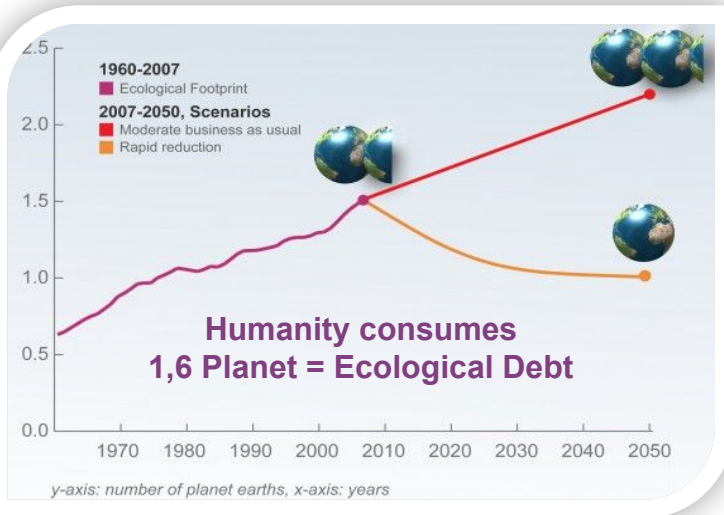


Circular Economy - UNAFIC

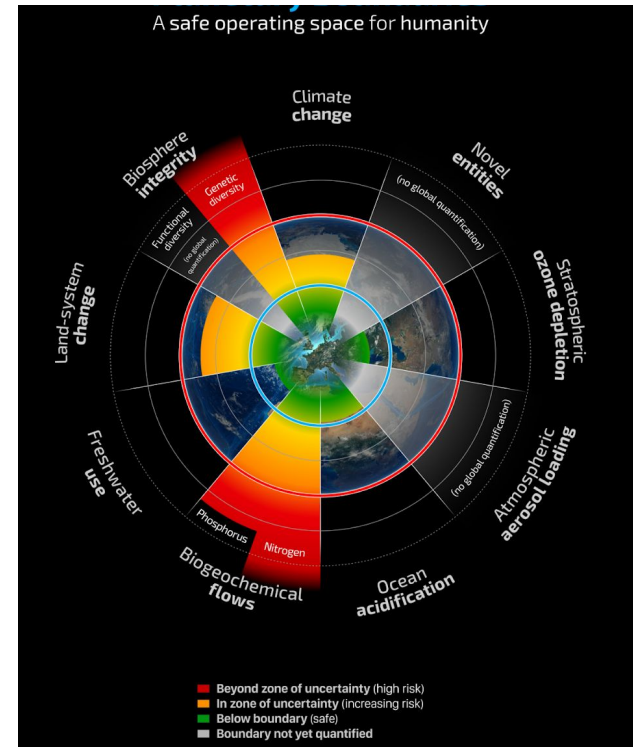
Nov 20, 2018 - Y THELIER



Global Environmental Issues



Overconsumption / Limits of the planet



WHY ?

→ Demography: 9 billion inhabitants in 2050

→ Climate change: +2°C

→ Linear System

Agenda



1. *Circular Economy*
2. *The Chemical Industry Context*
3. *Circular Economy Business Models & Framework*
4. *Business Cases in the Downstream Industry*

Circular Economy: DO MORE WITH LESS

Objective: Looking beyond the current "take, make and dispose" extractive industrial model.



WATER

- Contracts focused on by-product recovery/ sludge process & recovery, digestion and co-digestion.

- Water re-use



WASTE

- Solid Waste Recycling Centers
 - Plastic recycling
 - Energy recovery
- Methanization & Landfill gas to energy
- Mechanical Bio Treatment & organic production
 - Depackaging & Trading
- Hazardous waste recycling

