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VISIT OF ROSIGNANO SITE A FOCUS ON PEROXIDES ACTIVITIES

October 12, 2017

PROGRAM

PEROXIDES OVERVIEW

- > Roadmap overall view
- > H₂O₂ technologies
- > Focus on aquaculture
- > Sustainable Development

ROSIGNANO OVERVIEW

- > History and challenges
- > Rosignano's new energy deal, ensuring the site long term future
- > H₂O₂ in Rosignano & businesses interactions

PEROXIDES OVERVIEW

ROSIGNANO OVERVIEW





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Peroxides

Overview

Georges Crauser
President of Peroxides

Rosignano site, Italy
October 12, 2017

Solvay is leader in Hydrogen Peroxide

Key Figures



Production capacity & sites include all JVs
Net sales of 2016

H₂O₂, growth driven by sustainability

1*

+0,5 MMT



Textiles

1970s



3*

+1,3MMT



Pulp
Bleaching

1990s



4.5*

+1,2 MMT



HPPO
for polyurethane

2010s



H₂O₂ in new
chemical routes



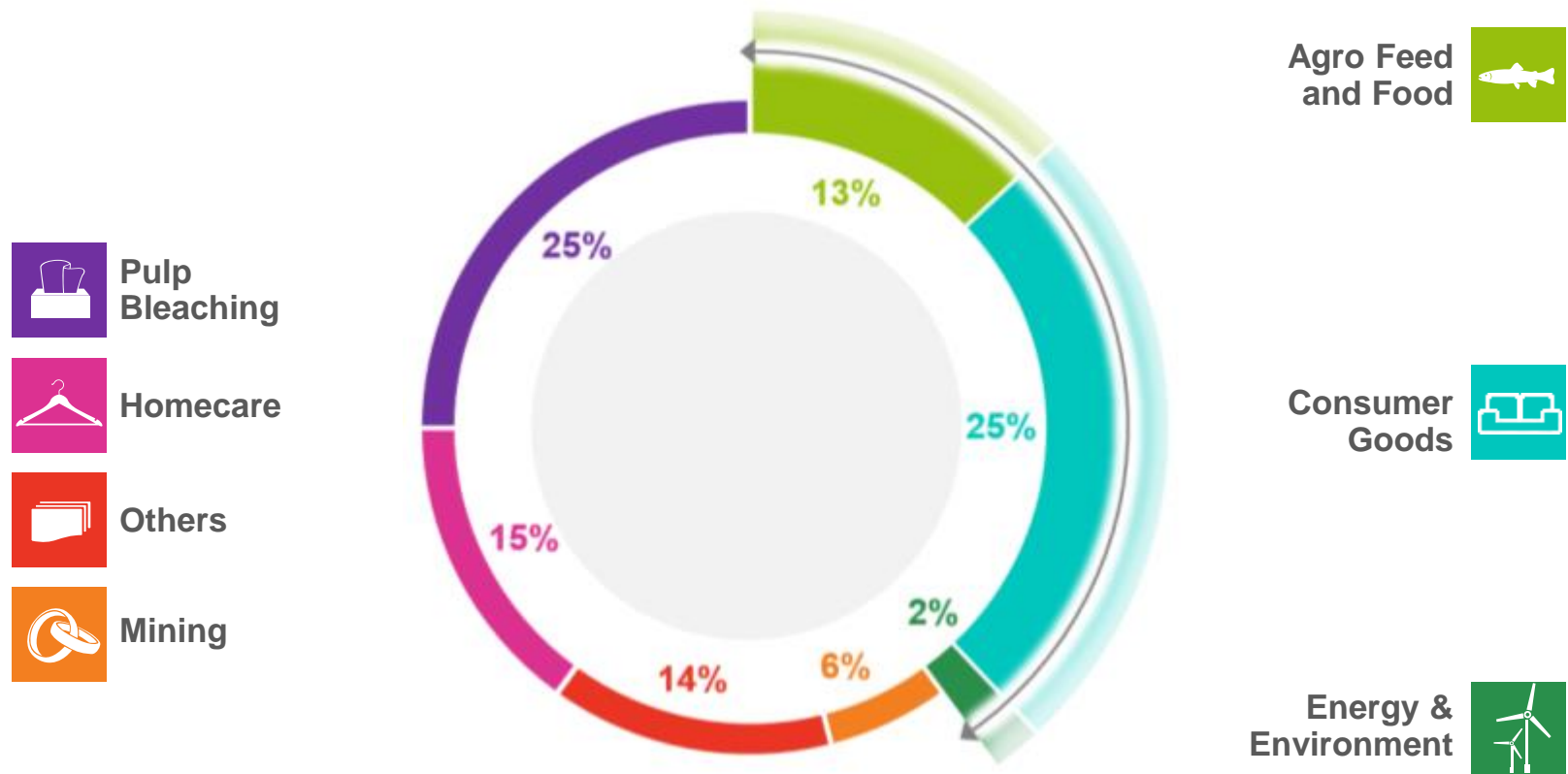
Aquaculture,
Food, Water

2015>

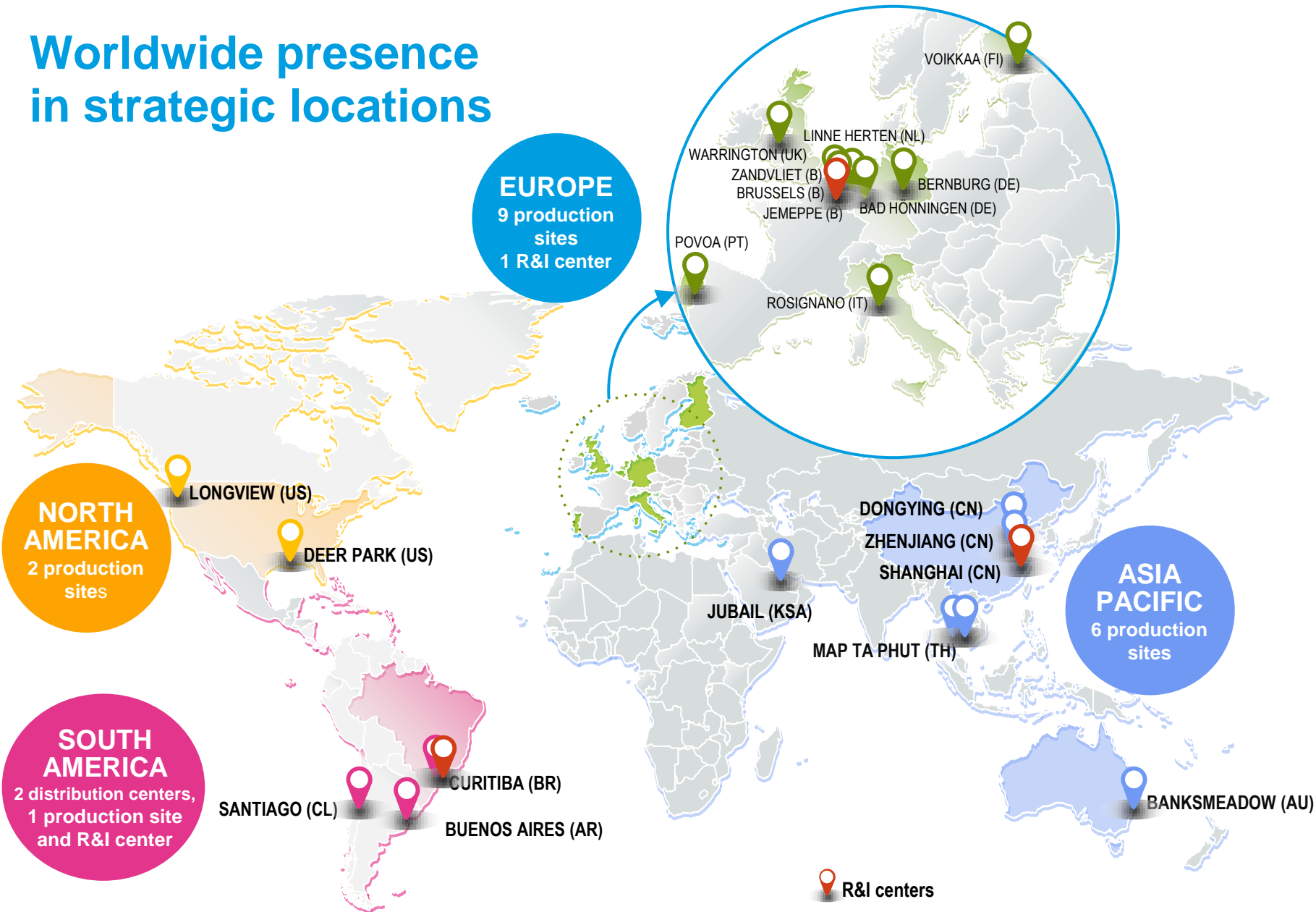


* Approximated H₂O₂ global demand (Millions Metric Tons) - Sources Peroxides Team analysis

