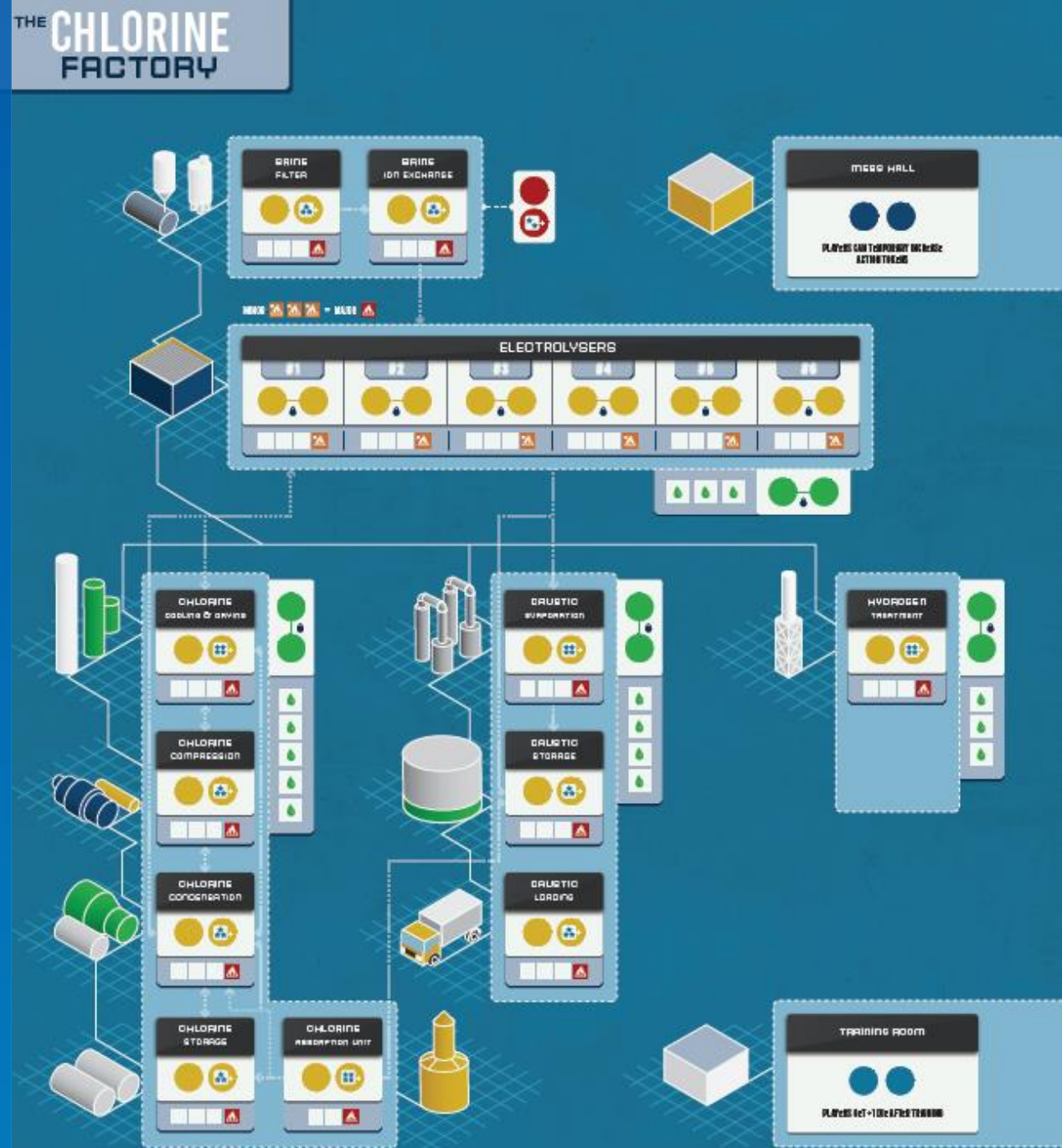


New ways to improve process safety in the Chlor-Alkali Industry.



Who is Ton Manders

- Master Chemical Engineering 1984, Technical University of Eindhoven, the Netherlands
- After Military Service started in 1986 at Akzo Nobel (today Nobian) in engineering, and had several functions in production, research, commissioning & start-up, project manager and Director Technology, Research and Development for the chlorine and chloromethane business.
- Since 2016 Technical and Safety Director Euro Chlor (Cefic)