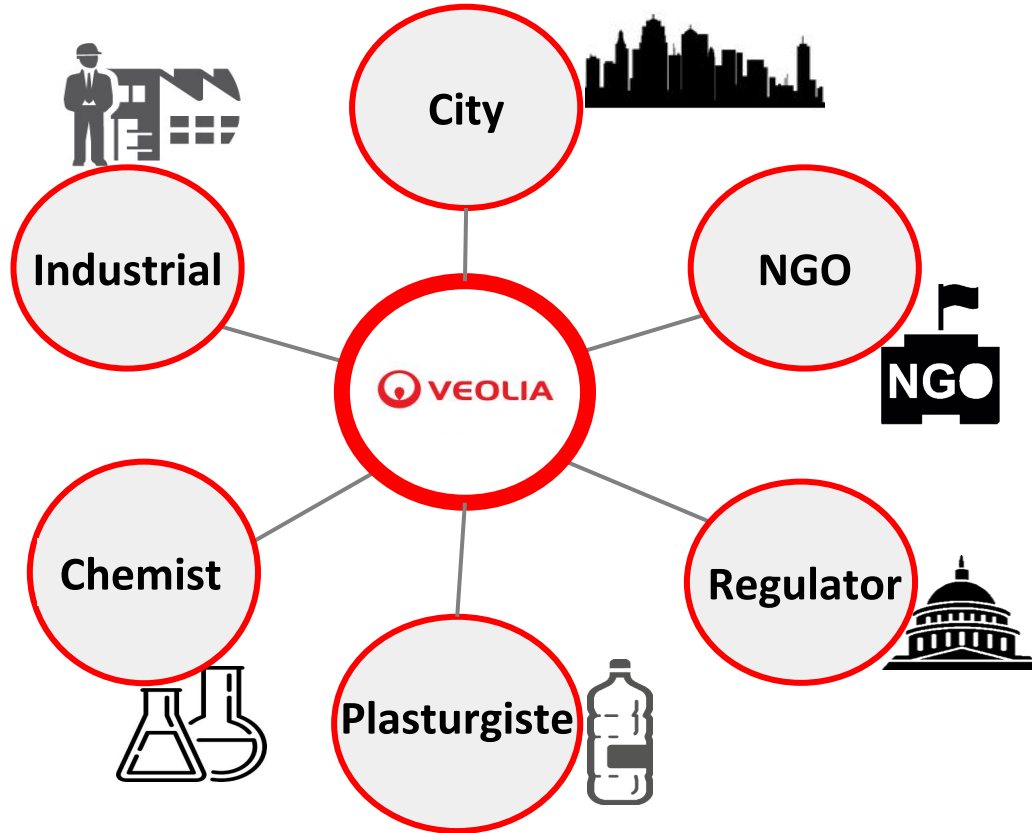


ENERGY

- Production and distribution of energy
 - Related works and maintenance, including in that case the production of electricity out of cogeneration

- Energy efficiency/ performance-based contracts for all type of buildings & utilities.

