I$  is the monthly income.

Apart from one study (Mattingly & Morrissey, 2014) where the median monthly income was adopted, other studies used the mean monthly income based on sampled households. This was premised on the polycentric form of the studied city (Auckland) where the topography necessitated a division of the city into several land use and population density zones. When the city has several distinct cultural, spatial, and economic features, the median income is preferred to prevent biases.

From the simplified equation, the fulcrum of studies has been the valuation of the housing and transportation variables. Household-level data on monthly income is easy to obtain either by surveys or using secondary data. The following sub-sections give insights on the separate housing and transportation cost valuation based on the previous studies.

### 4.2.1 Housing cost valuations

The housing markets in different countries have dissimilarities and this is an important consideration in affordable housing estimates. In Iran where the majority of the population are renters, housing affordability was measured using monthly rental equivalents. Housing expenses including mortgage payments, maintenance costs, and taxes among others were scaled-up into monthly rent (Isalou et al., 2014). In Brazil, only 17.9% of the population were renters so house owners' expenses such as tenure, monthly rent, wall and roof maintenance, bathroom, electricity, water, sewage, and garbage collection were all valued to obtain a monthly rent equivalent (– Acolin & Green, 2017). However, this approach has some disadvantages. Researchers do not have the time and permits to vet all housing purchase agreements and mortgages to know the terms and conditions. The conditions regarding tenure, sewage, maintenance, garbage, and electricity bills may vary among the households

used in the studies. Thus, to use this approach, it is expected that researchers and practitioners make some reasonable assumptions and clustering to control for these variations.

To control for this, the majority of studies used the market rental values or the real rents that tenants pay monthly or annually other than using the owners' expenditures '(Mattingly & Morrissey, 2014; Saberi et al., 2017; Guerra et al., 2018; Aljoufie & Tiwari, 2020). This approach has also been criticized to have some subjectivity when data is solicited as a survey since the sincerity of respondents is not assured. Nonetheless, it makes valuation easier since the raw data can be run in models. Consequently, other studies used both the monthly rents of tenants and the owners' monthly rent equivalent '(Dewita et al., 2020; Schouten, 2021). Due to the disadvantages of both the real rents and the owners' rent equivalent, they can have separate models in the evaluation of affordability.

Thus generally, the housing affordability component of the H+T comprises variables such as homeownership status, mortgage repayments, rent payments, electricity, water, sanitation bills, maintenance costs, taxes, owner's equivalent rent, and average or median property prices. 'Dewita et al. (2020) emphasized the need to consider the residential density, distance from the city center, housing type (number of bedrooms), development type (self-owned or estate housing), and the type of tenure in estimating the housing costs. These findings show that the distinct spatial, neighborhood, and socio-economic characteristics of the Ghanaian cities would require consideration when adopting an H+T model in light of the unique characteristics of Ghana's real estate market.

#### **4.2.2 Transportation cost valuations**

The transportation cost estimates also have complex dissimilarities. Typically, residents are either owning a private vehicle or travel by public transport. Besides, there are different types of privately owned vehicles and public transport modes which have divergent maintenance costs and lorry fares. Thus, affordability may vary depending on vehicle ownership, type of vehicle ownership, exiting transport modes, and preferred transport modes. Affordable transportation is thus calculated based on specific assumptions and city contextualization. So far, all studies have included the costs borne by private vehicle owners and non-vehicle-owners but these were ultimately aggregated, hence the actual transportation burden of these two categories remains unrevealed. The solution for this is to have different models for these two categories. However, it should be noted that these would require extensive secondary data.

For private vehicle owners, the transportation variables commonly used include as average



number of vehicles per household, number of trips generated per day, trip distances, vehicle costs (fuel, parking, maintenance cost) per duration, tolls, and taxes. Regarding non-vehicle-owners, the common variables are public transportation zoning, transport fares for different transport modes, transport modal shares, trip distance, and the number of trips. In light of the effects that the purpose of a trip can have on modal choice, trips to work, school, shopping, recreation, and visiting friends may vary. Therefore, some housing surveys or censuses collected data about the purpose of trips (Isalou et al., 2014; Mattingly & Morrissey, 2014; Saberi et al., 2017).

## 5.0. Lessons and policy implications for the Ghanaian context

So far this review has covered papers published outside Ghana. However, the findings and lessons can lead to potential exploratory and empirical studies in Ghana and other African countries. Based on the review of variables and methodologies, this section discussed critical lessons and policy implications for real estate planners, managers, and researchers in Ghana.

It is evident from previous studies that both the housing and transportation components rely on secondary and spatial data. To assess the H+T affordability in Melbourne, Saberi *et al.* (2017) relied on several data sources including the Department of Transport, Planning and Local Infrastructure, Australian Prudential Regulatory Authority, and Public Transport Victoria. Even when surveys were used, some datasets such as trip distance and time, mortgage payments, and modal share were solicited from relevant institutions. For example, it requires GPS technology to ascertain the travel distances and trajectories of journeys in a neighborhood. Similarly, trip distance and costs would need documentation. In Brazil, large databases of survey data were also employed through annual household surveys (–Acolin & Green, 2017). This means besides the decade after decade housing census, annual state-funded data collection can help to build this proposed open-source databases which would be very useful. These are major issues to be considered in Ghana where secondary open-source data is scarce, difficult to obtain, and sometimes unavailable (Ajayi et al., 2021; Yanocha, Mason & Hagen, 2021). At the moment the majority of affordable housing studies from Ghana have relied on surveys that lack these datasets. Although these are valid approaches future studies can be enriched with institutional income, housing, and transportation data. Therefore, to adopt a modified H+T in Ghana, research institutions must make efforts at creating open-source databases to support researchers and practitioners. Databases are the engine room for quantitative evaluations and impactful policies.

