



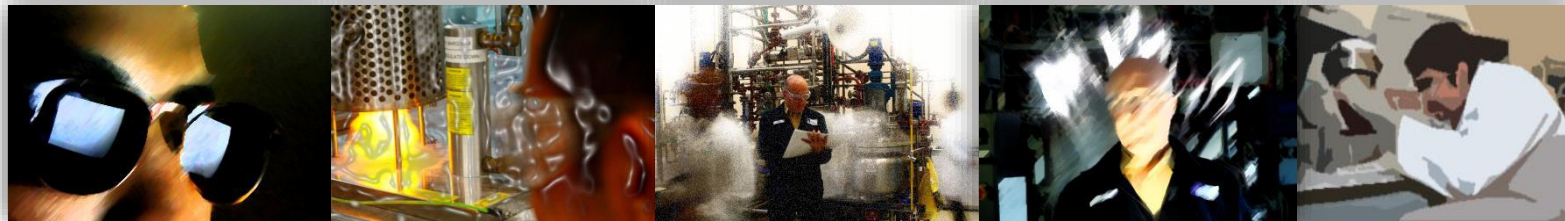
Institute of
Chemical and
Engineering Sciences

CREATING GROWTH, ENHANCING LIVES

Research and Innovation in Safety

RESEARCH AND INNOVATION IN SAFETY CONSORTIUM – RISE (K)

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INTRODUCTION & BACKGROUND

A CATASTROPHIC CHEMICAL DISASTER IN SINGAPORE?

“...their complex operating environment and high concentration of highly hazardous chemicals means that any accident can potentially result in catastrophic consequences”

Mr Hawazi Daipi,
Senior Parliamentary Secretary for Manpower
in Parliament (9 Mar 2015)