Social responsibility & multiple stakeholders : cooperation



**€4.4 billion in 2017
(circular economy)**

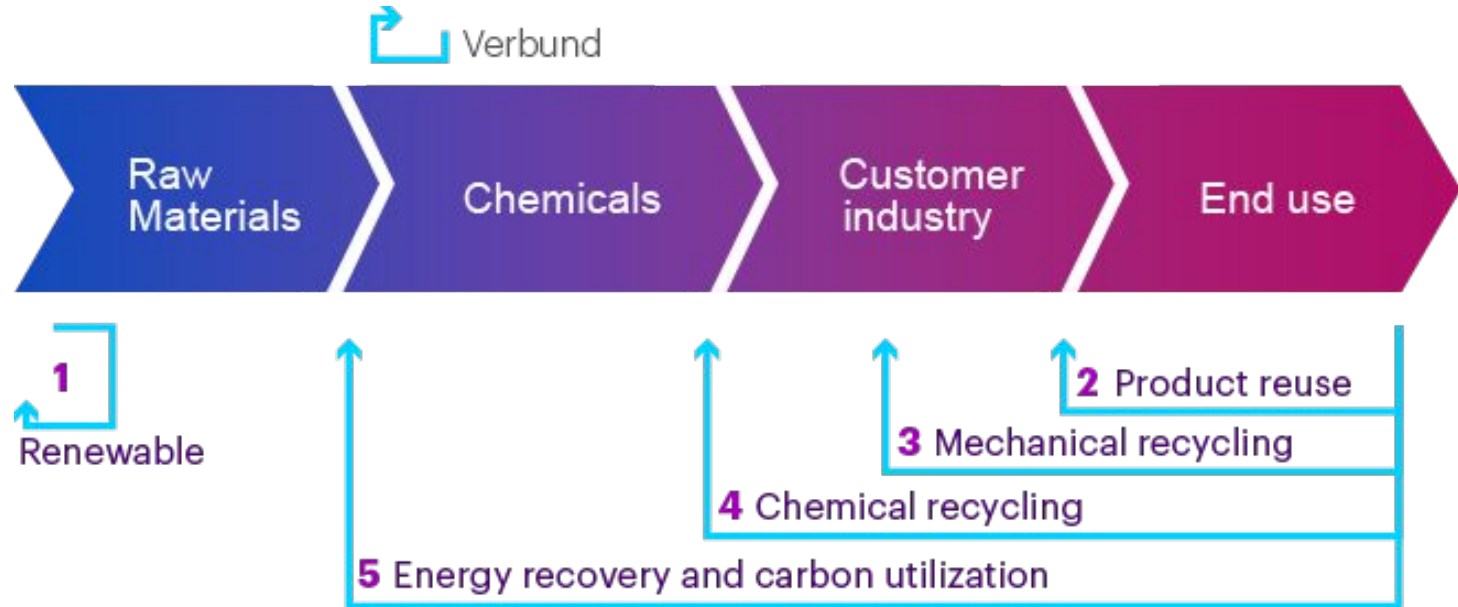
**playing a leading role
accompanying industries with
strong regulations or social
pressures to circular economy**

Agenda



1. *Circular Economy*
2. *The Chemical Industry Context*
3. *Circular Economy Business Models & Framework*
4. *Veolia Business Cases in the Downstream Industry*

Specific Loops to the Chemical Industry



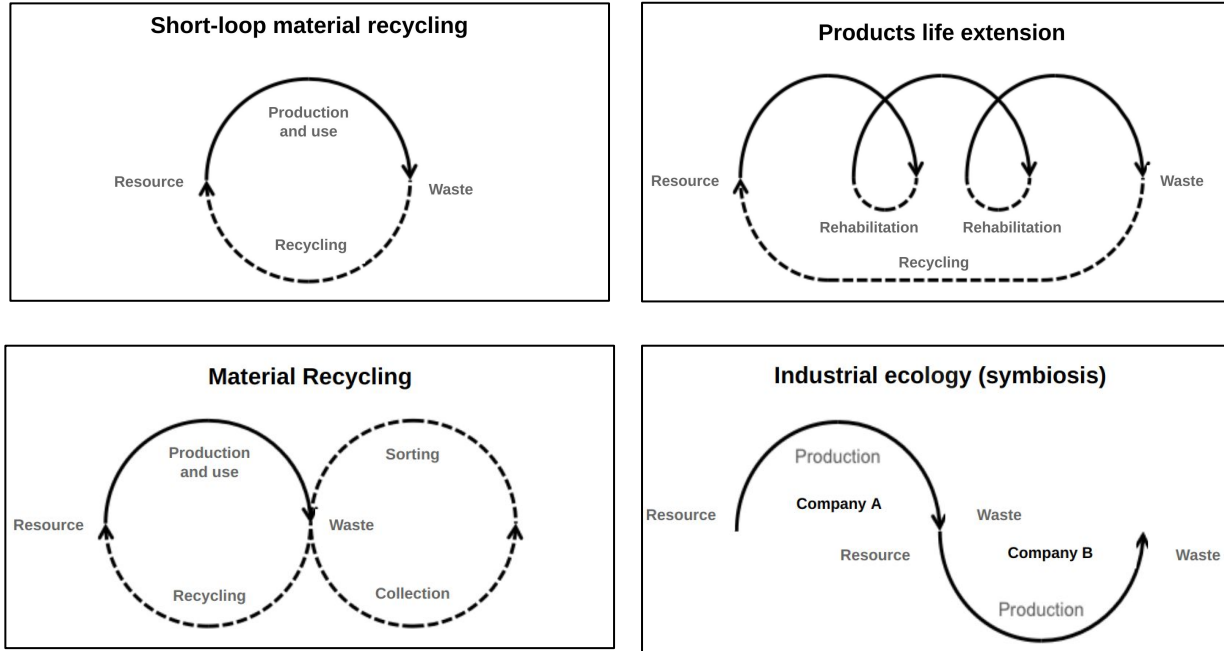
Source: Accenture

Agenda



1. *Circular Economy*
2. *The Downstream Industry Context*
3. *Circular Economy Business Models & Framework*
4. *Business Cases in the Downstream Industry*