Serving well-diversified, growing markets



Worldwide presence in strategic locations



Innovation through technology and applications

APPLICATIONS

Disease control

Hard
pollutants

Unmet needs

AQUACULTURE



WATER TREATMENT



**NEW COMPLETE
SOLUTION TO BE
DEVELOPED WITH
Customers**

CUSTOMER

IN YOUR PLANT



LARGE VOLUMES



STANDARD



TECHNOLOGY

Flexible

Adaptable

Sustainability as part of the strategy

Peroxides 2020 mid-term aspiration

SAFETY

<0.5

MTAR rate
Peroxides (-45%)

CARBON INTENSITY

-34%

CO₂ emissions/
Ebitda

ORGANIC WASTE

5

Tons organic waste
per Peroxides plant
per year (-82%)

Contribute to *Society*

Local societal actions
Social business solutions

Innovate *Sustainable* solutions



Ecofriendly products
Design/efficiency
Improved service

New business models
Partnerships (Pull)
New markets (Push)



Act *Responsibly*



Manufacturing
Supply chain
Purchasing

Safer workplace
Clean plant operation
Empowered teams

SOCIETAL ACTIONS

46%

Peroxides employees
involved in societal
actions (+15%)

SUSTAINABLE SOLUTIONS

40%

of Peroxides portfolio
in sustainable
solutions (+8%)

PEOPLE ENGAGEMENT

80%

Peroxides
engagement index
(+1%)

Technology innovation of satellite peroxides production

MEGA-PLANT

200 – 350 kt/yr



MERCHANT

40 – 100 kt/yr



myH₂O₂

8 – 18 kt/yr



*Breakthrough concept
of small, safe & robust
satellite production
units*

*Tailored to and located
on customers'
premises*

HPPO: Hydrogen Peroxide for Propylene Oxide

A game changer generating strong growth & guaranteed returns

HPPO plants

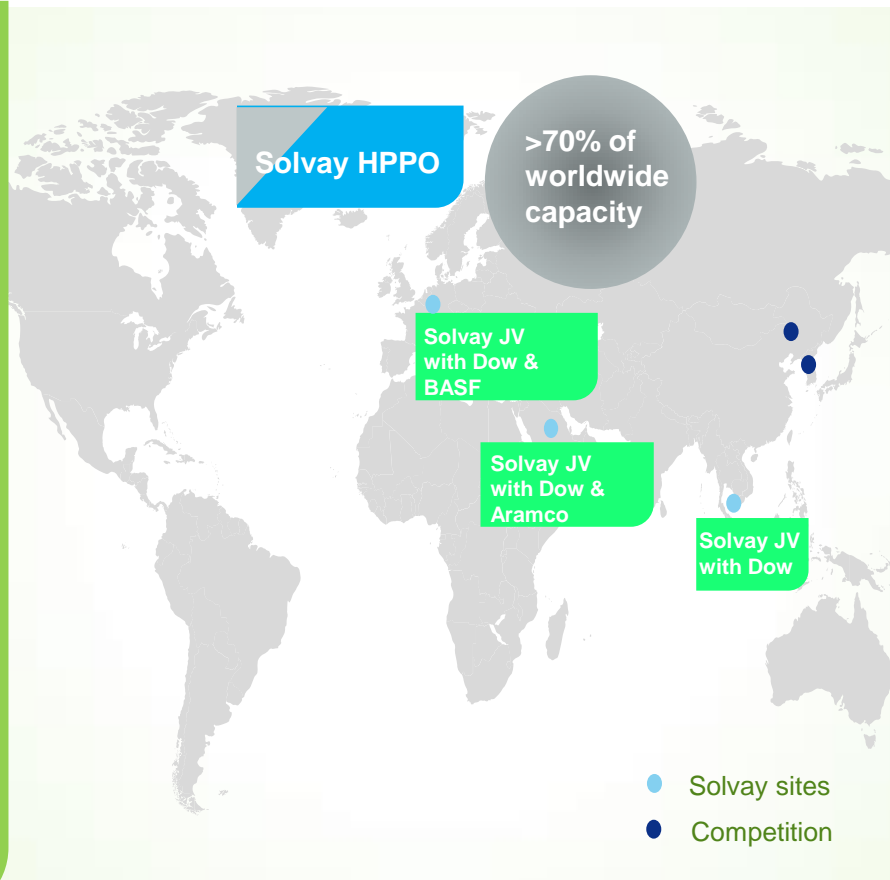


LT guaranteed return contracts with the 2 WW leaders (BASF, DOW) in PO/PU chain

Only 2 players able to compete in Mega-HPPO plants

Strong Customer intimacy – JV setups

Sustained & profitable business



HPPO: the preferred route to PO

Low capital intensity & environmental impact

50% of new PO capacities since 2009 chose HPPO route

New HPPO capacities nearly doubled H₂O₂ capacities over 6 years

Maintaining our leadership, Balance commodity & specialty approach

Commodity approach

Low service level & commodity pricing

Sustainable & higher returns

Specialty approach

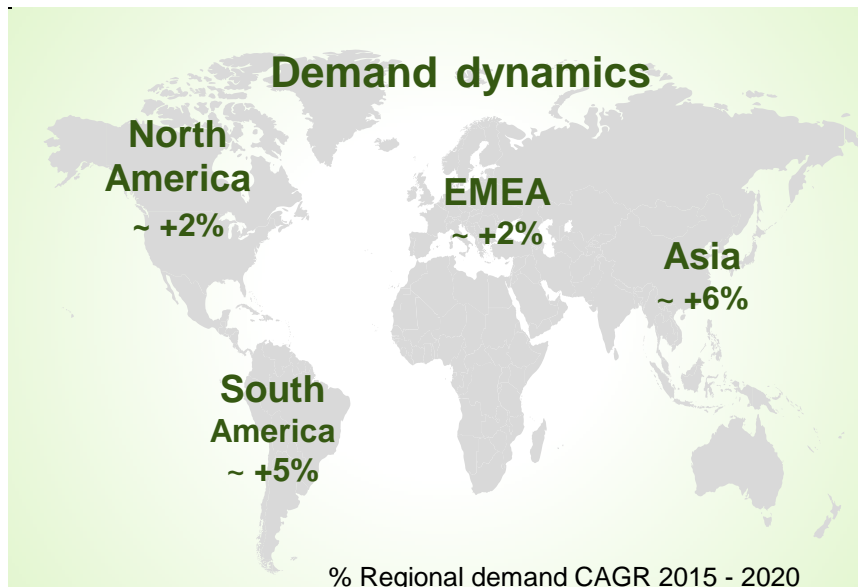
High service level & price differentiation

Innovation in Technology

Innovation lead by sustainability opportunities



Strong commitment to excellence programs



Selective investments underpinning growth

HPPO Plant in Saudi Arabia

- Mega-plant (DOW & AramCo) for PO & Derivatives

H2O2 plant on Solvay's Zhenjiang platform (China)

- High-added value segments
- Synergies with Solvay's businesses

Capacity expansion in North West USA


- Capturing strong regional pulp growth , based on customer intimacy
- Supporting innovation in pulp market

