



**LIFE20 ENV/CY/000615**  
LIFE Environment and Resource  
Efficiency project



**Demonstration of an innovative method for the detoxification  
of pharmaceutical wastewater from pharmaceutical facilities**

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# PHARMA DETOX-General Information

**Area of implementation:** Limassol Cyprus,  
Duiven Netherlands

**Project Budget:**

3,340,922 €

**EU Funding (LIFE):**

55%

**Duration:**

66 months

**Start date:**

01/09/2021

**End date:**

28/02/2027



**Coordinating Beneficiary:**



**Associated Beneficiaries:**



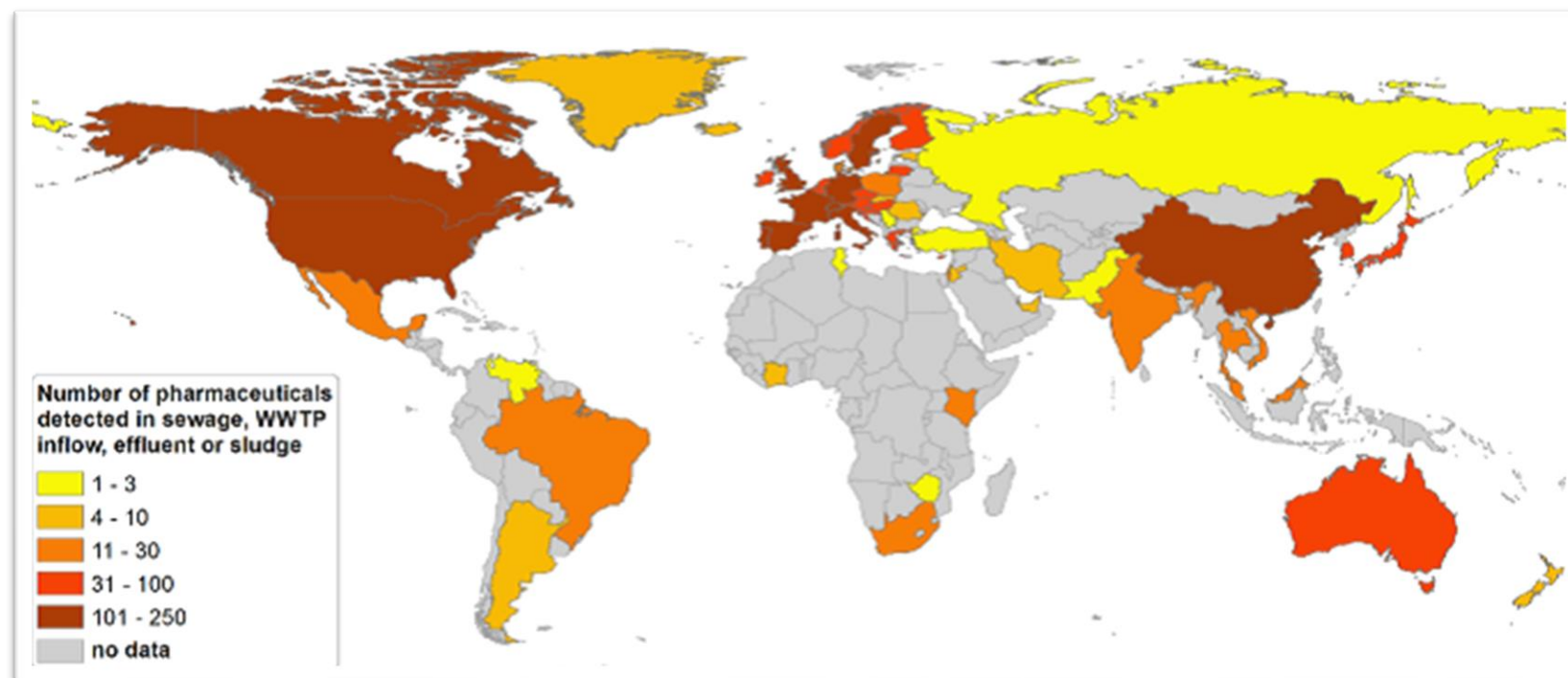
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# Pharmaceuticals in the environment