Circular Economy Framework A Diversity Of Loops



Agenda



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Circular Economy Business Cases in the Downstream Industry

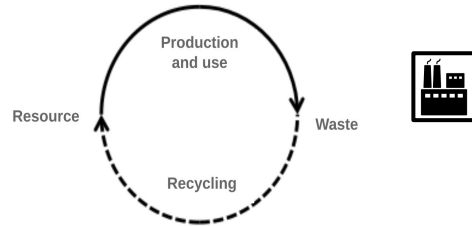


SHORT LOOP

Water Reuse - Reducing the Water footprint

Sinopec, China

Short-loop material recycling



Yanshan Petrochemical, China (Wholly owned subsidiary of Sinopec)

Context

- Region faces a **water deficit and shortages**
- One of the largest production sites for high-quality synthetic rubber and resin, phenol, acetone and refined petroleum products. It processes more than **10 million tonnes** of crude oil and produces 800,000 tonnes of ethylene per year.

Opportunities

25-year contract

- Veolia and Beijing Yanshan Petrochemical decided to **extend the scope of their partnership to the management of the entire water cycle** on the Yanshan site, in particular cooling water, demineralised water, industrial water, drinking water, chilled water, wastewater, and the fire water loop.
- Veolia will optimize the water consumption on the site and **increase the water-recycling rate**.
- Modernizing the wastewater treatment plant to bring it into line with the latest standards in the Beijing area.

Impacts

→ Implementation of a comprehensive energy optimization program, covering all the water production facilities on the site.

→ **Reduce** freshwater consumption and Beijing Yanshan Petrochemical's water footprint



Water Reuse - Reducing the Water footprint

Sinopec, China

Business Model

- 5,600,000 m3/d. of recirculated cooling water
- 40,000 m3/d. of industrial water
- 74,000 m3/d. of demineralized water
- 37,700 m3/d. of chilled water

Provide full operations, maintenance and upgrade of the cooling, demineralized, industrial water, drinking water, chiller water, waste water and fire-fighting water.

Benefits for Environment



Secure compliance with local regulations DB-11/307-2013 :

Enable to meet the new discharge regulation regarding **COD level to 30mg/l** in Nikouyu lake
- value taken of punctual sampling (every 2 hours)

Benefits for Clients



- **Treat the brine** from this existing plant in order to achieve Zero Liquid Discharge objectives
Dealing with **"crisis situation"** : BYPC faces recurrent pollution of their cooling loops (heat-exchangers leakages) requiring strategies to contain and to treat the problem.

- Ensure **water production continuity** while upgrading the critical assets and quality to reduce and **avoid plant downtimes**.

- **52%** expected energy savings, **5GWh** saved per year, with ROI less than **2 years!**

Financial Agreement

Joint-Venture (50-50) between Veolia & BYPC



50%

50%



Beijing Yansan Veolia Water Co.

JV agreement amendment
Veolia operational control

Capital Increase agreement
Veolia in cash / Sinopec : Asset transfer

BYP set up a **25-year equally-owned joint venture** to take over, upgrade and operate all the existing wastewater facilities :

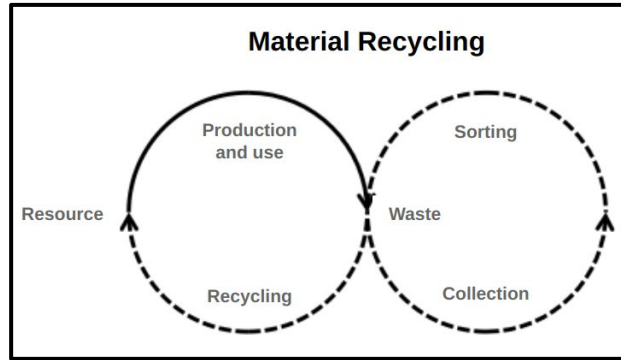
- AOT with retrofit
- O&M on domestic water treatment
- facilities and fire-fighting facilities

