EU-CIRCLE framework: Analysis & Overview of the questionnaires and the presentation of the EU-CIRCLE operational framework

Georgios Eftychidis – Ilias Gkotsis
Center for Security Studies (KEMEA)

EU-CIRCLE Questionnaire

Feedback gathered by CI stakeholders:

- ✓ Through a web designed questionnaire (http://eu-circle.kemea-research.gr/index.php/survey/index/sid/154347/newtest/Y/lang/en)

- ✓ Through the Workshop/Training Programme on "Critical Infrastructure Protection" on the 14th and 15th December 2015 at the premises of KE.ME.A in Athens (Greece), organized by Center for Security Studies (KE.ME.A.) in cooperation with DG HOME and Joint Research Centre

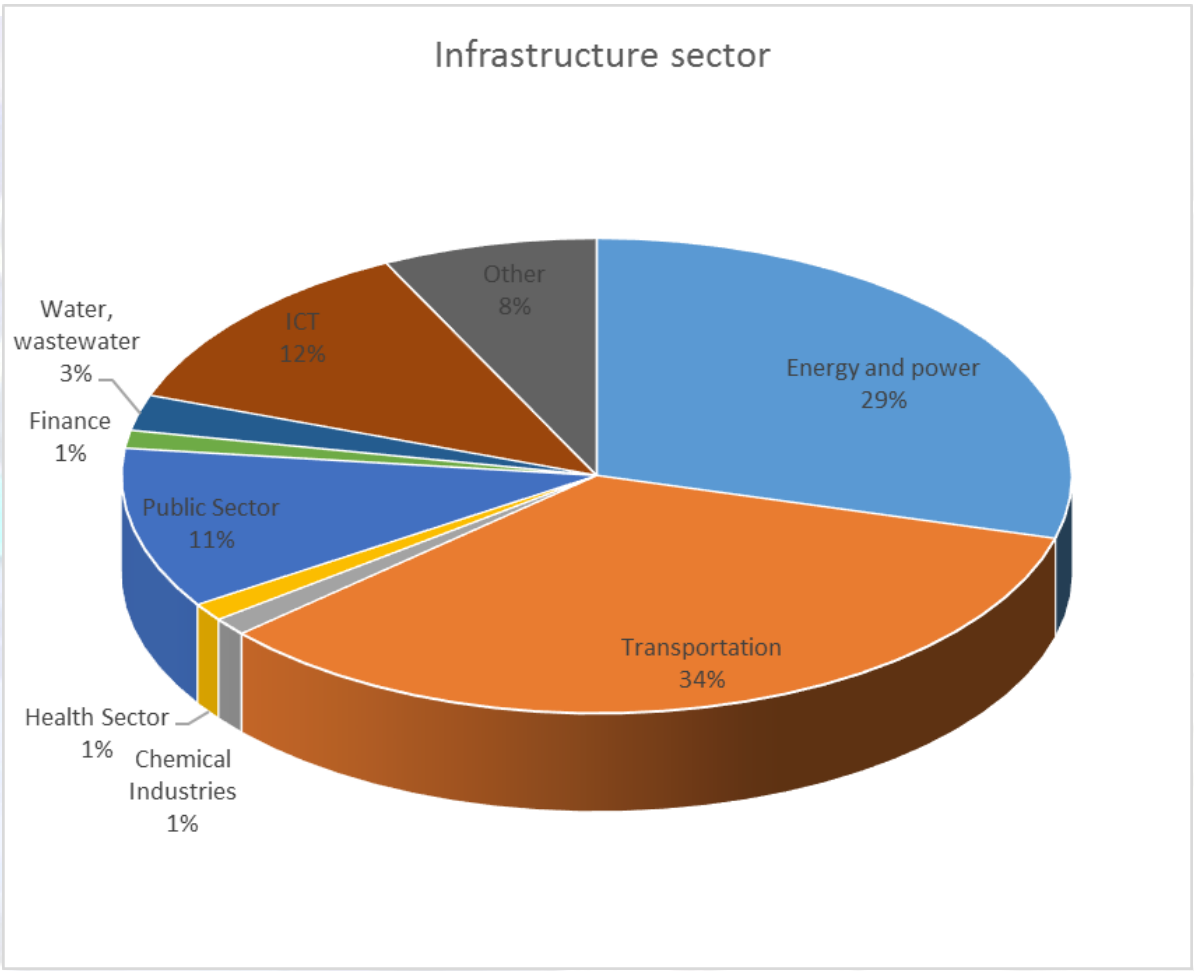
Major Outcomes Infrastructure Sector

76 Questionnaires filled

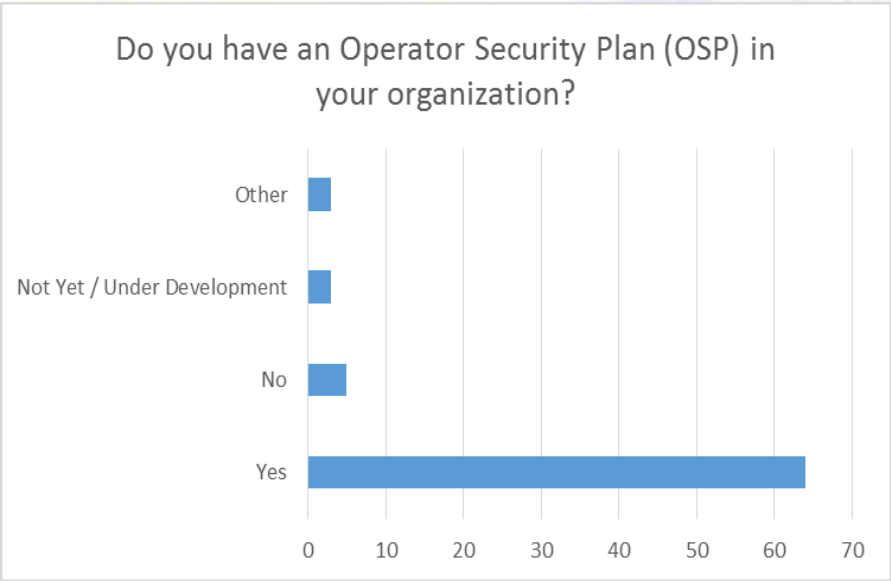
- 60 interviewed
- 16 online

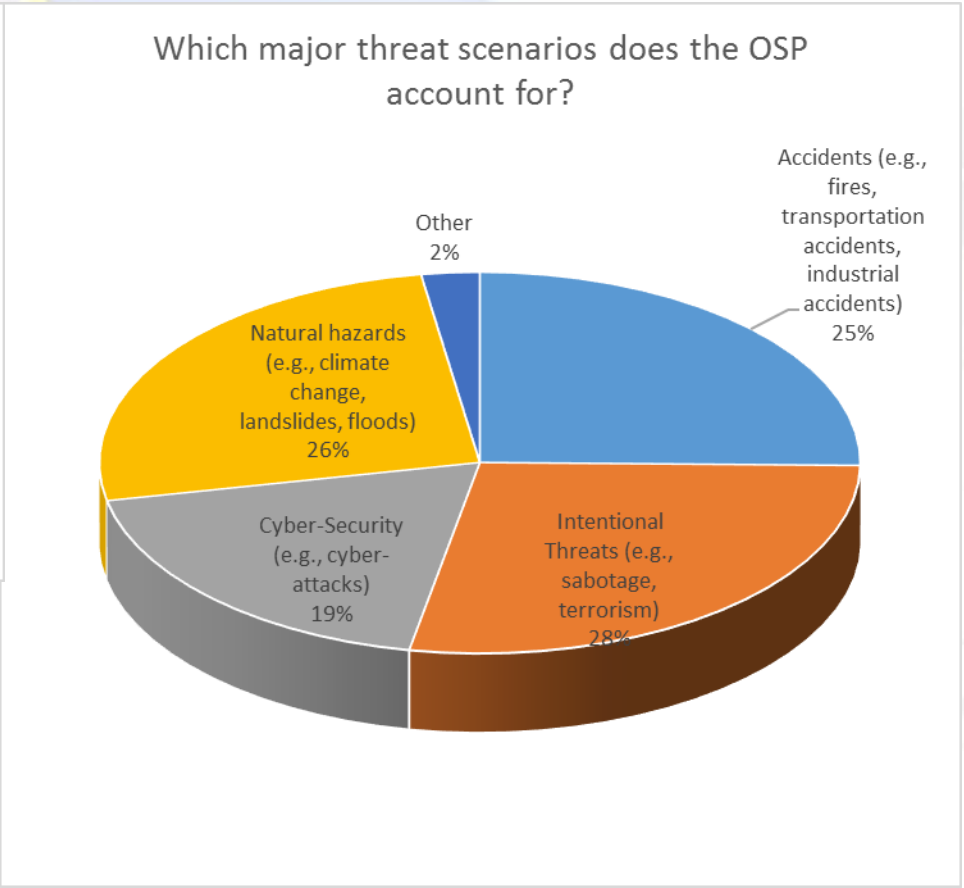
Mainly from

- Transportation (34%)
- Energy (29%)
- ICT (12%)



Major Outcomes
Operator Security Plan (OSP)





65% have an OSP
Threats considered

- Intentional
- Natural hazards
- Accidental
- Cyber

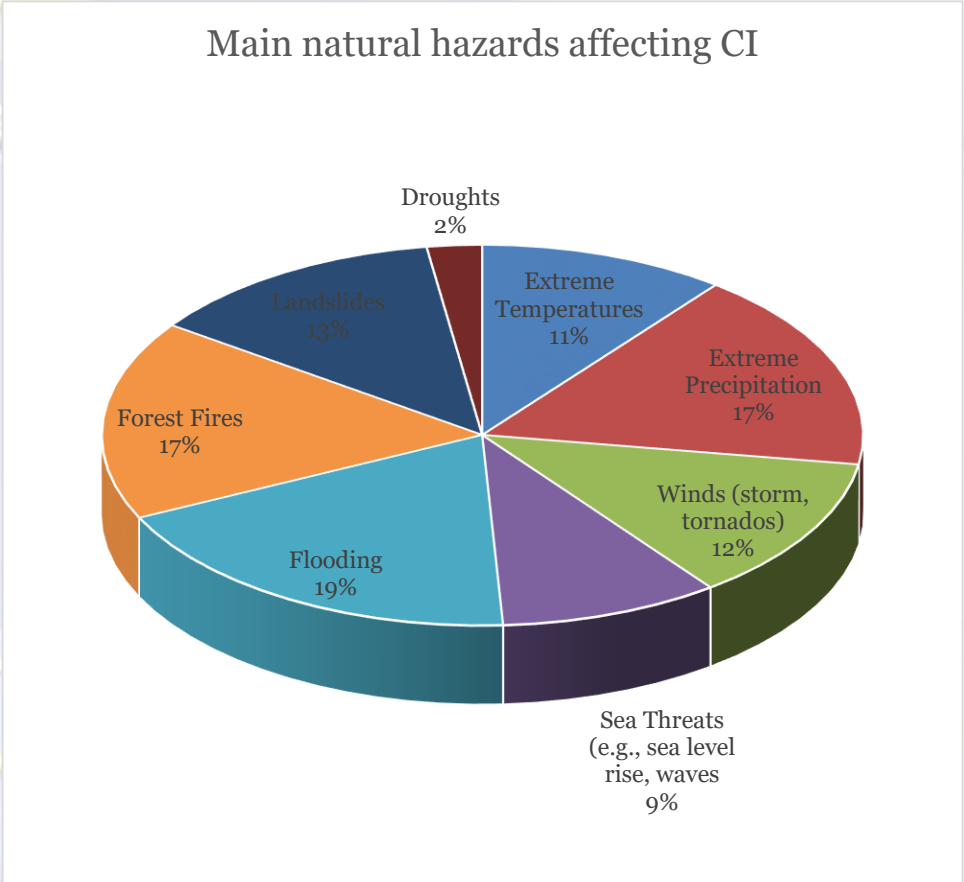
Major Outcomes
Operator Security Plan (OSP)

Have important assets of the infrastructure been identified in the OSP?