➤ **2017 landmark year as these 3 projects start producing returns & cash**

Key achievements & moving forward

2016-2017 KEY ACHIEVEMENTS

BUSINESS

- 
- **Start of Eagle**
 - **1st myH2O2 signed**
 - **Alliance** with Suez (Water Treatment)
 - **Partnership** with **Stingray** (Salmon farming)
 - Start of **HPPO3 plant**



2017-2020 NEXT STEPS

- ▶ **Eagle mix optimization**
- ▶ **More myH2O2s**
- ▶ **Innovation in New market and through New business model**
- ▶ Start of **new salmon platform**

TRANSFORMATION

- 
- **Leaner industrial footprint**
(Sodium Percarbonate, Bussi)
 - **Push market focus**
 - **Sustainability launched**
 - **Diversity & Inclusion** embedded in Peroxides



- ▶ **MORE strategic options** explored for industrial footprint
- ▶ **MORE customer insights** for more business development
- ▶ **MORE leverage on Sustainability** for more business & structure approach to Solvay target
- ▶ **MORE engagement**

Peroxides: a growing solution provider

Sustained returns supported by **selective new capacities & commercial excellence**

- **Double digit growth** CAGR over 2015-2020
- CFROI in **value creation** zone in 2016

Global market and technology **leadership**

- **Partnerships** with key customers
- **Selective investments** in growing high-added value segments
- Strong push for **innovation** in tech., apps. & business model

Sustainability driving past & future growth

- Sustainable solutions **shaped** H₂O₂ industry over past decades
- Push for more sustainability aligned with Group targets to bring **new growth** for H₂O₂



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Peroxides Industrial Operations

Rosignano site, Italy
October 12, 2017

Andrew Willson
RDT

High Productivity Plants

Manufacturing Excellence

Clean Plant Operation

Heat Recovery



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Aquaculture

Rosignano site, Italy

October 12, 2017

Alastair Smart

Business Manager, Peroxides

The potential of Aquaculture: asian domination

Demand

- Seafood has the most **unsatisfied demand function** of any protein
- **China seafood consumption per capita tripled in the last 30 years** - seafood demand will continue to increase in China for some time, increasingly for high value species
- OECD outlook: **fish consumption and growth dominated by Asia and China**
 - Asia and China dominates fish consumption and growth world wide
 - Europe has near zero volume growth
 - Growth of aquaculture could eventually increase seafood consumption growth in developed markets



Aquaculture is the future

Supply

- Seafood supply: all growth needs to come from Aquaculture
- Aquaculture represents 50% of the supply base and will contribute 100% of the growth
- In supply volume terms Aquaculture is a developing country industry, and China dominates
- Salmon is the only large aquaculture industry primarily based in developed countries - this industry represents less than 5% of total aquaculture



Possible threats



- Sealice fluctuates with season but is relatively constant from year to year.
- Main factors affecting usage are relatively high treatment complexity and cost (compared with most other treatments), efficacy (resistance issues in south, mid and west regions in Norway), and treatment mortality events.
- Sea lice is still extending its range Northwards in Norway.
- Sealice can be treated with five different medicines (including H₂O₂) or mechanical treatments.



- The two most important factors for outbreak of AGD are considered to be high salinity and relatively high seawater temperatures.
- AGD is treated either with hydrogen peroxide (H₂O₂) or freshwater.
- H₂O₂ treated fish have been reported to return to feed faster and therefore may be less stressful to the fish.
- The amoebae damage the gills and cause mucous buildup on the gills restricting oxygen exchange and thereby affecting fish performance.

AGD : Amoebic gill disease

Solvay Aquaculture: Aqua Pharma



Solvay Aquaculture – Aqua Pharma

- Worldwide presence (EMEA, APAC, North America/Canada, South America)
- Products based around peroxide (**Paramove** – registered medicine) for treating parasites and **Aqualisan** offering powerful environmentally friendly oxidising capacity for disinfection
- Primarily **H₂O₂** and **Peracetic Acid (PAA)** Opportunities
 - Sea lice and AGD management – salmon industry (treatment in-situ in sea cage baths and wellboats)
 - Other finfish species, other external parasites
 - Shrimp & FW finfish – pond disinfection and parasite control
 - Land based hygiene management – RAS and Processing, Fish tankers (adjunct with poultry, dairy, and red meat industries)

AGD : Recirculation Aquaculture Systems

Aqua Pharma Partnership



- **Treatment Solution Provider**
- **Bundles the service offering of chemical and treatment,**
- **Sophisticated equipment and treatment method,**
- **Global**



Solvay Aquaculture: Salmon case

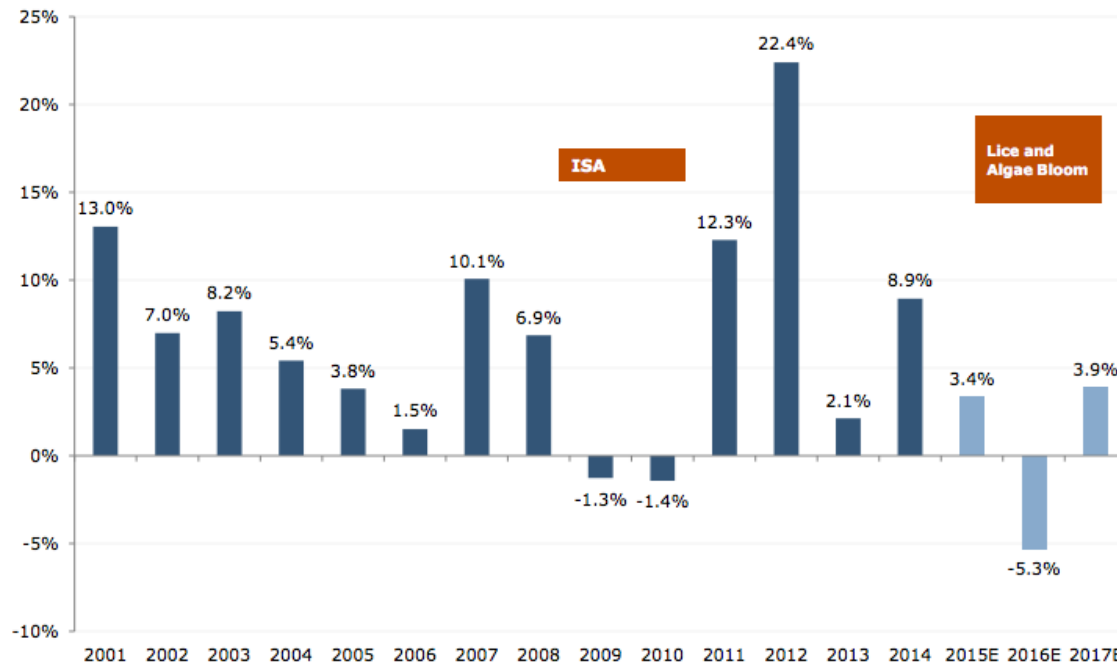


Salmon supply volatility

Biological and Environmental supply constraints in the salmon industry

It is estimated that for 2016, lice resistance in Norway has led to Norwegian production being reduced by 70Kt

YOY change in global Atlantic salmon supply and forecast (%)



Salmon farming

Facts about H₂O₂ use in Salmon Aquaculture

- Costs related to treatment of salmon lice pass 5 billion kr annually in Norway (€0.5 Billion).*
- H₂O₂ is used today as pharmaceutical product for treating sealice and AGD for salmon – usage ratio is reported to be around 70% lice to 30% AGD in Norway but probably 40:60 Scotland. It is also present in Chile, Canada and Australia (100%).

Other species

- Potential benefits for peroxygen use in many other species that make up 95% of aquaculture production

*Source: Norwegian veterinary institute 2016, the health situation of Norwegian aquaculture



Unpredictable factors impacting H₂O₂ usage

ALGAE	LOW SALINITY	LOW SEAWATER T°	OVER USAGE > RESISTANCE	H2O2 REPUTATION
High numbers of algae at certain times of the year will restrict usage of H ₂ O ₂ because of unpredictable results	When there is significant rainfall or snow melt, freshwater inputs to the sea will limit development of AGD	Seawater temperature is most important for AGD - a slight increase or decrease of 1°C, may be critical	<80% efficacy in Norway is considered to be too low to be viable for a treatment	When rare unpredictable significant mortalities occur it stops H ₂ O ₂ use for extended periods.