Circular Economy Business Cases in the Downstream Industry



MATERIAL RECYCLING LOOP

Material recycling



Context

- Recycling material rely on the loops recycle, compost and methanation (longer loops).
- Today, this model isn't performant as in each cycle the material partly loses its value. It is used as « end of pipe » solution by the linear economy.

Opportunities

- Solution to optimize this model: **Cradle to cradle approach**
- **End waste of single-use packaging.** Industrial using single use packaging need to manage their materials in loop.
- **Reduce the built industry's waste**
- **Reduce the chemical industry's dependance on hydrocarbon** (mechanical recycling, chemical recycling and use of renewable raw materials).

Impacts

- Secure raw materials supply
- Reduced **costs** of waste management
- Increased **revenue** streams from selling unwanted outputs
- **Costs** of recycled materials is lower than virgin ones allowing industrials to reduce their buying costs (not true for plastics industry)

Successful Conditions

1/ **Optimize materials' supply chain:** make recyclable products (choice of material, no use of toxic components..)

2/ **Organize material branch**

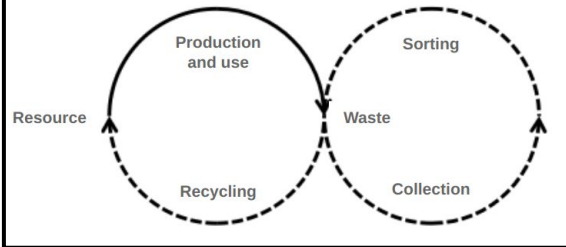
3/ **Improve the offer:** increase the collect quantity, reduce its costs improve the sorting of waste and recycling process and infrastructures, improve information on recycled materials

4/ **Improve demand:** incentive industrials to use recycled materials, develop norms and adapt regulations

Bottle To Bottle, From The Source To End User

Rostock, Germany

Material Recycling



Rostock, Germany

Context

- Europe's plastics manufacturers would like to find ways to extend the life of their products indefinitely.
- It's a goal shared by numerous European Union countries that have established incentives and requirements for recycling plastic packaging in particular.

Opportunities

- Developed a flake-based recycling method for PET (polyethylene terephthalate) bottles that allows direct reuse of the recycled material for new food packaging, e.g. a new beverage bottle.
- Converts 1 billion PET drinks bottles/ year into so-called recycleate from which preforms/bottles can again be manufactured.

Impacts



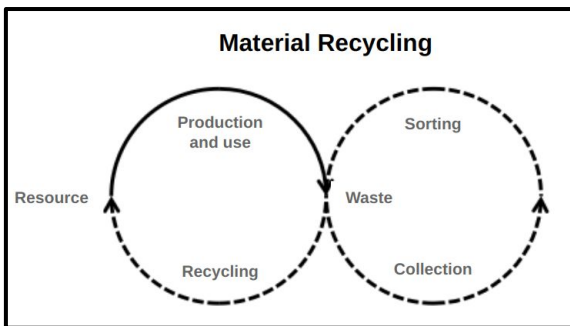
- **1 billion bottles** recycled each year
- **31,000 metric tons** of petroleum saved
- Up to 50% of recycled PET can be used to produce new bottles.



- Compliance with the principal regulations governing food contact materials in the EU and the US.

Mechanical plastics recycling

The Netherlands Case



The Netherlands

Context

- Dutch government releases a government-wide program for Circular Economy(2016-2050) :
 - All raw materials will be used and reused efficiently
 - In case new raw materials needed, they will be obtained in a sustainable manner
 - Product and materials will be designed in a such way that the can be reused

Opportunities

Veolia is now the European leader in recycling and manufacturing high-quality polypropylene.