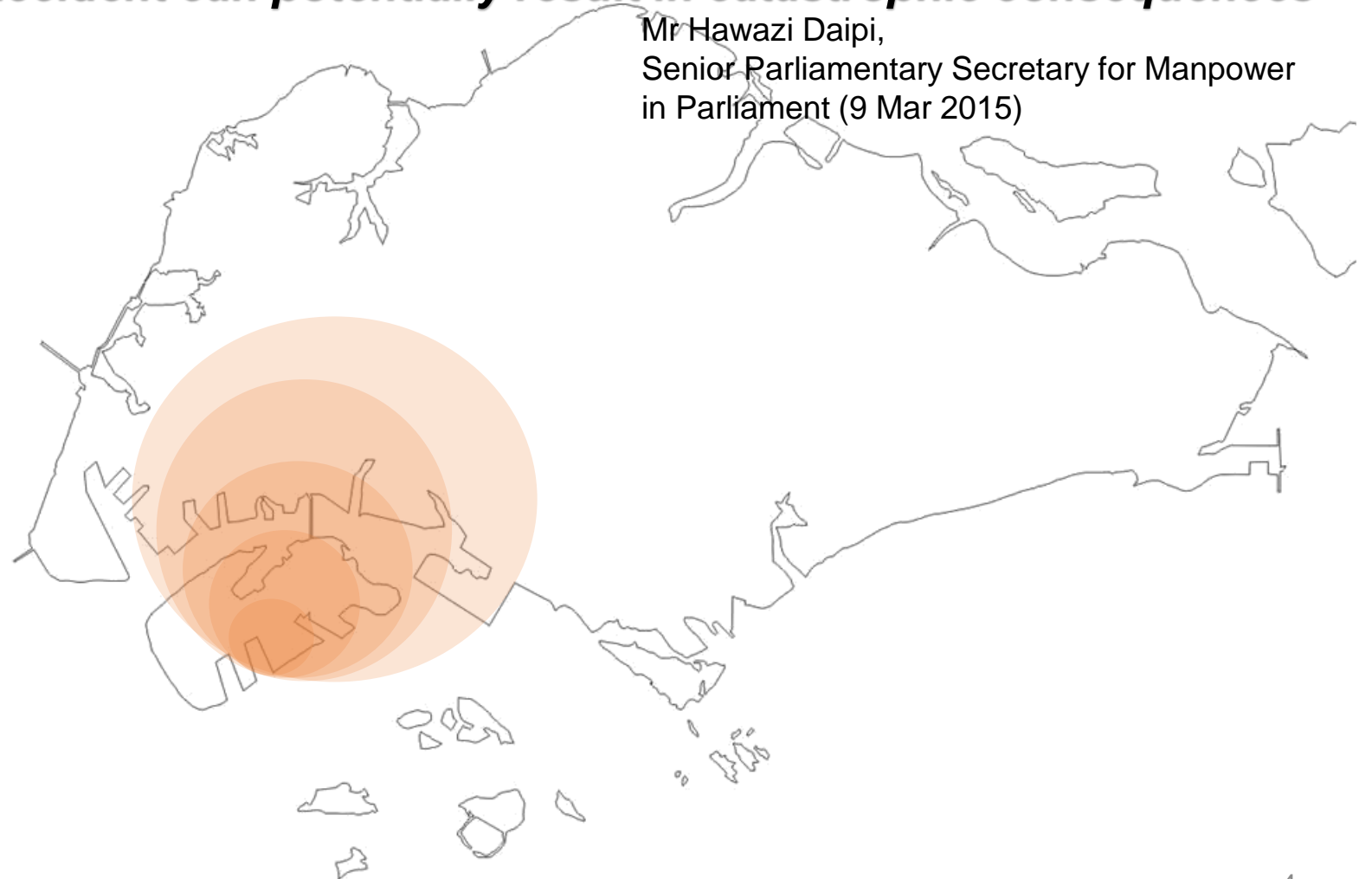
Low Probability

High Consequence



Lower Probability

Smaller Consequence



BACKGROUND ON MOM-ICES COLLABORATION

- Singapore introduced new legislation to cover Major Hazard Installations (MHIs), effective Sep 2017
 - MOM approached ICES to provide R+D in process safety to support the local MHI industry
 - MOM and ICES to set up a research-active Centre of Excellence
- MOU signed on 20 Oct 2016 to provide a framework for this collaboration
 - Major Hazards Department are collaborating with ICES in the first project under this MOU

Proposed programme to work on Singapore-centric issues related to:

- Dense urban environment
- Tropical weather conditions
- Advanced manufacturing

A MULTI-AGENCY ISSUE: ELECTROSTATIC DISCHARGE HAZARDS



Process Safety for
Major Hazards
Industries

Lead Agency
(Major
Hazards
Department)



Waste Treatment
Facilities



Fire Safety
for
Flammable
Liquids

PROCESS SAFETY ISSUES IN SINGAPORE

CURRENT STATE AND FUTURE OPPORTUNITIES

OVERVIEW OF CURRENT SITUATION

High Density & Aging Chemical Plants

- Highly integrated, dense cluster of chemical plants in Jurong Island
- Aging plants and potential **domino effects**

Tropical Climate

- Hot & humid weather conditions could significantly affect process equipment reliability
- To date, safety and reliability data collection has taken place primarily in the temperate zone. Better understanding of the tropical climate and weather conditions offers opportunities for improving safety measures in Singapore.

Manpower: Technical Process Safety capability & expertise

- Lack of locally available technical process safety capability to support chemical plants.

EMERGING ENVIRONMENT

Advanced Safety Regulation for MHIs started end 2017

- Advanced Safety Regulation (Safety Case) requires access to **strong research capabilities** to support both the generation and assessment of safety cases.
- Beyond Safety Management, Add-on Controls, **From Reactive to Proactive Safety**

Industry 4.0 & Jurong Island 2.0

- Enhancing efficiency of process plant operations
- Increasing reliability and availability of aging plant assets
- Highly integrated multi-plants with interconnected feedstocks – cluster, complex system behavior
- Leveraging on data analytics from greater usage of sensors (e.g. condition monitoring) to monitor process equipment and plant performance
- Predictive maintenance with Industrial Internet of Things (IIoT)

DIGGING DEEPER INTO THE ISSUES - FOCUS GROUP DISCUSSIONS (FGD)

- The FGD was conducted in April 2018 in which 20 companies participated including:
 - Air Products, Asahi Kasei, BASF, CIL, Chemical Specialties, Chevron Oronite, Chevron Phillips, Eastman, Evonik, Exxon Mobil, Infineum, Kuraray, Lloyd's Register, Mitsui Elastomers, Mitsui Phenols, PCS, Prime Evolve, Shell Chemicals, SRC, Vopak.



