

# Zero-Discharge Economy: A New Approach for Environmental Protection and Sustainable Development in Vietnam and A Case Study in Nguyen Khoi farm, Phu Tho province, Vietnam

The Ha CAO<sup>1</sup>, Ngoc Duy VU<sup>1</sup>, Thị An Hang NGUYEN<sup>2</sup>, Van Chieu LE<sup>1</sup>,  
Luong Quyet NGUYEN<sup>3</sup>, Phuong Thao NGUYEN<sup>3</sup>, Thi Viet Ha TRAN<sup>2</sup>, Trung Hieu DANG<sup>1</sup>, The Anh CAO<sup>4</sup>

<sup>1</sup>VNU University of Science, Hanoi, Vietnam

<sup>2</sup>VNU Vietnam Japan University, Hanoi, Vietnam

<sup>3</sup>Nguyen Khoi Farm, Phu Tho, Vietnam

<sup>4</sup>KU Leuven, Flanders, Belgium

## INTRODUCTION

On its pathway to become a modern industrialized country, Vietnam has to face to many challenges, including environmental pollution and climate change. The traditional approach to solve environmental pollution is costly, and waste of resources. This paper introduces a new approach for environmental protection and sustainable development from Europe, which relies on the “circular economy”. In addition, based on the experience of European countries, the potential to recover energy and fertilizer by co-digestion of organic matter in municipal/industrial wastewater and solid/kitchen waste is estimated, Finally, the “zero-waste” piggery breeding model in Nguyen Khoi farm, Phu Tho province, Vietnam is introduced to demonstrate the economic and environmental impacts of the model at the household level.

## OBJECTIVES

Introducing the “Circular economy” model.

Evaluating the fertilizer and energy recovery potential in Vietnam when organic matter of municipal/ industrial wastewater and municipal solid/ kitchen wastes are co-digested.

Estimating the economic and environmental impacts of the “zero-waste” piggery breeding model, an example of “Circular economy” at the household level.

## RESEARCH METHODS

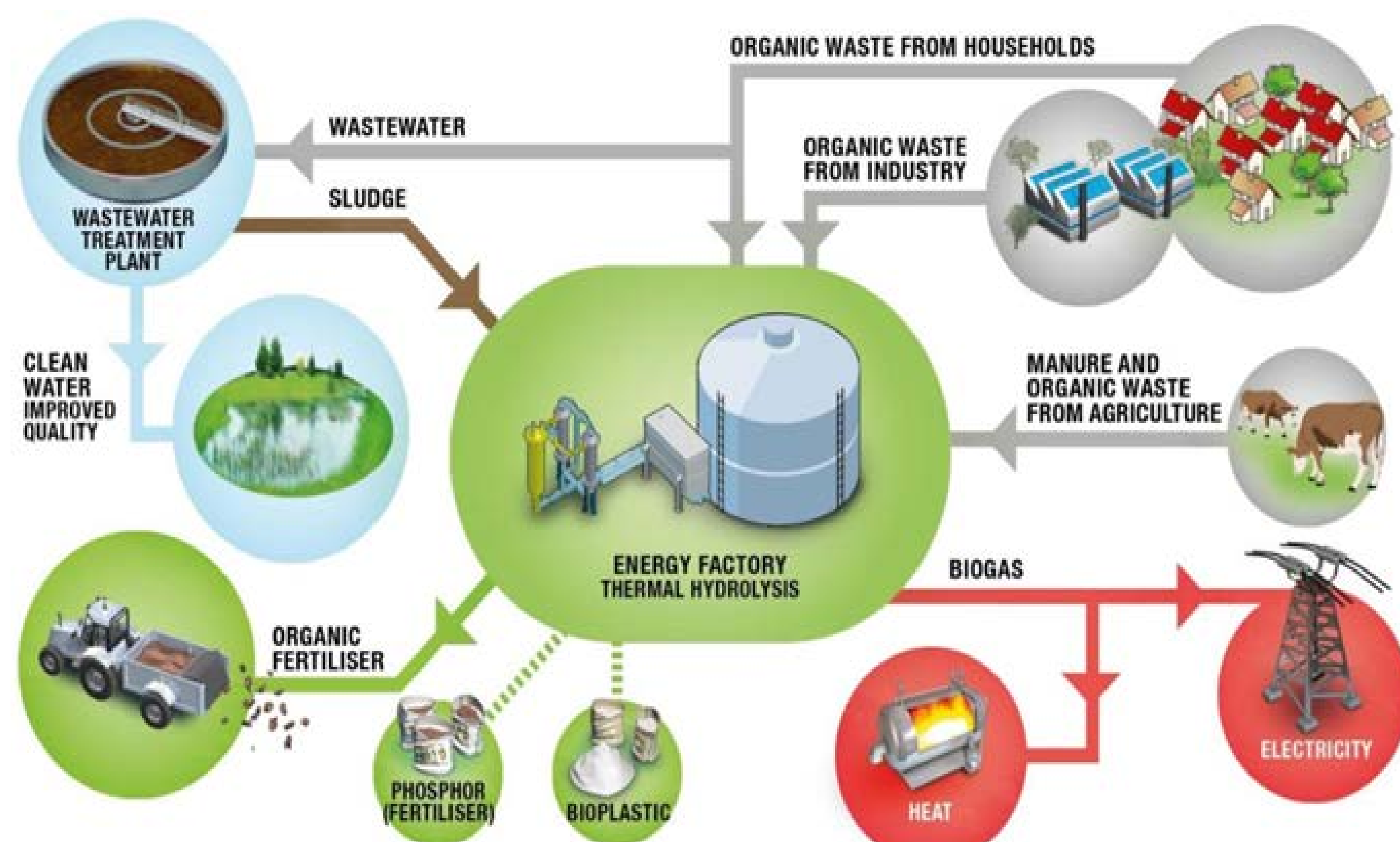
Literature review is used to collect information about the “Circular economy” model.