About Euro Chlor

KEY FACTS

36 producing members

100 partners

62 manufacturing locations in
19 European countries

97% of all European production
capacity

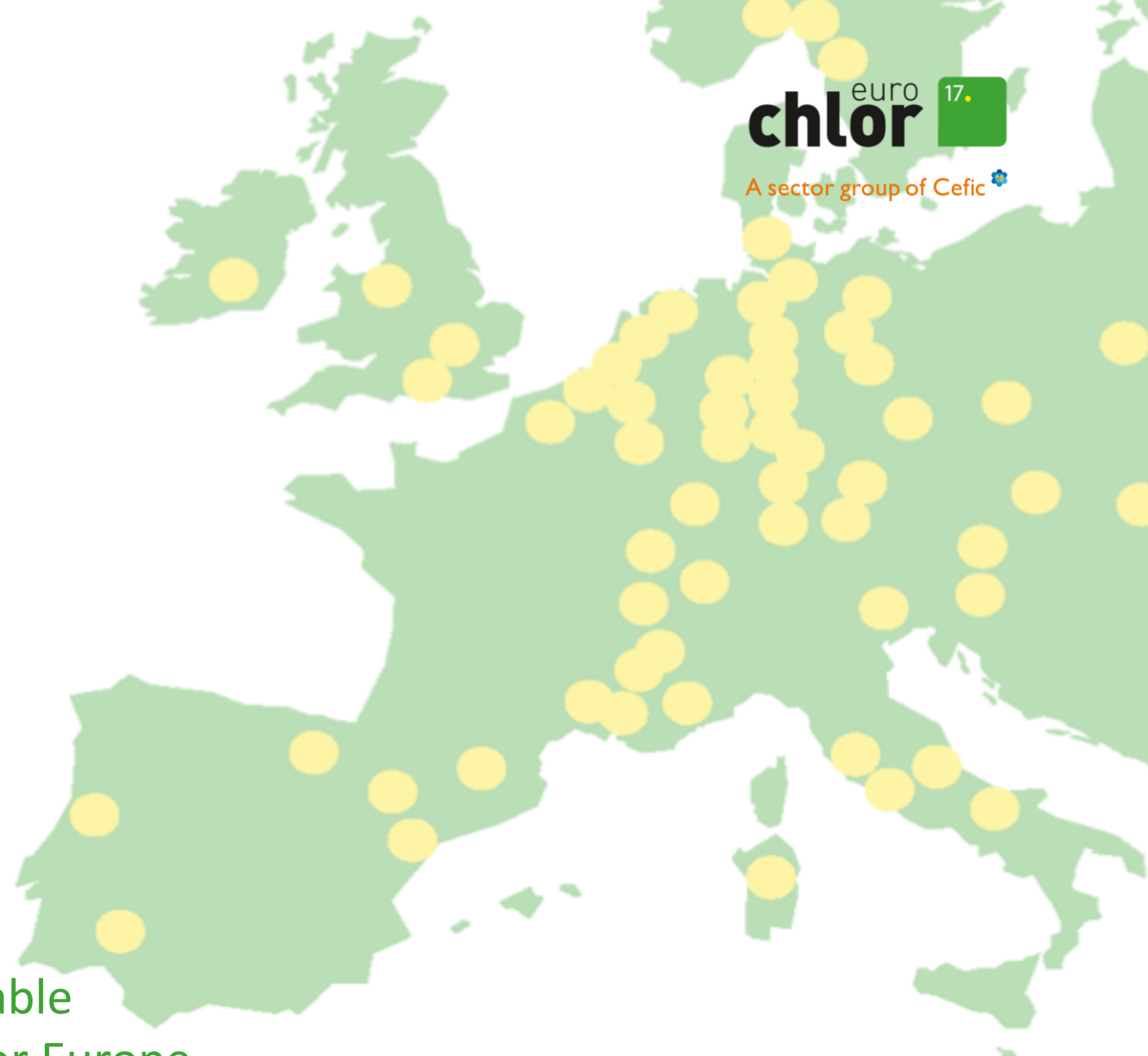
9,645 kilotonnes of chlorine
produced in 2021

17.

Our role is to support a safe, sustainable
and successful chlor-alkali industry for Europe

euro
chlor 17.

A sector group of Cefic



Euro Chlor 2050 vision



SAFE. COMPETITIVE. GREEN.

Towards a safe, competitive,
climate neutral and circular
European chlor-alkali industry.

2050



Safety leader

Remain a leader in safety by continuously delivering outstanding performance throughout the value chain, including contractors, transporters and customers.



Competitive supplier

Regain long-term international competitiveness and aim for continuous growth in demand for chlor-alkali products.



Climate neutral player

Contribute to Europe's Green Deal through climate neutral production and by facilitating the energy transition.



Circularity champion

Facilitate cradle-to-cradle usage and recycling of the chlorine atom. Drive circularity in the chlorine production process.

Euro Chlor 2050 mission

2020 _____ **2030**

Euro Chlor... a safe and competitive supplier
of chlor-alkali products and an integral part of
Europe's climate neutral and circular economy
transition.

_____ **2050**



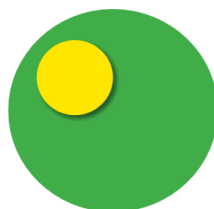
Euro Chlor vision

4 main elements selected

The European chlor-alkali industry's vision is towards a safe, competitive, climate neutral and circular industry



Safety leader



Competitive supplier



Climate neutral player



Circularity champion

Euro Chlor as a safety leader by 2050



Priorities for Euro Chlor as a safety leader

- ✓ We are committed to ensuring that our colleagues return home safely every day
- ✓ We are already sharing safety information but more can be done
- ✓ By 2050
 - ✓ Target zero incidents in our industry
 - ✓ Further share safety experience with everyone who sells/handles chlor alkali products
 - ✓ Collect data to help authorities ensure that imported chlor-alkali products meet high safety standards

WHY ?

Because every incident involving chlor-alkali is one too many



Priorities for Euro Chlor as a safety leader; 2021-2030 KPIs

Euro Chlor will track the industry's vision of safety pioneering with commonly used KPIs and clear targets



2021-2030 KPIs



Definition



Target

Lost Time Injuries (LTIs)

Number of LTI incidents¹⁾ related to chlorine production & transportation

Zero LTIs – Timeframe to be assessed by Technical Committee

Loss of Primary Containment (LOPC)

Definition developed by Technical Committee

Progressively decreasing target towards zero– Timeframe & sub-targets to be assessed by Technical Committee

Process Safety Incidents (PSI)

Definition developed by Technical Committee

Progressively decreasing target towards zero– Timeframe & sub-targets to be assessed by Technical Committee

Chlorine transportation

Chlorine transported in thousand tonnes of Cl₂ with specifications of the mode (rail, road, ship, pipeline)

No target (data collection & measurement KPI)

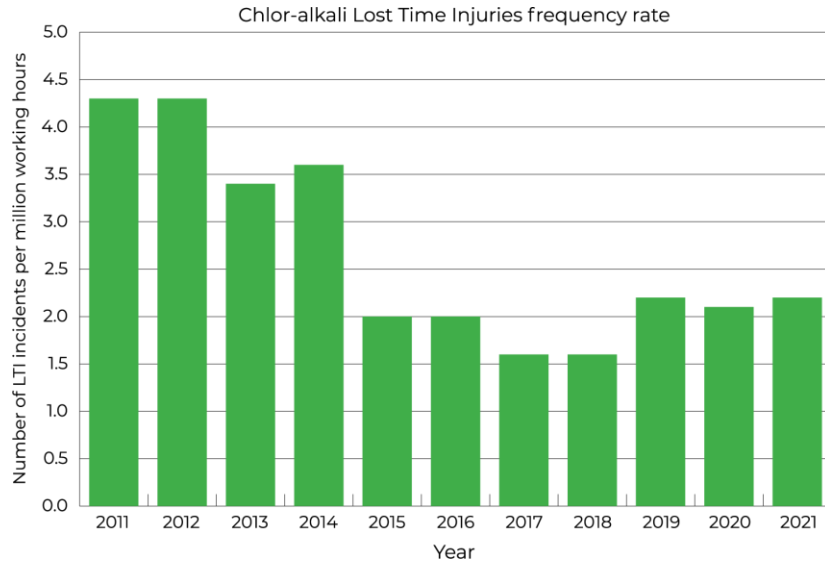
Transportation incidents

Number of incidents (not only LTIs) linked to transportation of chlorine, caustic, HCl & Hypochlorous acid

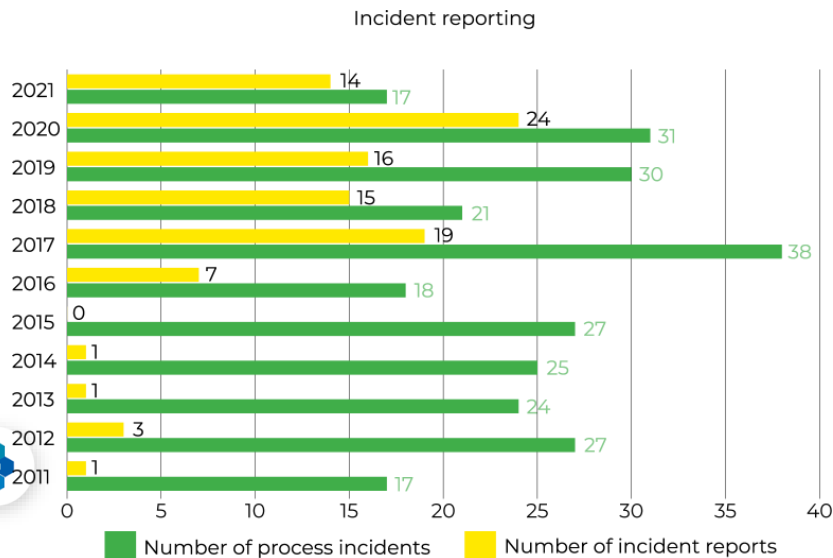
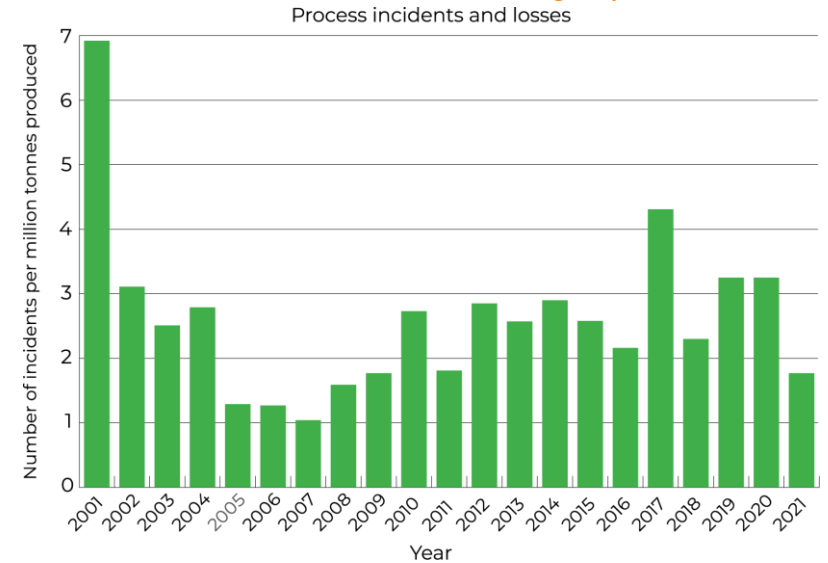
Progressively decreasing target towards zero– Timeframe & sub-targets to be assessed by Technical Committee

¹⁾ Expressed per million working hours

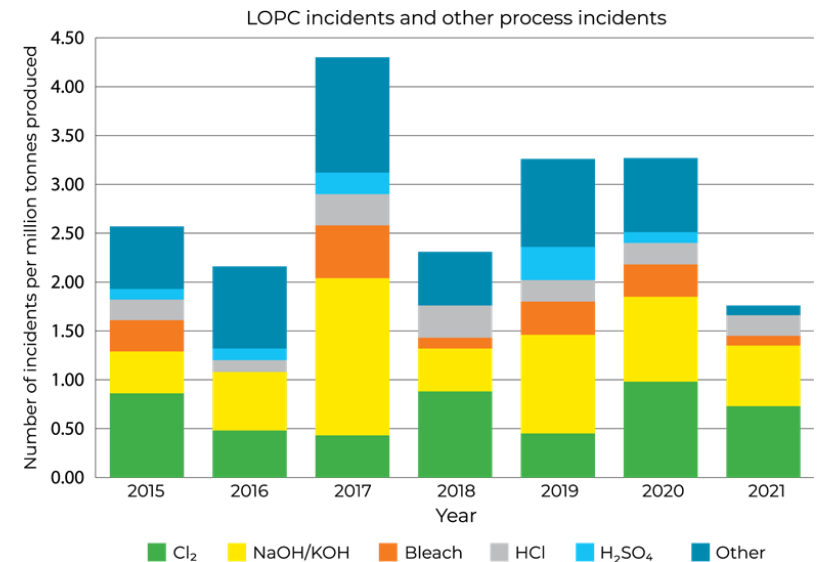
Priorities for Euro Chlor as a safety leader



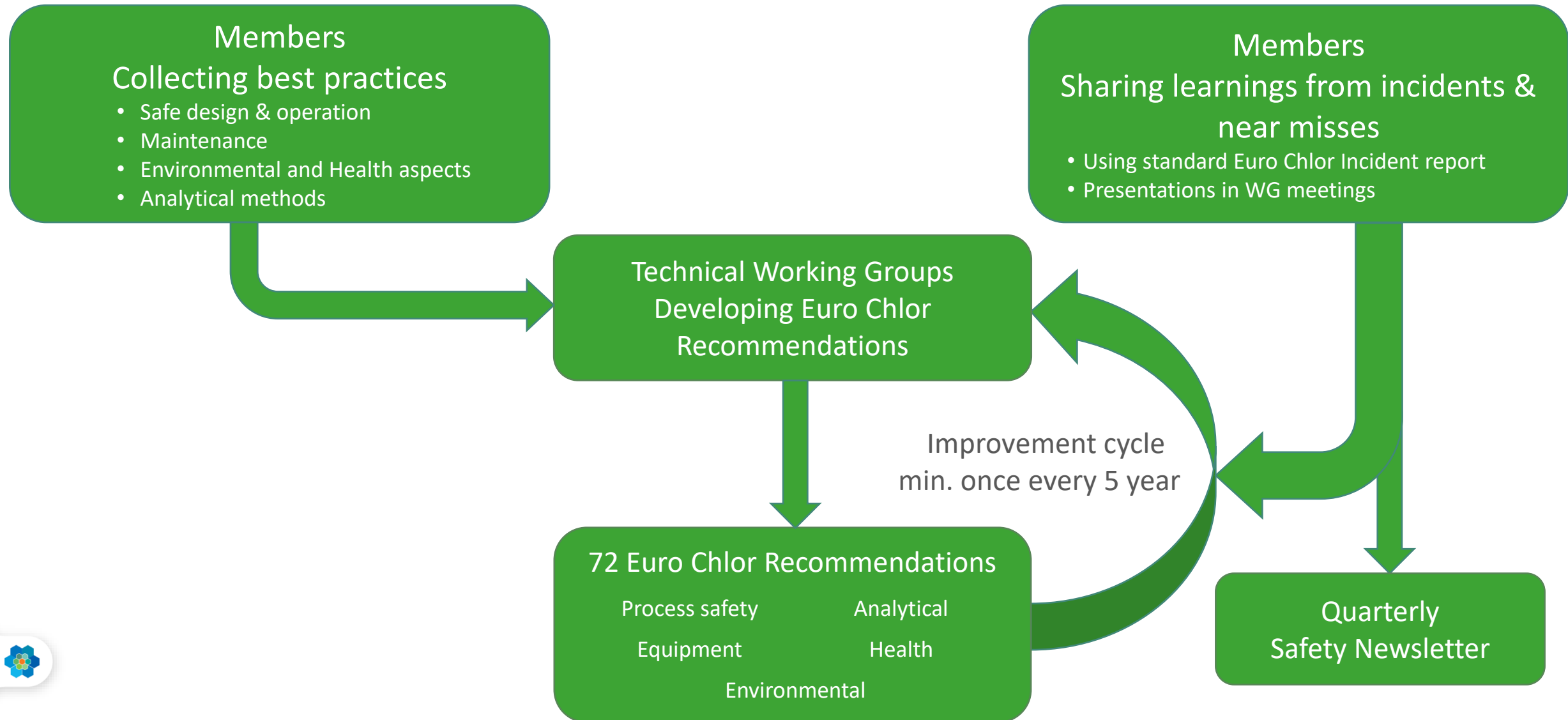
Ambition
is
ZERO!



Room for
improvement



The way of working



The way of working

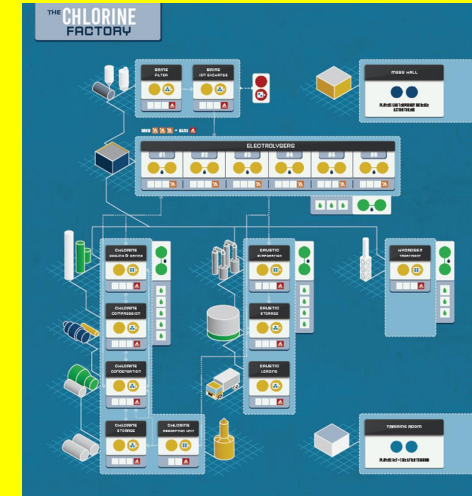
How to improve?