Technical
Workshop

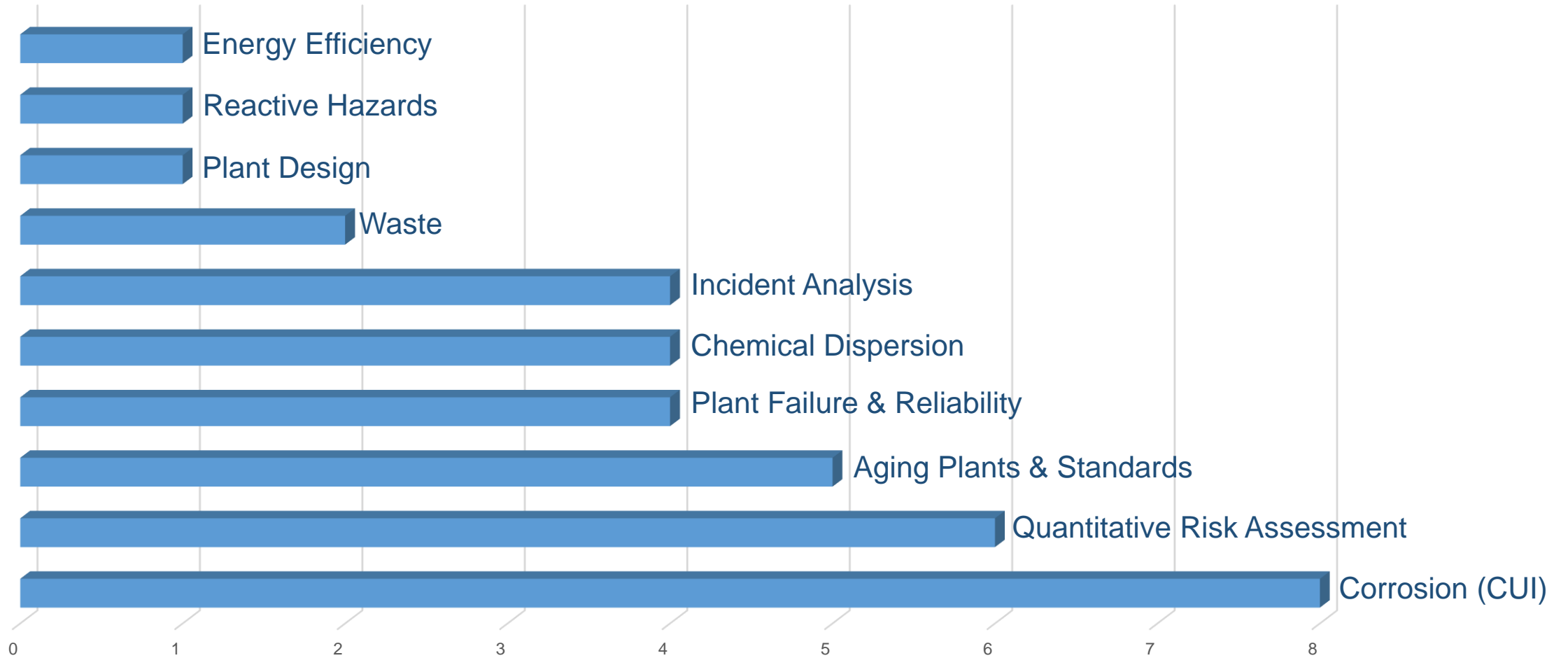
Management
Workshop

Company
Visits

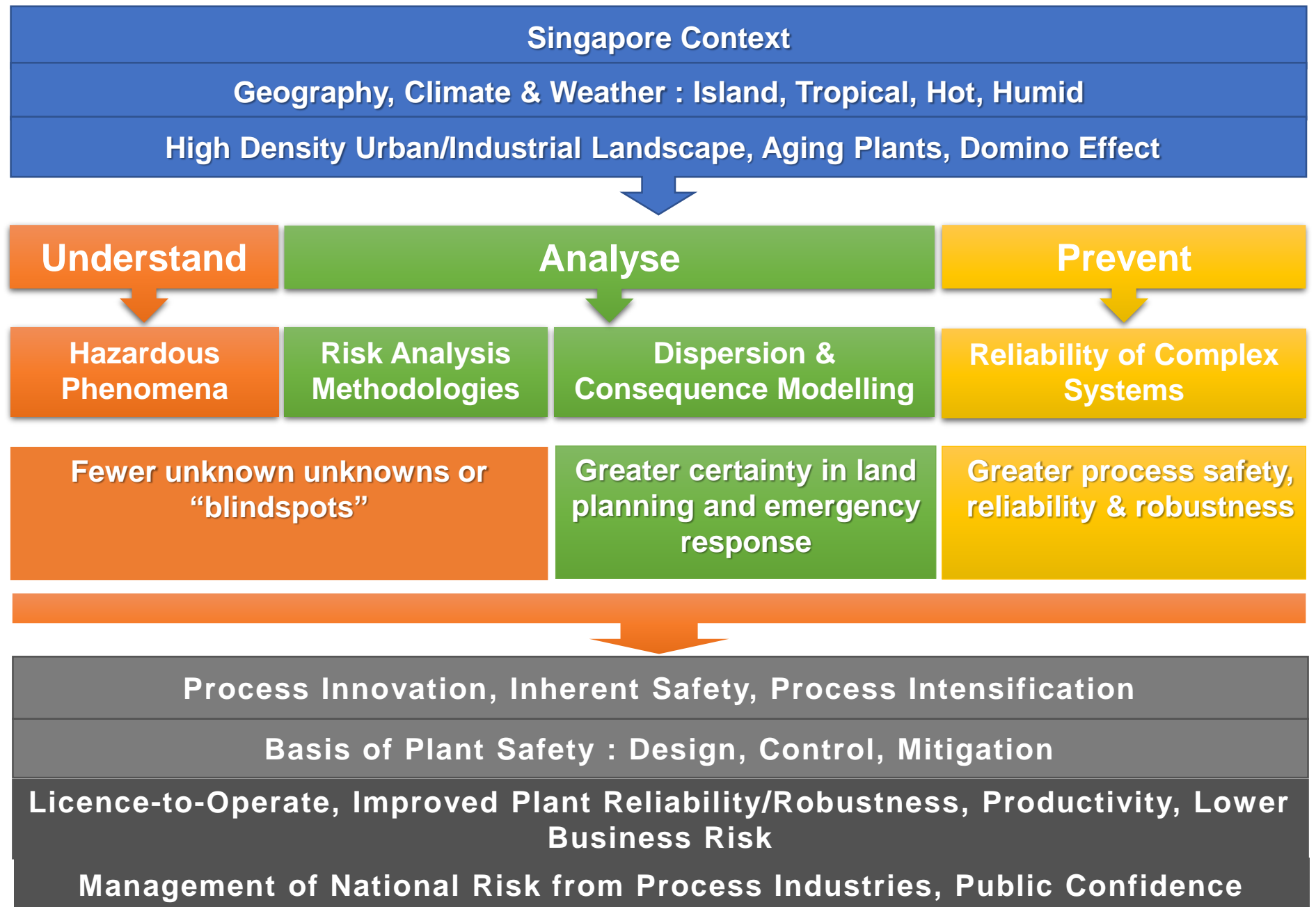
FGD OUTPUT – INDUSTRY ISSUES AND RESEARCH THEMES

	Focus Group Discussion	Company Visits
Hazardous Phenomena	<ul style="list-style-type: none"> • Safe Process Envelopes 	<ul style="list-style-type: none"> • Reaction Hazards
Risk Analysis Methodologies	<ul style="list-style-type: none"> • Quantitative Risk Assessments (QRA) • ALARP and Risk Criteria • Case Studies • Standards Review, Benchmarking, Equivalency 	<ul style="list-style-type: none"> • QRA • Standards • Incidents • Retrofitting of Inherent Safety Design
Dispersion and Consequence Modelling	<ul style="list-style-type: none"> • Dispersion and Consequence Modelling 	<ul style="list-style-type: none"> • Dispersion modelling
Reliability of Complex Systems	<ul style="list-style-type: none"> • Aging Plants and Reliability • Human Factors 	<ul style="list-style-type: none"> • Corrosion under insulation • Reliability • Safeguarding plant integrity • Vibration analysis
Others	<ul style="list-style-type: none"> • Waste Treatment 	<ul style="list-style-type: none"> • Lightning strikes • Waste • Energy conservation / efficiency

INDUSTRY PRIORITY TOPICS



FRAMEWORK FOR PROCESS SAFETY RESEARCH



FGD OUTPUTS - SOFT INFRASTRUCTURE FOR PROCESS SAFETY

What is It?