- At its Vroomshoop site in the north of the Netherlands, Veolia transforms plastic flakes - 90% of which are from household waste - into recycled plastic whose characteristics are identical to those of virgin plastic.

Impacts



→ **53 Kt/y of plastic recycled**

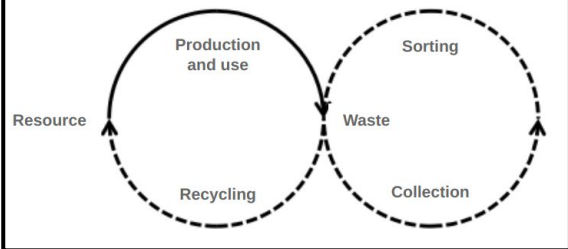
→ The quality of the plastic is constant and can be used to make piping, outdoor furniture and household appliances.



→ Compliance with the principal EU regulations

Osilub - Re-Refining Waste Oil Into Base Oil France

Material Recycling



Osilub plant (inaugurated in 2013)
Gonfreville l'Orcher, France

Context

- Less than **50%** of oil collected nationally is currently recycled.
- The **Osilub plant** is set in 2013 to increase the motor oil treatment capacity in France and more generally in northwestern Europe, to regenerate used oil into high-grade lubricants.
- Plant capacity: **120,000 tons per year**, or nearly 50% of the volume of used oil generated in France each year

Veolia's Opportunities

- A **dynamic partnership** with Total Lubricants; leaders in the oil manufacturing sector.
- Opportunity to make possible the **recovery of used oil** in the best manner, enabling us to provide our clients with very high quality products, in a virtuous process of a circular economy.
- A **product life cycle that can be repeated again and again**, providing the best solution to conserve natural resources for future generations

Impacts

→ **90%** of incoming material is re-refined into oil products in compliance with Customs and Petroleum Committee requirements

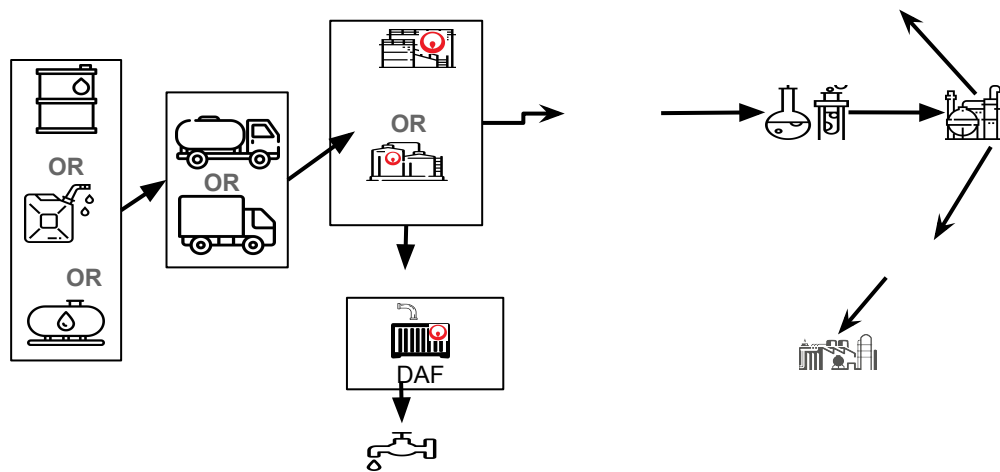
→ Meet European Directive 2008/98/EC that specifies that **recycling of waste is the best solution to preserve natural resources**



Osilub - Re-Refining Waste Oil Into Base Oil France

Business Model

- Total Investment: **€55 million** invested.
- Partnerships :
 - **Veolia** (65 %)
 - **Total Lubrifiants** (35 %)
- **Local Havres Community** (CODAH) :300 000 €
- Contract: **Build-own-operate**



