Water-Reuse in Industrieparks

工业园区的水资源再生利用

WaReIp

NaWaM WavE

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Bundesministerium für Bildung und Forschung

TECHNISCHE UNIVERSITÄT DARMSTADT

German Water Partnership

Modern water and wastewater technologies for urban areas and industrial parks – the German experience

Water-reuse concepts for industrial Parks

Funded by the **Federal Ministry of Education and Research (BMBF)**

政府支持：德国联邦教育及研究部

Duration: October 2016 – September 2019

项目时间：2016年10月 - 2019年9月

Introduction
介绍

- **South East Asia** belongs to the world's **fastest-growing regions**
- **urbanization** has a huge influence on new or on the expansion of **industrial park (IP) locations**
- In times of **climate change**, **shortage of resources** and the increasing importance of **environmentalism** it is important to **ensure a <u>sustainable water supply</u>**
- IPs usually rely on the **availability of water**

Introduction
介绍

Sustainable water management and water reuse concepts for IP's are becoming more and more important

- **demand** for **water** from **natural resources** can be **reduced**
- **valuable materials recovered** from the wastewater
- **costs** can be **reduced** (investment/running)

→ opportunity for **industrial developments** in regions with natural **water shortage** (e.g. in parts of South-East-Asia)

→ application potential for **chemical-pharmaceutical industry** is given due to their high water requirements/high amounts of wastewater

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Introduction
介绍

Industrial **W**aste**W**ater **M**anagement **C**oncept with a focus on **R**euse: **IW²MC→R**

- includes a sustainable **treatment** of **wastewater in IP**
- **Providing reuse-water** for different purposes

→ Reduction water demand from natural resources

Objective: highest possible **industrial reuse-factor (IRF):** based on reuse water flow / whole water consumption

→ High application potential for IP in water-stressed regions (e.g. Western parts of China)