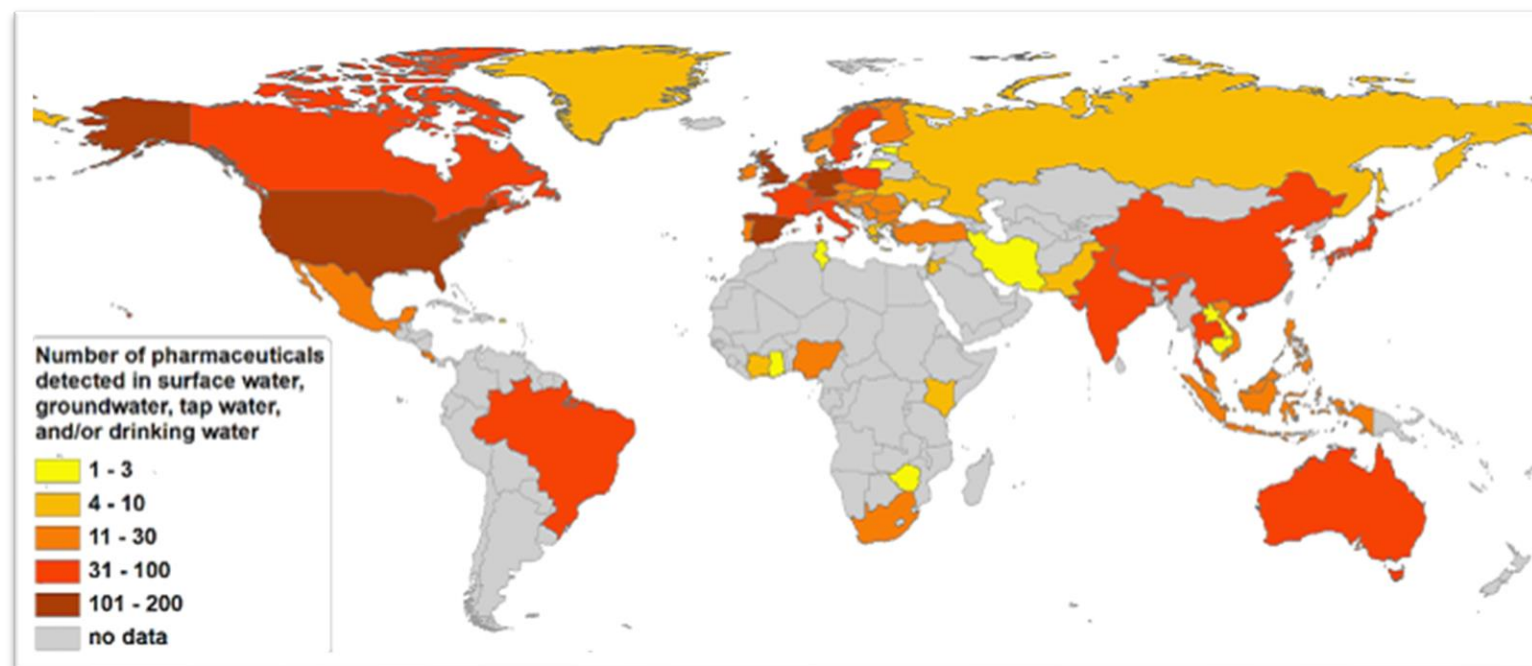
Many studies on soil, animals, fish, and water have shown the accumulation of Active Pharmaceutical Ingredients (APIs)

559 different  
pharmaceuticals  
have been  
detected globally



# Pharmaceuticals in the environment

200 different pharmaceutical substances found in surface, ground and even drinking water



***Over 100,000 tonnes of pharmaceutical products are consumed globally every year (24% in Europe).***



# Active Pharmaceutical Ingredients in Water and Soil



**Contamination by APIs** can occur through three different pathways:

- Wastewater of Pharmaceutical Industry (manufacture)
- Excretion of pharmaceuticals from animals and humans (use)
- Improper disposal of expired medicines (disposal)

## Data\* from 264 WWTPs:

Removal percentage of APIs from wastewater treatment was **lower than 10%**

Bioaccumulation of non-biodegradable APIs can cause

- Antimicrobial resistance
- Endocrine system-disruption
- Negative effects on aquatic life and plants

# PHARMA DETOX Project Objectives



**Pharma-Detox** project aims to the development and implementation of an innovative, economically viable, and cost-efficient system for the transformation of pharmaceutical compounds, present in wastewater, into non-toxic substances.