Members

Collecting best practices

- Safe design & operation
- Maintenance
- Environmental and Health aspects
- Analytical methods

Develop a safety game
for operators and Engineers



incidents &
incident report

Technical working Groups
Developing Euro Chlor
Recommendations

Introduction of safety trainings
For members and new also for
transport companies and down-
stream users

Improvement cycle
min. once every 5 year

72 Euro Chlor Recommendations

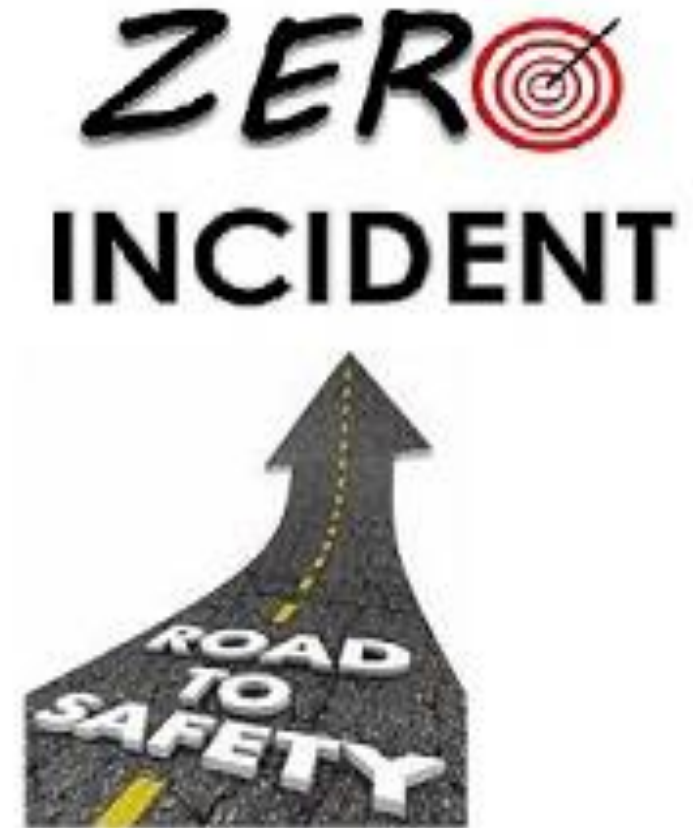
Process safety Analytical
Equipment Health
Environmental

Quarterly
Safety Newsletter



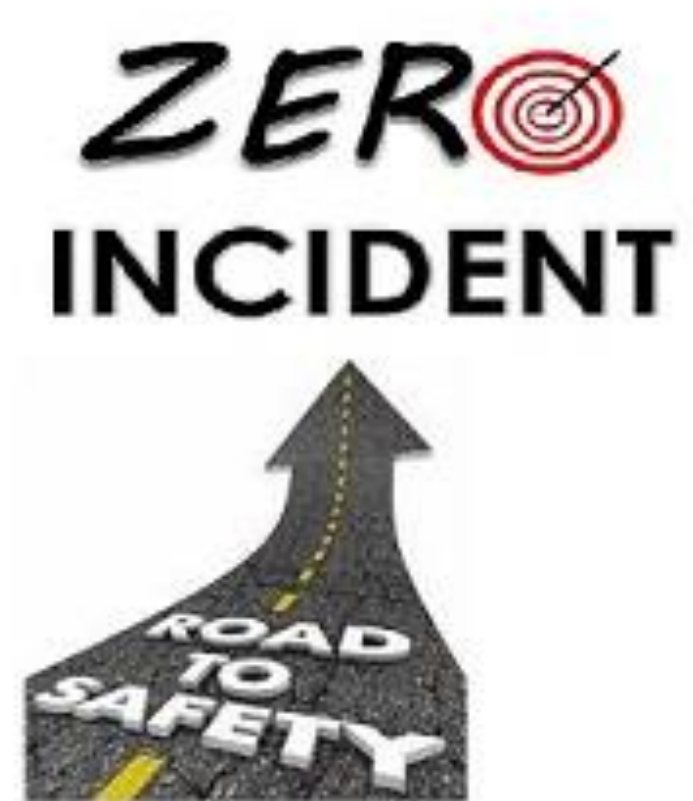
Route to zero

- ✓ How to achieve zero incidents?
- ✓ What can we do more?
- ✓ In 2016, Euro Chlor had 97 recommendations
 - ✓ Average age of documents was 13 years
 - ✓ Mainly focused on chlorine
- ✓ What to do??