The experience-based calculation is applied to estimate the energy and fertilizer recovery potential in Vietnam.

The case study is utilized to prove the applicability of the model at the household level in Vietnam.

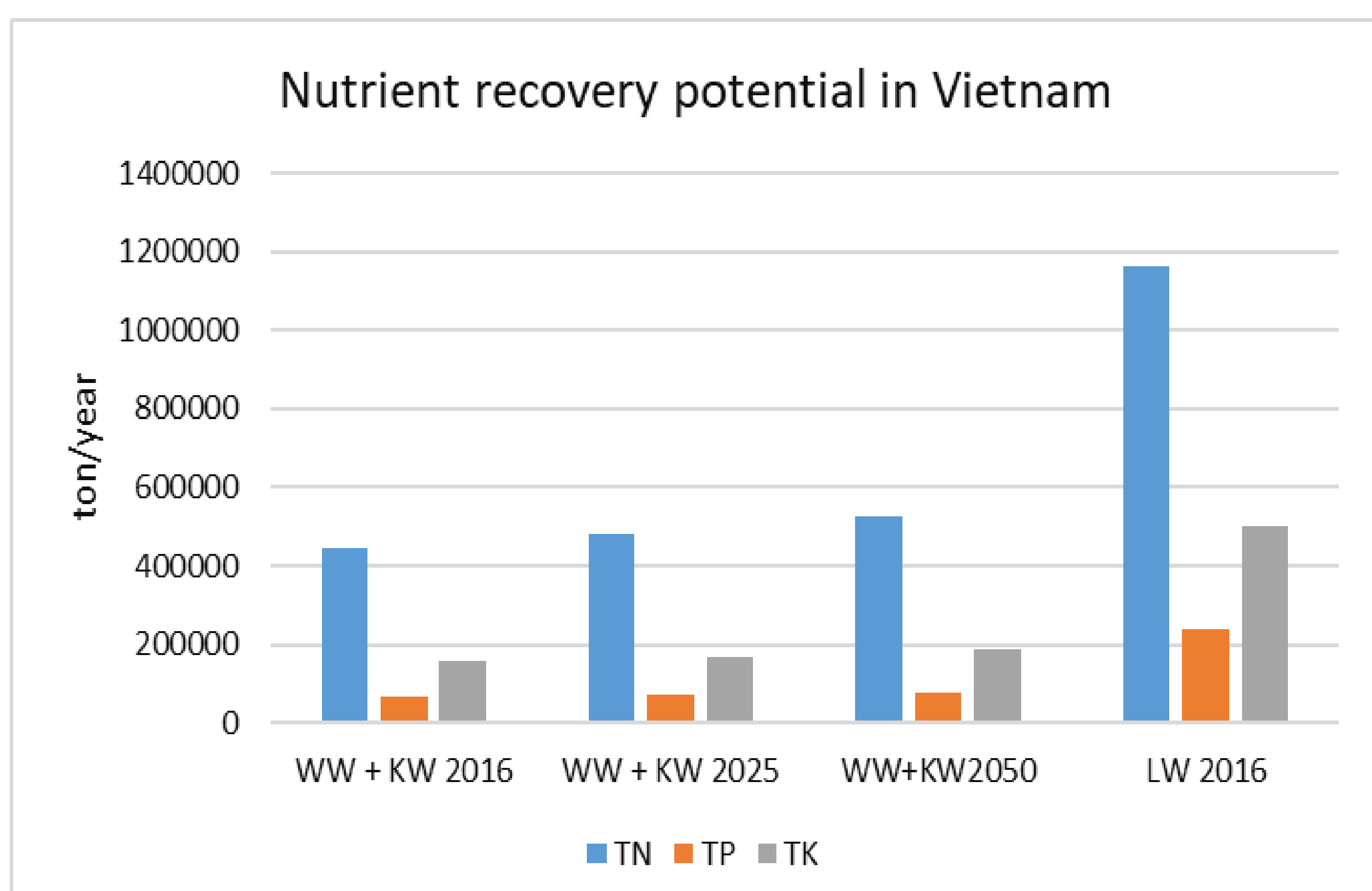