Logistics & Safety

- International coordination
- Same issues globally
- Safety can be challenging to manage in Developing Countries

SOLVAY AQUACULTURE:

A vital part of the production of quality seafood for the future





SOLVAY PEROXIDES

Sustainable development A driver for more business growth

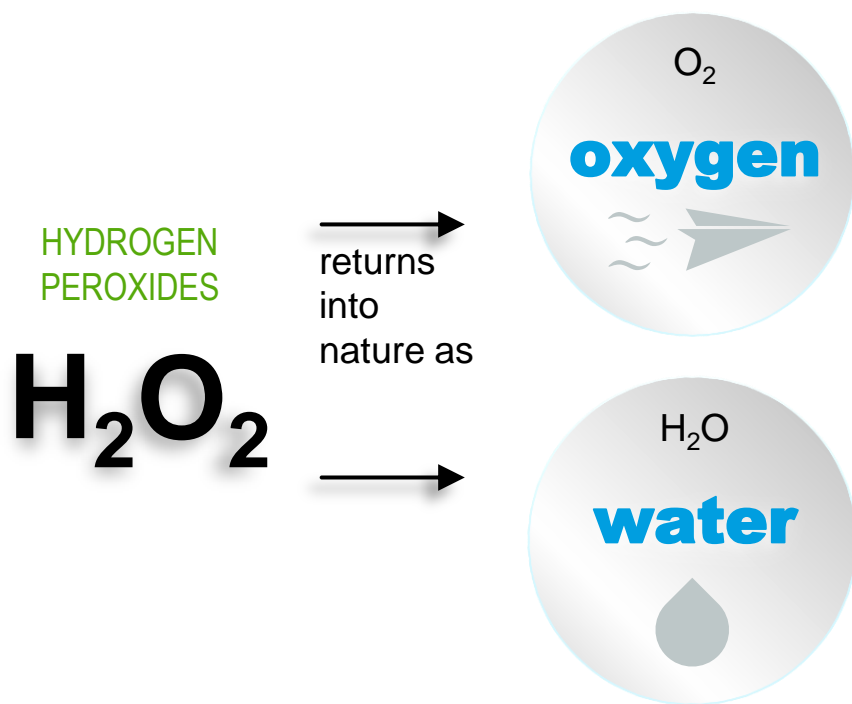
Rosignano site, Italy
October 12, 2017

Hanne Mertens
Sustainable development



Hydrogen Peroxide, an eco-friendly molecule

A good start to more sustainable development



Hydrogen Peroxide, an effective & green solution

Growth pushed by changing market needs

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+0,5 MMT



Textiles

1970s



3*

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Pulp
Bleaching

1990s



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+1,2 MMT



Consumer
goods

2010s



H₂O₂ in new
routes



Aquaculture,
Food, Water, Agro

2015>



* Approximated H₂O₂ global demand (Millions Metric Tons) - Sources Peroxides Team analysis

Sustainability as part of the strategy

Peroxides 2020 mid-term aspiration

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Embedding Sustainability at all levels

Primary area's of focus for 2017



Market pull & Technopush
leverage sustainability for more business growth



Isabelle Gubelmann

Improve **measurement** on Industrial **environmental impact**



Bob May

Assess current **energy consumption** & define ways to reduce



Bob May

Assess current **water usage** & define ways to improve



Andy Willson/ Bob May

Responsible **Raw Material** consumption

CLEAN PLANT OPERATION

Andy Willson

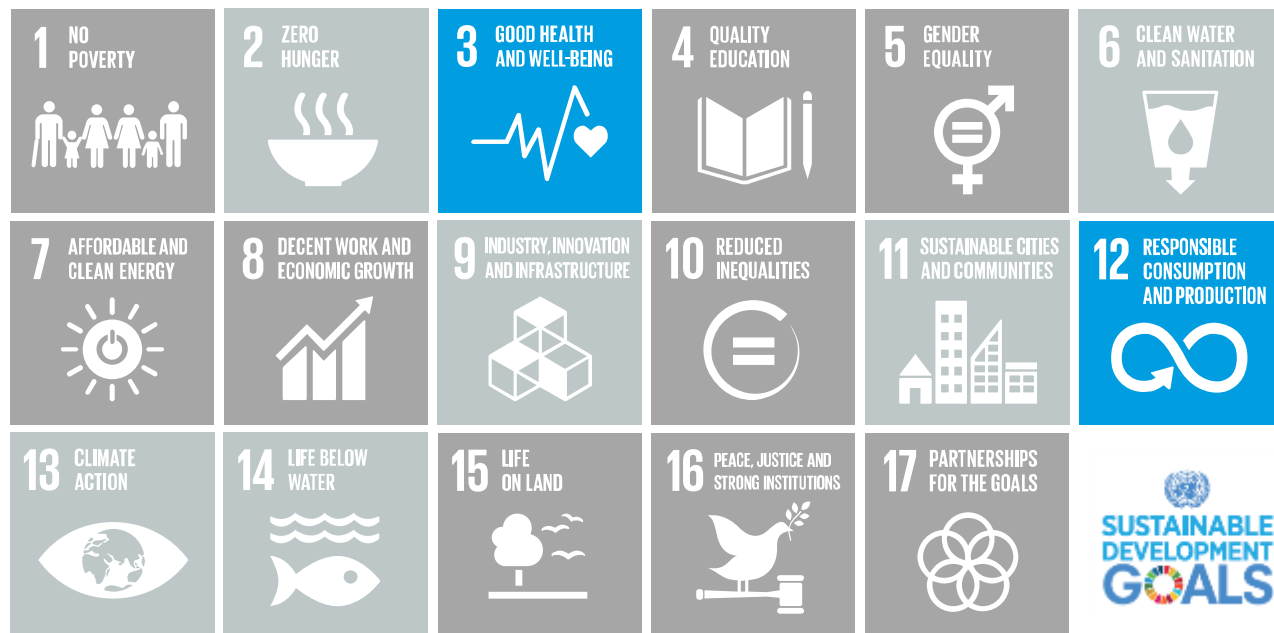
Build a sustainability **community** and promote **societal actions** (CSR)



George Crauser

1. Fully integrated approach
2. Defined workplans
3. Leveraging existing Excellence programs
4. Strong leadership team involvement

Peroxides solutions respond today to more than half of the UN sustainable development goals



**Through dialogue & partnerships
with different stakeholders**



Sustainable solutions: MyH₂O₂[®]

Climate action and responsible consumptions



CO₂ emissions

By 2050, the EU will cut greenhouse gas emissions to **80%**

**Reduce
the impact
of industry
on environment**



myH₂O₂[®]:

Industrial solution to cut down on carbon emissions through a decrease in road transport while enhancing safety

**SATELLITE
PEROXIDE
PRODUCTION**



Additional benefits

- > raw materials reduction
- > modular concept





8 billion
people by
2024

Protein through
**Marine
aquaculture**



PARAMOVE®



prevention and control
of disease in the
**aquaculture
industry**

- > control of lice
- > control of parasitic diseases



Sustainable solutions: Water treatment solutions

Clean water



WATER SCARCITY



Drivers for water re-use

Water treatment solutions



Water treatment solutions

WATER RE-USE

- > Advanced Oxidation Process solutions in compliance with most stringent industrial WWT regulations
- > Chlorine-free disinfection and odor control solutions for WT



