# Water-Reuse concepts for industrial parks in South-East-Asia


***A.Dell*, J.Fischer**, J.Behnisch***, S.Bauer*, M. Wagner*** and H.J. Linke ****

** Department of Landmanagement, TU Darmstadt, Germany*
*(E-mail: dell@geod.tu-Darmstadt.de; linke@geod.tu-Darmstadt.de)*
*** Department of Material Flow Management and Resource Economy, TU Darmstadt, Germany*
**** Department of Wastewater Technology, TU Darmstadt, Germany*


## Introduction

*Figure 1: Urbanization of Shanghai, China (Source: own photo)*

Including their megacities and urban areas, South East Asia is belonging to the **world's fastest-growing regions**. Such tendencies of urbanization also have a huge influence on new or on the expansion of industrial parks. Referring to water shortage and pollution as well as the increasing environmental awareness in several of these regions (e.g. in China and Vietnam) a sustainable water management is becoming more and more important.

Therefore, the development of new water reuse concepts for industrial parks to reduce their high water consumption from natural resources is an important approach to realize urbanizations. The research approach develops an Industrial **WasteWater Management Concept with a focus on Reuse (IW²MC→R)** including a sustainable treatment of wastewater as well as the reuse of water for different purposes. The IW²MC→R is aimed at an industrial reuse-factor (IRF, reuse water flow/whole water consumption) as high as possible and therefore, it could have a high application potential in water-stressed regions.

## Results & Discussion

Proceeding from the situation in Germany, where the word »industrial park« is mainly linked to historically developed pure chemical industrial parks and the water-stress level is comparatively low, a first result for the investigations in China and Vietnam is that **parks with mixed industries** are much more common than pure parks. In addition, whereas in Germany the focus is mainly on the development of existing industrial parks, these countries are particularly more dynamic in creating new ones. Due to the **unbalanced distribution of natural water resources and the partly high pollution rates of waterbodies**, water shortage is much more severe in these countries, too. Table 1 gives an overview of additional observed differences between the three countries.

| | Germany | China | Vietnam |
|---|---|---|---|
| **Park size** | Ø 340 ha | Ø 4.500 ha | Ø 330 ha |
| **Park types** | usually historically grown chemical parks | trend towards »theme parks« e.g. chemical parks | mixed parks (light industry) |
| **Water supply** | different, usually 3 different quality types (sometimes up to 9) | usually 3 different quality types (drinking-, industrial- und deionized-water) | just one quality (domestic water ≠ drinking water) |
| **Central wastewater treatment plants** | treatment techniques usually highly individualized (historically grown), common to treat municipal wastewater as well | different – eye-catching separate treatment lines for different wastewater qualities in one park | very similar - given standard: waste water qualities A and B |
| **Pipe system** | above-ground pressure pipelines as well as underground pipelines | usually above-ground pressure pipelines | mainly underground pipelines |
| **Water-Reuse** | no comprehensive reuse standard available - internal water circuits close to the process usually available, can be expanded across companies | reuse standard available, but so far only isolated implementations in the industrial sector | no comprehensive reuse standard available - but interest exists and measures already implemented on a small scale |

*Table 1: Differences between industrial parks in Germany, China and Vietnam (Source: own figure)*

After the investigations in the three countries two different initial situations of the water management in industrial parks (figure 3) could be identified, which are the baseline for this research. Here, it is obvious that the application of **cross-company reuse-water is not usual**. The main difference between the two initial situations is the **layout of the pipe system**. Situation 1 has just one collective wastewater sewer, whereas situation 2 has one sewer for each production plant. The innovative IW²MC→R, which is also consisting of two different approaches (see figure 3), ties in with the two initial situations, but enables the **supply of reuse water through a water-reuse plant (WRP).** In the WRP, the water is treated additionally in different

## Methodology

To identify and generate new water-reuse opportunities within industrial parks and to examine the initial situations especially in regions with natural water shortage literature and case study analyses as well as expert interviews have been conducted in **Germany, China and Vietnam**. The idea behind was to learn from the existing industrial parks for new ones, which are the focus of this approach.

*Figure 2: Visit of different central wastewater treatment plants of industrial parks in China (Source: own photo)*

The case studies comprised in particular on-site visits as well as interviews with the managing and technical experts from the water supply and wastewater units (e.g. see figure 2). The following three topics were decisive: **actual water supply situation, actual wastewater system and possibilities of water-reuse**.
The results served as a basis for the development and adaptation of a new integrated water-reuse concept for industrial parks.

