Solar Driven Water Treatment for Remote Areas of Developing Regions

An Innovative and Sustainable Approach using **Solar Technology** and **Anodic Oxidation**

BSW Off-Grid Power Forum at Intersolar Europe 2015

Florian Benz, CEO AUTARCON GmbH
Intersolar Europe

AUTARCON Pure. Simple. Solid.

Member of German Water Partnership

iKU Der Innovationspreis für Klima und Umwelt 2013

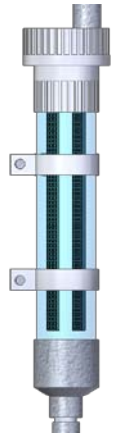
AUTARCON GmbH – decentralized water treatment

Fakts

- Spin-off 2010 University of Kassel
- 6 employees
- 30 Units in currently 9 countries: Egypt, India, Laos, Ghana, Gambia, Cameroon,…

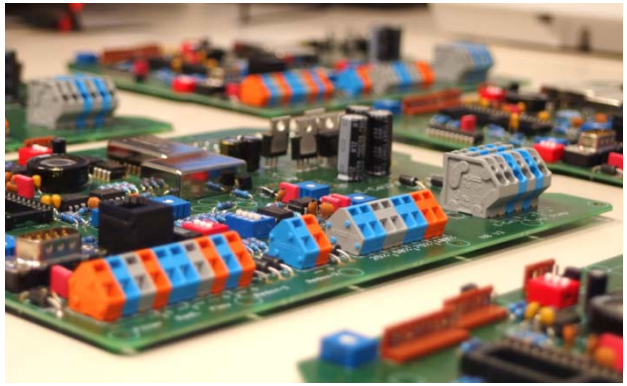
Customers

- NGOs and Governmental Institutions
- Desaster relief
  - Pakistan
  - Nepal earth quake prove towers
- Military Institutions
- Research Institutions
- Private



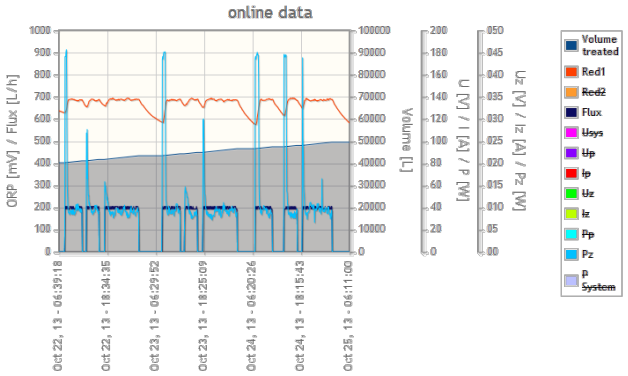
AUTARCON GmbH - Activities

1. Drinking water treatment
   - Control of Chlorine electrolytic cells
   - Residual - Disinfection
   - Removal of Arsenic, Iron, Manganese
   - Online Monitoring and Quality control
   - For up to 3.000 persons per day



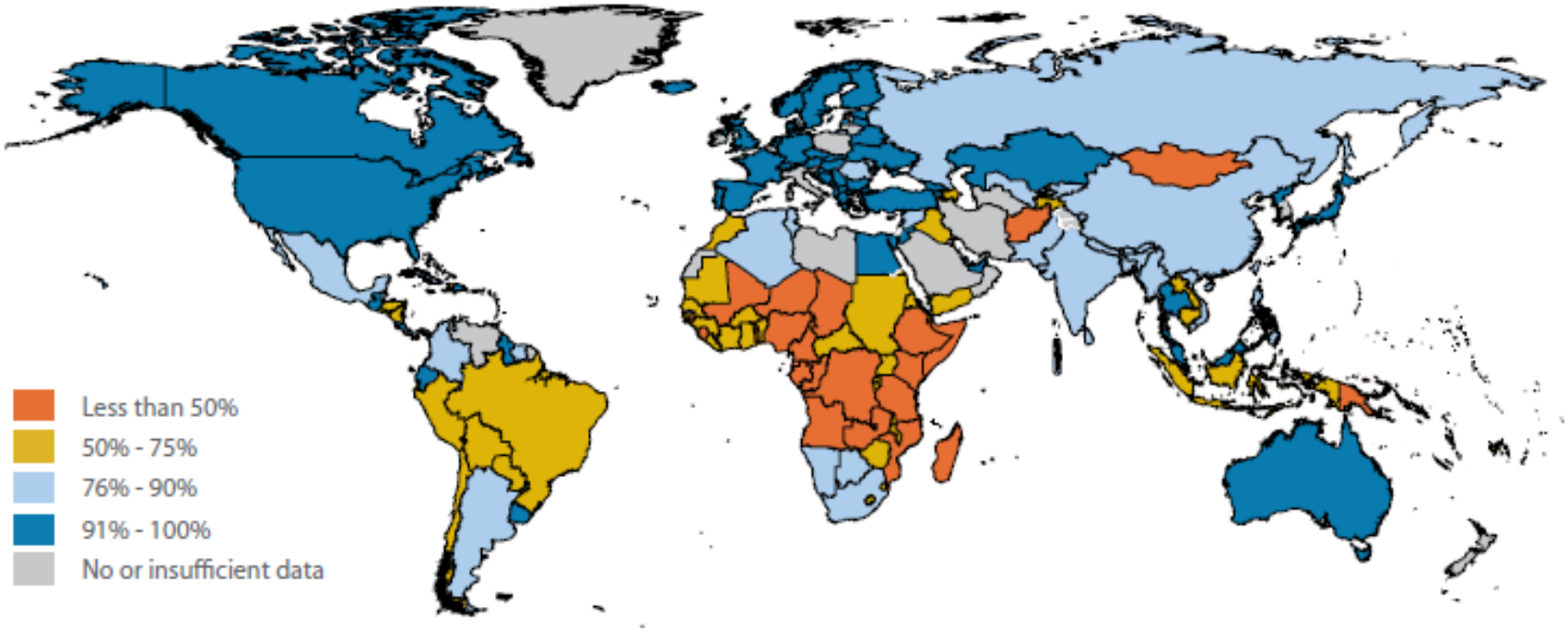
2. Wastewater Treatment
   - COD and BOD5 reduction + disinfection