## RESEARCH RESULTS

### “Circular economy” model in Europe



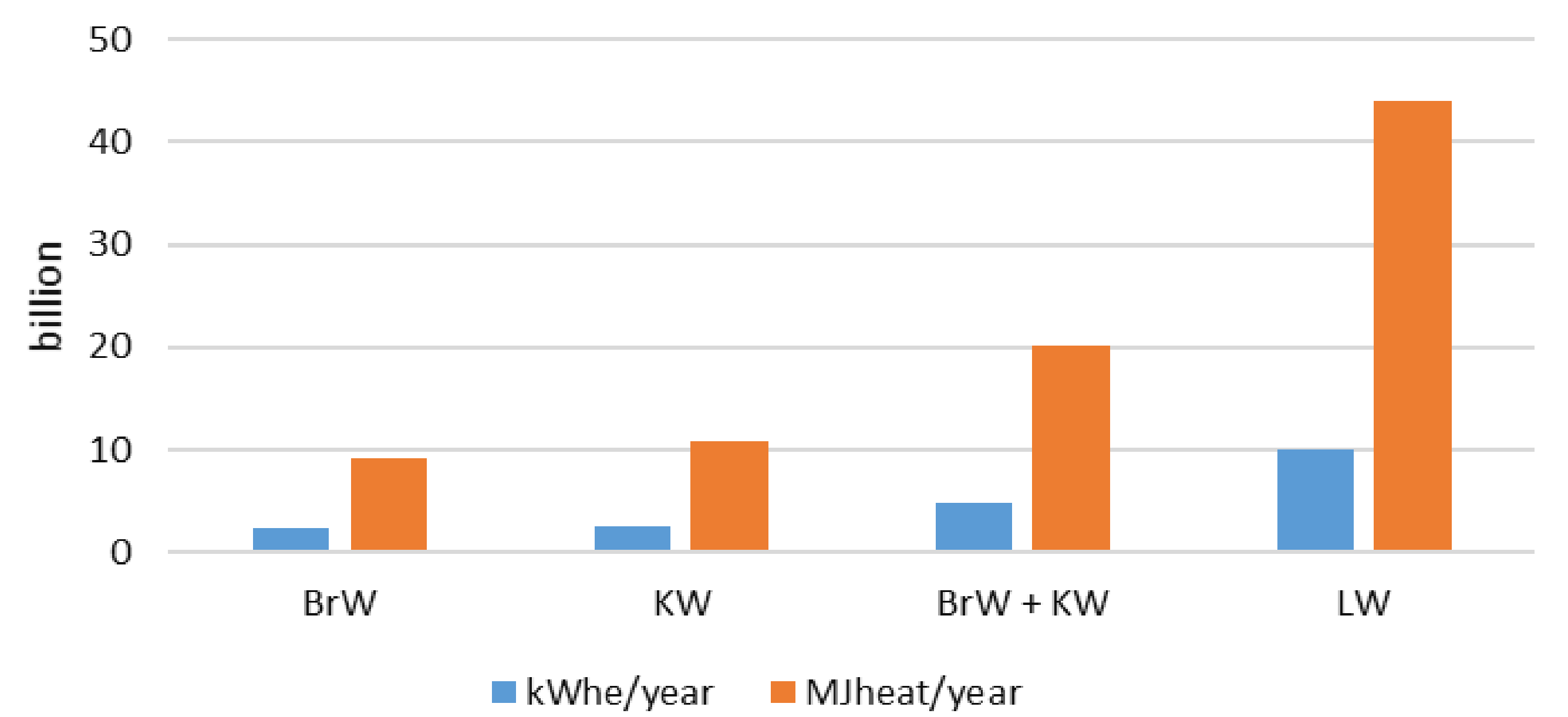
The “Recycling City” model, in which the city is integrated with “Zero waste agriculture” - Billund Bio Refinery Plant