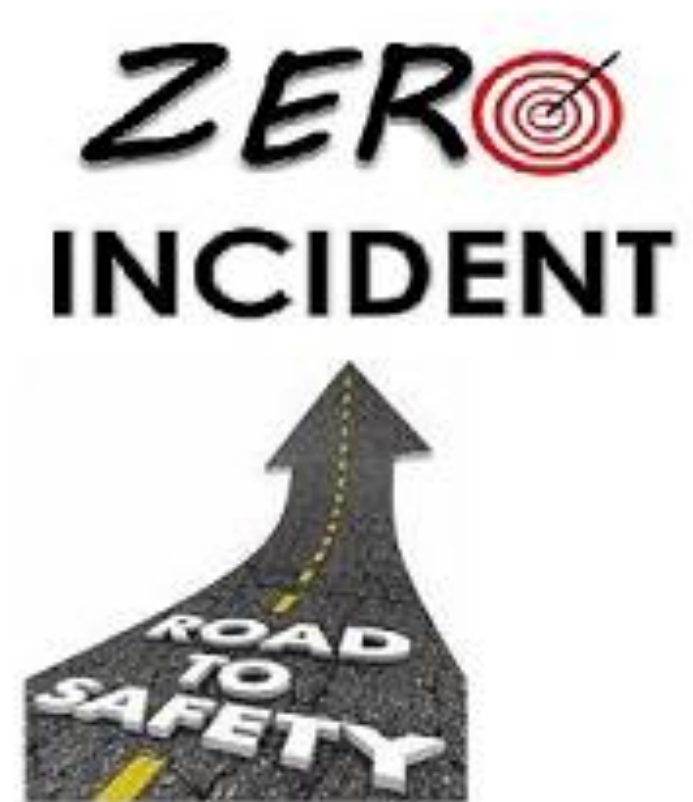
The route to zero

- ✔ What did we do:
 - ✔ Introduced safety newsletter every quarter
 - ✔ Harmonising our safety recommendations and updated content
 - Reduced/combined and now 73 documents
 - Average age is two years
 - Five new documents
 - More attention to other products and downstream
 - ✔ Visiting and discussing with members how to improve
 - ✔ Workshop with members to discuss improvement options



Route to zero

- ✓ Outcome of workshop and member visits
 - ✓ How can Euro Chlor help to bring message across?
 - ✓ Documents are good but youngsters do not learn from reading them
- ✓ Result:
 - ✓ Introduced safety trainings
 - Started in 2021
 - Training consists of 11 lessons of 1.5 hours each
 - So far over 240 participants covered (over three rounds)
 - ✓ Try to find new training methods....



New methods of training

- ✔ Based on input of members of Health Working Group, University of Delft in Netherlands contacted in 2018
 - ✔ Department Technology, Policy & Management: Gamelab
 - ✔ Large experience with the development of serious games for simulations and trainings
- ✔ In May 2019, contract signed to develop together board game to train operators and engineers on safety



Development of game

- ✔ Kick-off with university and several members of GEST Working Group in July 2019
- ✔ Main conclusions of kick-off meeting:
 - ✓ Goal is to reduce incidents in chlorine plants. To achieve this, game should aim for players to become more aware of their lack of knowledge and help improve decision making.
 - ✓ Target group is primarily shift leaders, engineers and operators. Maintenance and Plant managers should also be able to play, but for more general awareness creation
 - ✓ Should be a group game, where 4 to 6 players sit together, discuss decisions and solve incidents

 Board game would fit best



Development of game

- ✔ Development of board game (August 2019 – March 2020)
 - ✔ Several meetings of small group
 - People from university
 - Engineer from one of the members
 - Euro Chlor staff

- ✔ Prototype ready for testing at beginning of 2020
 - ✔ But Covid-19 came into the game.....
 - ✔ Delays as face-to-face testing was not possible
 - ✔ First face-to-face test with engineers from Nobian in September 2020
 - ✔ Online test (via Teams) with GEST members in December 2020
 - ✔ Online tests with engineers from member companies in March 2021



Development of game

- ✔ Prototype ready to test with operators since May 2021
- ✔ But Covid-19 still makes face-to-face tests with operators impossible
- ✔ Finally, first test with operators from Inovyn in Antwerp on 9 February 2022

✔ very positive feedback:

“ The game created a good dynamic between the operators and seems to really add value in enhancing operator knowledge levels. In any case, I saw that a lot of work had already been put into the development of the game, with clearly good results. After yesterday I am also enthusiastic about the further development.”

Suggestions for improvements - see later.

- ✔ But first a bit more about game....