3. Load management for optimization of energy efficiency



Conditions in decentralized drinking water supply

- 900 Million people without access to improved water sources
- 82 % of those live in rural areas (unicef 2010)



Priorities

"Pathogen removal is of most important concern to assure safe drinking water conditions."

WHO 2010

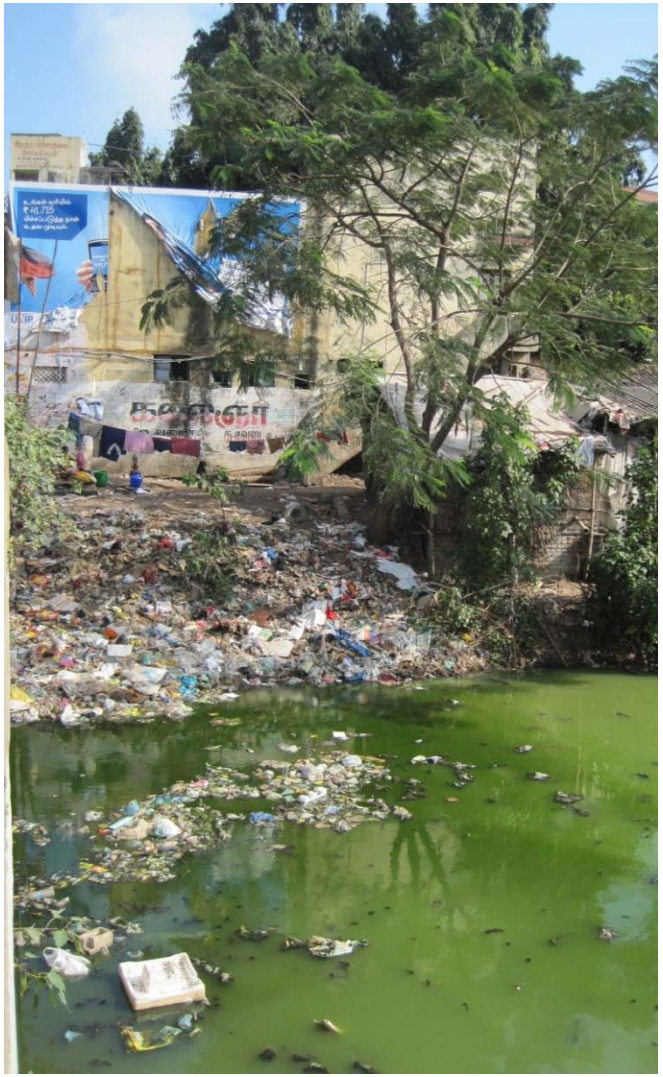
Fotos: Waterkiosk Foundation, AUTARCON

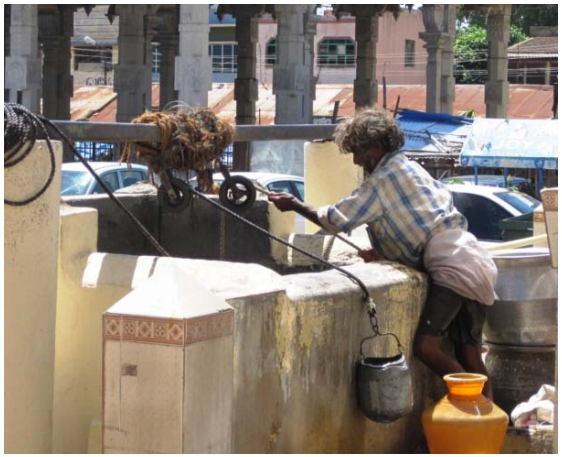
Water Supply in rural developing regions