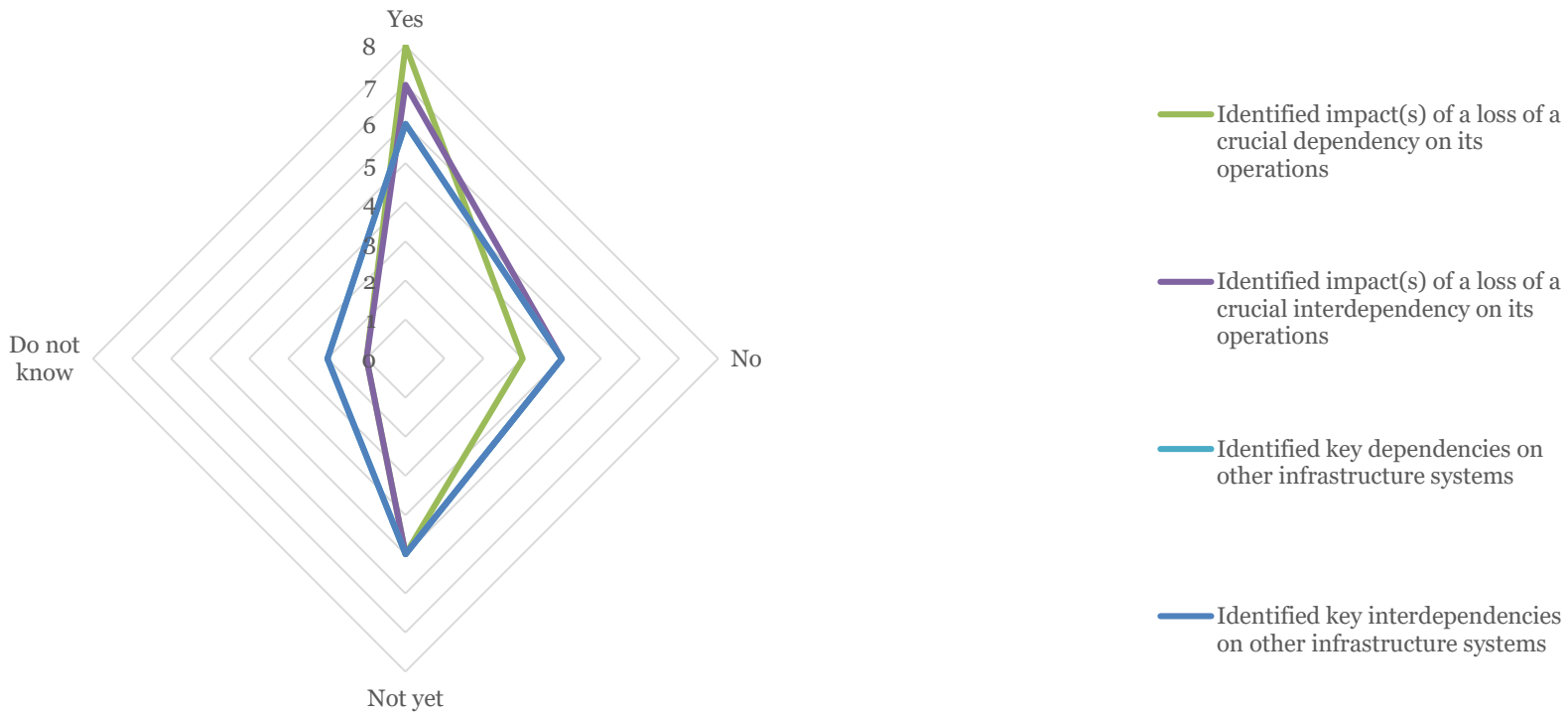
- Yes 83,33%
- No 16,67%

Has a risk analysis been conducted as part of your OSP procedure?