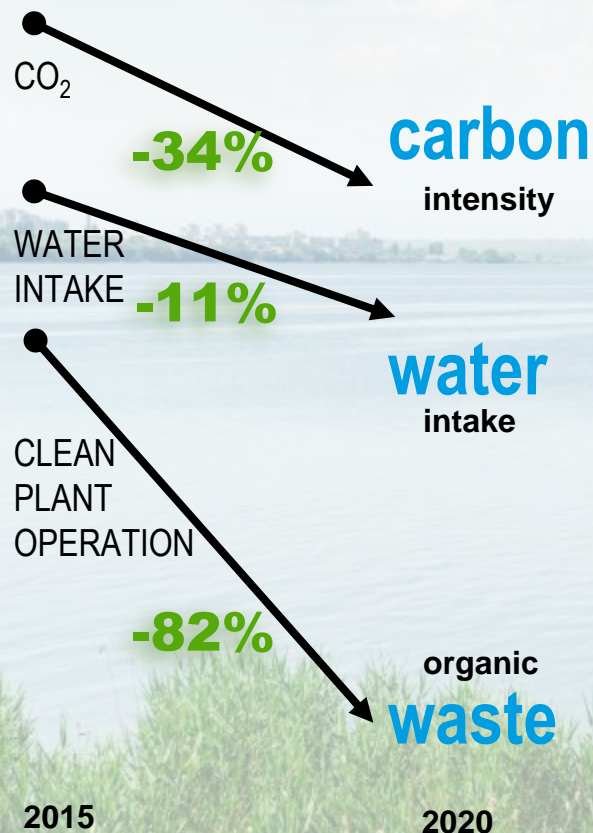
Sustainability for continued business growth

Both with existing customers as in new markets



Towards the sustainable peroxides plant

Reducing our operations impact



Sustainable development workshops



Highly engaged teams in a safer workplace

GBU Peroxides is committed for more responsible behavior

Main initiatives launched



- ▶ **Safety Excellence** program
- ▶ **Behavior Based** Safety

- ▶ **Diversity & Inclusion** program
- ▶ **Mentorship** program

Contribute to society

Peroxides connecting with local communities



Biodiversity conservation in Belgium



Helmets **donation** to improve road safety in Thailand



Food bank in US



Special Olympics in Rosignano, Italy

SOCIETAL ACTIONS

350 employees involved in societal actions (vs 460 by 2020)





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Innovation for waste water treatment

Rosignano site, Italy

October 12, 2017

Isabelle Gubelmann-Bonneau

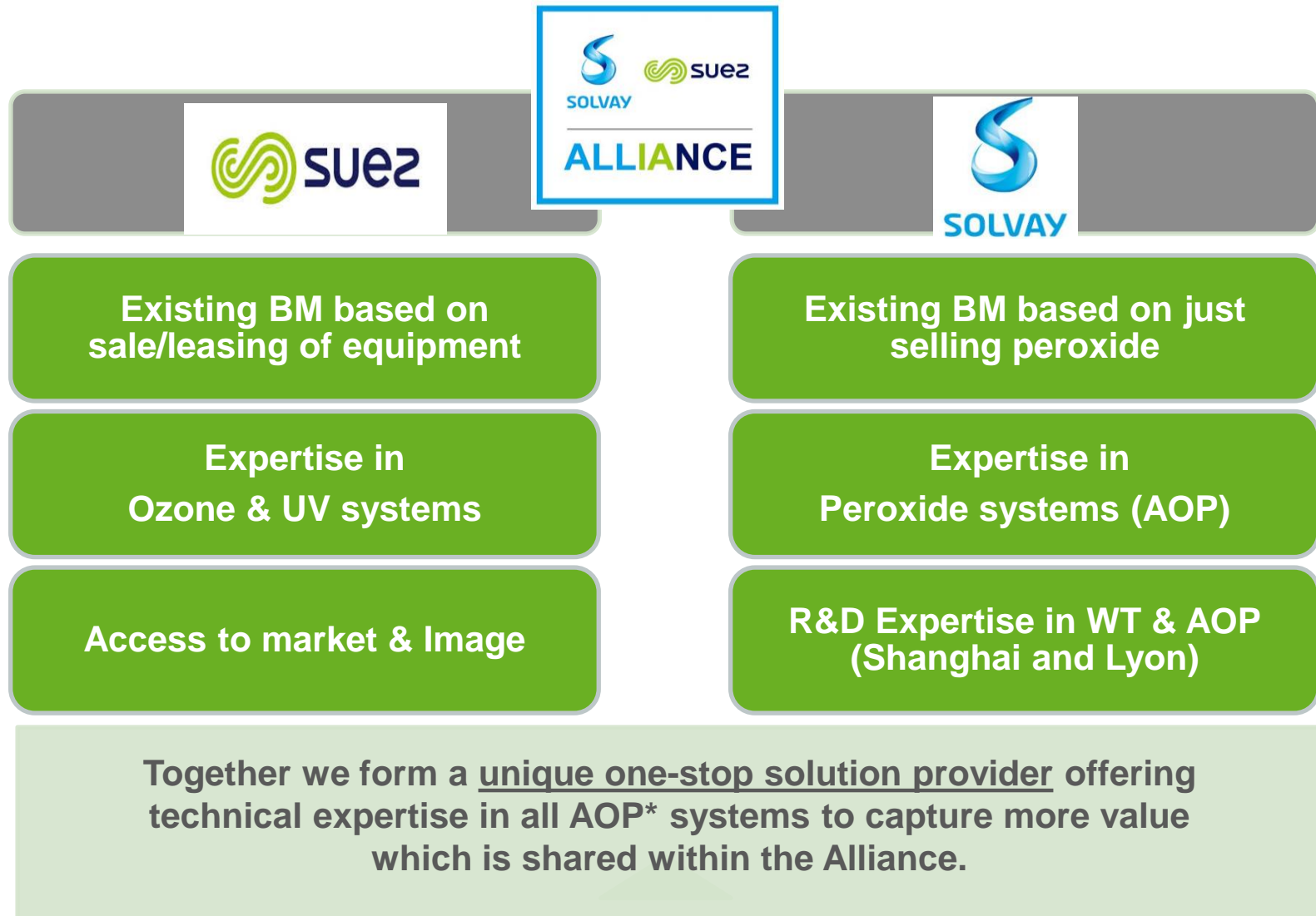
Juan Wu

Strategic Marketing

Market context

- Water scarcity
- Stricter regulation imposed to Industrials
- Need for consistently achieving compliance
- Solutions currently used uncertain
- The highest constraint in CHINA from 01.2015
(Organic residues less than 50 ppb)