Fotos: Waterkiosk Foundation

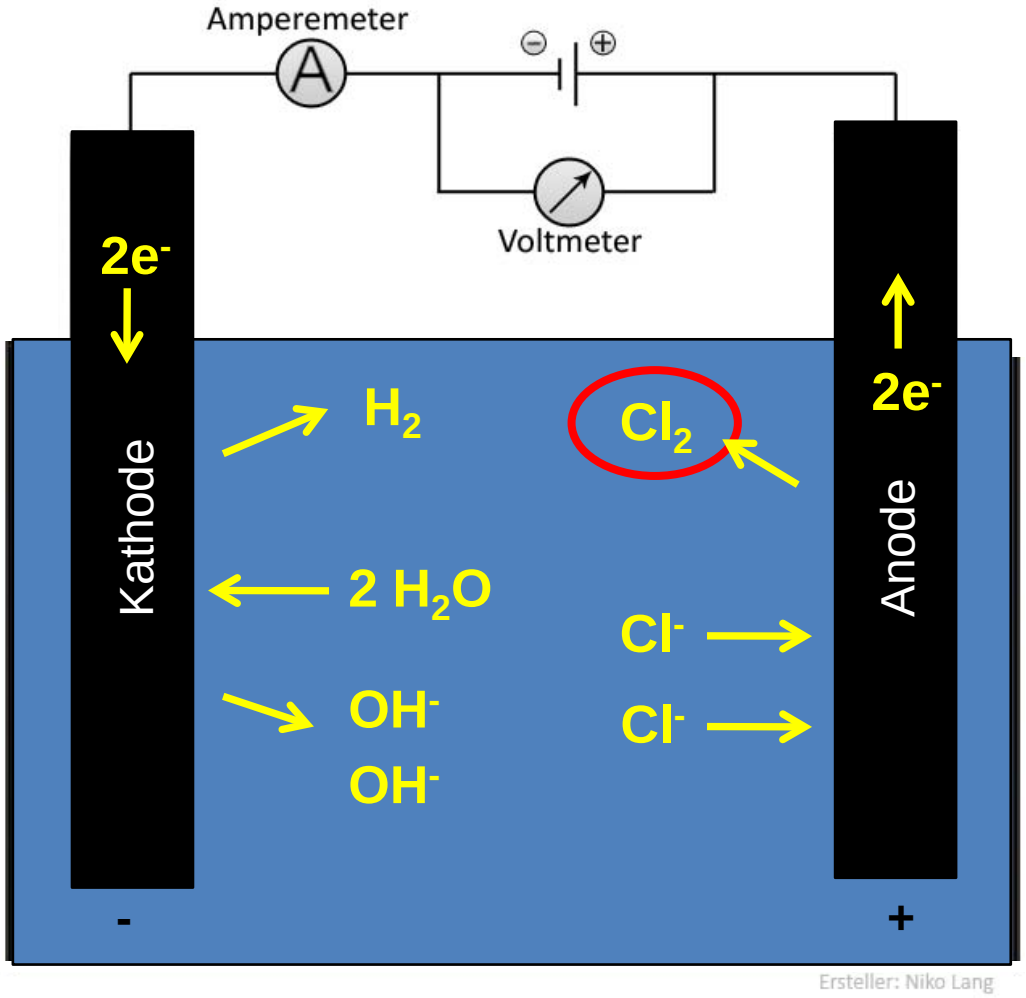
Challenges in off grid water and energy supply

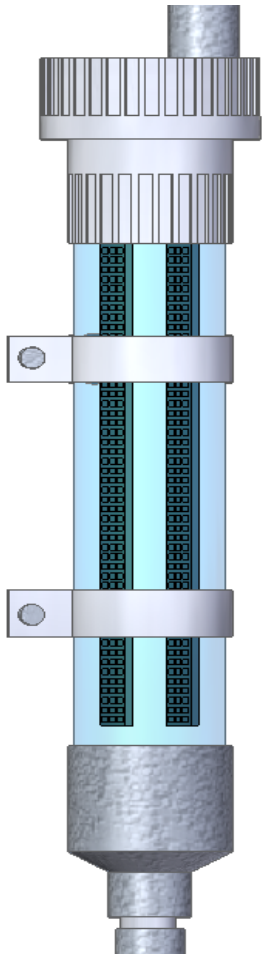
1. Continuous supply of **residual disinfectant** (a must!!)
2. Constant energy supply
3. Simplicity in maintenance
4. Water quality control





Chlorine production with Anodic Oxidation (AO)

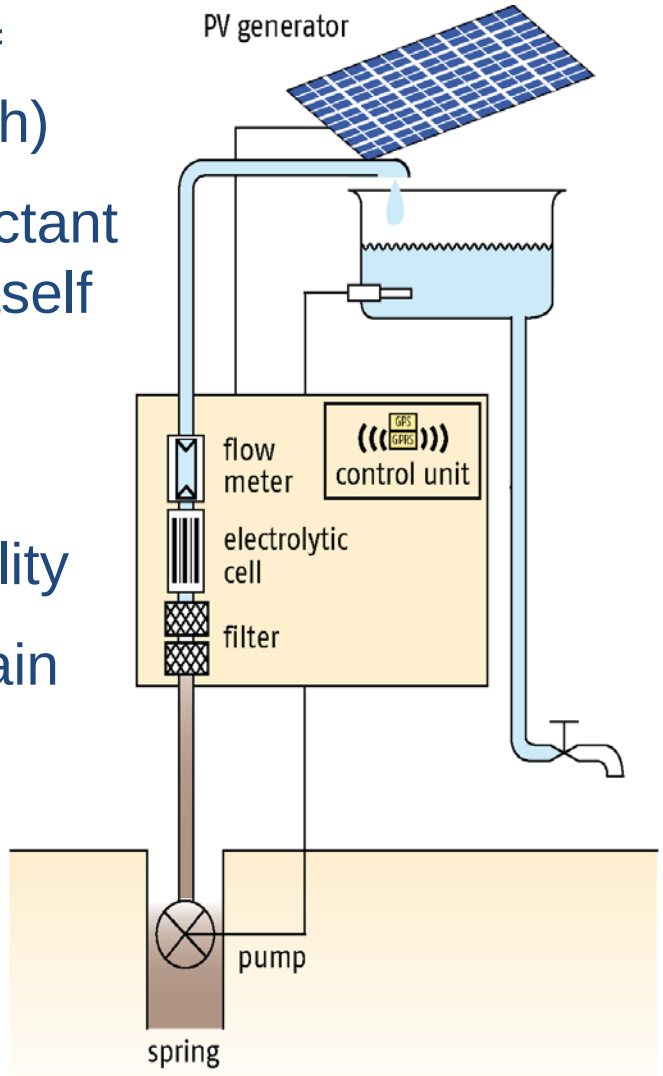


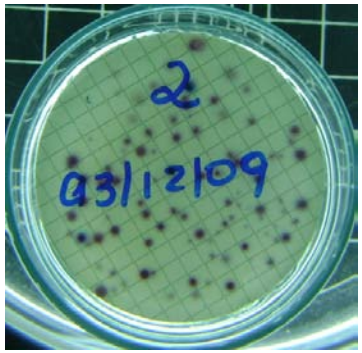


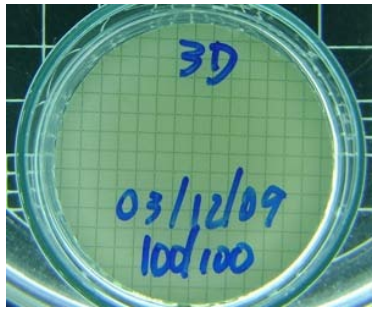
Reaction in water $Cl_2 + H_2O \leftrightarrow HOCl + H_3O^+ + Cl^-$