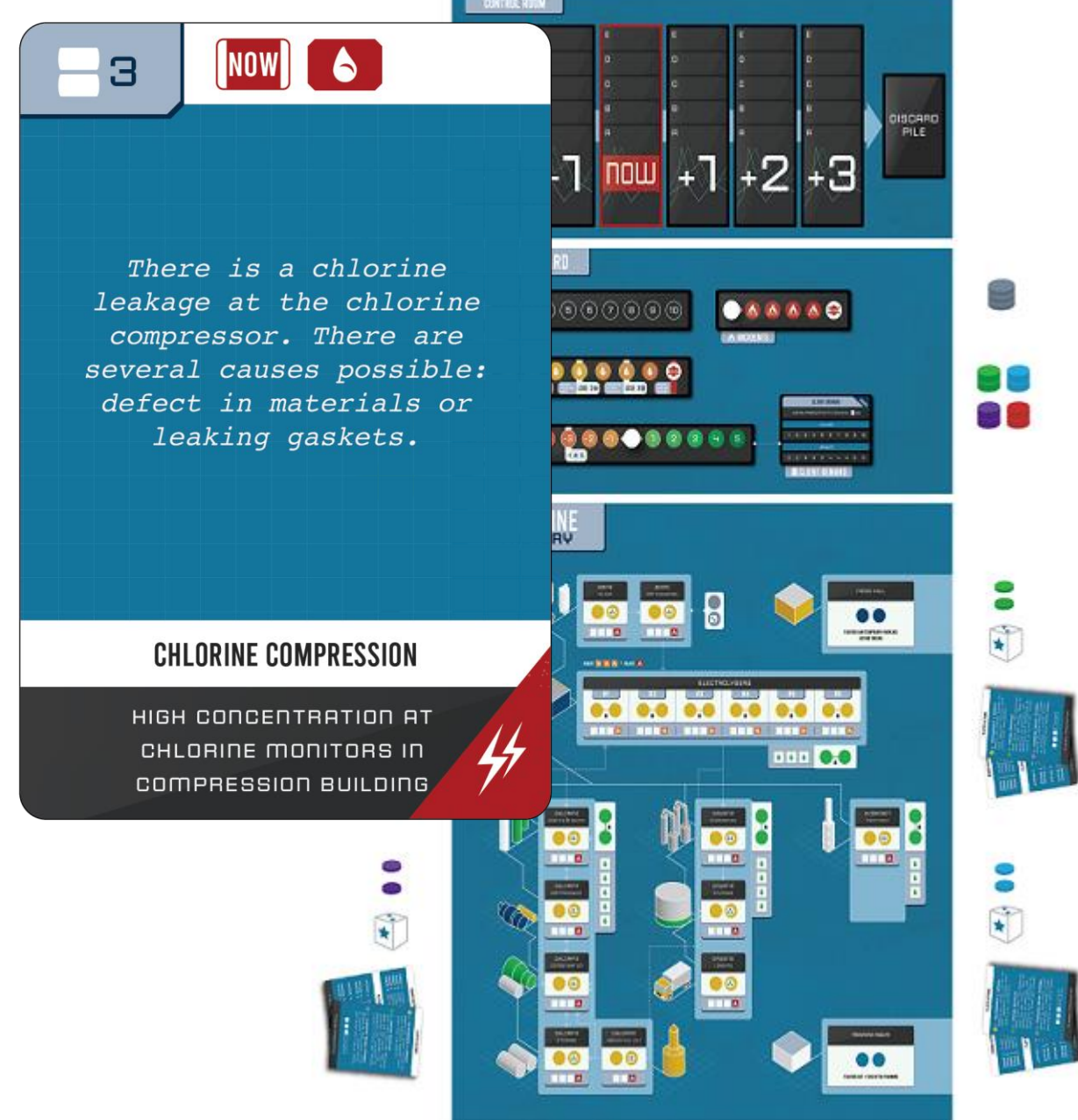
Game itself

- ✔ Simplified representation of real plant with main units present and other units part of main units
- ✔ Played with four players and one facilitator;
- ✔ Players act as one team trying to beat game
- ✔ Consists of 10 rounds
- ✔ In every round, certain production required



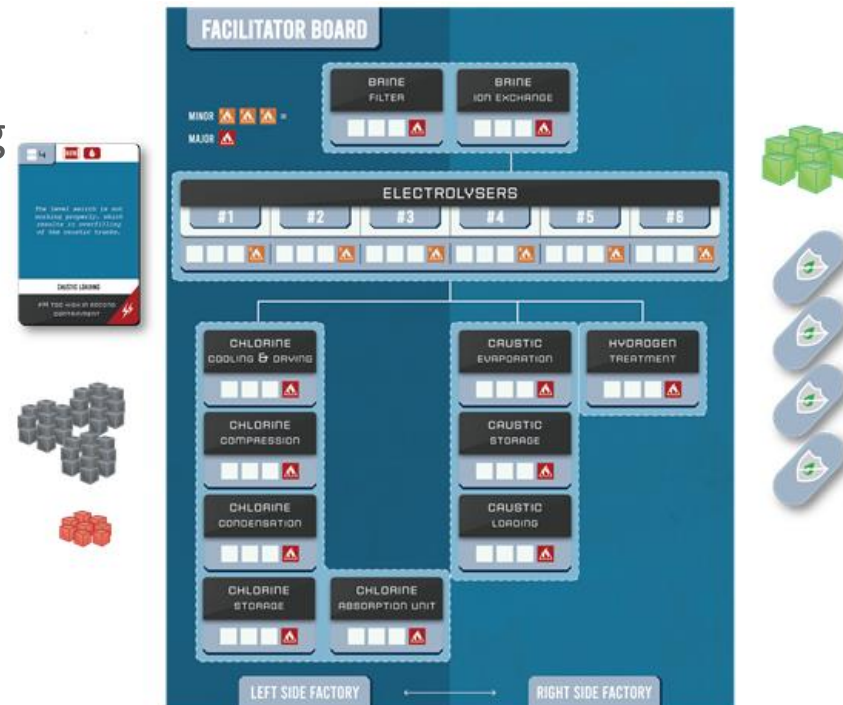
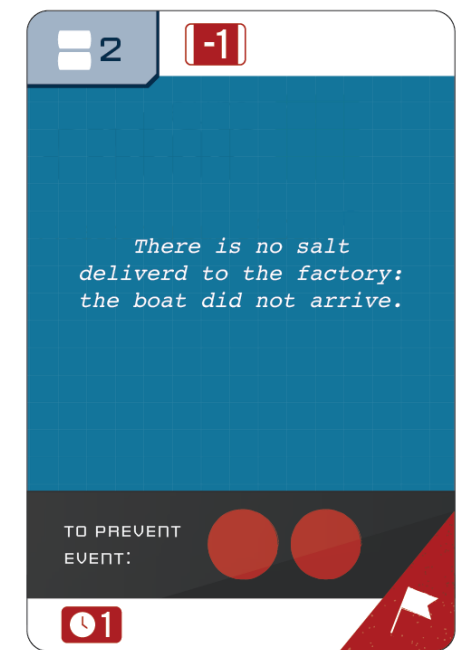
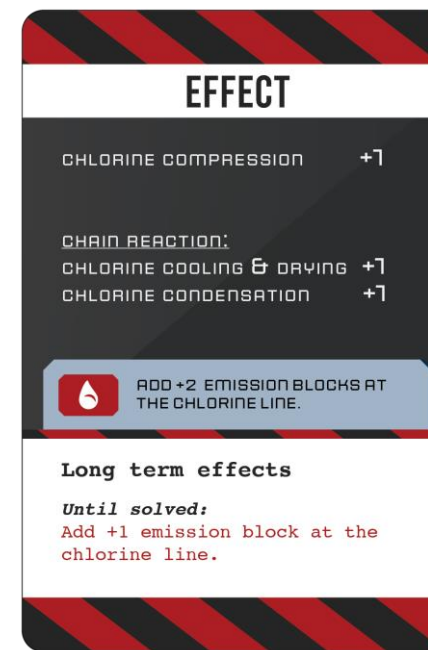
Game itself