- ☁ The prototype system will be installed at Medochemie Ltd. located in Limassol, Cyprus.
- ☁ Medochemie Ltd. has many facilities in Cyprus, the Netherlands and Vietnam.
- ☁ The 2<sup>nd</sup> demonstration phase will take place in the Farmaceutisch Analytisch Laboratorium Duiven B.V., the Netherlands.



# PHARMA DETOX Pilot System

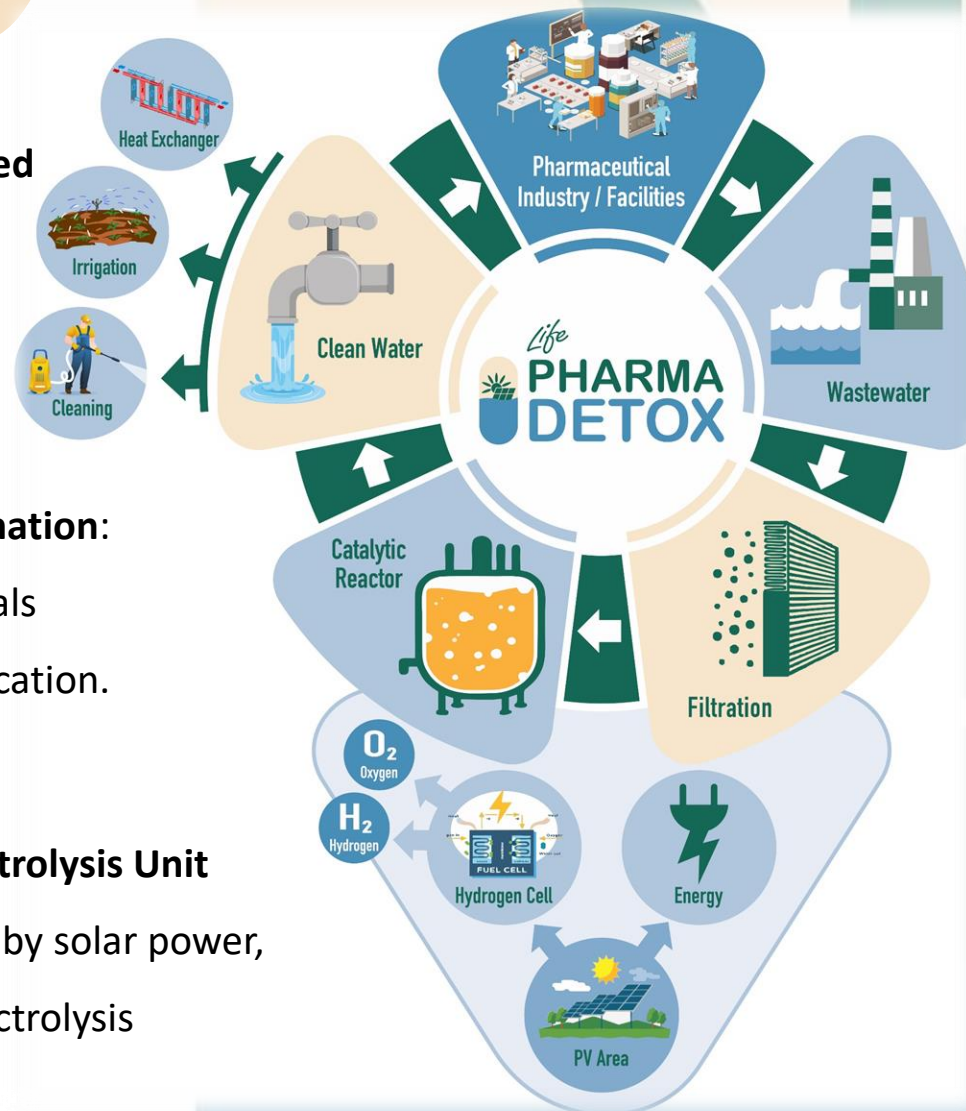
**Very Low toxicity produced water**

**Catalytic hydrogenation:**  
Pharmaceuticals  
reduction/detoxification.

**Water electrolysis Unit**  
H<sub>2</sub> Production by solar power,  
PV-electrolysis

**Wastewater produced** during the  
equipment cleaning.

**Filtration Unit:** Production of high purity  
water, 80-90% reduction of the volume of  
wastewater led to catalytic reactor



# PHARMA DETOX Expected Results



✓ **Avoid** Active Pharmaceutical Ingredients (APIs) release in the wastewater sewage system

✓ **Convert** 1,606 kg of APIs to nontoxic compounds.



✓ **Save** 3,650 m<sup>3</sup> of potable water annually.

✓ **Reuse and Recycle** clean water for irrigation or cleaning purposes or use in cooling systems.



✓ **Minimize** the system's environmental footprint using 100% renewable energy sources and no chemicals.

✓ **Transfer** the project's results to other pharmaceutical companies across Europe.

✓ **Communicate and promote** public awareness at local and regional level