Our solution – SuMeWa|SYSTEM

1. Highly efficient utilization of solar energy (up to 1000 L/h)
2. Direct production of disinfectant from ions of source water itself
3. Chemical free residual Chlorination
4. Online control of water quality
5. Easy to operate and maintain





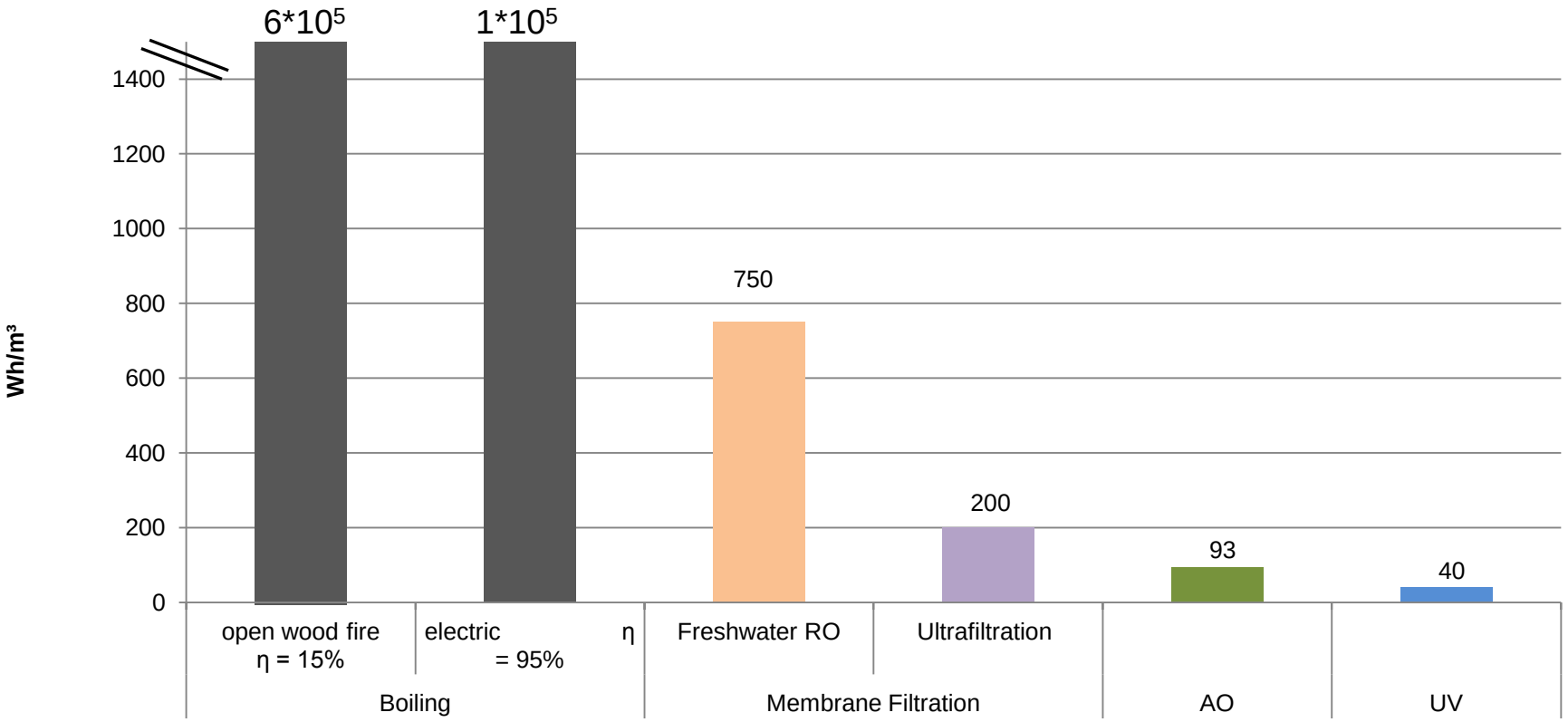


AUTARCON Pure. Simple. Solid.