New Business Model to capture more of the value chain



AOP : Advanced Oxidation Process



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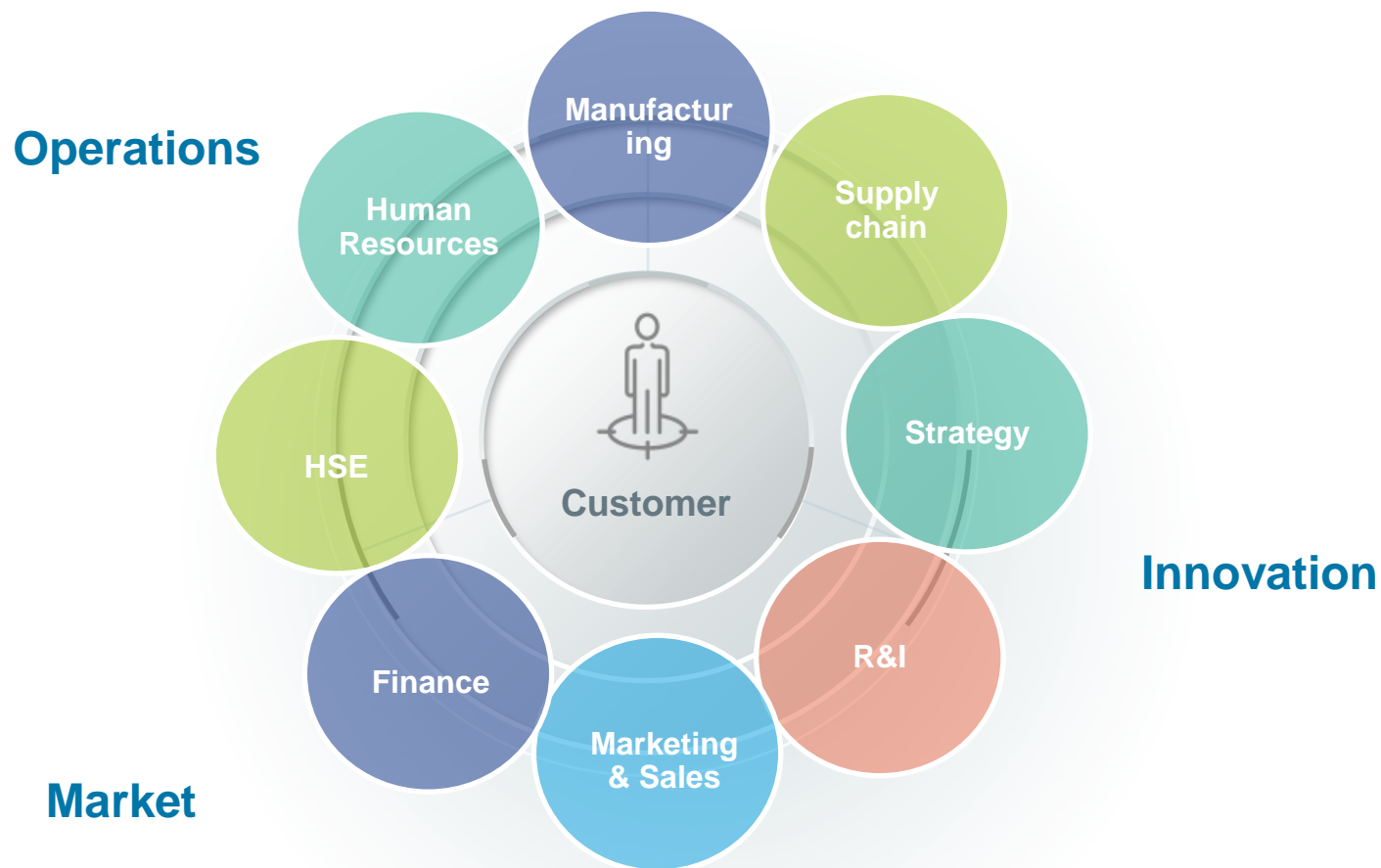
Peroxides Customer Pull

Rosignano site, Italy
October 12, 2017

Juan Wu
Strategic Marketing

Customer pull

Collaboration with our customers



✓ Walk through customers' journey

✓ Co-Create value together

Customer pull

Leveraging Solvay group expertise

Chemistry

Sustainability

Marketing

Digital

Water treatment

Excellence programs

Workshops with customers



Solwatt™



SOLVAY

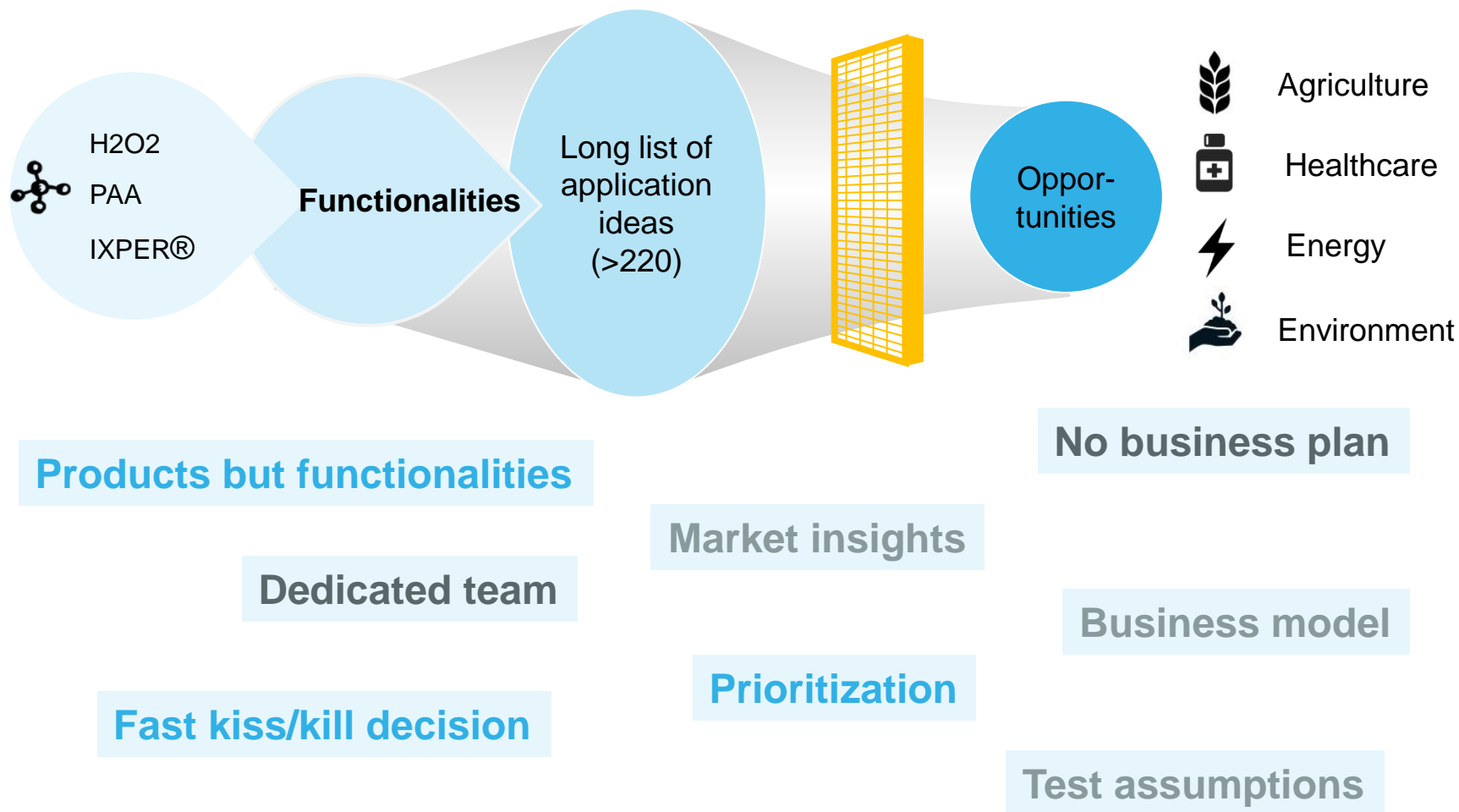
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Peroxides Techno Push

Rosignano site, Italy
October 12, 2017

Sandrine Hellinckx
Strategic Marketing

TECHNO PUSH aims at identifying the future growth platforms in markets we are not in today



Confirming market needs & offering a differentiating value proposition drive the investigation of the 4 opportunities



Agriculture



Healthcare



Environment



Energy



PEROXIDES OVERVIEW

ROSIGNANO OVERVIEW



Rosignano site

Rosignano site, Italy
October 12, 2017

Davide Papavero
Site manager

safety first MTAR results



MTAR* = 0
(Medical Treatment Accident Rate
- medium/high gravity accident)

MTAR Group's Objective < 0,75

Dedicated Safety campaigns and programs



* updated September 2017



MORE THAN 100 YEARS OF HISTORY AT A GLANCE

1912

The foundation of soda ash plant starts with the construction of a brick farm



1959

Solvay builds St. Luce dam on the Fine river to feed the site with surface water



The hydrogen peroxide plant starts



1939

Construction of chlorine-soda plant based on mercury cells



1997

Solvay sells the polyolefin plant to British Petroleum.