### Fertilizer and energy recovery potential in Vietnam



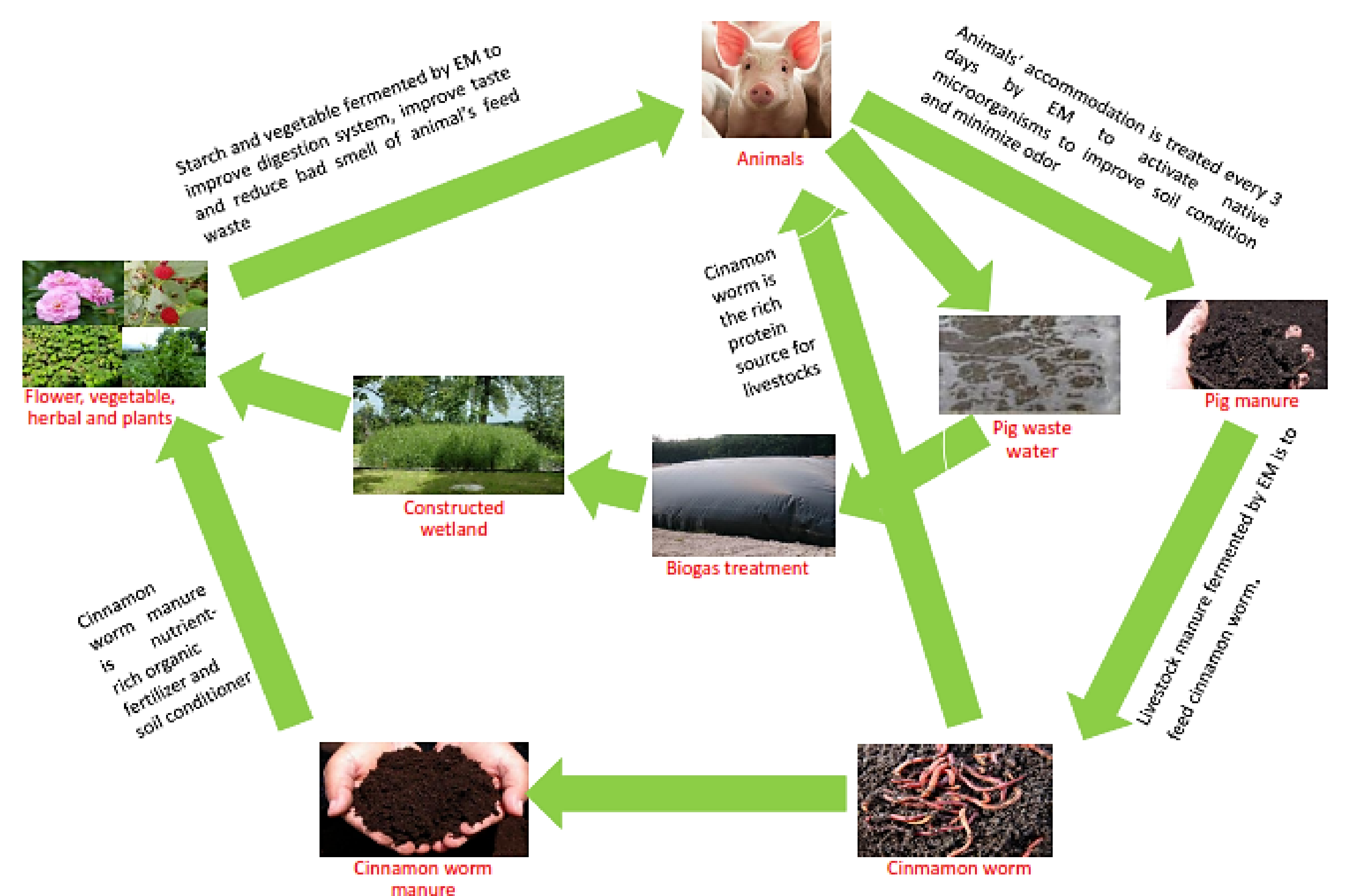
Note: TN-VN2016= total N of Vietnam in 2016; TN-U2016= Vietnam Urban in 2016; TN = total N; TP = total P; TK = total K; WW+ KW: Wastewater + kitchen waste; LW: livestock waste.

### The Vietnam potential of energy recovery in the form of electricity and heat in 2016



Note: BrW = brown water; KW = kitchen waste; LW = livestock waste

### “Zero-waste” piggery breeding model in Nguyen Khoi farm, Phu Tho province, Vietnam



#### Environmental values:

Total weight of treated pig manure: 132.313 kg/year

Total volume of treated wastewater: 1.332.250 L/year

Total weight of produced cinnamon worm manure: 79.388 kg/year ~ 430 kg chemical fertilizer

#### Economic values:

Cinnamon worm production: 43,5 million VND

Cinnamon worm faeces: 198,5 million VND

Total 242 million VND

## CONCLUSION & RECOMMENDATION

“Circular economy” is a development model, which has been successfully applied in Europe. Once applied in Vietnam, the model can help to reduce the heavy load of organic solid waste and wastewater on the environment. It also provides a chance to recover existing resources (e.g. C, N, P, K, energy, etc.) in solid waste and wastewater. The potential of recovery of fertilizer and energy by co-digestion of organic matter of municipal/ industrial wastewater and municipal solid/ kitchen wastes in Vietnam is significant. Due to its environmental and economic benefits, “Circular economy” can be considered as a new approach for environmental protection and sustainable development in Vietnam. In order to realize this model in Vietnam, a comprehensive change is necessary, from policies to actions, especially the way of thinking.

## CONTACTS

Corresponding author: Assoc. Prof. Cao The Ha,

#### Affiliations:

Master's Program in Environmental Engineering (MEE), VNU Vietnam Japan University (VJU)  
Centre for Environmental Technology and Sustainable Development (CETASD), VNU University of Science (HUS)

Email: [caotheha@gmail.com](mailto:caotheha@gmail.com) Mobile phone: (+84) 904189510