✓ **Draft policy recommendations to the EU**

✓ **Market exploitation of the system** in EU industries and globally





# Concentration of APIs in Wastewater

API	Concentration of API in wastewater (µg/L)	Lowest Value of PNEC-ENV and PNEC-MIC (µg/L)
Amikacin	-	16.00
Amoxicillin	3-67 (Oral) 2,140,000-2,330,000 (Injectable)	0.25
Cloxacillin	3,573,000	0.13
Lincomycin	1,530,000	0.81

API	Concentration of API in wastewater (µg/L)	PNEC (µg/L)
Diazepam	17,500	2.50
Diclofenac	88,000	8.72
Clavulanic Acid	55,400 (Oral) 2,240,000 (Injectable)	56
Dicloxacillin	71,000	0.05

**PNEC-ENV:** Predicted No-Effect Concentrations for the environment (no eco-toxicology)  
**PNEC-MIC:** refers only to antibiotics, Minimum Inhibitory Concentration (no AMR)

# Main physicochemical parameters of Wastewater streams



## Ampoule Injectable Facility Line 1 and 2

pH: 4.6-7

Conductivity: 38-492  $\mu\text{S}/\text{cm}$

$\text{Cl}^-$ : 27-124 mg/l

COD: 2,899 mg/l –38 mg/l



## Oral Penicillin Facility

pH: 8.5

Conductivity: 140-1,051  $\mu\text{S}/\text{cm}$

$\text{Cl}^-$ : 100mg/l

COD: 2,583 mg/l -343 mg/l



## Injectable Penicillin Facility

pH: 6.5-8.5

Conductivity: 814-2,210  $\mu\text{S}/\text{cm}$

$\text{Cl}^-$ : 8-1,365 mg/l

COD: 12,207mg/- 2,497 mg/l

# Bench Scale Tests



Hydrogenation Catalytic Reactor operational parameters:

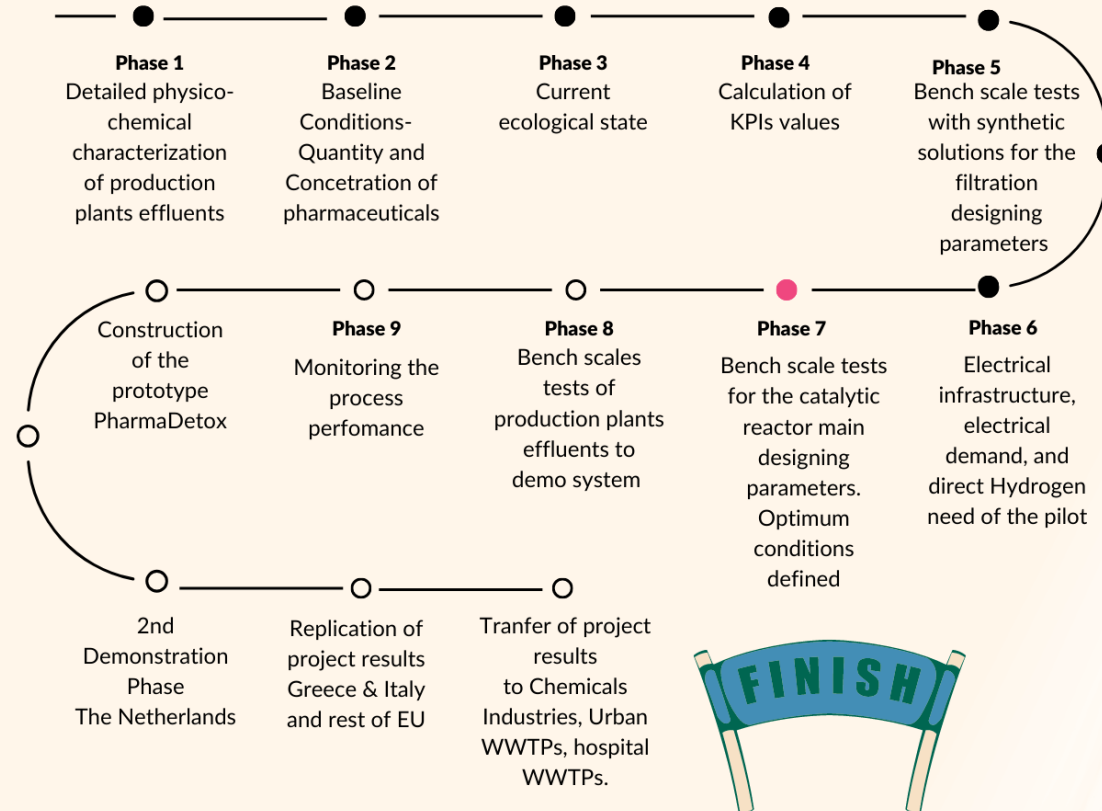
- ✓ Gaseous phase 95 vol. %  $\text{H}_2$ /5 vol. %  $\text{O}_2$ , (120 cc/min flow)
- ✓ 1 wt. % Rh on  $\text{Al}_2\text{O}_3$
- ✓ Continuous flow at 1.3 atm total pressure and 25 °C

According to the first bench scale tests

- 🧪 **Conversion** of drugs (in 95 vol. %  $\text{H}_2$ ) **>90%**
- 🧪 **Toxicity of solution decreases** to very low levels

# Progress and Next Steps

## PHARMA DETOX ROADMAP

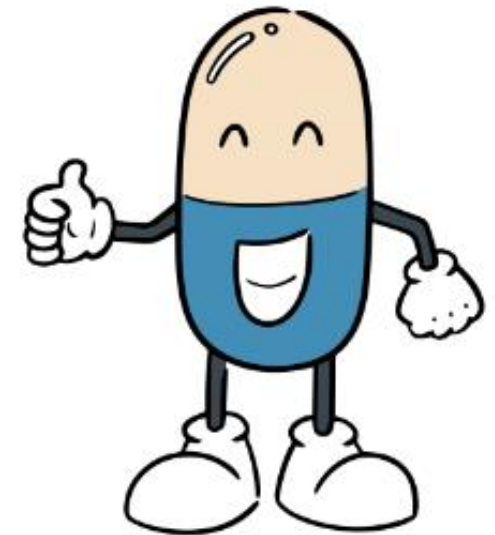




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90 <b>Th</b> Thorium 232.03806	79 <b>Au</b> Gold 196.966569	7 <b>N</b> Nitrogen 14.0067	19 <b>K</b> Potassium 39.0983
39 <b>Y</b> Yttrium 88.90585	8 <b>O</b> Oxygen 15.9994	92 <b>U</b> Uranium 238.02891	

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