The housing market in Ghana is dominated by the private sector. Consequently, several transaction and tenancy agreements may go undocumented. It is imperative to track housing rentals, purchase transactions, and other expenses which are important for housing affordability estimates. –Gavu (2018) found that electricity and pipe water connections were among the top five determinants of residential rental values in Accra. These variables were considered in previous H+T studies "– (Isalou et al., 2014; Acolin & Green, 2017; Aljoufie & Tiwari, 2020; Dewita et al., 2020), however, they are difficult to ascertain in household studies in Ghana due to scarce secondary documentation. They are only available to researchers and planners when residents willingly provide them.

Similarly, the multi-modal transport sector mixed with formal and informal transport modes is dominated by private operators. The challenge to transportation planners has always been how to get data from the private sector. Complexities arise when there are different transport modes and inconsistent demand trajectories among commuters. It is easier to track the weekly transportation spending of a household if they travel by the same transport modes than when they change regularly or travel by the available transport modes. Also, it is easier to track transportation spending when mass rapid transit is in high supply because transport fares are stable and subsidized by the state. However, several commuters who are non-vehicle-owners travel by the available mode of transport, hence it is difficult to measure the affordability in light of different transport fares for the multi-modal transport (Alimo et al., 2022). This is even worst in sub-Saharan Africa where informal transport modes such as motorcycle taxis and paratransit are prevalent since their prices are unregulated (Ehebrecht et al., 2018). Research institutions and planners must find ways to document the H+T spending to enhance affordability estimation.

The above discussions focused on data sourcing and documentation but another important factor to consider in the Ghanaian context is the polycentric nature of cities. The polycentric model assumes that commuters do not only travel to the Central Business District (CBD) and all offices are not in the centroid. This deviates from the largely used monocentric model where all workers commute to the CBD and their trip distances and costs may be similar. Considering the large informal sector and street activities in Ghana, the polycentric model needs to be considered along with the monocentric models. That is the topography and zoning plans need to be considered in future H+T studies so that there can be clustered analysis for a better understanding of the H+T burden in Ghana. This means median rental, transport, and income values can be used as applied in Auckland (Mattingly & Morrissey, 2014).

To guide future research, it is worth noting some important variables that case studies in Ghana can consider in light of the limitations of the Ghana housing and transportation market. Given the large informal market where incomes are elastic and usually undocumented, the monthly or annual income can be obtained through surveys. Regarding the housing market, several factors need to be considered. Ghana's housing supply is driven by the private sector rather than real estate developers or the government. This means the chances of cross-subsidy between housing and transport are low amidst difficult rent control. House ownership accounts for 47.2% of the supply market, residential renting forms 31.1%, and rent-free occupants 20.8% (Ehwi et al., 2021). These suggest that a mix of rentals and owners' equivalent rent would be required to predict the housing cost component of the H+T costs. However, these depend on the composition of the households in the city or neighborhood in question. Other variables to be considered are mortgage repayments, electricity, water, sanitation bills, maintenance costs, taxes, residential density, distance from the city center, number of bedrooms, development type, and housing tenure.

Regarding transportation costs, it is preferable to separate private-vehicle owners from non-vehicle-owners. For private vehicle owners, the transportation variables may include the average number of vehicles per household, number of trips generated per day, trip distances, costs of fuel, parking, maintenance costs, and location of the workplace. The transportation costs of non-vehicle-owners may comprise the price and preferred or available transport modes over the same trip distance for all sampled households, trip distance, the number of trips per day, the purpose of trips, and the level of congestion in the city (an ordinal scale). It may also be prudent to consider the weather conditions in the city. For instance, on rainy days, taxi fares are abnormally higher than normal days, especially when commuters have to do roadside ride-hailing otherwise known as “dropping”. Perhaps, one approach to ensure fair representation of these different types of commuters is to focus on one type for each study. However, in segregating, their housing variables or characteristics need to be similar. For instance, the model would be wrong if the sample for the transportation coefficients is different from that of housing.

## 6.0. Conclusion

This paper reviewed 9 peer-reviewed papers covering the application of the H+T affordability index. It also discussed how the lessons learned can be applied to create a modified H+T affordability index in Ghana, and enhance housing policy and planning. As a novel topic in the Ghanaian context, the variables used in past studies, their strengths and weaknesses as well as the relevant systems required to make their application plausible have been discussed.

The review showed that to adapt a modified H+T Affordability index in Ghana, it is important to build open-source H+T datasets and draft policies that will help planners to track and document transactions in the current private-sector-dominated H+T market. Additionally, the topography and zoning plans should be considered in future H+T studies due to the polycentric developments in some Ghanaian cities. It is evident in all studies reviewed, that the addition of the transportation burden to housing affordability estimates gives a different perspective on the household burden and dipper understanding to guide policymaking. The authors are hopeful that this study can lead to more empirical investigations of H+T affordability in Ghanaian and African cities at large and be incorporated into housing and transportation policies.

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