Rosen power plant starts.
The era of fossil fuels is over and the gas era begins



2015

The chlorine-soda plant is sold to INEOS



2007

The chlorine-soda plant is converted to membrane cells



1979

The jetty was created to discharge the ethylene



2004

Aretusa plant starts; Solvay recycles output from the municipal wastewater treatment plant



THE LAST 5 YEARS AT GLANCE

2012/13

Poor competitiveness of Rosignano in the soda ash market



2015

IPPC authorization renewed for 12 years



2017

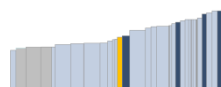
Start-up of the new Rosen plant

2014

Peracetic acid plant erection and start-up



Recovered competitiveness Soda ash plant well positioned among synthetic producer



Assured salt and water availability for the salt mine till 2036



2015-2017

ITINIRIS 1 + 2 project; Solvay's biggest electronic grade plant in the world



2016/2018

World class factory Second wave



2013/2016

World Class Factory Manufacturing & services excellence program



Site of national relevance for sustainable chemistry



Identity card

3 Group GBUs

200 ha
Industrial area



449

Direct Employees
2nd January 2017



M€ 290

Turnover 2016



1912

Beginning of
construction



M€ 90

Economic return on
Rosignano & Livorno

SODA ASH & DERIVATIVES

The only Italian Soda Ash Plant

- Solvay's biggest BICAR production capacity
- The only Solvay CaCl₂ Production Unit

PEROXIDES

The biggest Italian hydrogen Peroxide Plant

- The only Italian Peracetic Acid Plant for water treatment

SPECIAL CHEM

Electronic Grade H₂O₂ Plant

- High purity H₂O₂ dedicated plant

an integrated Industrial Park, that hosts



**CHLORINE &
DERIVATIVES
INEOS GROUP**



**HIGH DENSITY
POLIETHYLENE**



**STEAM AND
ELECTRICITY FOR THE
PLANT**



**LEADER IN EUROPE
FOR MILLS
CONSTRUCTION**

Research Center

**Product with
improved
environmental
footprint**

**ROSEN Cogenerazione
CCGT Power 185 MW
Steam 320 T/h
(only operated by
Engie)**

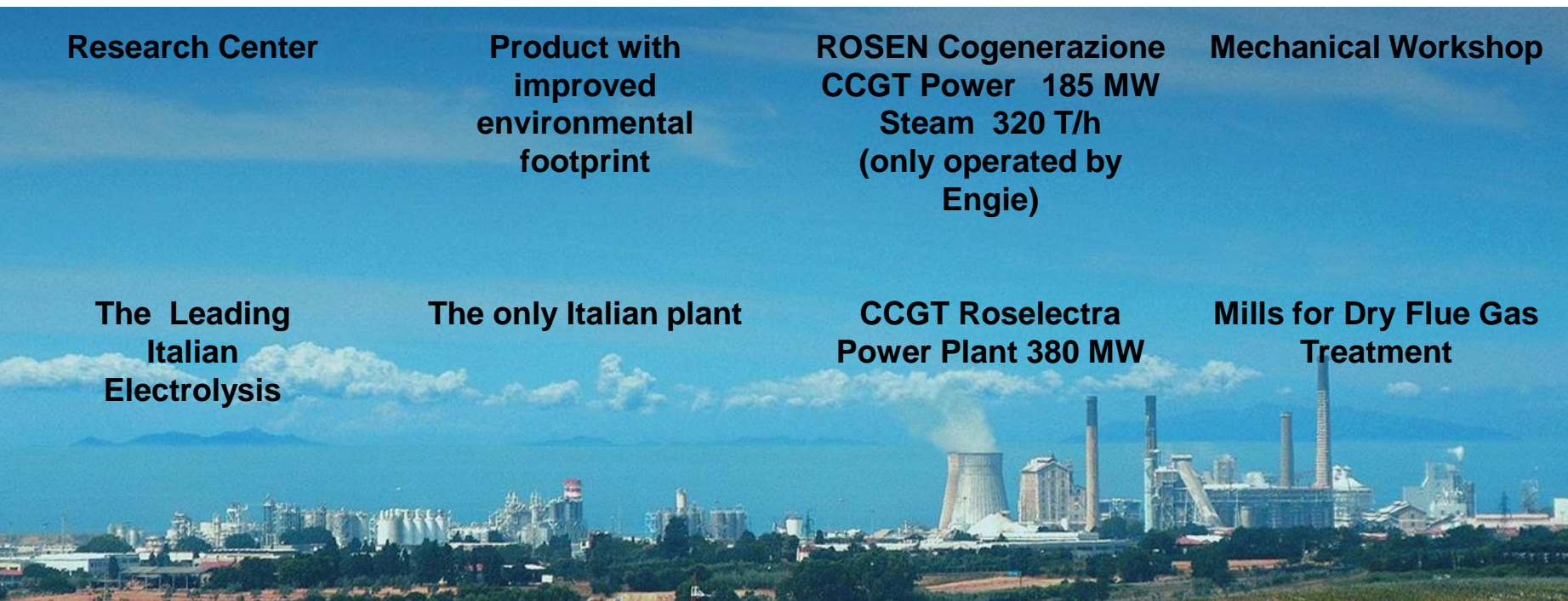
Mechanical Workshop

**The Leading
Italian
Electrolysis**

The only Italian plant

**CCGT Roselectra
Power Plant 380 MW**

**Mills for Dry Flue Gas
Treatment**



our Tuscan settlements outside the site

SAN CARLO QUARRY

PONTEGINORI SALT MINE

SOLVAL - WASTE
RECYCLING PLATFORM

JETTY

SANTA LUCE LAKE



Site map



Challenges for 2018-2020



Solvay
Life
Saving
Rules

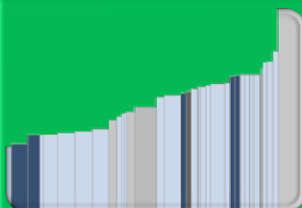
Safety first

- No accidents
- Safety for choice



Reduction of energy costs

- Rosen project to be optimized
- Specific consumptions/new culture
- Advanced process control (APC)