Member of German Water Partnership

iKU Der Innovationspreis für Klima und Umwelt 2013

Comparison of energy requirements for water disinfection

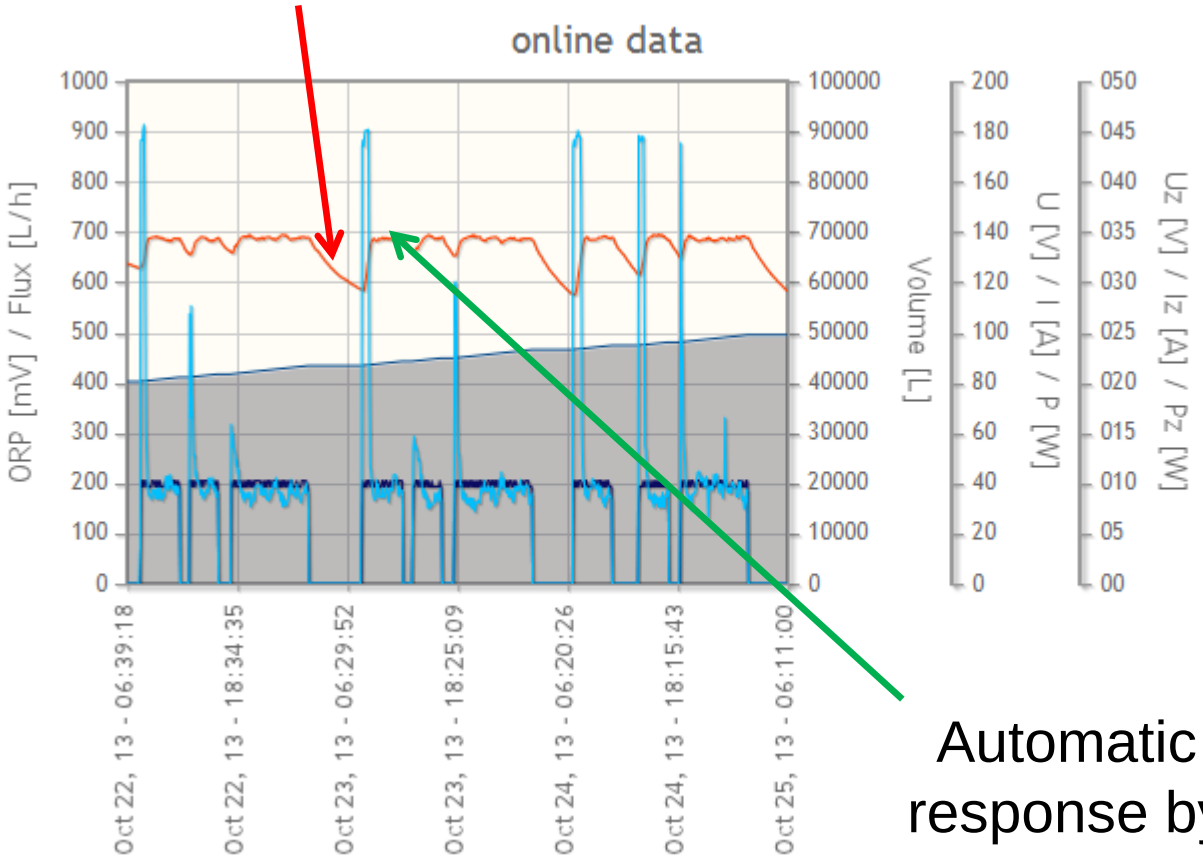


In remote areas relevant for dimensioning of solar PV System

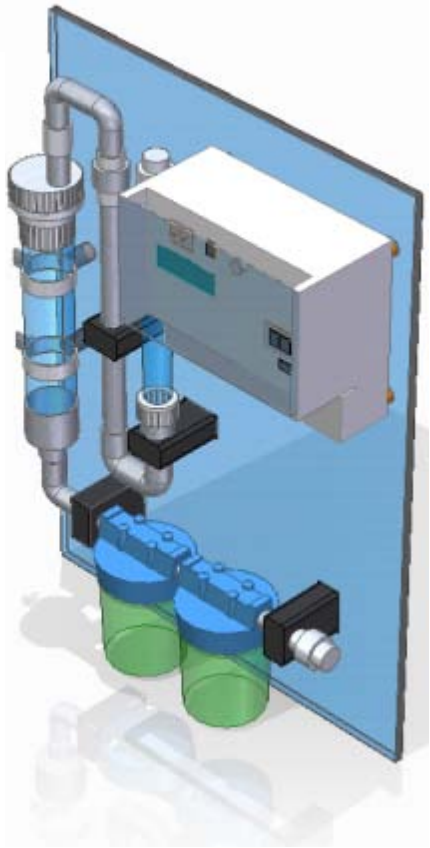
Example here: Disinfection without pumping and pre- filtration (20h/d Cameroon)

Online Water Quality Control – Worst Case

Drop of water quality



Automatic response by system



[Link to online monitoring India]

Additional Treatment – Maintenance Free

Removal of:

- Turbidity
- Iron
- Manganese

In the Future:

- Arsenic
- Fluoride

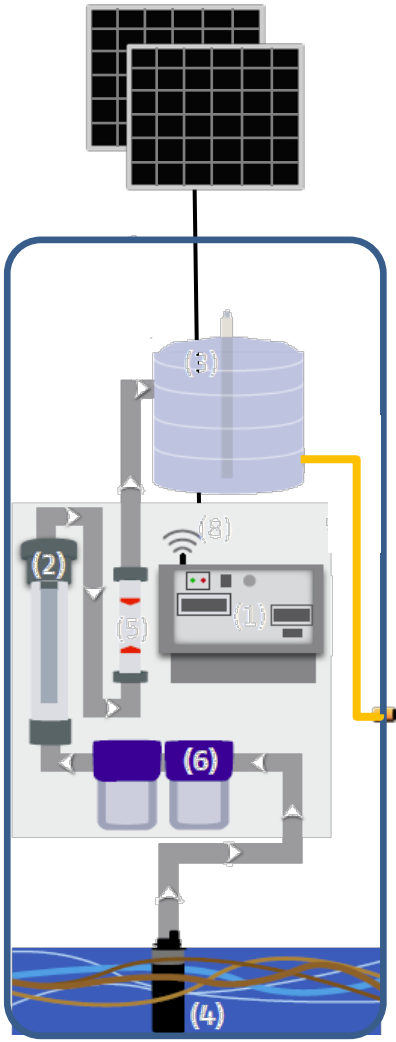
Additional Treatment – Maintenance Free

Comparison of different drinking water treatment technologies

	Micro-filtration	Ultra-filtration	Reverse Osmosis	UV	Thermal treatment	SuMeWa
Disinfection efficiency						
Bacteria	+	++	++	++	++	**++**
Virus	-/+	+	++	++	++	**++**
Protozoa	+	++	++	-/+	++	**++**
Removal of particulate matter	Yes	Yes	Yes	No	No	**Yes**
Decoloration	-	+/-	+/-	-	-/+	**+**
Residual disinfectant	No	No	No	No	No	**Yes**
Online water quality monitoring	No	No	No	No	No	**Yes**
Ease of use	+	-/+	--	-	++	**++**
Maintenance requirements	Medium	High	Very High	High	Very low	**Very low**
Investment cost	Medium	High	Very high	High	Very low	**High**
Energy consumption	Medium	High	Very high	Very low	Very high	**Very low**
Operational costs	Medium	Very high	Very high	Very high	Very high	**Very low**

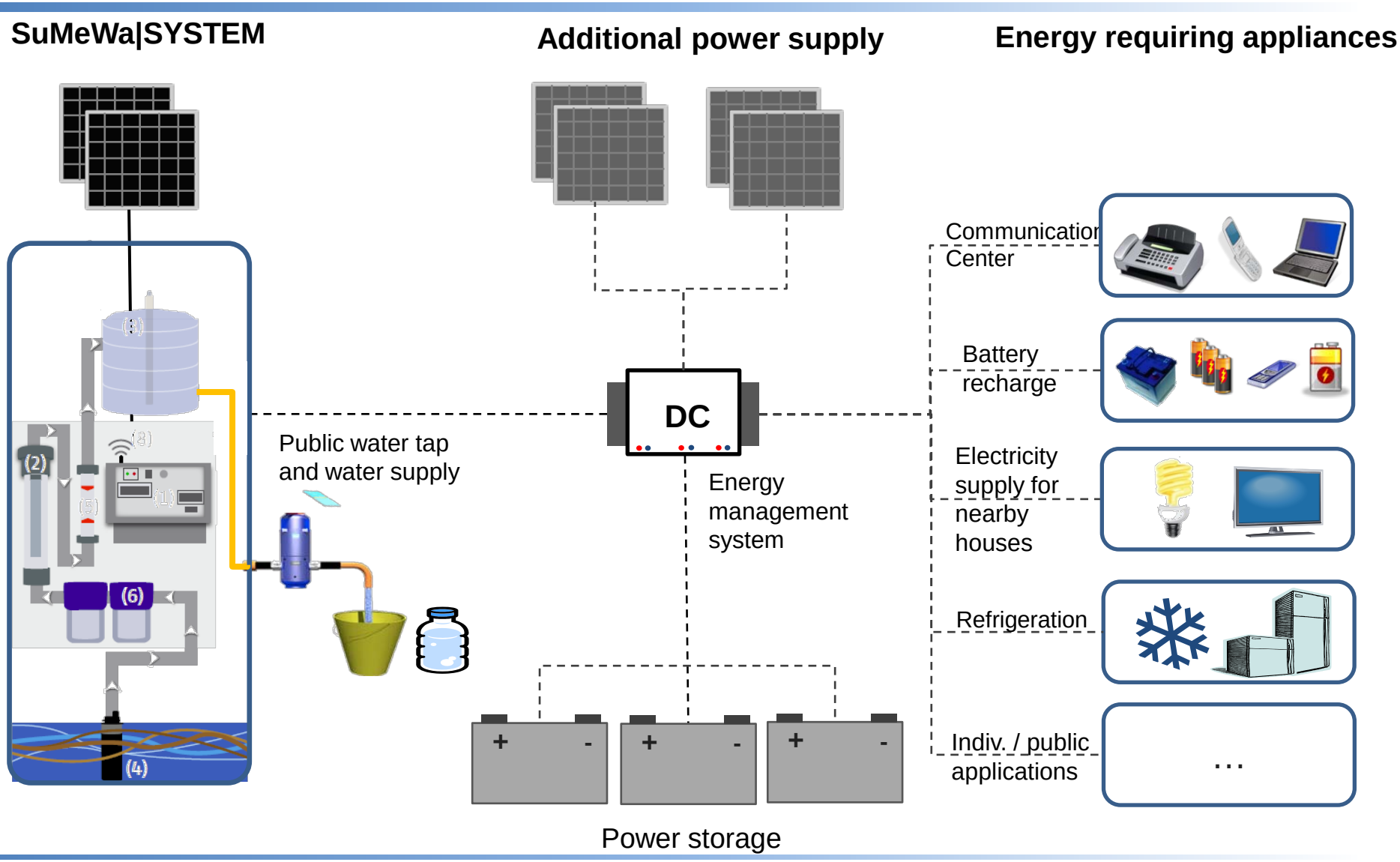
Source: collection of different sources among them WHO 2008, Röske 2006, Loo 2012, and own assumptions

Business Models – Supply of safe drinking water



Public water tap and water supply

„Water, Energy and IT Supply Service Center“



Project: Western Desert Egypt

Oasis

- Groundwater from 700 m
- Very high iron and manganese content
- Power supply only with diesel generators (1h per day)

- Currently 5 units installed
- ~ 500 persons per unit

- Additional 6 units ordered

Western Desert Egypt

Examples AUC RISE Egypt

Installation by local people

Examples Egypt Western Desert

Examples Egypt Western Desert

Training for Maintenance

Creation of water business

Creation of water business

- “Local” water supply – delivery 30 km

Conference Announcement:
Solar Energy Solutions for Electricity and Water Supply

Cairo, Egypt, 7. – 10. October 2015

2 Days Conference Programm

2 Days Excursion into Western Desert

First International Conference on

SOLAR ENERGY SOLUTIONS FOR ELECTRICITY AND WATER SUPPLY IN RURAL AREAS

THE AMERICAN UNIVERSITY IN CAIRO

October 7 - 10, 2015

This conference aims to showcase and discuss promising approaches and applications for different types of renewable energy as sustainable solutions for rural populations with no access to centralized power and water supply. The focus is on solar electricity and its economic applications for village electrification and the supply of safe drinking water. In addition to photovoltaic solutions, small wind generators as well as small hydro and biogas systems for heat and electricity generation will be discussed.