Possible application of treated wastewater as…
再生水用途

Process water
工艺用水

Cooling water
冷却用水

Toilet flushing
厕所冲洗用水

Irrigation water
灌溉用水

Fire-fighting water
消防用水

Water for road cleaning
街道清洁用水

…etc.
…等

Introduction
介绍

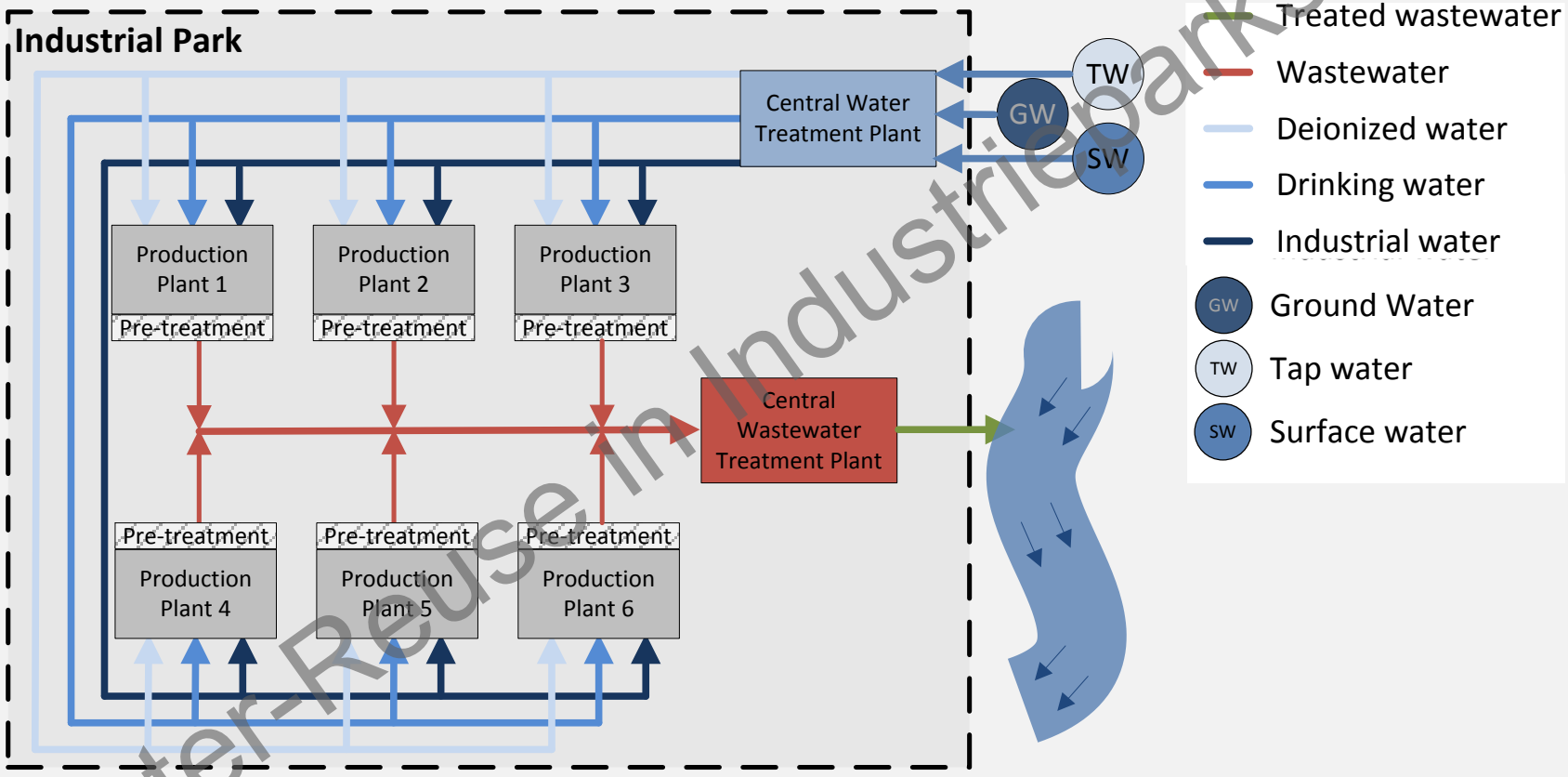
Development of IW²MC→R

Objective: Calculation of the highest possible **industrial reuse-factor (IRF)**

- **Investigations** in Germany, China and Vietnam (conducted 2017)
  - → The idea was to learn from the existing industrial parks for new ones
  - → three topics were decisive: actual water supply situation, actual waste water system and possibilities of water-reuse
  - → **2 initial situations** in industrial parks

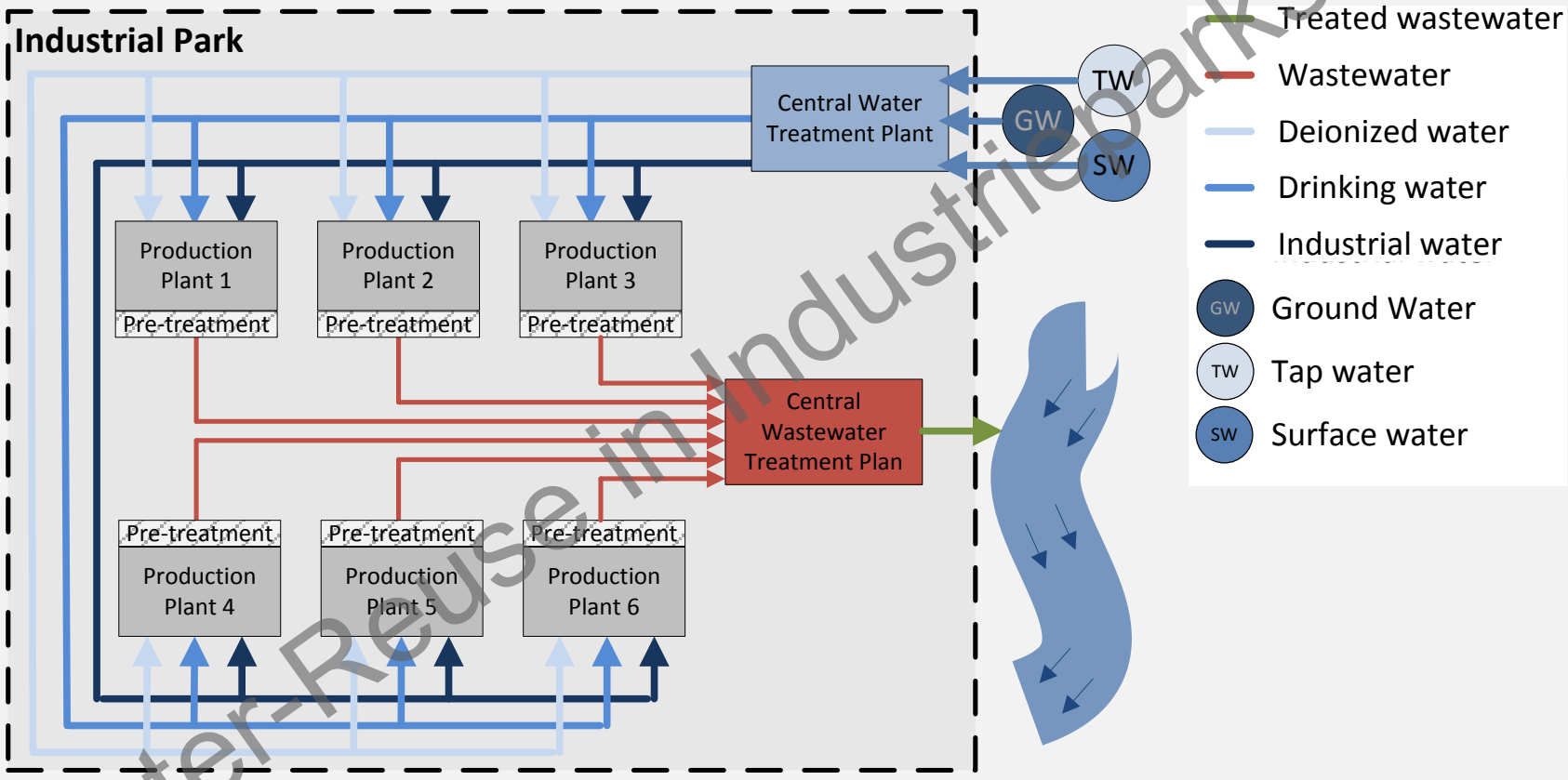
Initial situation
现状

Situation 1 (Germany, Vietnam, China)

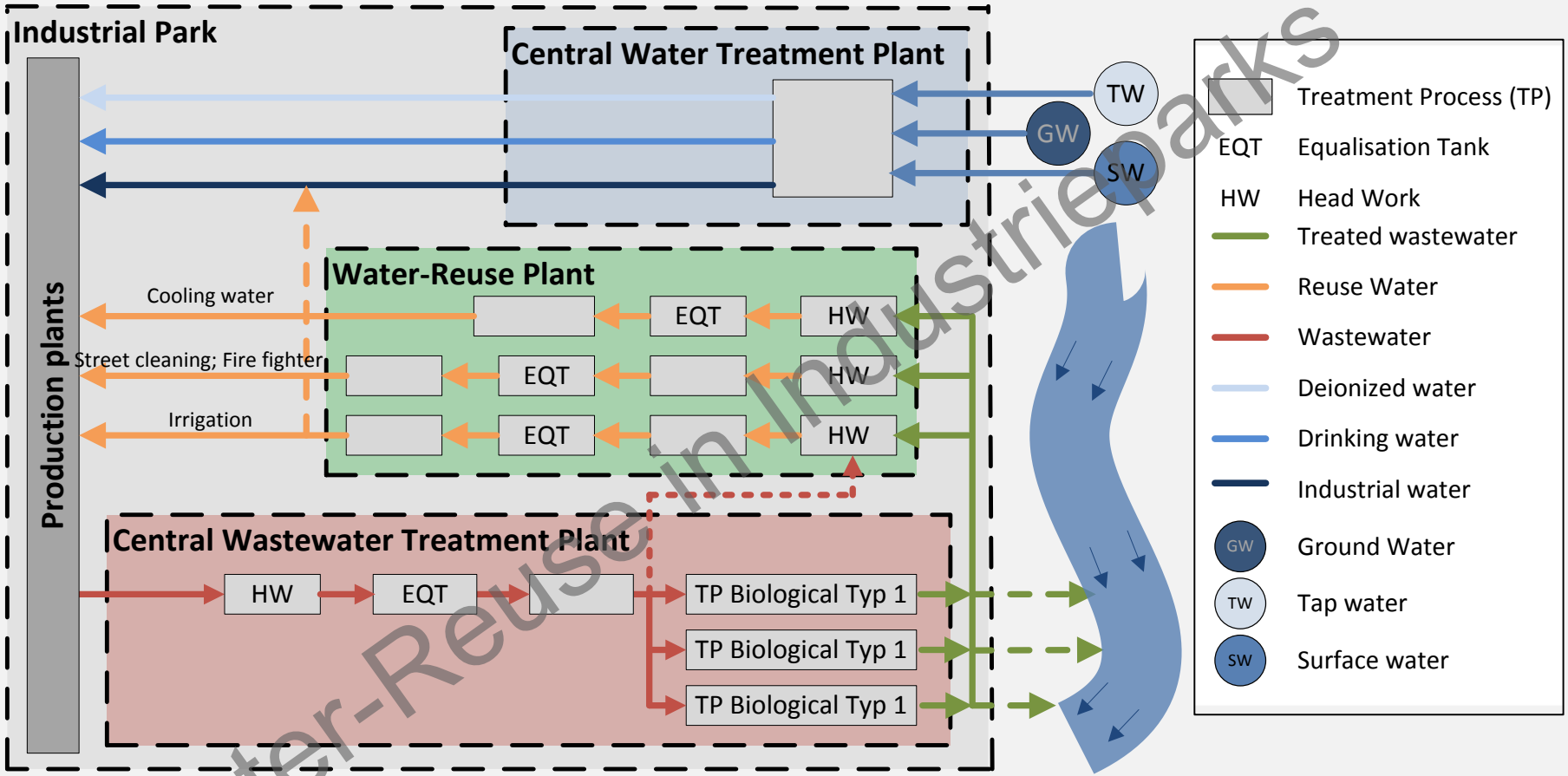


Initial situation
现状

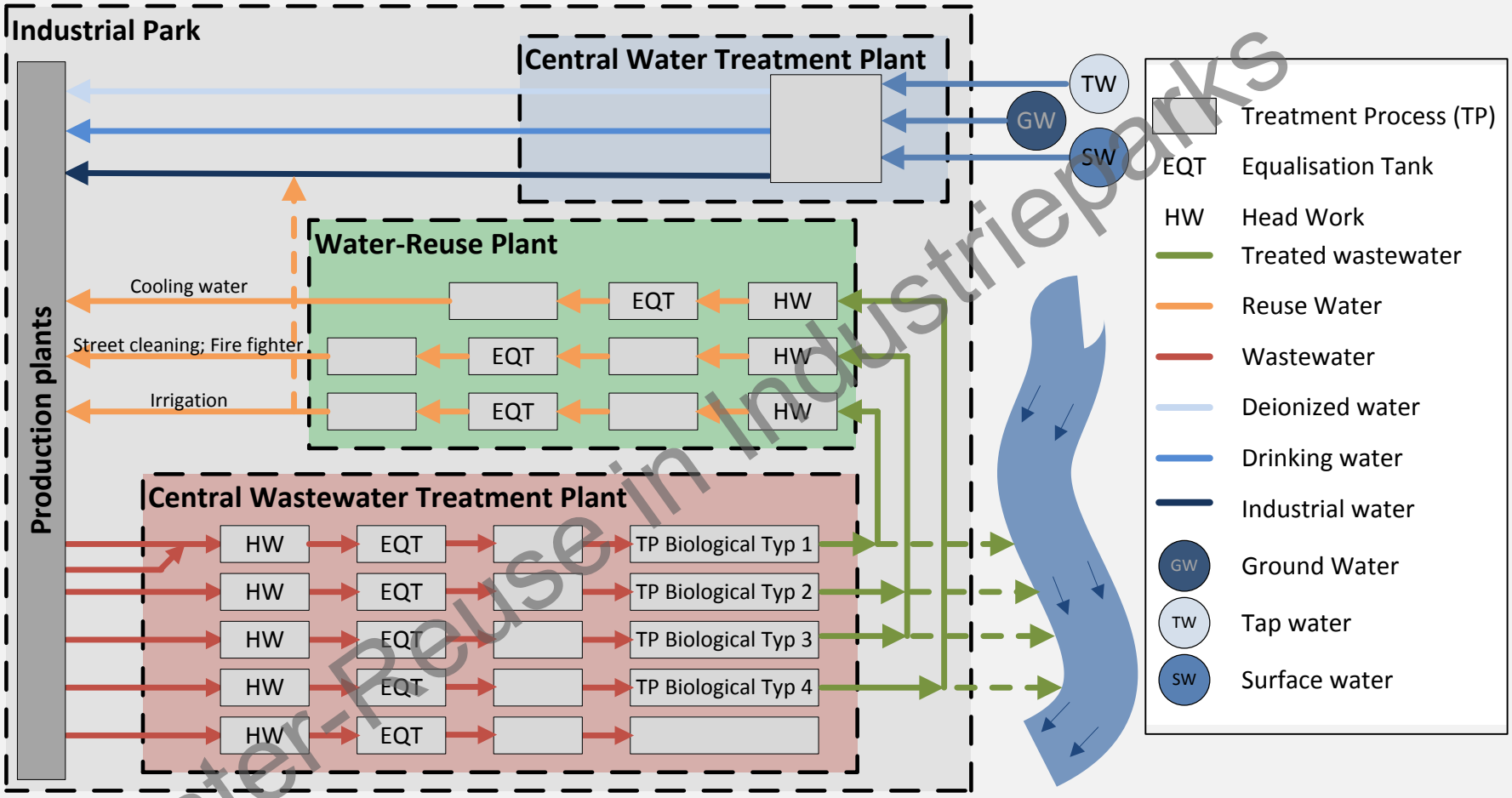
Situation 2 (China)



Reuse-Concept 1



Reuse-Concept 2



Identification of appropriate treatment technologies
合适的处理技术

… for linking existing water flows
污水与水源的联系

	Reuse-Water-Quality A 水源质量 A	Reuse-Water-Quality B 水源质量 B	Reuse-Water-Quality C 水源质量 C
Wastewater Quality A 污水质量 A	Treatment Technology X/ Treatment Technology Z 技术 X / 技术 Z	Tech. X 技术 X	Tech. X / Tech. Y / Tech. Z 技术 X / 技术 Y / 技术 Z
Wastewater Quality B 污水质量 B	Low development need 低处理需求	No technical solution identifiable 没有技术处理办法	Economic solution is not known 没有经济处理办法
Wastewater Quality C 污水质量 C	Low development need 低处理需求	High development need 低处理需求	Tech. X + Tech. Y 技术 X + 技术 Y

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Practical experiments
实际测试

- Development of new treatment technologies
  污水处理新技术的研究
- Tests with real wastewater
  使用真实污水进行测试

Wastewater lab EnviroChemie
试点：Enviro化学公司

Test column
实验柱

Laboratory pilot plants (activated sludge process with salt water)
TU Darmstadt
达姆工大的实验室净水装置

Calculation: Industrial Reuse-Factor (IRF):

Industrial reuse-factor (IRF): based on reuse water flow / whole water consumption

Model Industrial Park (MIP): depending on a case study in CHINA

→ Calculation of different **average values** of **investigated parks** to the size of **6 production plants/companies**

→ **Indicators** to calculate the **Reuse-water flow**

- parks size (6 Production plants)
- size of **green spaces** → reuse-water demand for **Irrigation**
- size of **road spaces** → reuse-water demand for **street cleaning**
- number of **Employees** → reuse-water demand for **sanitary water** (e.g. toilet flushing)

→ Calculation of **whole water consumption**

- Amounts of waste water of 6 exemplary production plants/processes

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Calculation: Industrial Reuse-Factor (IRF):

Case study CHINA – 6 Prod. Plants

Park size	279 ha
Green spaces	22% = 60 ha
Road spaces	9% = 24,4 ha
Employees	18.366

Green spaces in Industrials Parks:
China: min. 20 % → Governmental regulations

Water demand:

for irrigation	Irrigation of public greens	**1,5-4 l / m²*d**	*GB 50282-1998, China*
for street cleaning	Street cleaning, China: *2-3 work tours per day*	**1-4,5 l / m²*d**	*GB 50282-1998, China*
sanitary water	Mixed industrial areas	**50 l / Empl./*d**	*DVGW-Regelwerk Arbeitsblatt W 410*
Fire fighting water	Depends on the existing system		
Cooling water	Depends on the existing system		
Process water	Depending on the production plant		

First calculation for MIP China (6 PP)

Calculation of the requirements of reuse water:

▪ irrigation:	1.650 m³/d
▪ Street cleaning:	660 m³/d
▪ Sanitary water:	735 m³/d
	3045 m³/d

Calculation of **whole water consumption:**

Amounts of waste water of 6 exemplary production plants/processes:

1. H2O2:	1.438 m³/d
2. GPPS:	1.205 m³/d
3. chlorine:	1.342 m³/d
4. superphosphate:	960 m³/d
5. berverages:	6.500 m³/d
6. butchery:	548 m³/d
Sanitary WW:	918 m³/d
Sum:	**12.912 m³/d**

Source: BVT - Large Volume Organic Chemical Industry - LVOC 2017

IRF: ~24 % → Process-, fire fighting-, cooling water → **IRF: >24 %**

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  达姆施塔特工业大学
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  - Wastewater Technology (**AT**)
    专业领域：污水处理技术
  - Material Flow Management and Resource Economy (**SuR**)
    专业领域：物流管理和能源经济
  - Work and Engineering Psychology Research Group (AI)
    研究组：工作和工程心理学
- Institute for Sanitary Engineering and Waste Management of Leibniz Universität Hannover (**ISAH**)
  汉诺威大学环境经济与废物管理研究所
- Institute of Environmental Engineering & Management at the Witten/Herdecke University (**IEEM**)
  维藤/海德克大学：环境工程与管理研究所
- EnviroChemie GmbH (**EC**)
  Enviro化学有限公司
- Endress+Hauser Conducta (**EH**)
  恩德斯豪斯自动化设备有限公司
- Kocks Consult GmbH (**KC**)
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- University of Technology Qingdao, China

  青岛理工大学
- Hanoi University of Civil Engineering, Vietnam

  越南河内土木工程大学

Overview of the different research fields
不同研究领域的概述

- Determination of **water savings potential** (*using the example of chemical-pharmaceutical industrial parks*) (LM, AT)

  节水潜能的评估（例如：化学制药工业园的节水潜能）

- Development of **new treatment technologies** and their coupling (ISAH, EC)

  新的污水处理技术（链）的研发

- Testing of technical implementation (technical **infrastructure and measurement concept**) (KC, EH)

  技术实现的检测（技术基础设施和测量方案）

Overview of the different research fields
不同研究领域的概述

- **Ecological and economic evaluation** of different treatment technologies (SUR, IEEM)

  不同污水处理技术的生态及经济评估

- **Multi-criteria selection support** for concept layouts (ISAH)

  基于不同指标的评价

- **Socio-technical application** - stress analysis of employees (AI)

  社会技术的应用--员工的应力分析

- Examination of **transferability** to other industrial park types and industrial locations (LM)

  其他工业园种类及工业园地点的可移植性分析

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Thank you for your attention.

感谢您的关注！

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