- Services and non-physical assets required to maintain standards of Process Safety such as specialist expertise including process safety capabilities.

Who needs It?

- Needed by companies for projects and specialised services required to stay competitive.
- Needed by Singapore to attract new companies to invest.

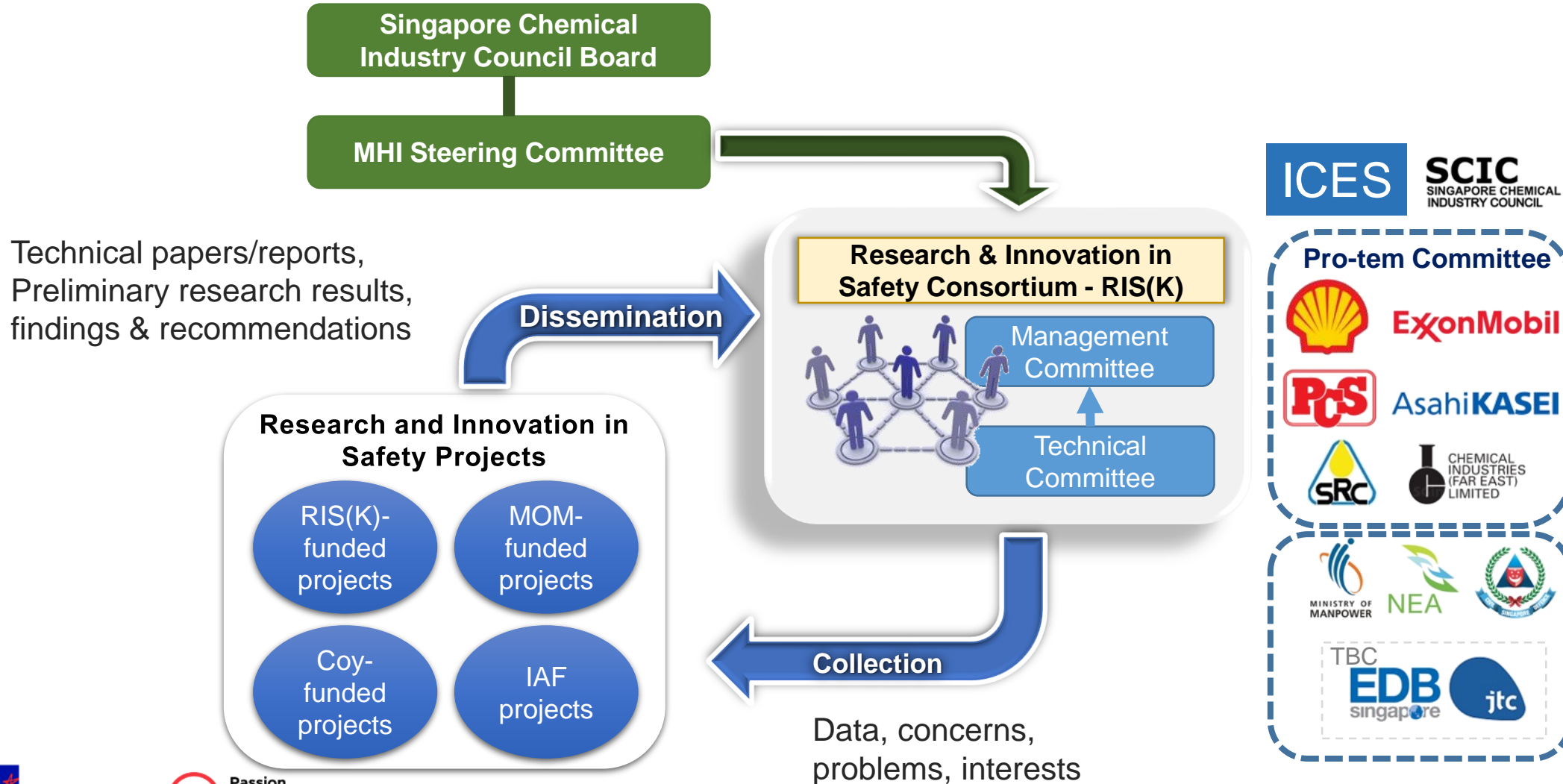
Who should pay for It?

- Companies say: Public funding because
 - It would be contributing to Singapore's attractiveness as a chemical manufacturing hub.
 - Companies should pay for company-specific projects
 - Singapore SMEs have the least resources to address their process safety needs and are the ones in greatest need of this soft infrastructure.

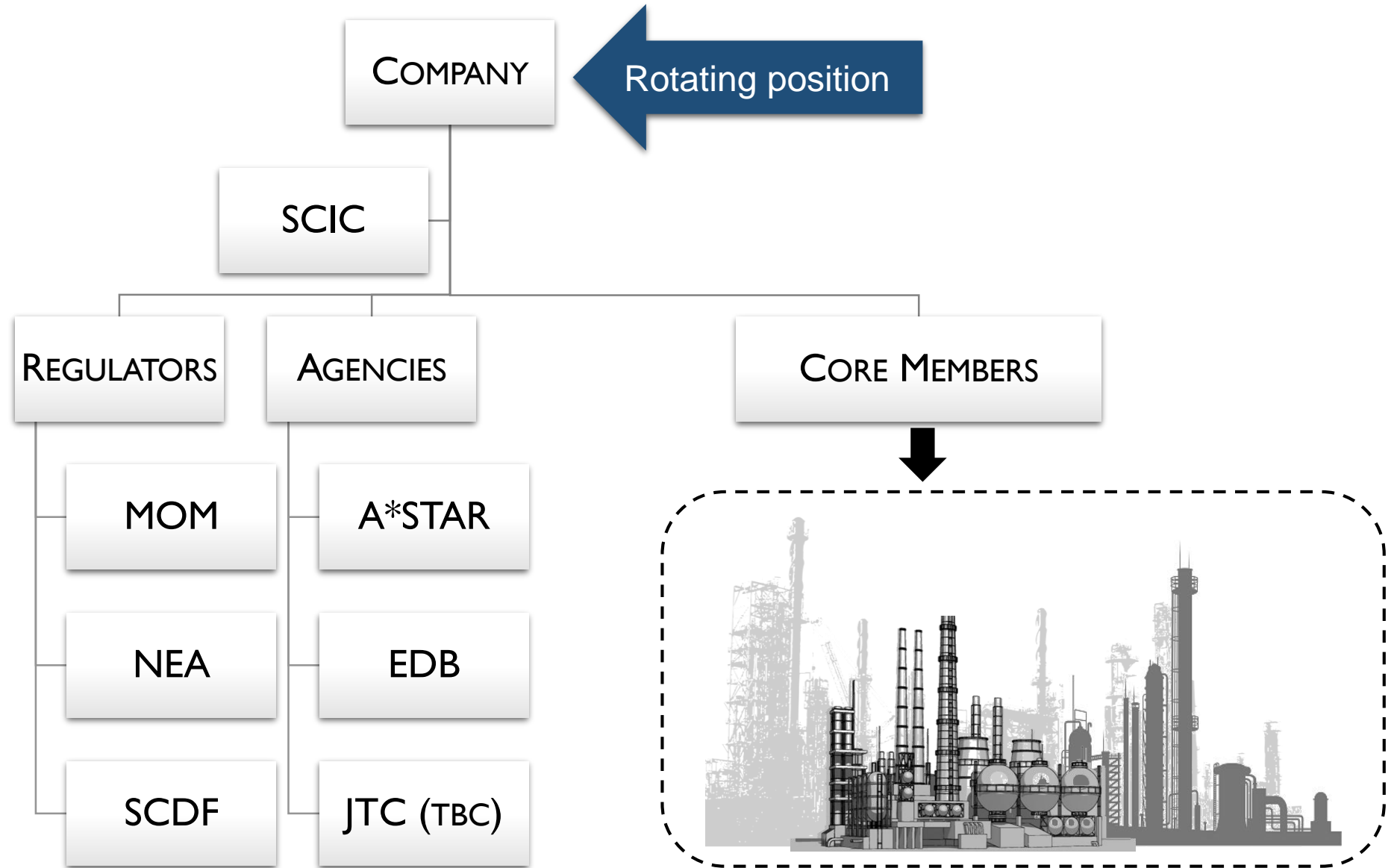
RESEARCH AND INNOVATION IN SAFETY
CONSORTIUM, RIS(K)