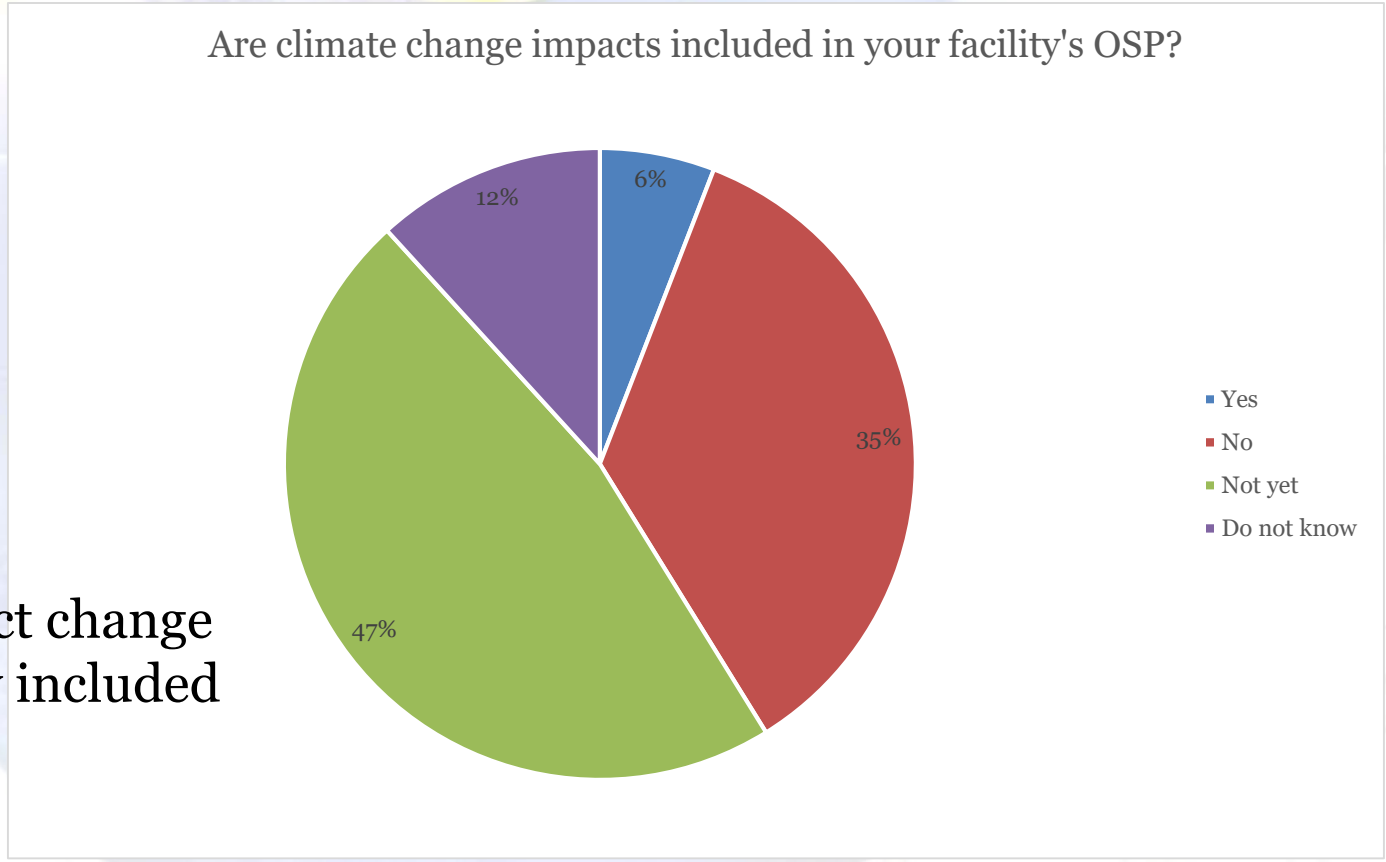
- Yes 66,67%
- Not Yet / Under Development 33,33%