Technical Innovation

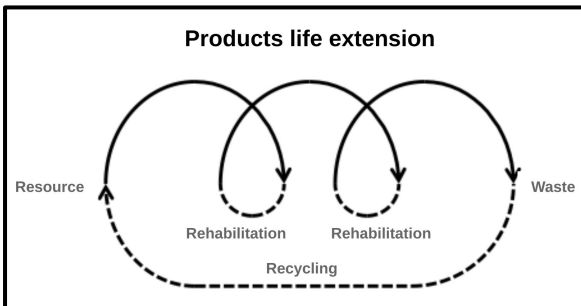
- Scraped-film vacuum distillation is based on processes used by the fine chemicals industry. It **preserves the oil molecules and ensures a high yield**.
- As the oil passes through a series of treatment stages, scraped film distillation sorts reusable components, removing foreign or contaminated elements with remarkable precision, **yielding 75% regenerated oil**.
- The base oil produced by Osilub can be used in high-grade motor oils that meet the **most recent specifications**.
- Treatment of the oil produced by Osilub is finished at the neighboring Lubricants plant.

Circular Economy Business Cases in the Downstream Industry



PRODUCTS LIFE EXTENSION LOOP

Recycling/Regeneration for Sulfuric acid USA



North America, United States

Context

- Sulfuric acid has applications in **almost every industry** (manufacture of batteries, fertilizers, synthetic fibers, cosmetics, and also oil refining).
- In the USA, **100 refineries** with alkylation units use either sulfuric acid or hydrofluoric acid as the production catalyst.
- The increasing demand for sulfuric acid and the increased production of spent acid in oil refineries & chemical plants make regeneration & reuse an interesting option.

Opportunities

- **7 Sulfuric acid production facilities** – Acquired in mid 2016
 - Regenerate spent sulfuric acid back to relatively pure and concentrated sulfuric acid for reuse
 - Continuous onsite treatment of acid gases to avoid refinery shutdowns. (Acid gases used as feedstock)
- **1.9 Million total acid production** in 2017
- **40+ Years of Experience** in Sulfuric Acid Regeneration

Impacts

→ Our plants not only regenerate the refiner's spent acid, but also recover a refiner's acid gas as sulfuric acid or other sulfur product/

→ As an American Chemistry Council Responsible Care® member, Veolia committed to providing high-quality services to our customers.



Recycling/Regeneration for Sulfuric acid USA

Technical Solution

- Some plants use Spent Acid Regeneration (SAR) processes, where unreacted sulfuric acid that was used in other processes is regenerated for re-use
- SAR unit is used to regenerate the sulfuric acid used as the catalyst in the H_2SO_4 alkylation process at the refinery.
- KOH used to regenerate the base used as a neutralizer of the fluoridric acid catalyst in the HF alkylation process at the refinery.
- Having on-site reduces transportation costs of the acid/base as well as load/unload infrastructure and costs.
- SAR unit generates significant amount of steam that can be used in the refinery.

*The Red Lion
SAR/SGR plant in
Delaware City, DE*



Red lion Plant is
**producing 93% and
99.2% sulfuric acid**



Benefits for Environment



Compliant with EPA's "Tier 3" Rule

- Reduces the amount of sulfur permitted in gasoline from 30 ppm to 10 ppm
 - "Tier 2" in 2000 reduced permitted sulfur from 300 ppm to 30 ppm
- Complete **waste traceability and reporting**
 - Reduce offsite waste handling
 - Reduced environmental footprint / **Zero risk to employees**



Benefits for Clients



→ **Avoided treatment and disposal costs**

→ Economically beneficial onsite regeneration of sulfuric acid

→ Use acid gas as feedstock to make sulfuric acid or other sulfur products

→ Asset financing

→ Guaranteed uptime of critical assets to ensure your production

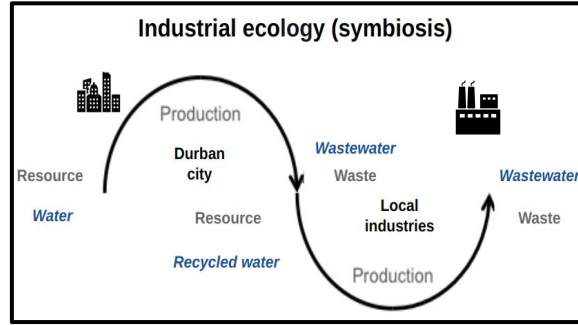
Circular Economy Business Cases in the Downstream Industry



INDUSTRIAL SYMBIOSIS LOOP

Recycling wastewater for industrial reuse

Durban, South Africa



Durban, South Africa

Context

- **Scarcity of water** in South Africa's Durban region.
- **Increased demand** in drinking water and high-quality water in growing industrial sector.