A PUBLIC-PRIVATE INITIATIVE FOR ENHANCED
PROCESS SAFETY

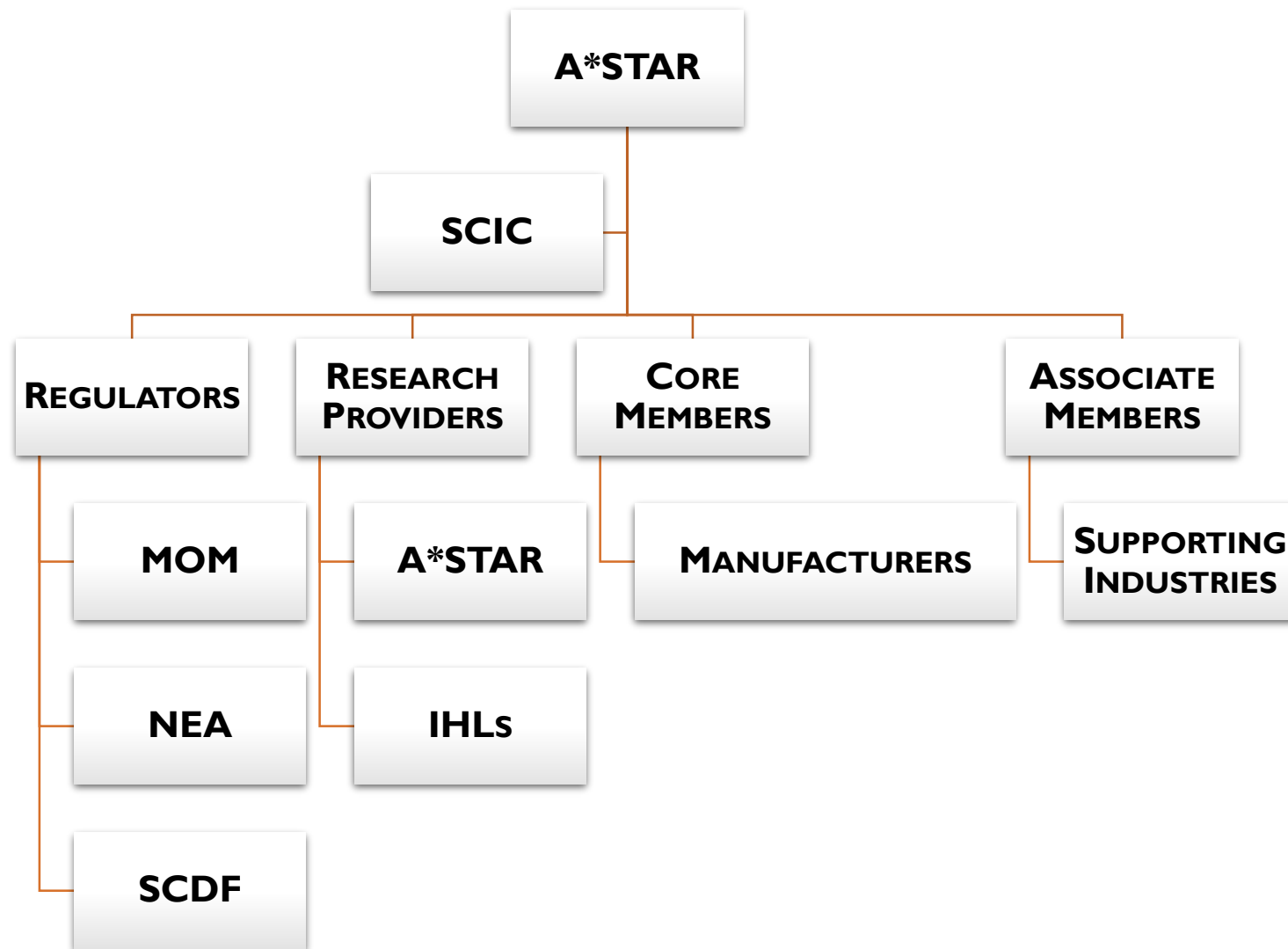
RESEARCH & INNOVATION IN SAFETY CONSORTIUM – RIS(K): STRUCTURE



MANAGEMENT COMMITTEE



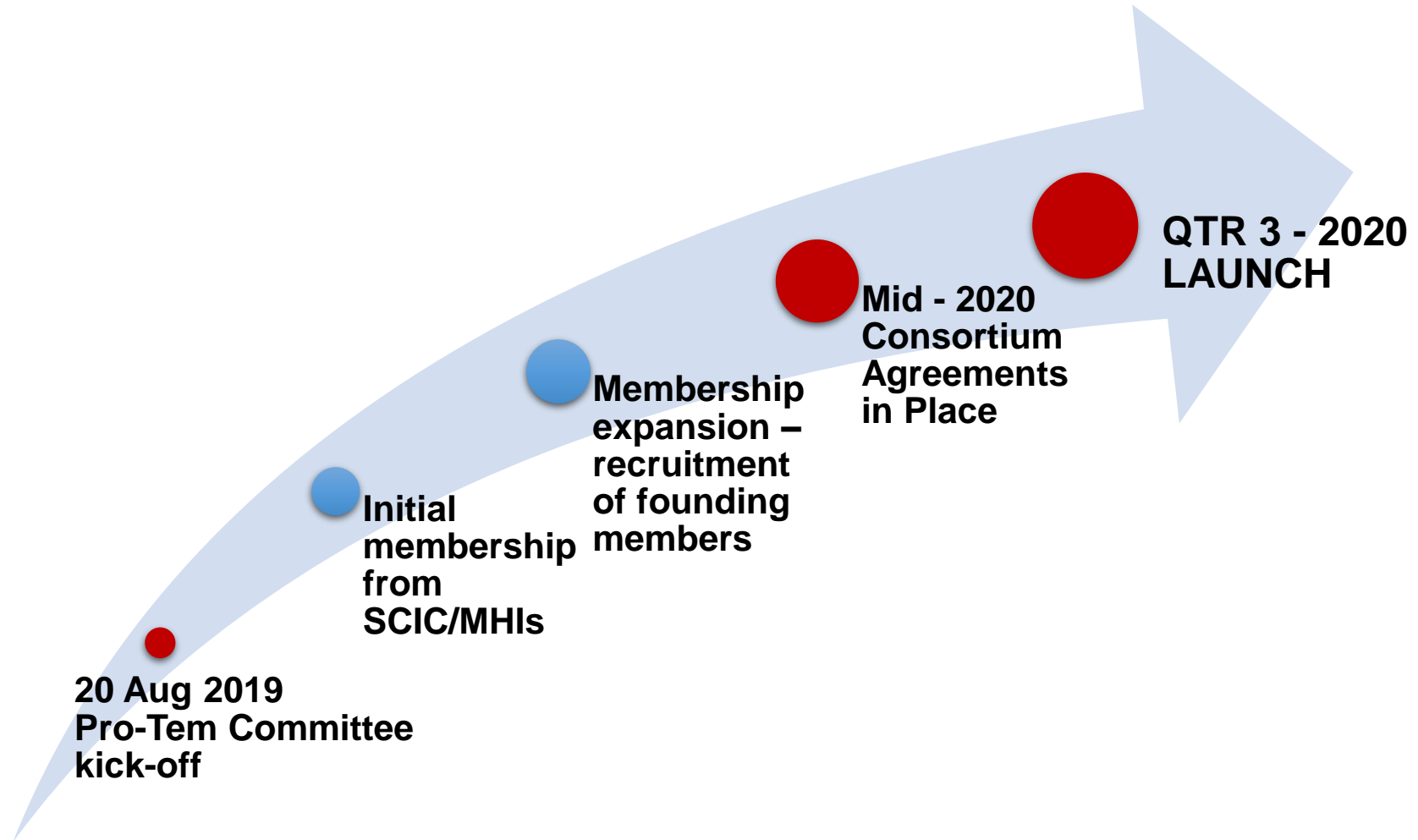
TECHNICAL COMMITTEE



POTENTIAL OUTCOMES AND BENEFITS OF RIS(K) CONSORTIUM

- Set **national research agenda** on process safety topics
- Contribute and influence **standards creation, policy and legislation**
- Test bedding and benchmarking of **safety solutions and technology**
- Better leverage on available **funding**
- Research support and **networking** (industry/academia/authorities)
- **Training** and outreach

TIMELINE FOR LAUNCHING THE CONSORTIUM



END