Major Outcomes
Dependencies and Interdependencies

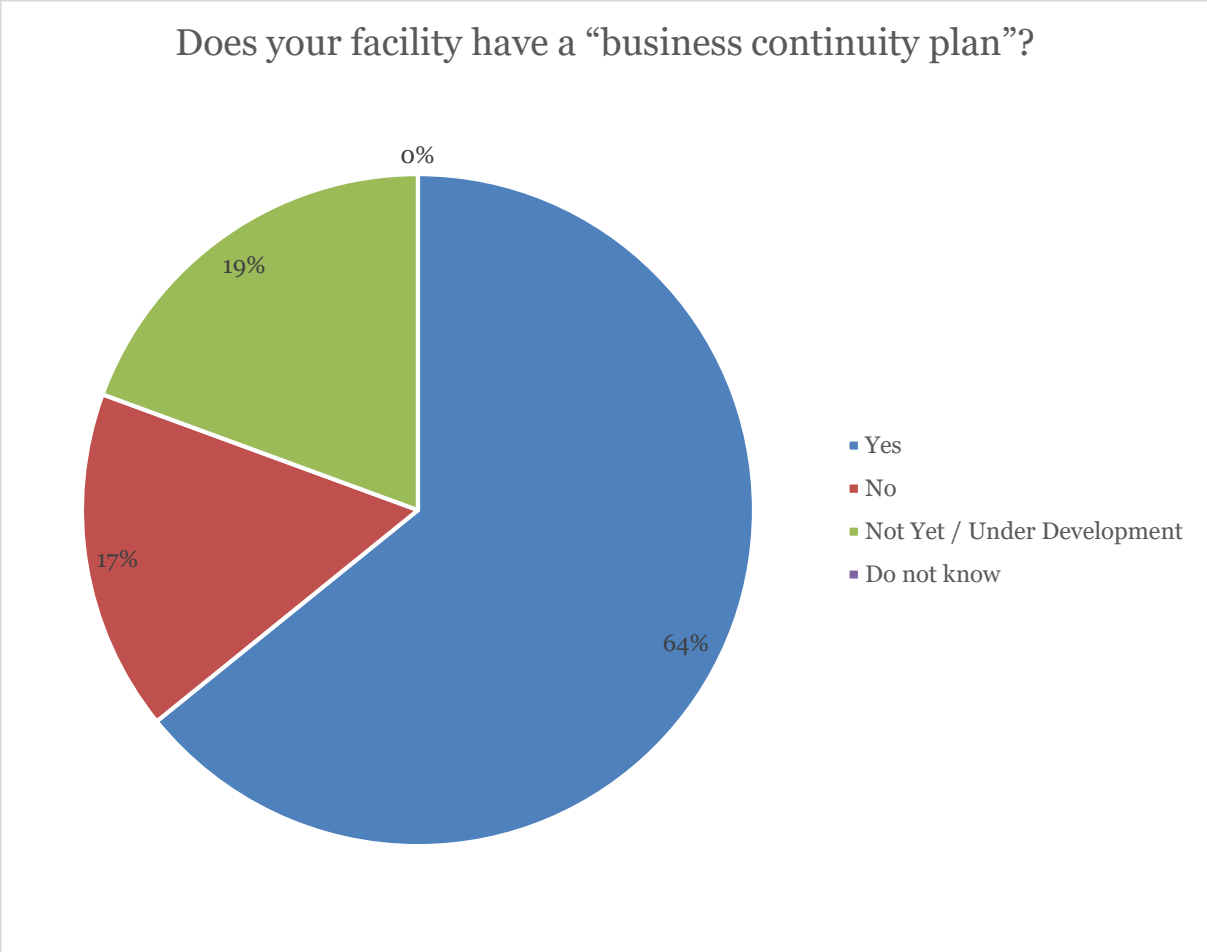


Major Outcomes
Climate Change Impacts

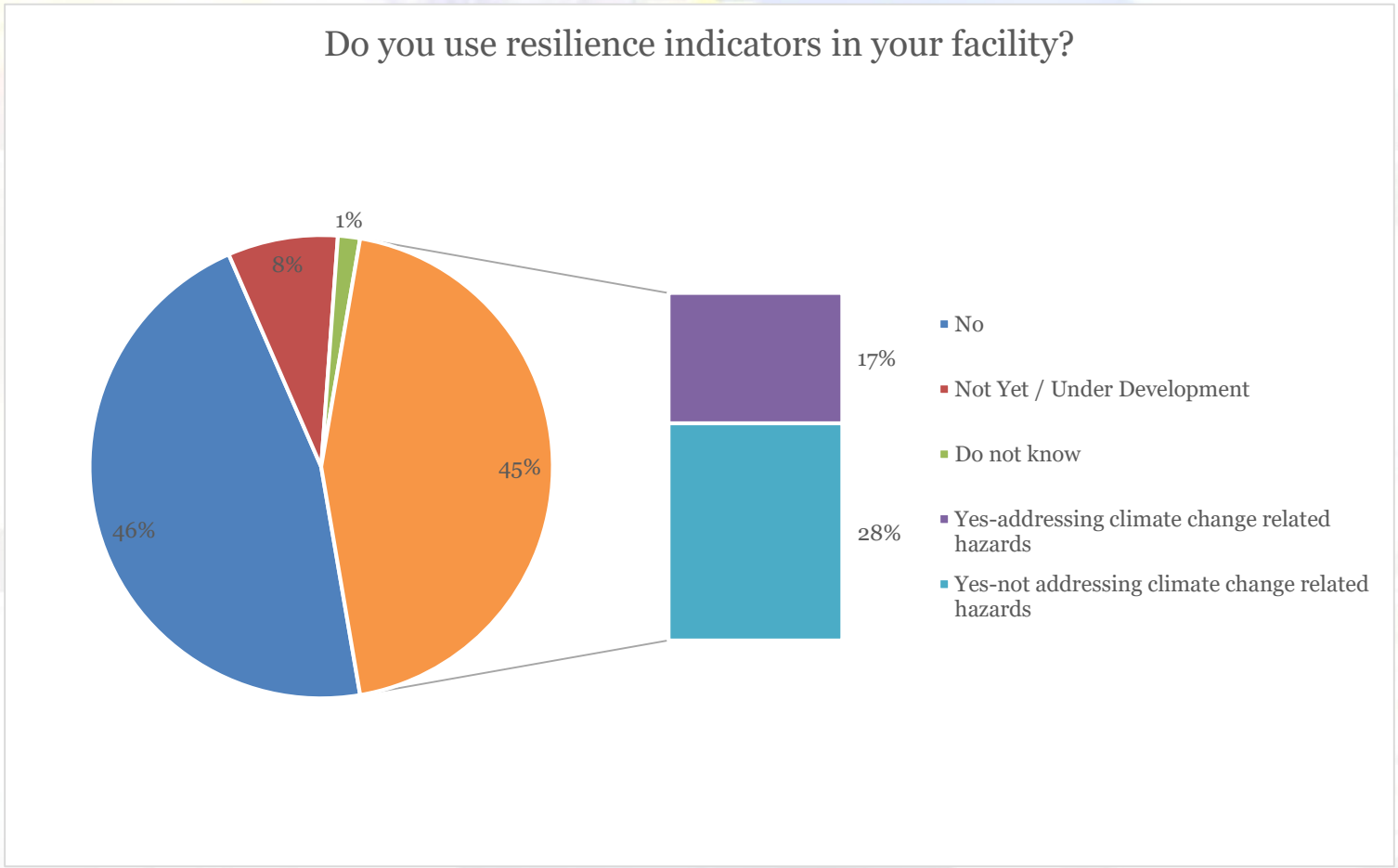


Climate impact change is roughly included in OSP

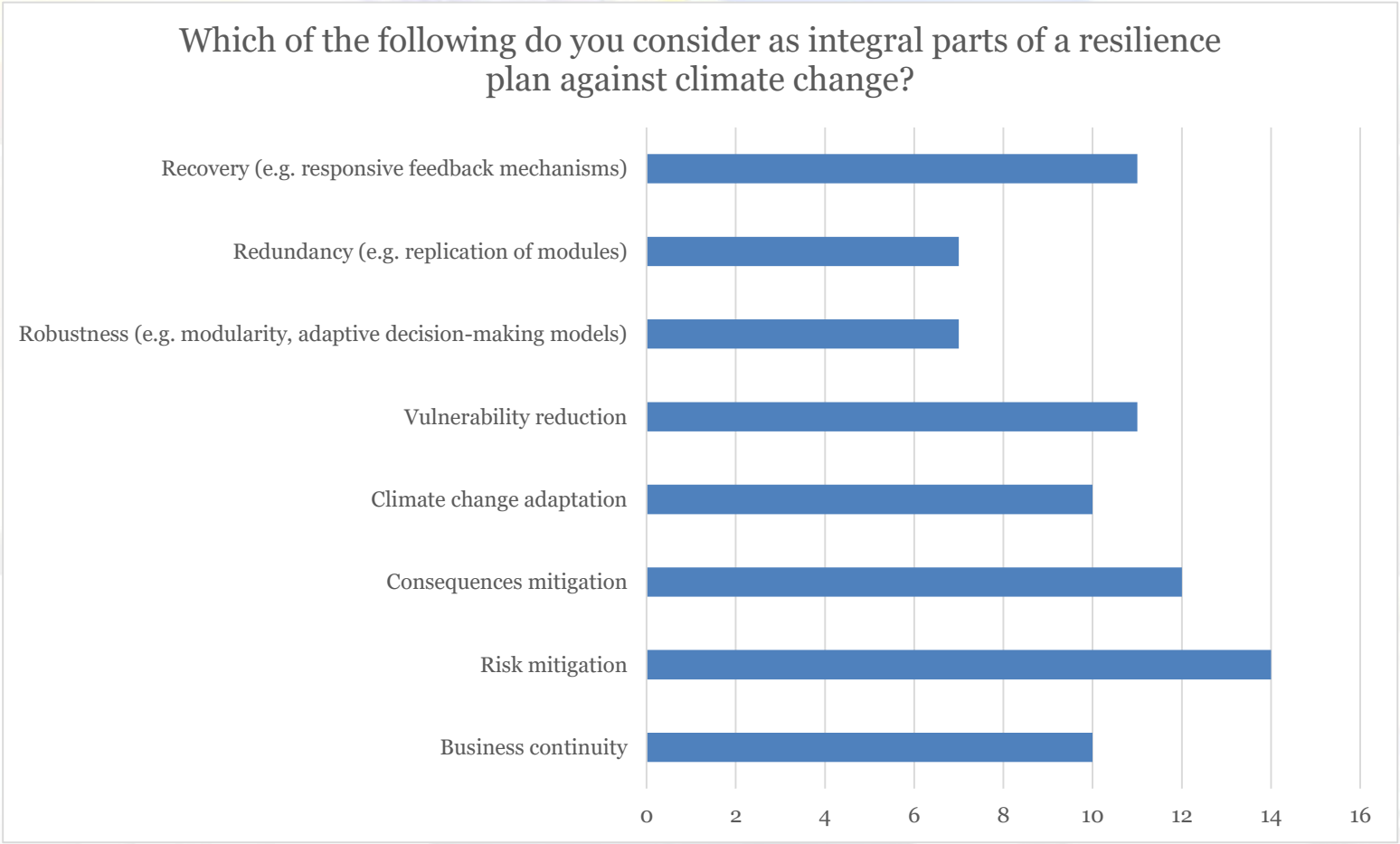
Major Outcomes
Business Continuity Plan



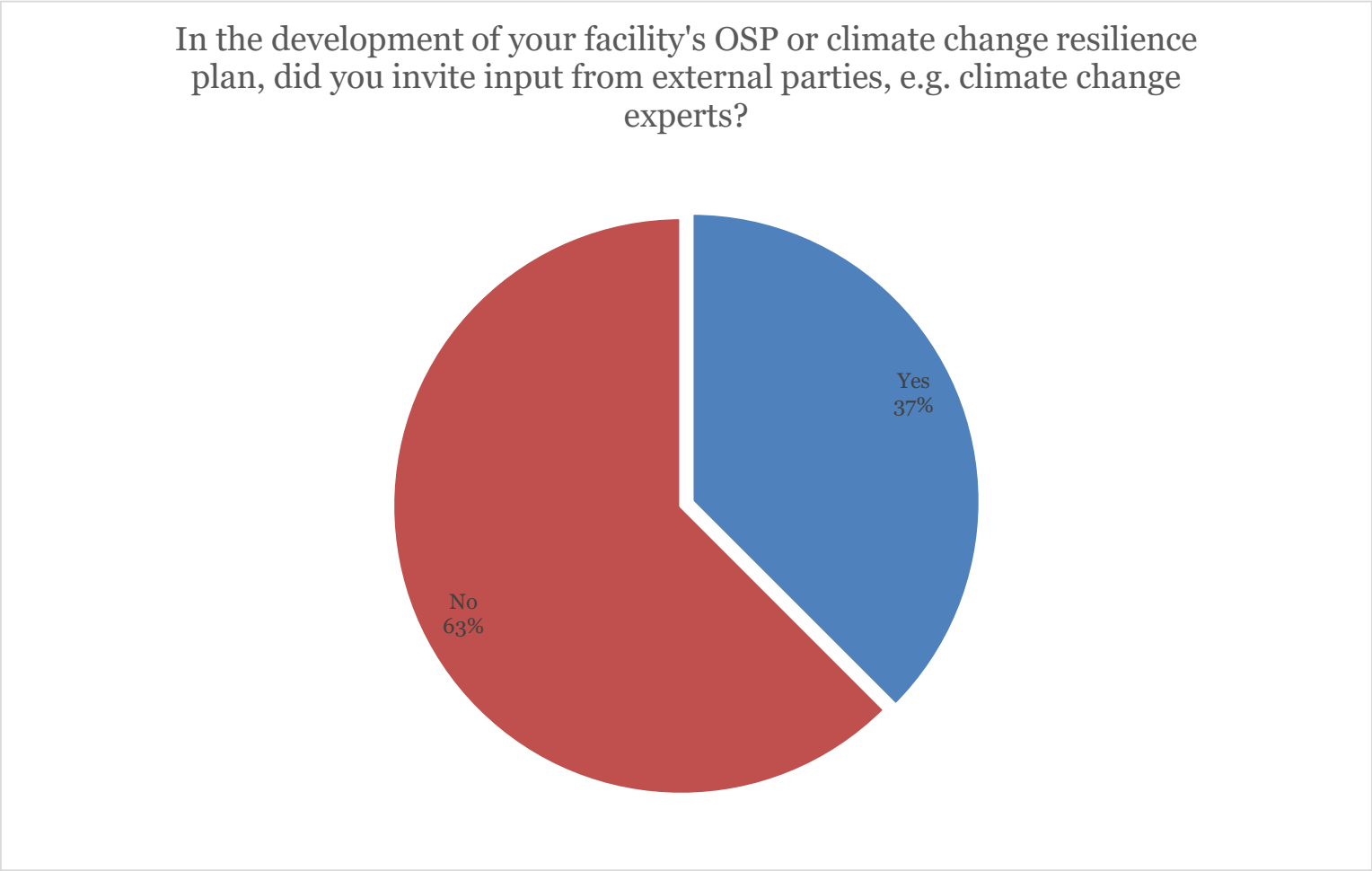
Major Outcomes
Resilience Indicators



Major Outcomes
Resilience and Climate Change



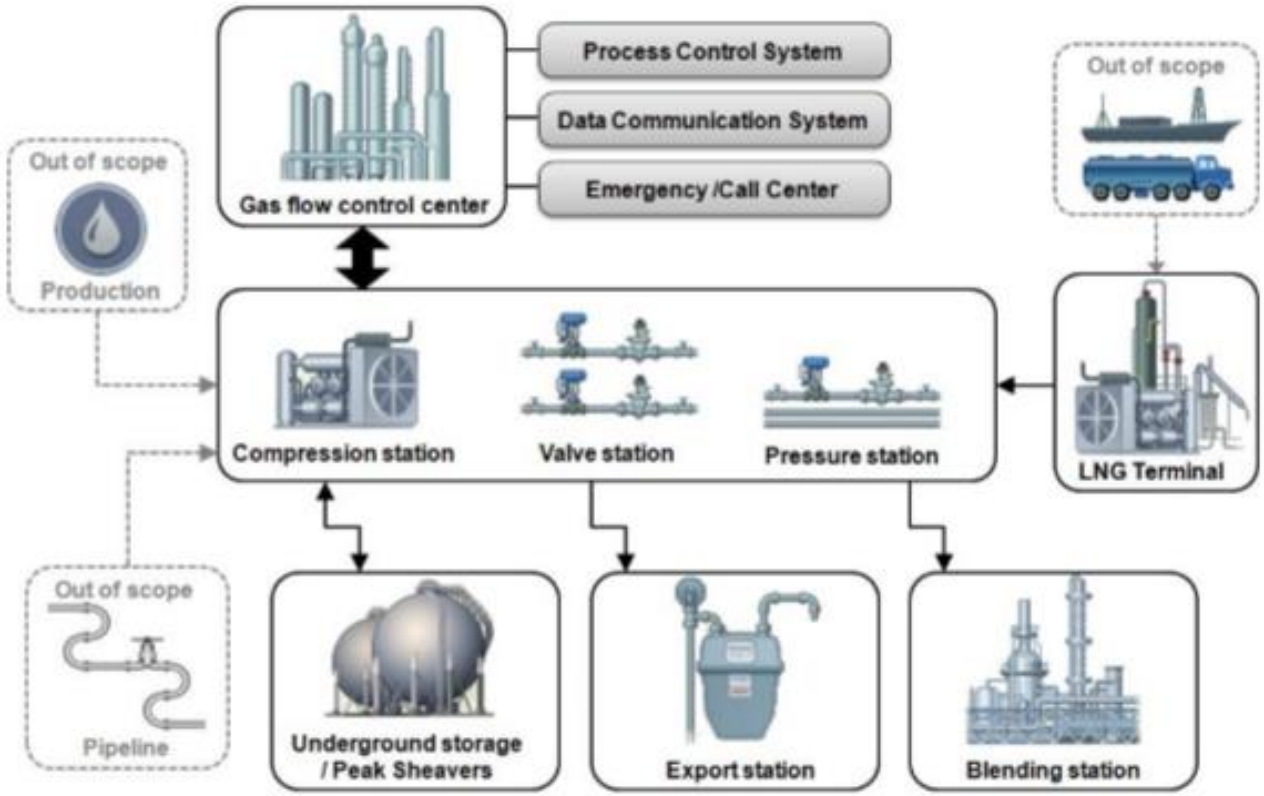
Major Outcomes Communication



Questions to stakeholders

- What is/are the **reference time period** for your operational plans?
- Can you decompose the network of your CI down to physical **assets** (units) and links?
- What **scenario** of meteorological conditions may create problems to CI asset?
- What is the **resolution** that you wish to be offered to you
- What assets will be influenced (**impact**) by the scenario
- What you can do to **mitigate** the impact
- What will be the **downtime** of the asset before return to operationality
- Can you describe **interdependencies** among assets of your CI and other CIs

Gas infrastructure physical assets scheme



Security Risk Assessment Methodology, GIE 2015

Climate change risk scenarios

- High temperatures
- Intense rainfall
- Prolonged drought
- High intensity forest fires
- Extended flooding
- Rapid snow melt
- Sea level rise
- ….

Severe weather conditions related to the impacts: Transport - MARITIME

HAZARD	IMPACTS	HAZARD	IMPACTS
# of days with Tmax(heat stress): Tmax≥ 25 °C, Tmax≥ 32 °C, Tmax≥ 43 °C	*overheating and fatigue, hazardous for certain groups of workers*	**Snowfall Rs ≥ 1 cm/d, Rs ≥ 10 cm/d, Blizzard: Rs ≥ 10 cm/d, Tmean≤ 0 °C, WG ≥ 17 m/s**	*snow cover, high humidity at harbour*
Cold waves: Tmean≤ 0 °C, Tmean≤ -7 °C, Tmean≤ -20 °C	*cold waves: freazing sea and structures*	**Sea level rise, sea storm**	*flooding, erosion of coastal structures, affection of chemical structure of buildings, and structural fatigue, Degradation of wharves through increased corrosion*
Extreme precipitation - floods: # of days R≥30- 50mm/day, 100mm/day Total daily precipitation	*seaport flooding,thunderrstorms, electricity breakdown at port, reduced visibility, degradation of wharves through increased corrosion, delays and cancelations for airline traffic*	**extreme winds, wind gusts(6h): WG ≥ 17 m/s , WG ≥ 25 m/s**	*wind effect on ships ' performance and harbour structure, delays to berthing and cargo-handling operations, waves, increased problems on ship navigation Damage to infrastructure on seaports.*
fog	*reduced visibility, high humidity on harbour*		