- ✓ Players can increase production by taking cards
 - ✓ Cards also introduce treats and/or emissions to solve
 - ✓ They need to judge if there might be chain effects involved...
- ✓ They have to balance production and safety of plant
- ✓ Opportunities to increase skills by following training etc
- ✓ During game, problem/stress level increases



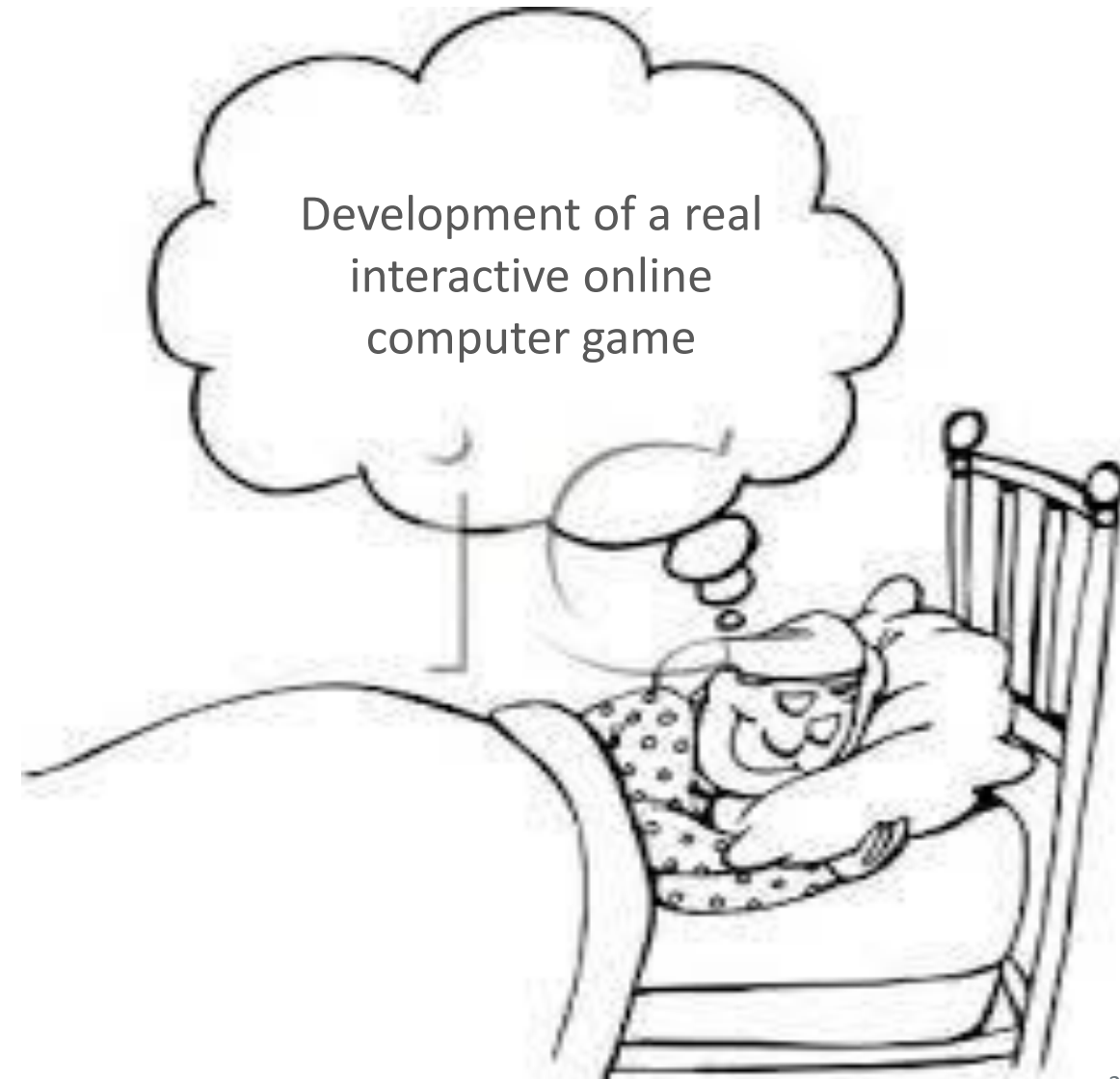
Game itself

- ✓ Working together and good knowledge of chain effects key
- ✓ Facilitator is very important for game:
 - ✓ He/she knows exactly effects of all cards on table ; While players have to judge/predict this themselves
 - ✓ Can manipulate the complexity
 - ✓ Discusses afterwards improvement/learning areas for team that played game



Next steps

- ✓ Next steps
 - ✓ Printing game boxes; one box available for each member site in Europe (if interested)
 - ✓ Training sessions for game facilitators
 - ✓ Handing over game boxes to sites
- ✓ Getting feedback from members on how it works and further improvements.....



Thank you.

Ton Manders
tma@cefic.be

About Cefic

Cefic, the European Chemical Industry Council, founded in 1972, is the voice of large, medium and small chemical companies across Europe, which provide 1.1 million jobs and account for 15% of world chemicals production. Cefic members form one of the most active networks of the business community, complemented by partnerships with industry associations representing various sectors in the value chain. A full list of our members is available on the Cefic website. Cefic is an active member of the International Council of Chemical Associations (ICCA), which represents chemical manufacturers and producers all over the world and seeks to strengthen existing cooperation with global organisations such as UNEP and the OECD to improve chemicals management worldwide