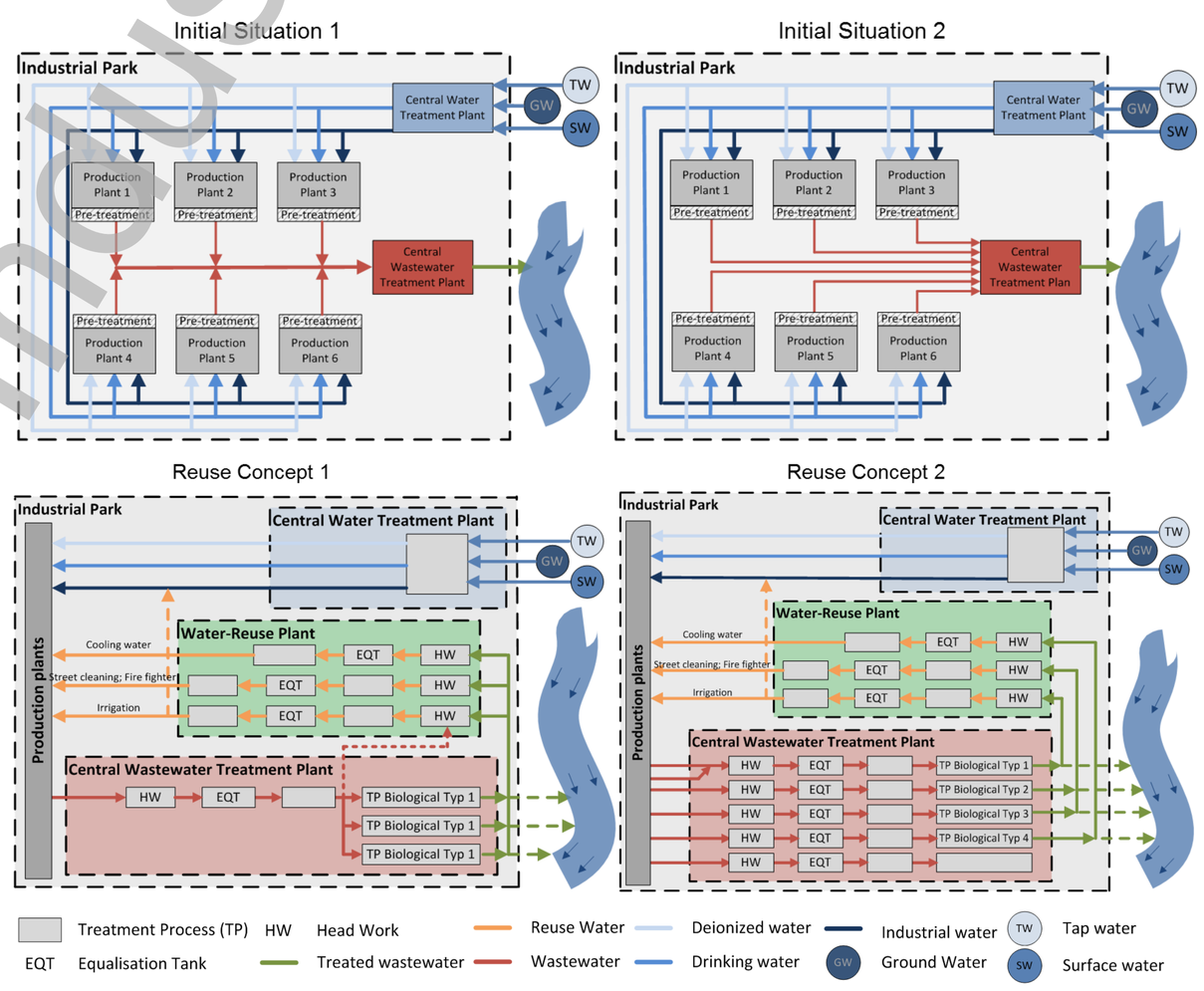


*Figure 3: Initial situations of water management in industrial parks and two different reuse concepts (Source: own figure)*

lines according to its subsequent use and to the **principle »fit for purpose«,** e.g. for irrigation, street cleaning or toilet flushing. E.g. in Chinese industrial parks especially water for irrigation and street cleaning has a high relevance, due to governmental regulations for green spaces which have to take up more than 20% of the park area and to prescribed street cleaning work tours (2-3 per day) with a water demand of 1-4.5L/m²*d (GB 50282-1998).
In order to initiate an integrated water reuse system in industrial parks, it is a main task to identify the qualities of existing water flows as well as suitable treatment technologies for linking those flows. By **using a model industrial park (MIP)** as a first step, this approach enables the calculation of water input and output qualities and quantities as well as the possibility of modifying production types.

## Conclusions

The approach points out that two different concepts of an integrated water management for industrial parks (IW²MC→R) are conceivable referring to different initial situations. Such innovative water management systems have nowadays a very high application potential for fast growing and water-stressed regions, whereas the current water situation in industrial parks makes it rarely possible to develop and maintain such sites. The **reduction of the water consumption from natural resources by the highest possible reuse-factor in the park** is thereby the main aspect. Further research is being conducted within the framework of the project **WaReIp (www.wareip.de).**


SPONSORED BY THE
Federal Ministry of Education and Research
PTKA Projektträger Karlsruhe im Karlsruher Institut für Technologie

The authors would like to express appreciation for the support of the sponsors: