SEMIZENTRAL Germany

Ein integrierter Ansatz für die Infrastruktur-versorgung schnell wachsender Megacities

TECHNISCHE UNIVERSITÄT DARMSTADT

SEMIZENTRAL GERMANY

Wasser Berlin International
25. März 2015

Abwassermanagement

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Institut IWAR

Member of German Water Partnership

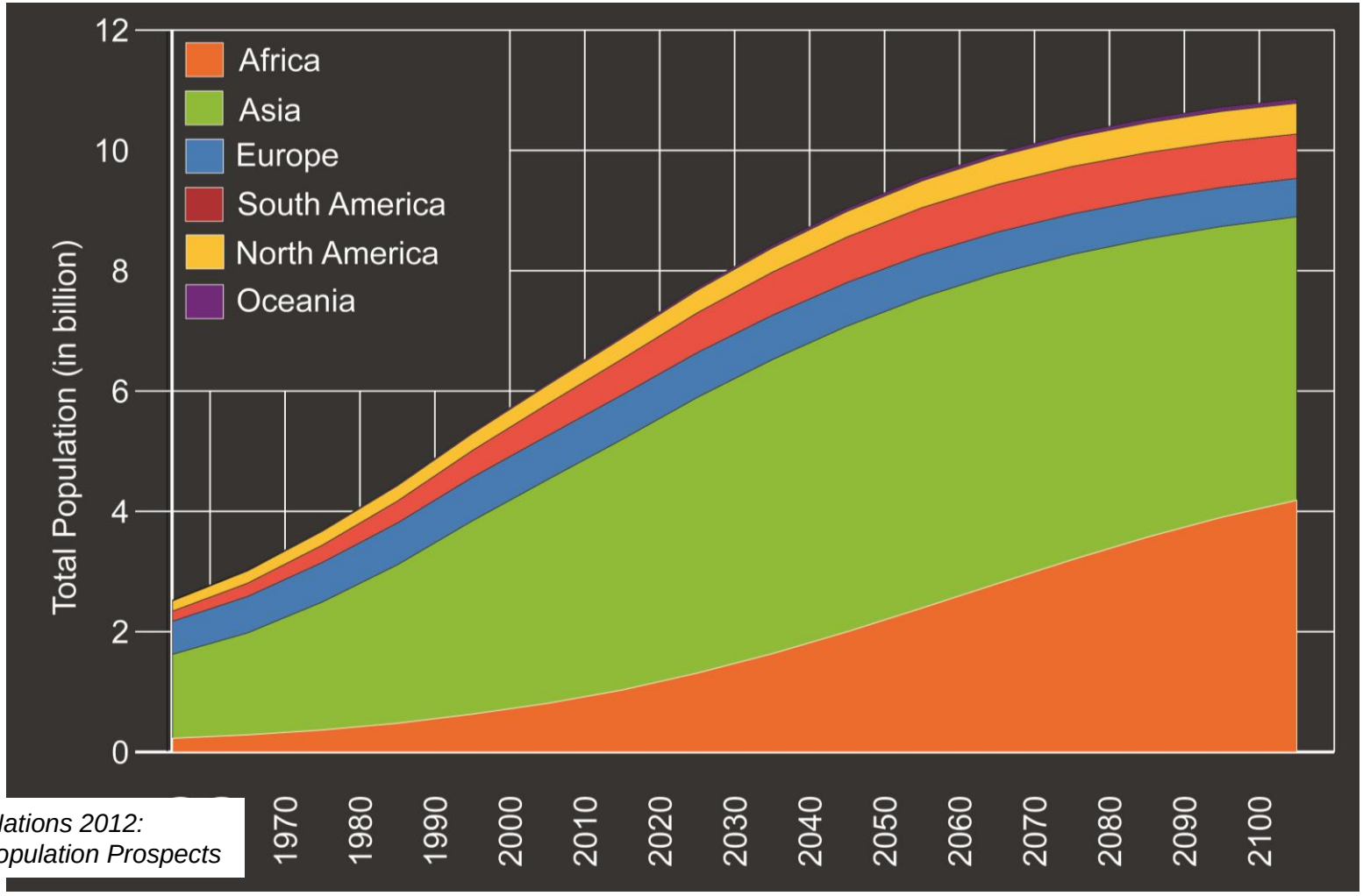
Conclusions

„Cities of the Future“ will differ from those of yesterday and today.

Water and Sanitation Infrastructures will be **much more diverse** and **varying** and **adapted** and **flexible** to changing conditions.

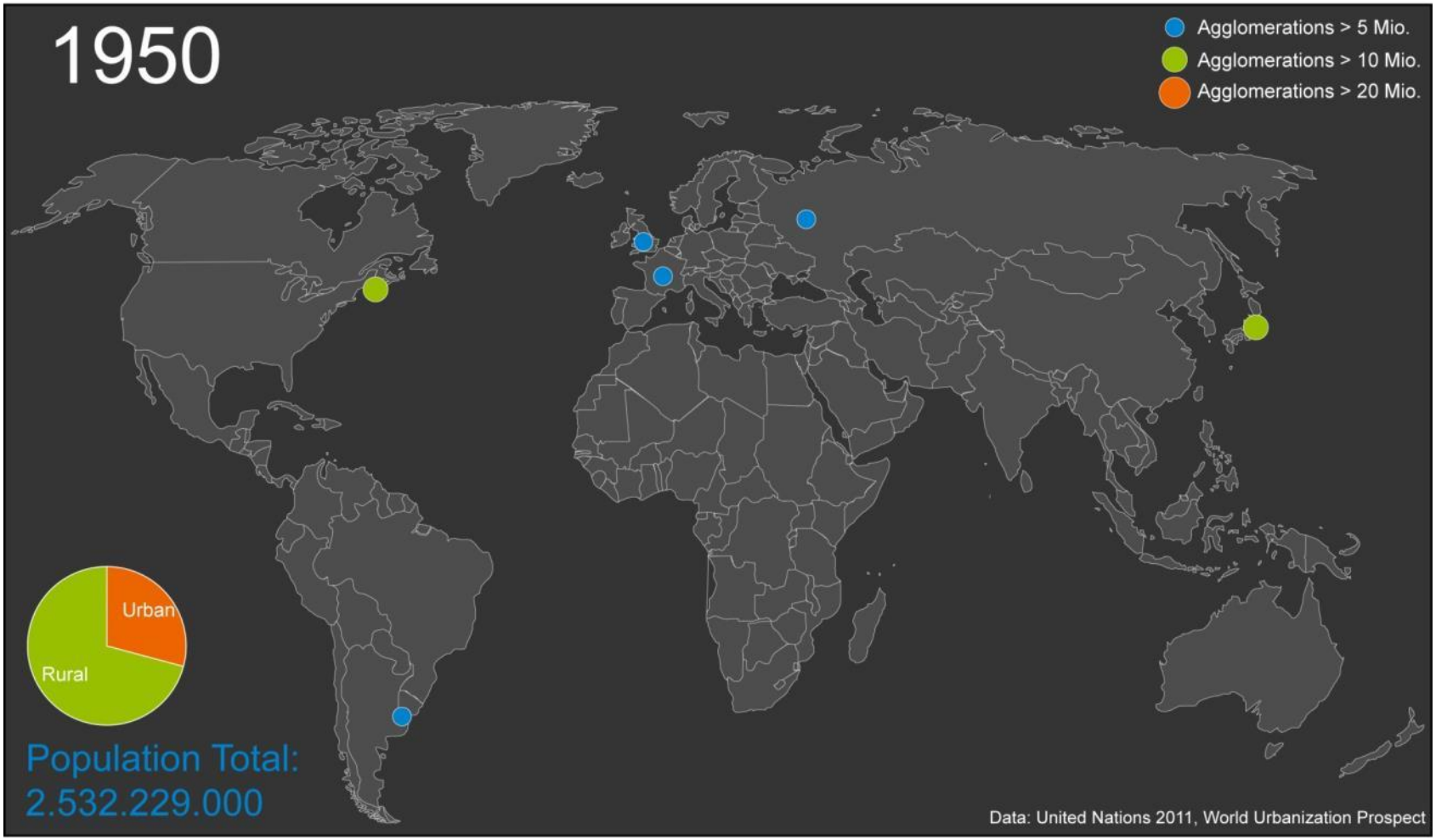
Wastewater is no waste, but a resource

Challenge 1:
World Population Growth

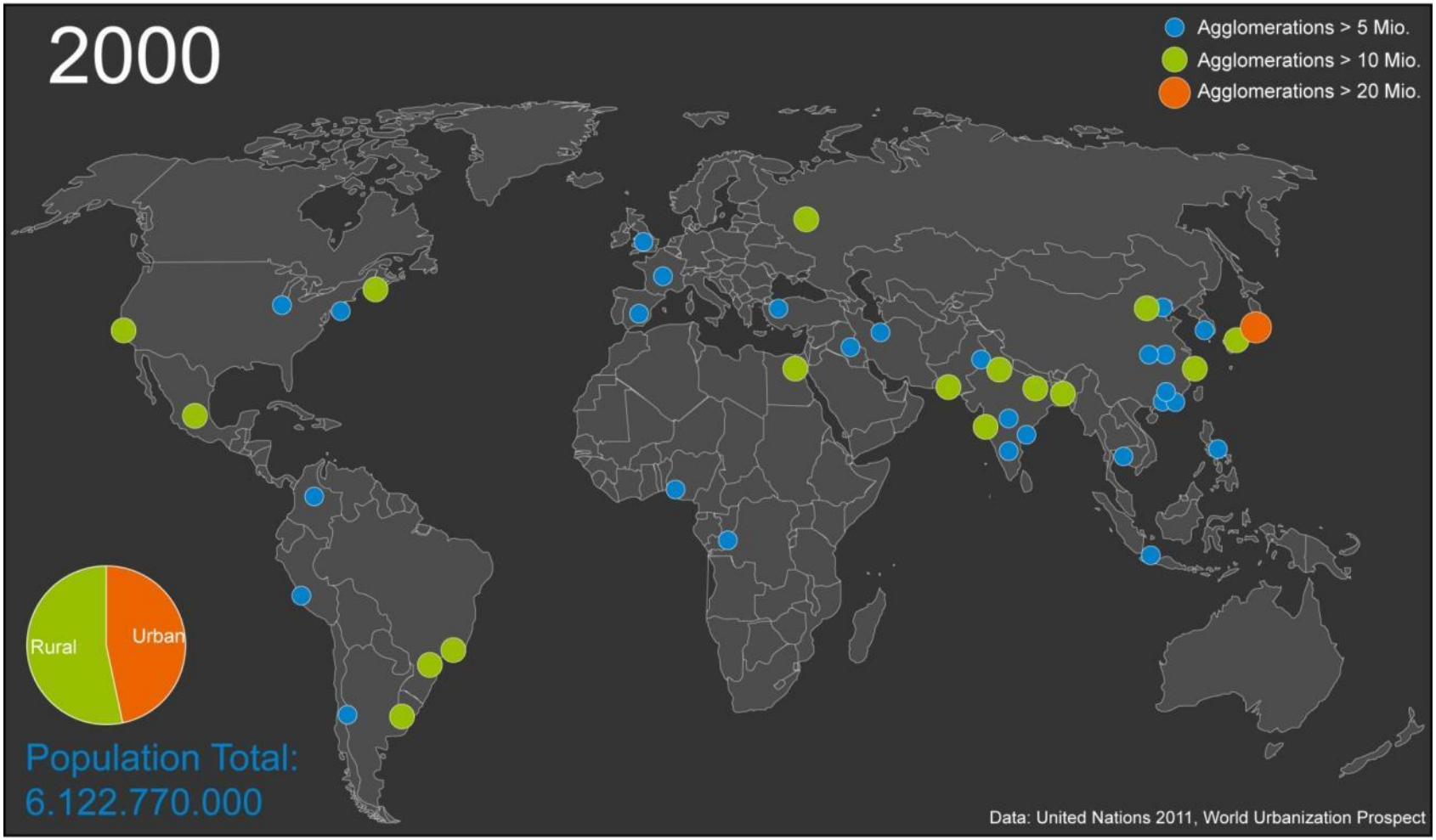


United Nations 2012:
World Population Prospects

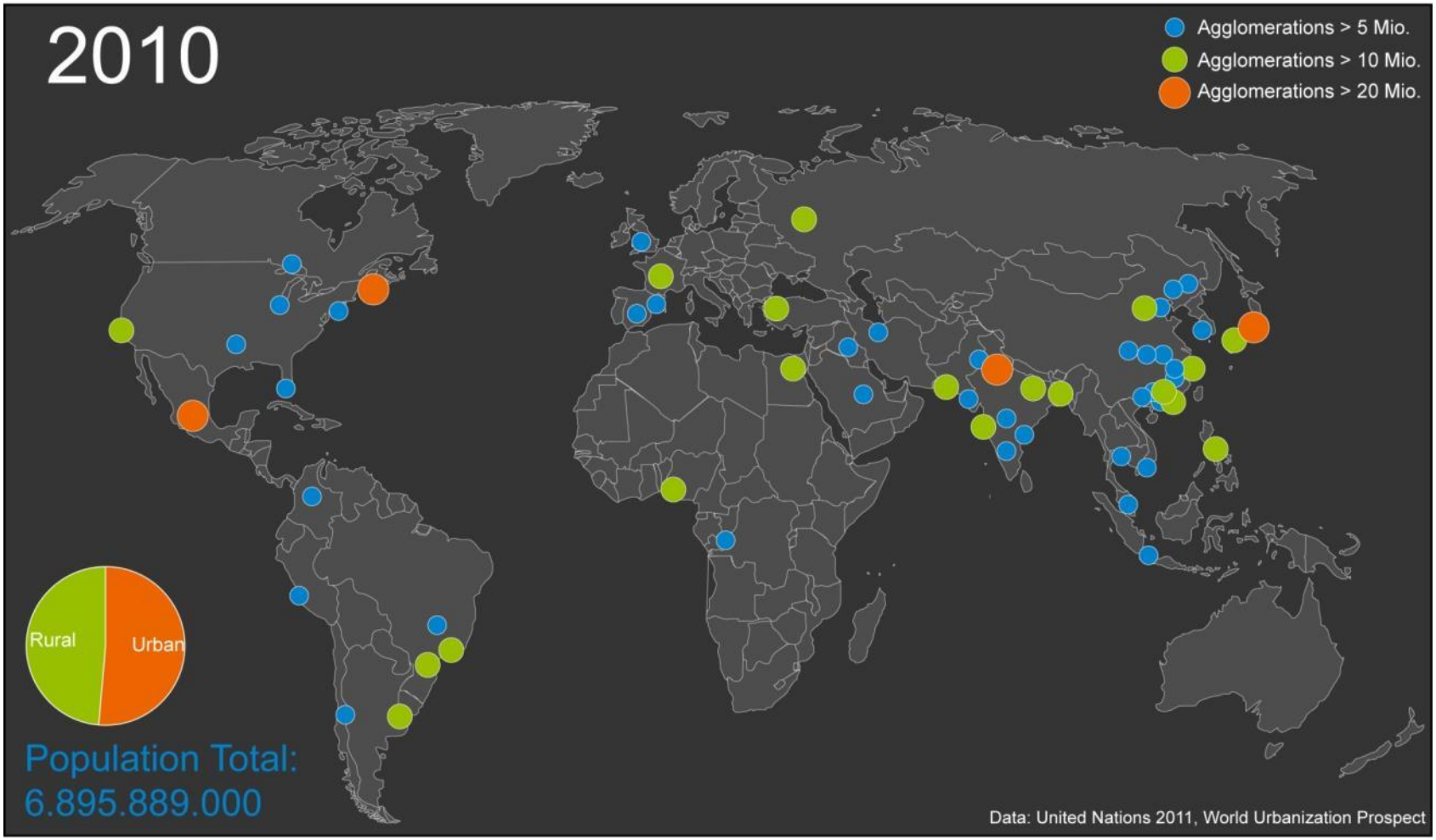
Challenge 2: Urbanization



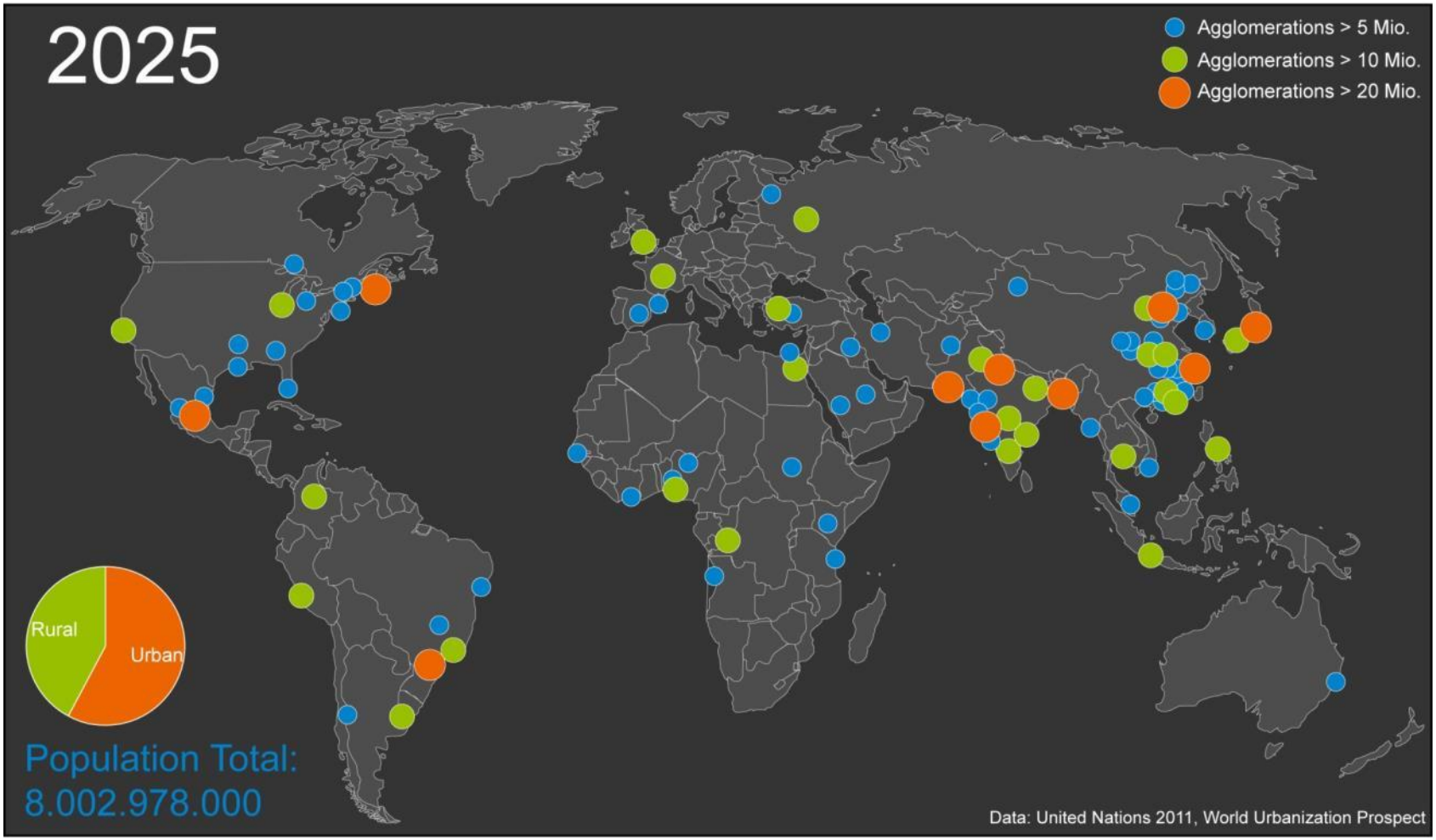
Challenge 2: Urbanization



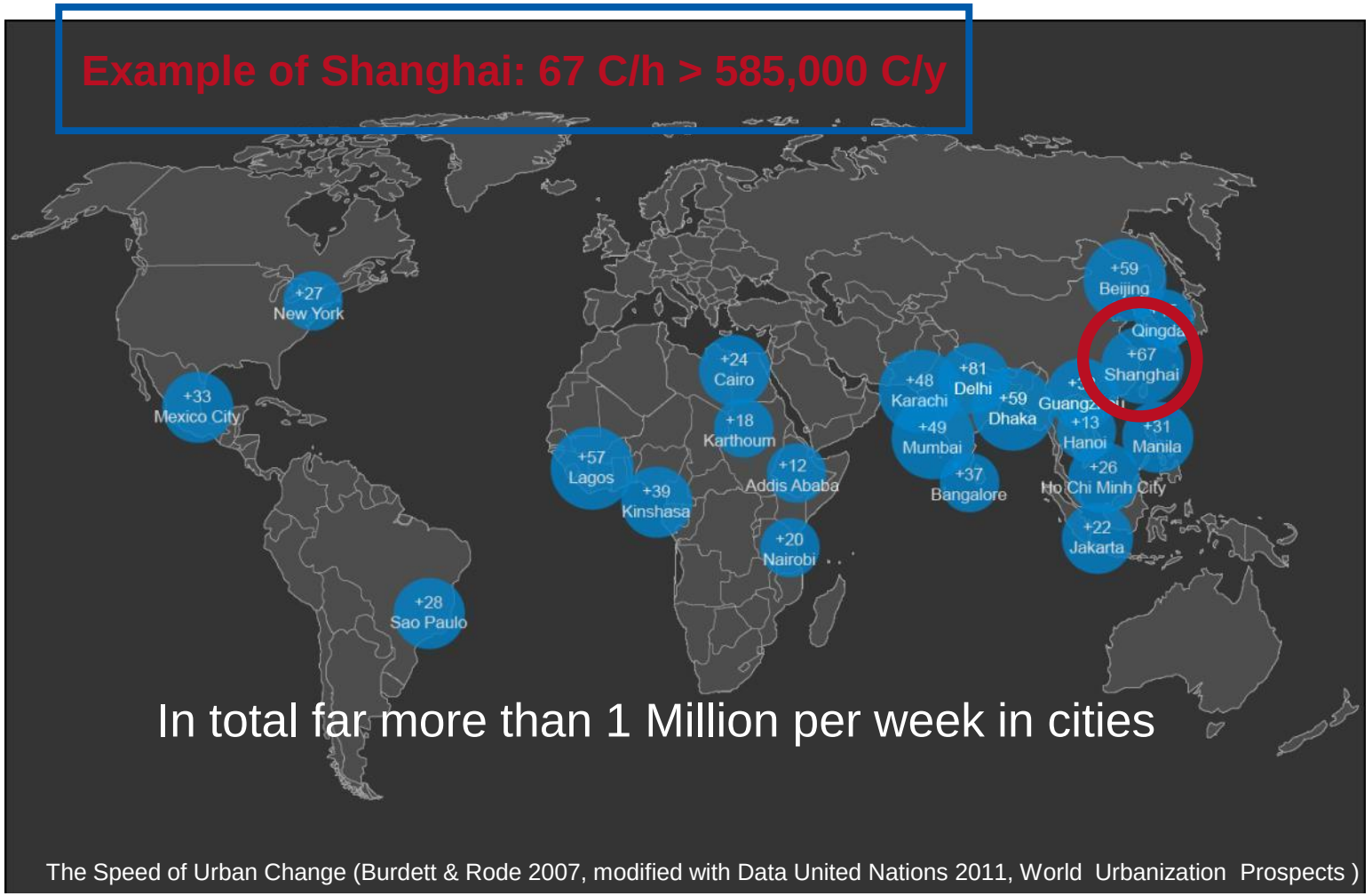
Challenge 2: Urbanization



Challenge 2: Urbanization



Challenge 3: Dynamic of urban growth



Growth rates e.g. Shanghai

Population growth

67 C/h → **585,000 C/y**

Additional water (daily!)

132 L/(C·d) → ***77,200 m³/d***

Additional solid waste (daily!)

1 kg/(C·d) → ***585 Mg/d***

Investing in infrastructure

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- **Investment for infrastructure**
  - Huge systems (several million conected units)
  - High investments
  - Longterm investments
    - 30% of investment for technical treatment facilities (12 years depreciation)
    - 70% of investment for sewers and canals (50 years depreciation)

➔ You better should be sure that your investment fits for the future…

Challenge 4: Limited Ressources

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1. Water

Jialing/Chongqing 2006;
www.zeitenschrift.com/magazin/54-wasser.jpg 26.5.2013

2. Energy

http://www.hvv-mobility.com 26.5.2013

3. Nutrients (P, N, ..)

www.baecktrade.de 26.5.2013

Centralized sectored infrastructures:
An idea from the past – for the future?

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Challenges of today:

Population growth – in cities – very fast – with limited resources

Can a system that was evolved

- more than 100 years ago
- for global population < 2 billion
- mostly rural
- lacking modern technology

be the solution when

- global population is > 7 (8) billion
- mostly urban
- experiencing resource constraints **??**

Adapted from IWA-President Glenn Daigger;
„Change in Paradigm: Waste to Resource"; Weftec 2010, New Orleans

Resource efficiency requires new infrastructure solutions

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1. **Water reuse fosters decentralization**

2. **Energy (heat) recovery fosters decentralization**

3. **Fulfilling high quality standards foster professional operation**
   → rather *partly- (semi)-* centralized than *de*-centralized at household level

4. **Energy self-sufficiency** fosters combination of different sectors (water supply, wastewater treatment and waste treatment)

→ ***We know what is needed ! Why don‘t we start?***

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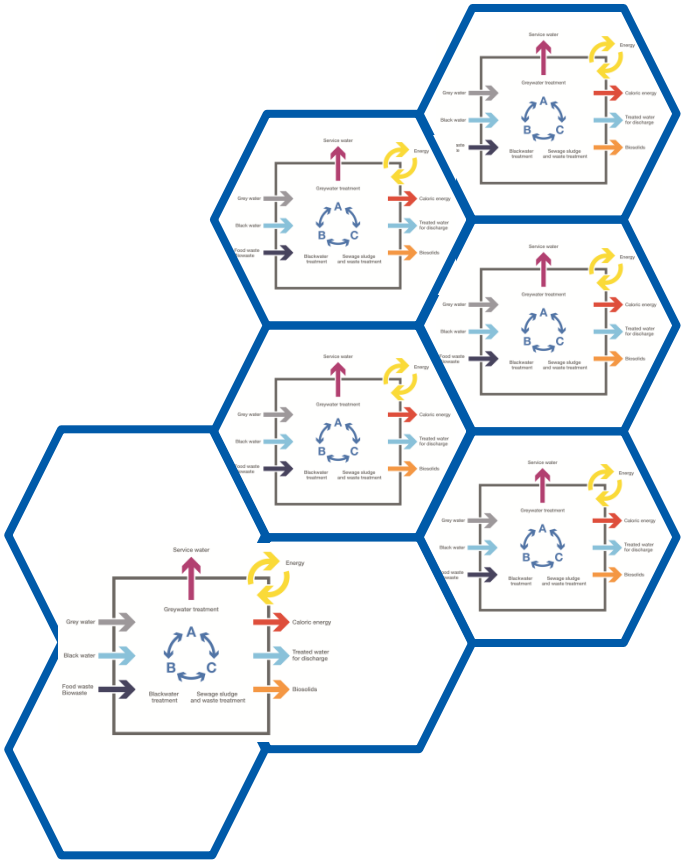
Integrated treatment on district level

- adaptable to growth rate
- flexible
- adjusted
- integrated
  (water, wastewater, waste, energy)
- enclosed construction → low-emission

- „As small as possible, as large as necessary“
- **Infrastructure on demand**



„SEMIZENTRAL“
Resource Recovery Center (RRC)

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- Waste water as a resource for
  - Water
  - Energy
  - Nutrients
- Products instead of wastes
  - Non-potable service water
  - Irrigation water
  - Biogas/electricity
  - Biosolids (stabilized/rich in nutrients)
- Flexible and adaptable

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Mass flow in the RRC

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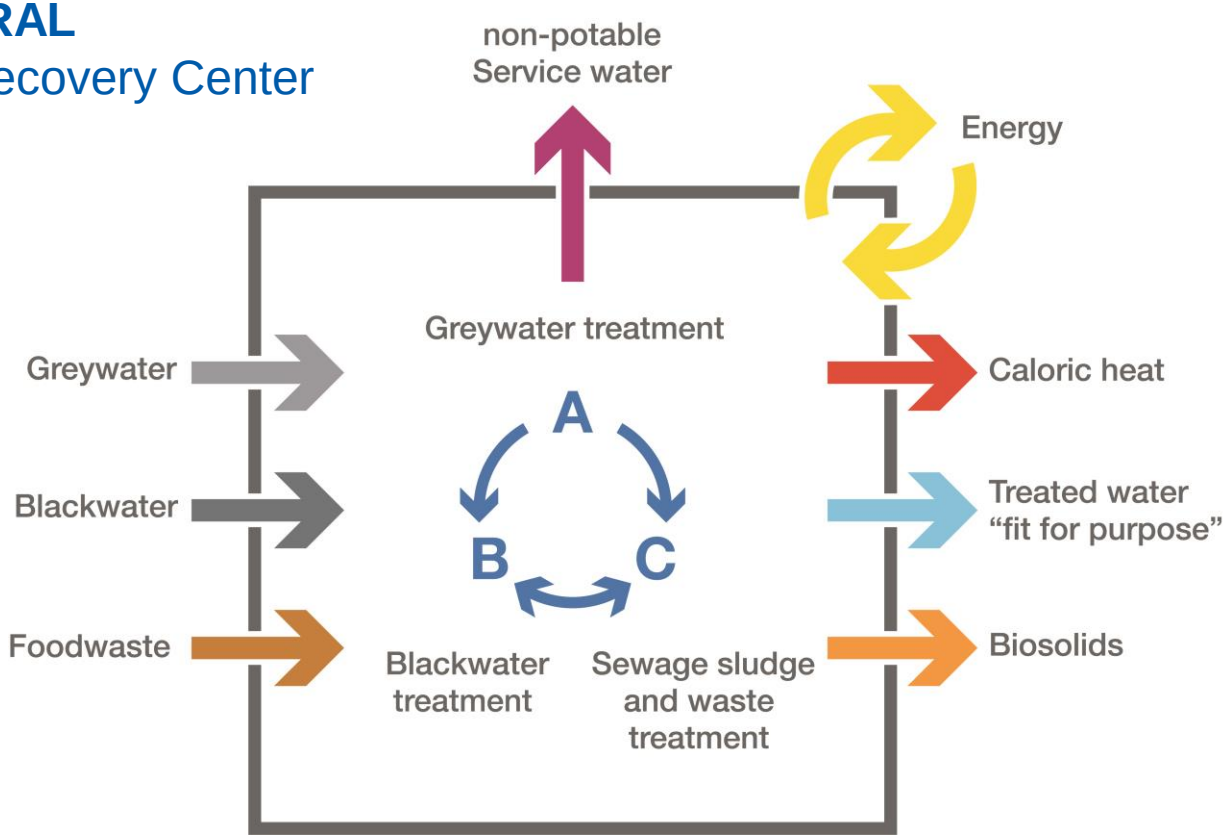
SEMIZENTRAL
Resource Recovery Center



IWAR

The „Knowing-Doing Gap“ [1]

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Das Problem ist nicht die Analyse, sondern die Umsetzung.

- **Die Herausforderungen sind seit Jahrzehnten bekannt**
  - Donella & Dennis Meadows “Limits to growth” 1972 und 2002
  - Vielzählige (Wasser) Forschungsprogramme weltweit
    - Cities of the Future, Future Megacities, Zukunftsstadt, Morgenstadt, …
    - Resource Recovery Cluster
    - Intra-urban Water Reuse
    - Water & Energy / Water, Energy and Climate
    - Water, Energy, and Food Nexus / Water, Energy, Food and Health Nexus
    - …

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Warum schafft so viel Wissen keine Veränderung?

The Knowing-Doing Gap, Jeffey Pfeffer and Robert I. Sutton, Havard Business School press, 2000

Man findet immer Gründe, nichts zu verändern…

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- **Technisch**
  - Zu viele Alternativen, mehr Erfahrung benötigt, es wird in der Zukunft sicher noch bessere Lösungen geben, …
- **Karriere**
  - Keine Auswirkungen auf hochwertige Veröffentlichungen, könnte nicht funktionieren, zeitaufwendig, …
- **Organisatorisch**
  - Nicht mein Aufgabengebiet, nicht mein Verantwortungsbereich, werde ich nicht für bezahlt, …
- **Kommunikation**
  - Interdisziplinäre Zusammenarbeit kann schwierig sein, lieber Kollegen beeindrucken anstatt etwas riskieren, Konkurrenz statt Kooperation, …
- ….

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The Knowing-Doing Gap, Jeffey Pfeffer and Robert I. Sutton, Havard Business School press, 2000

Was getan werden muss , um Dinge zu verändern

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- **Sich selbst in die Verantwortung nehmen**
  - Sie selbst müssen anfangen.
  - Sie müssen andere überzeugen.

- **Sie müssen den Schritt der Kommunikation in der eigenen Community und zwischen anderen Communities gehen**
  - Politik – kommunal, regional
  - Architekten und Stadtplaner
  - Banken und andere Finanzierungsinstitutionen
  - Fachleute und Experten im technischen Bereich
  - …

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- **Akzeptieren Sie Fehler – Fehler sind Teil jedes Lernprozesses**

Case Study Qingdao, P.R. China

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City of Qingdao

CorbisImages

Case Study Qingdao, P.R. China

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Emerging metropolis at China's east coast in ShanDong Province

Natural Water resources are deeply limited
(groundwater salination because of seawater intrusion, heavily pollution and/or grounding of surface waters)

- Available water resources not sufficent for higher demands
- Urban growth needs further water

➔ The Qingdao solution:
seawater desalination

➔ **Energy demand: 3 - 4 kWh/m³**

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➔ **The SEMIZENTRAL solution:**
Reuse for <1 kWh/m³

CorbisImages

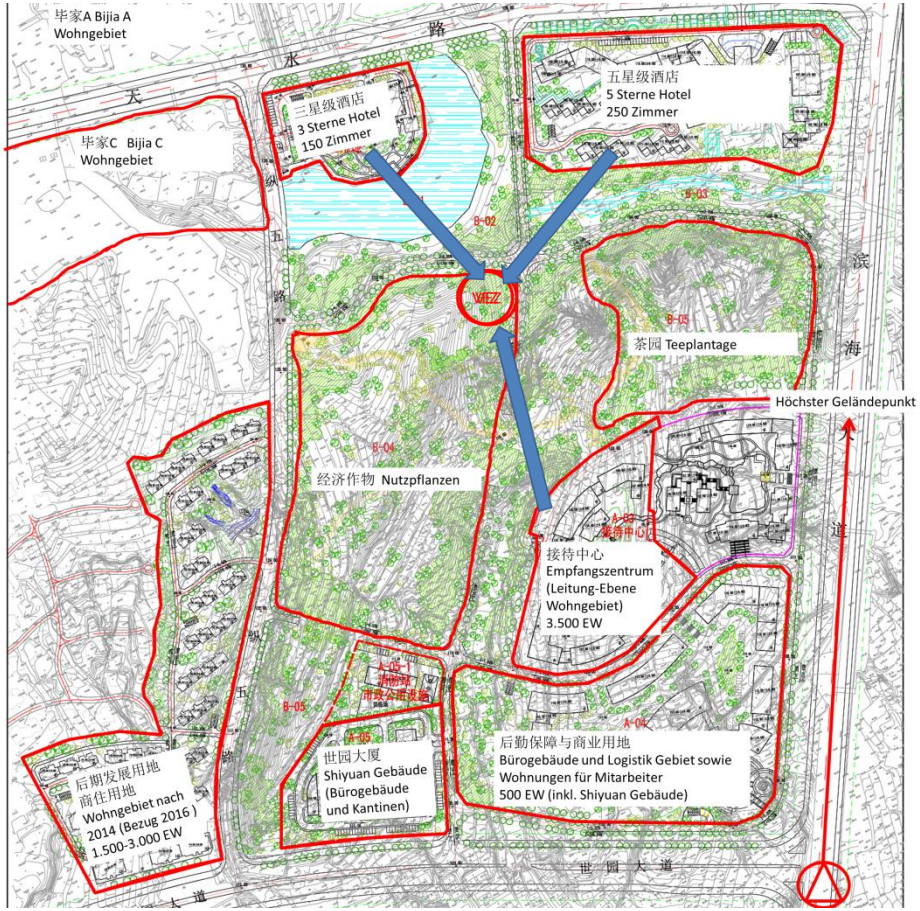
SEMIZENTRAL goes WHE Qingdao

The worldwides first implementation in context of the **2014 World Horticulture Exposition** in Qingdao

Catchment area

- 3 Hotels
- Housing areas for staff and guests
- New developed housing areas
- Office buildings

- **rd. 12.000 people to serve**



April 2014: Semizentralized
Resource Recovery Center Qingdao Shiyuan

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Semicentralized Resource Recovery Center (RRC) – a modular approach

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Technical basics

Greywater treatment

- Non-potable service water production with MBR

Blackwater treatment

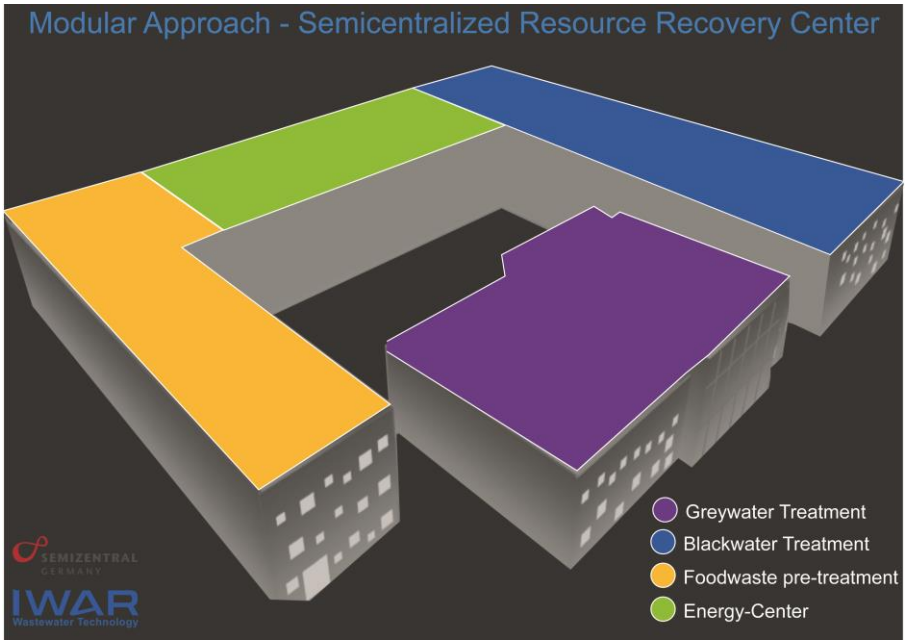
- Irrigation water with MBR

Foodwaste pre-treatment

- Mechanical pre-treatment

Energy-Center

- Anaerobic thermophilic treatment
- Electric energy by CHP station



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Resource Recovery Center Qingdao

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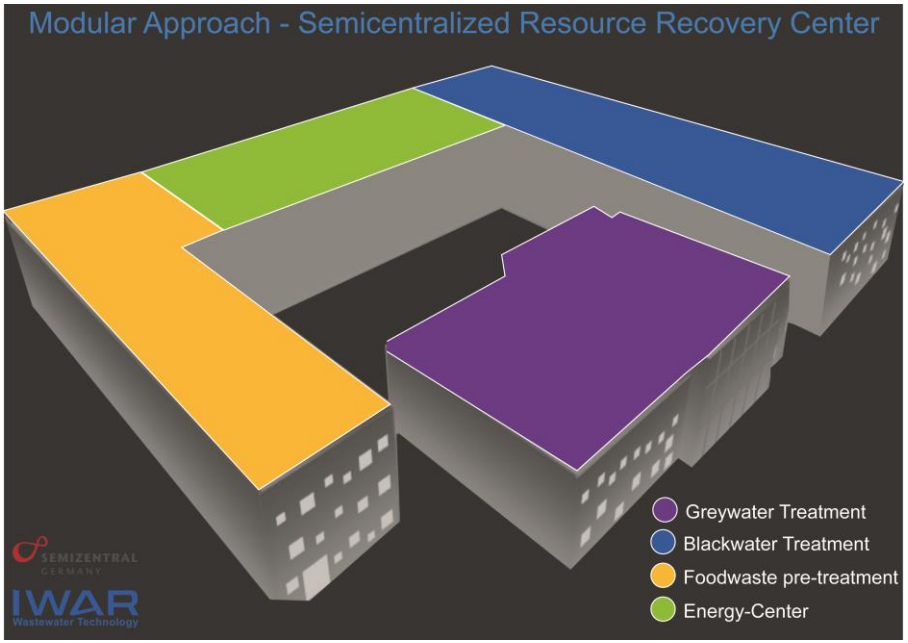
Advantages of the system

On the water side

recycling rates between 40% (greywater only) and 100% (grey- and blackwater)

On the energy side

- Energy self-sufficient operation possible
- even energy-autarcic operation, depending on gas storage capacities



SEMIZENTRAL
RRC Qingdao Shiyuan

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Research foundation in Germany by the German Federal Ministry of Education and Research

- 14 partners headed by Wastewater Technology and Water Reuse, IWAR, TU Darmstadt
- **All-over** (German) **research volume:** approx. **7 Mio. €** for accomp. research for 3.5 years
- plus **sponsoring** of German Industry Partners (wilo, Aerzen, Auma, Binder, Ott, LAR): approx. **500.000 €**

Member of German Water Partnership

Investment und Operation

- **Chinese Investor**
  Volume of investment: approx. 7 Mio. €
- **Chinese Operator** – with support from German Consortium in initial-operation and operation optimization

SEMIZENTRAL STC Qingdao Shiyuan Research Partners

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Germany

- **IWAR**
- Kocks Consult GmbH
- Endress + Hauser
- m+p consulting
- Roediger Vacuum
- Emscher Gesellschaft für Wassertechnik mbH
- Institut für sozial-ökologische Forschung Frankfurt (ISOE)
- Fachgebiet Landmanagement, TU Darmstadt
- Fachgebiet Entwerfen und Stadtentwicklung, TU Darmstadt
- Institut für Baubetrieb, TU Darmstadt
- Far Eastern Consulting
- Gebrüder Heyl
- GECOc

China

- *Tongji University Shanghai*
- *Qingdao University of Technology*

Staatssekretär Dr. G. Schütte (BMBF) bei der Eröffnung im April 2014

Characteristics of SEMIZENTRAL

- **40% to 100% fresh water saving by water reuse**
  for toilet flushing and further purposes (e.g. irrigation, street cleaning, fire fighting)
- **heat recovery** from greywater*
  (shower, bathtub, washing machine)
- **energy from sewage sludge and bio-waste**
  - electric energy
  - additional caloric energy
- agricultural use of nutrient-rich, stabilized and hygienized residual products
- **flexible, with the city growing, (infra-)structure**

* not realized in Qingdao

Qingdao Shiyuan – ein erster Schritt

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Besucher in Qingdao

- Forschung und Entwicklung
- Stadtentwicklung
- Ingenierbüros und Design Institute

Zwei weitere Standorte derzeit in Machbarkeitsstudien

- Jieyang (Guandong Provinz, China), Chinesisch-deutsche Metallstadt

Politisches Interesse

- Austausch zwischen dem BMBF und den chin. Ministerien für Wissenschaft und Forschung sowie Siedlungsentwicklung (*MoST und MoHURD)*

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Conclusions

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Wastewater is no waste, but a resource.

The use of resources needs equivalent infrastructures

- District-related, co-growing (on demand), „semizentral“
- Water qualities „fit for purpose“ → toilet flushing water doesn‘t need drinking water quality
- Integrated infrastructures (water, wastewater, biowaste, energy production)
- **Health protection** affords **professional operation**
  („as small as possible, as big as necessary“)

Future-oriented Water Supply and Sanitation is adapted to local needs and challenges

„Cities of the Future“ differ from those of yesterday and today:
Water infrastructures are much more **diverse and varying**, are **flexible** and are continuously **adapted to changing conditions**

But the most important…

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We need to start changing things.

Today.

In small steps.

In big steps.

The size is not important.

But starting is.

Infrastructure challenges in fast growing urban environments

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SEMIZENTRAL GERMANY

From left to right: Martin Wagner, Peter Cornel, Susanne Bieker
Technische Universität Darmstadt, Institut IWAR

Member of German Water Partnership

The Knowing-Doing Gap[1]

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- The problem is not “analysis” – it is implementation
- Challenges are known since decades
  - Donella & Dennis Meadows, Limits to growth, 1972 ad its update in 2002
  - Numerous (Water) Research programs world wide
    - Cities of the Future, Future Megacities, Zukunftsstadt, Morgenstadt, …
    - Resource Recovery Cluster
    - Intra-urban Water reuse,
    - Water & Energy / Water, Energy and Climate
    - Water, Energy, and Food Nexus / Water, energy, Food and Health Nexus
    - …
- Why do so many research cause so few changes?
- Do we have the tendency to treat “talking” as equivalent to “doing” ?
- “power point presentations” as substitute for “action” ?

[1] *The Knowing-Doing Gap, Jeffey Pfeffer and Robert I. Sutton, Havard Business School press, 2000*

One can always find a reason not to transfer knowledge to implementation

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- Technically
  - Too many alternatives, needs further evaluation, Better technics will come up, ...
- Career
  - No impact on citation index,
  - risky, might fail,
  - Takes a lot of time, …
- Organizationally
  - Somebody else's responsibility (industry, politicians, decision maker (?), ..
  - Not my business, I am not paid for networking with …
- Communication
  - Conferences are not for learning from each other but to impress the colleagues with the quality of the presentation given
  - Competition instead of teamwork
- ….

Steps to promote doing

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- **You are the one who has to care** (be prepared to take chances)
- **You are the one who has to convince others**
  (create enthusiasm, involve people, spread out seeds, …)
- **You are the one to network in and outside the own (scientific) community**
  - Politicians/ governance
  - Architects / City planner
  - Bancs / financing institutions / KFW
  - Communication / Public relation specialists
  - Social sciences, Artists, Lawyers, …
- Accept failures; There is no leaning without error, no doing without mistakes
- Promote teamwork instead of competition
- **Tell me and I'll forget;**
  show me and I may remember;
  involve me and I'll understand. Confucius