Objective

- Municipal wastewater reuse for process and cooling water production

Opportunities

Veolia recycles the city's wastewater since 2001, for reuse by local industries.

Successful **Public-Private Partnership** including various stakeholders (the first ever signed in South Africa):

- Durban Metro,
- Mondi pulp & paper industry,
- Sapref refinery,
- Veolia

Impacts



→ **98%** of municipal wastewater recycled
→ Additional **40,000 m³** of drinking water produced each day



→ Using recycled water also enables industrials to reduce their costs: the project's partners achieve **5 million euros** in annual savings.

Recycling wastewater for industrial reuse

Durban, South Africa

Benefits for Durban

- The sale of treated wastewater to the industry has freed enough demand of potable water to **supply 400,000 extra people in the city**.
- Delay investment on potable water production and distribution of water to all communities
- Indirect increase of drinking water resources



Benefits for Industrial Clients (Mondi & Sapref)

- Savings: **30% savings on process water**
- Risk mitigation: reduced the risk related to water availability (agreed price for the next 20 years and higher security in case of scarcity events)



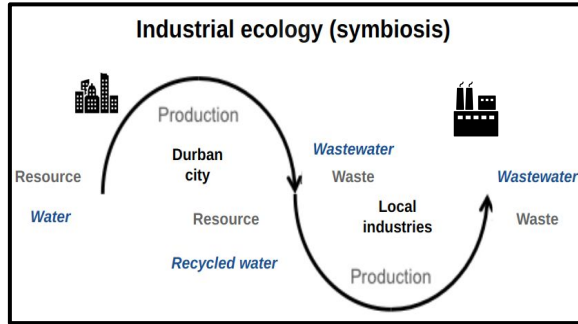
Benefits for Environment

- **10 percent reduction of wastewater discharged** into the ocean, mitigating pollution impacts.
- Multi Quality of wastewater tailored for the different uses (fit to purpose) and consistent quality of the treated wastewater



Recycling wastewater for industrial reuse

Vila-Seca, Tarragona, Spain



Context

- Tarragona Petrochemical Park: 25% of Spanish chemical production in seasonal water scarce area.
- Water requirements cover 61 municipalities (120 MLD) + 29 industries (75 MLD).
- UNESCO-protected Ebro River cannot ensure that full municipal + industrial supply.

Objective

- To reuse of high quality reclaimed water from two nearby urban wastewater treatment plants to supply industries: *Repsol, Dow, BASF, Bayer, Solvin, Messer, Clariant, Catalan Water Agency*

Opportunities

Recycling of the the city's wastewater since 2013, for reuse by local industries.

- Veolia installed an enhanced physicochemical pre-treatment process to address high water quality variability and meet the high water quality criteria required by industrial end users.
- Comprising 3 phases, the plant will grow from 6.8 hm³ /year to 10.5 hm³ /year and to a final maximum flow of 20 hm³ /year.

Impacts

→ Reduce river water withdrawal, reduce WW pollution

→ Allows industrial expansion with the same freshwater withdrawal



Recycling wastewater for industrial reuse

Vila-Seca, Tarragona, Spain

Technical Solutions



Reclaimed water blended with Ebro river water (40%, aiming to 90% reclaim) make-up water of ethylene cracker.

Compound	Ebro River	Reclaimed water
Conductivity	950 $\mu\text{S}/\text{cm}$	19 $\mu\text{S}/\text{cm}$
Cl	95 mg/L	2.94 mg/L
CaCO ₃	260 mg/L	<0.1 mg/L
SO ₄	160 mg/L	0.0167 mg/L
NH ₃	0.1 mg/L	<0.8 mg/L
PO ₄	0.1 mg/L	<0.002 mg/L
TOC	1.2 mg/L	<0.3 mg/L

THANK YOU FOR YOUR ATTENTION