For over a billion people around the globe, safe drinking water and sustainable energy are unavailable. Despite numerous announcements and ambitious plans by national and international organizations, this situation has improved very little over the past 30 years. During the same timeframe, renewable energies have undergone impressive advancements, both in terms of the development of mature technologies and in their economic competitiveness with fossil fuels. This has given rise to new and more economic applications for rural development.

THE AMERICAN UNIVERSITY IN CAIRO
الجامعة الأمريكية بالقاهرة
Research Institute for a Sustainable Environment

Topics

Papers are invited on the following topics:

Presentations*

1. Sustainable systems for the supply of safe drinking water
2. Village electrification systems based on renewable energy
3. Renewable energy for water pumping and irrigation systems
4. Practical examples of renewable energy solutions in rural and urban environments

Panel Discussion

- Financing models for the dissemination of solar energy solutions

Workshop

- Cooperation of government agencies, NGOs and the private sector in developing renewable rural energy solutions

*Submit paper abstracts by **June 30** by email to **rise@aucegypt.edu** . Instructions for submission are available at: www.aucegypt.edu/rise/solarconference

Abstracts will be reviewed by members of the Conference Advisory Board.

Organized by the Research Institute for a Sustainable Environment (RISE), AUTARCON and SolarInput

AUTARCON

SolarInput

RED Water Film

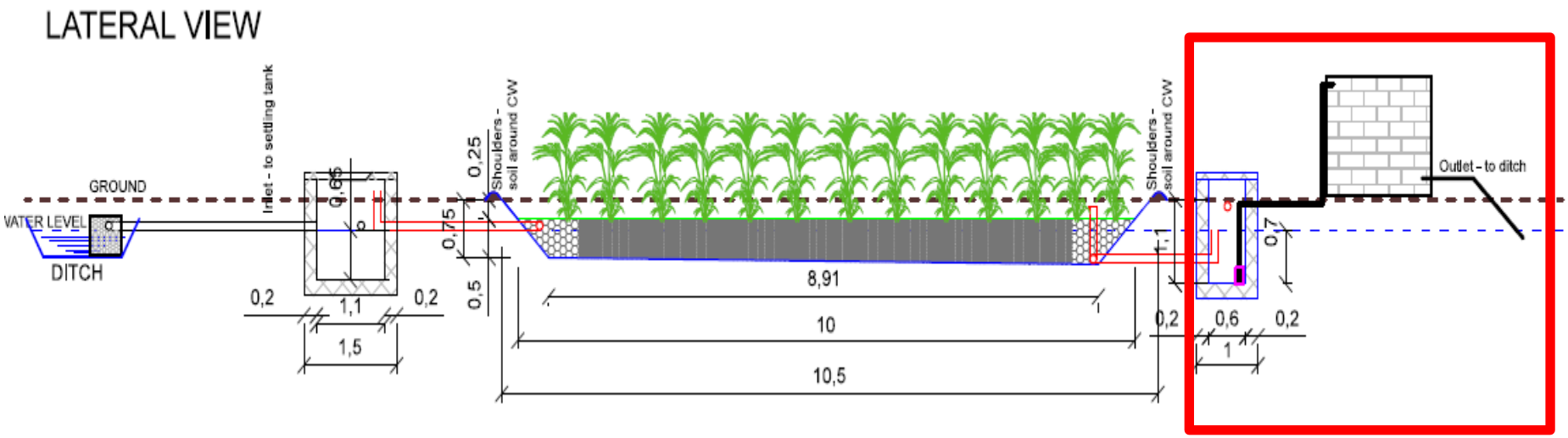
Questions and Answers

SuMeWa|SYSTEM: Examples worldwide

Examples India: Kalyani University

Setup of bank filtration and solar driven disinfection systems for pond effluent polishing.

IGNTU, MP: gravel bed effluent polishing



IGNTU, MP: Reedbed Effluent polishing

Lalpur, MP: water village supply

Delhi, Pakistan, Gambia, Brazil

India, Ethiopia, Pakistan

Areas of Application

1. Private sector
2. Public water utilities
   - Decentralized water treatment
   - Water refreshment in storage tanks
   - Safe supply of remote villages
   - Schools, hospitals, public buildings
   - Informal settlements
   - Emergency response
   - …

Core benefits for public water suppliers

Secure, permanent and safe production of disinfected water

- Compliance with national regulations and standards
- Trustable and reliable drinking water quality
- Very low maintenance and operational costs due to solar energy supply

Permanent online control of water quality allows

- Reduction of maintenance
- Reduction of water quality control (no chlorine tests needed)
- Constantly proven and recorded safe water supply

Maintenance on Demand

- No “preventative“ maintenance
- Short reaction time in case of malfunction
- Quick recovery of safe system operation

Core benefits in cases of natural disaster

Easy installation, quick access to clean water

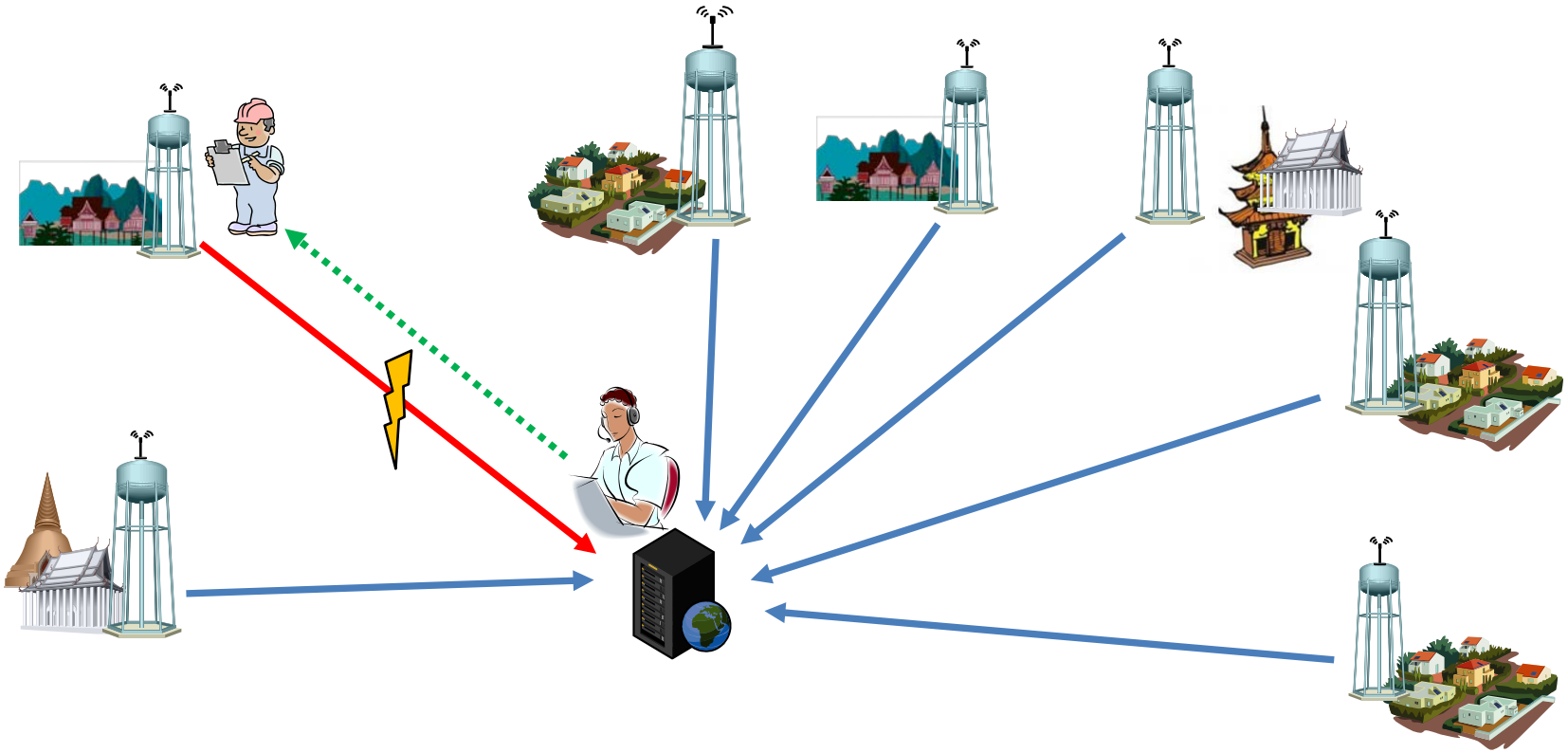
- Only 40 kg
- Complete equipment in one box 85x65x45 cm
- Easy to transport to disaster location
- Installation time 30 min
- No energy supply required
- Transforms surface water into safe disinfected drinking water
- Permanent online control of water quality

→ Exclusion of drinking water as source for infection

Remote online monitoring of decentralized water supply

Efficient operation and maintenance structure

- All parameters are automatic controlled and can be sent online
- Maintenance only required in case of malfunction



AUTARCON - Innovation durch Erfahrung

Spezialisierung liegt auf der dezentralen

- Ab- und Trinkwasseraufbereitung
- Überwachung der Wasserhygiene
- Solare Energieversorgung

für Entwicklungsregionen

Derzeitige wissenschaftliche Aktivitäten:

- European Union - FP7
  - SWINGS India: Nachhaltige Abwasseraufbereitung und Wiederverwendung
- BMBF KMU Innovativ
  - SolArEx – Solargetriebene Entarsenierung
  - $UFCl_2$- Membranfiltration und automatische Reinigung

SEVENTH FRAMEWORK PROGRAMME

Bundesministerium für Bildung und Forschung

AUTARCON Pure. Simple. Solid.

Member of German Water Partnership

iKU Der Innovationspreis für Klima und Umwelt 2013

Legal requirements drinking water supply (excerpt)

Parameter	WHO (2008)	India (IS 10500-2009)		Germany (TVöD)	To be reached with SuMeWa
		urban	rural		
Chemical					
Residual Chlorine	≥ 0.5 mg/L	min. 0.2	1.0	0.3	0.1 – 2.0 mg/L ✓
Turbidity	5	1	5	1	< 1 (Zeolith filter) ✓
TDS/ Conductivity	No guideline no guidline	500 mg/L	**2000 mg/L**	No guideline 2790 µS/cm	stays constant ✓
Iron	No guideline	0.3 mg/L	0.3 mg/L	0.2 mg/L	< 0.1 mg/L ✓
Manganese	0.4	0.1	0.3	0.05 mg/L	< 0.05 mg/L ✓
Biological					
E.Coli	0	0	0	0	0 ✓
Cryptosporidium	0	0	0	0	0 ✓