Competitiveness

- Manufacturing Excellence
- Quality
- Supply chain



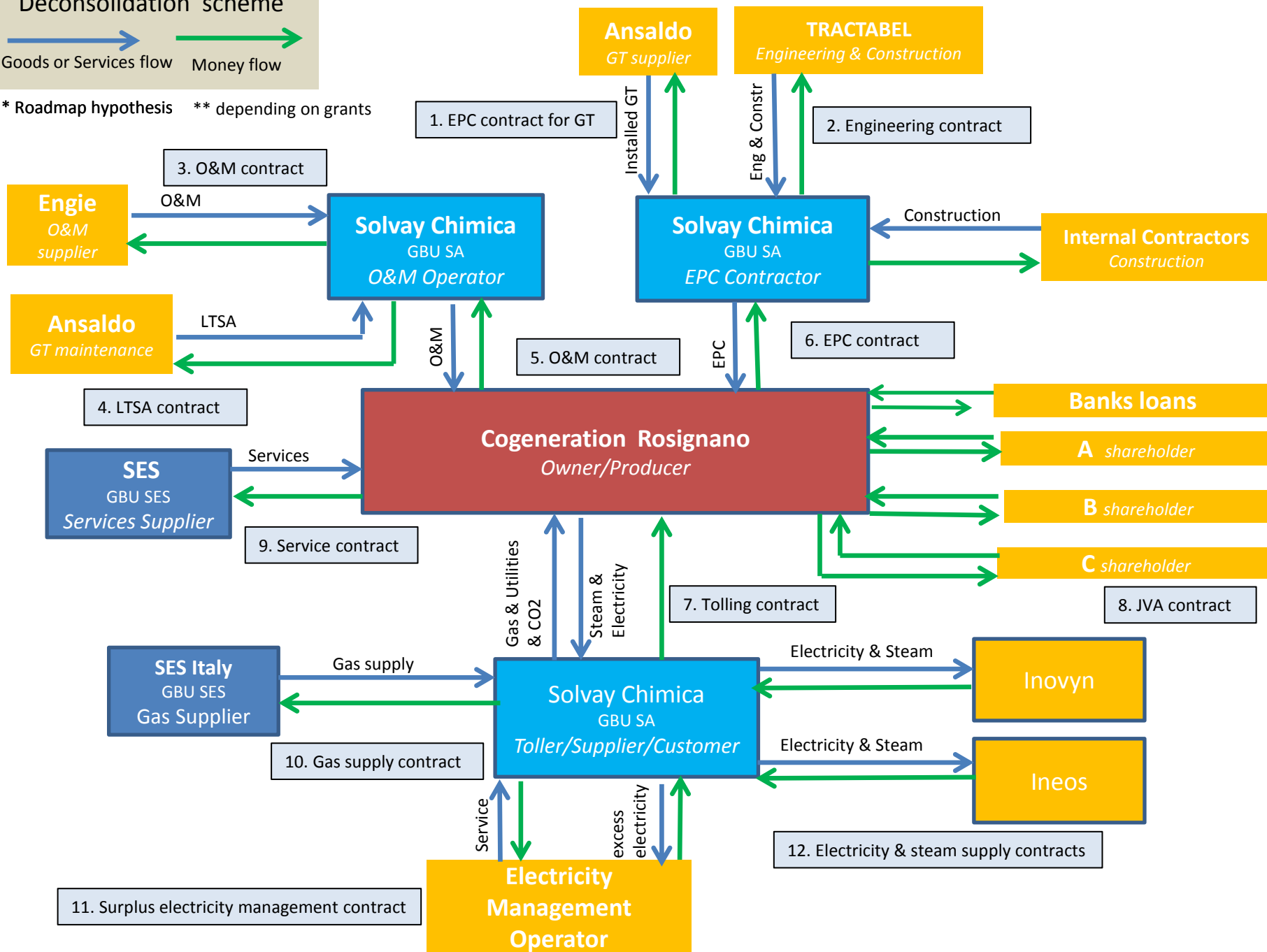
Environmental footprint

- CO2 recovery SIAD project
- Water sources - priority to recycled water
- Management of limestone and salt raw materials
- Relationship with the community

Deconsolidation scheme



* Roadmap hypothesis ** depending on grants





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Peroxides unit in Rosignano

Site integration of H₂O₂ plant

Rosignano site, Italy

October 12, 2017

Gianluca Pettinello

Peroxides Production Unit Manager

H₂O₂ perspective



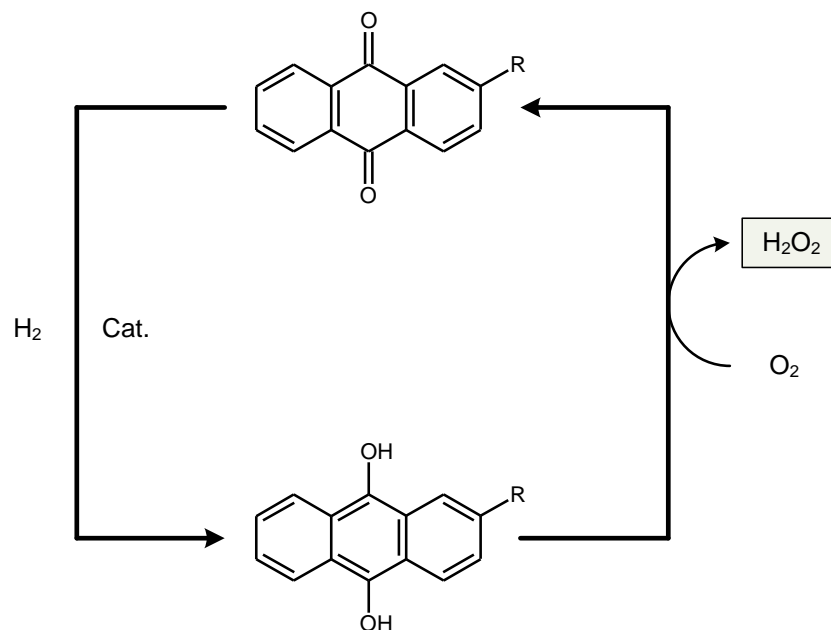
**H₂O₂
plant**

Hydrogen supply



inovyn
An INEOS company

- Hydrogen from electrolysis
- Caustic soda for reversion
- Sodium hypochlorite for cooling water treatment



Site utilities

Electrical Energy

High efficiency steam-electricity power plant



Water

- Water is in hydrogen peroxide
- Cooling



Steam

- Heating
- Compressing air (energy saving)



Nitrogen

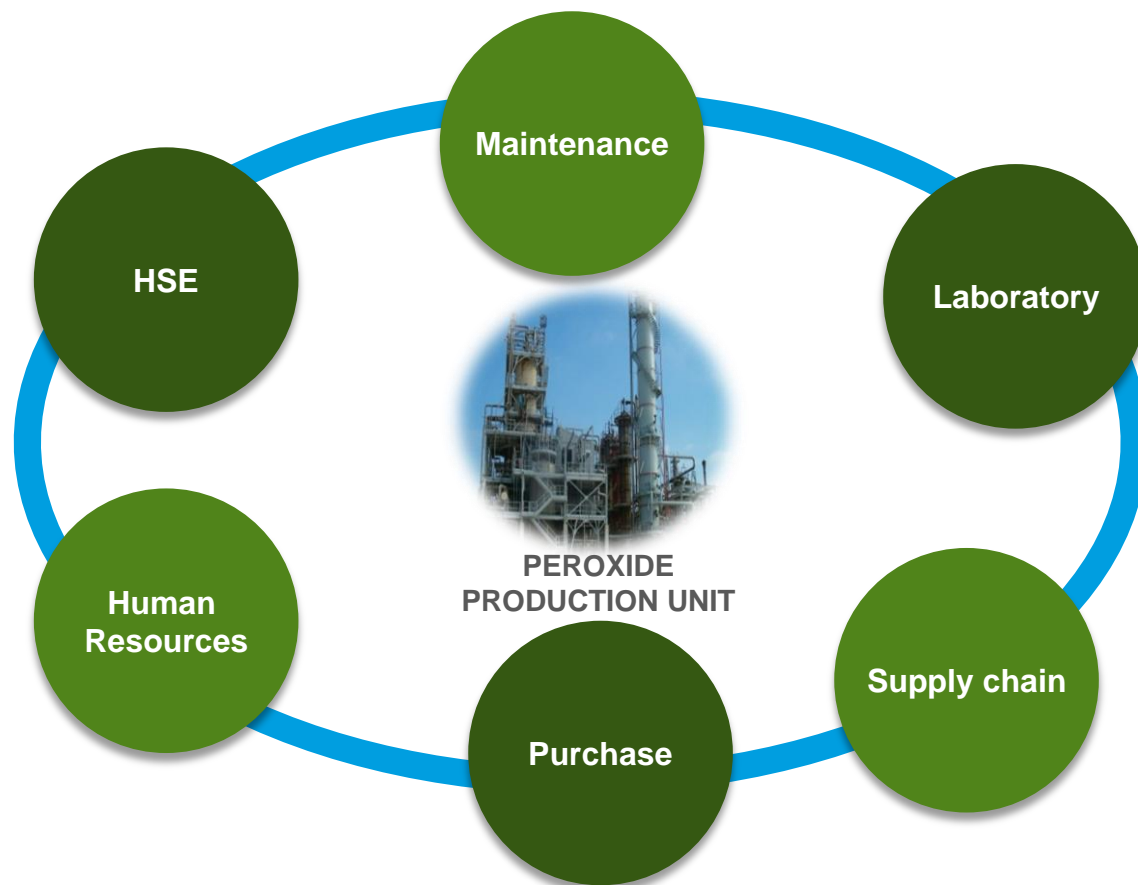
- Safety

Enriched air

- Energy saving



Site services



ITINERIS project : electronic Grade



H₂O₂ production plant



H₂O₂ Electronic Grade

Customer centricity

Examples

- **Manufacturing Excellence to satisfy EG demand in quantity and quality:**
 - H_2O_2 distilled throughput maximization
 - Minimization of steam consumption
 - Automatic CoA generation and communication to the teams (digitalization)
 - Central lab continuous improvement to meet EG metrology requirements
- **Close collaboration between the teams to achieve the goal**
 - Definition of the baseline and the specification
 - Joint communication with electronic grade customers during qualification period

Revamping of some critical sectors of the plant



2016: Distillation column



2017: Extraction column

H₂O₂ FOR PAA, SODA ASH & INOVYN

H₂O₂ to produce Peracetic acid for the municipal waste water treatment



H₂O₂ as an additive against corrosion in Soda Ash Plant (DCB column)

H₂O₂ in Inovyn electrolysis plant to treat effluents

MORE FUTURE



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