Severe weather conditions related to the impacts: Transport - ROAD

HAZARD	IMPACTS	HAZARD	IMPACTS
# of days with Tmax(heat stress): Tmax≥ 25 °C, Tmax≥ 32 °C, Tmax≥ 43 °C	*Reduced safety for vehicles driving, Railroad track deformities, instability of road substructure, melting asphalt and rutting, roadside fires, road asphalt cracking, problems on steel bridges, buckling risk, reduced safety for vehicles driving, fatigue among drivers, augmentation of Urban Heat Island Effect*	**Snowfall Rs ≥ 1 cm/d, Rs ≥ 10 cm/d, Blizzard: Rs ≥ 10 cm/d, Tmean≤ 0 °C, WG ≥ 17 m/s**	*reduced visibility, ice on the roads increased propability of incidents, reduced safety for vehicles driving, Damage to roadway integity due to thawing of permafrost, soil instability, ground movement and slope instability*
Cold waves: Tmean≤ 0 °C, Tmean≤ -7 °C, Tmean≤ -20 °C	*fatigue among drivers, Damage to roadway integity due to thawing of permafrosts*	**Sea level rise, sea storm**	*floods, coastal infrastructure at risk of inundation, erosion of coastal structures, buckling risk, reduced safety for vehicles driving*
Extreme precipitation - floods: # of days R≥30- 50mm/day, 100mm/day Total daily precipitation	*evacuation flooded roads/tunnels, bridges exposed to 20%-40% increase in 100-yr river discharge, reduced safety for vehicles driving*	**extreme winds, wind gusts(6h): WG ≥ 17 m/s , WG ≥ 25 m/s**	*trees and branches overturned trucks etc increased noise reduced road speed*
Humidity, dew-point, fog	*Reduced safety for vehicles driving, reduced visibility FMI Road Weather Model*	**Landslides (R≥ 150-200 mm/24h)**	*landslides, lushflow avalanches, landslides and associated risks, reduced safety for vehicles driving*

Severe weather conditions related to the impacts: Transport - RAILWAY

HAZARD	IMPACTS	HAZARD	IMPACTS
# of days with Tmax(heat stress): Tmax≥ 25 °C, Tmax≥ 32 °C, Tmax≥ 43 °C	*Rail buckling risk Disturbance to transport electronic infrastructures, signaling, shortened life expectancy of rail, increase wildfires can damage infrastructure*	**Snowfall Rs ≥ 1 cm/d, Rs ≥ 10 cm/d, Blizzard: Rs ≥ 10 cm/d, Tmean≤ 0 °C, WG ≥ 17 m/s**	*increased propability of incidents, soil instability, ground movement and slope instability, Ice on trains and catenary*
Cold waves: Tmean≤ 0 °C, Tmean≤ -7 °C, Tmean≤ -20 °C		**Sea level rise, sea storm**	*bridge washouts, underpass and basement flooding, disturbance to transport electronic infrastructures, signaling, erosion of coastal structures*
Extreme precipitation - floods: # of days R≥30- 50mm/day, 100mm/day Total daily precipitation	*flooding of underground transist systems, ushflow avalanches, trees and branches, landslides and associated risks,destabilization of embankment*	**extreme winds, wind gusts(6h): WG ≥ 17 m/s , WG ≥ 25 m/s**	*Disturbance to transport electronic infrastructures, signaling, trees and branches*
Humidity, dew-point, fog	*reduced visibility*	**Landslides (R≥ 150-200 mm/24h)**	*ushflow avalanches, landslides and associated risks*

Severe weather conditions related to the impacts: ENERGY

	COAL	NATURAL GAS	RES
HAZARD	**IMPACTS**	**IMPACTS**	**IMPACTS**
# of days with Tmax(heat stress): Tmax≥ 25 °C, Tmax≥ 32 °C, Tmax≥ 43 °C	*increased electricity demand for cooling/heating* *increased resistance of overhead lines* *increased sag of overhead lines* *damage to underground cables(drought)* *reduced capacity to underground cables* *Increased incidence of wildfire*	*increased electricity demand for cooling/heating,* *affection in generation, transmission, and transformer substations* *increased resistance of overhead lines* *increased sag of overhead lines* *Increased incidence of wildfire*	*cooling water issues for thermal power plants* *reduced generation efficiency for thermal power plants,* *availability of the hydropower supply* *Increased incidence of wildfire*
Cold waves: Tmean≤ 0 °C, Tmean≤ -7 °C, Tmean≤ -20 °C			
Extreme precipitation - floods: # of days R≥30-50mm/day, 100mm/day Total daily precipitation	*inundation of infrastructure components*	*inundation of infrastructure components,* *disruption and damage of vessels and pipelines*	*inundation of infrastructure components*
cloud cover, solar radiation			*increased resource availability*
Snowfall Rs ≥ 1 cm/d, Rs ≥ 10 cm/d, Blizzard: Rs ≥ 10 cm/d, Tmean≤ 0 °C, WG ≥ 17 m/s	*reduced ice accretion on overhead power lines*		*reduced icing problems for wind turbines*
Sea level rise, sea storm	*erosion of coastal structures*	*affect in generation, transmission, and transformer substations*	*erosion of coastal structures*
extreme winds, wind gusts(6h): WG ≥ 17 m/s , WG ≥ 25 m/s	*toppled pylons and downed overhead lines*		*forced wind turbine shut down*
average summer precipitation, soil moisture			*availability of the hydropower supply*

Severe weather conditions related to the impacts: WATER

	WATER*	WASTEWATER**
HAZARD	**IMPACTS**	**IMPACTS**
# of days with Tmax(heat stress): Tmax≥ 32 °C, Daily mean(TG), max (TX), min(TX), Drought, drier summers	*Increased water demands and pressure on infrastructure, socioeconomic drought, loss of potable water, availability of hydropower supply, dam failure: inadequate spillway design, geological instability, internal erosion*	*Increased demand for water delivery and collection systems*
Cold waves: Tmean≤ 0 °C, Tmean≤ -7 °C, Tmean≤ -20 °C, permafrost	*Rupture of drinking water lines, Rupture of water storage tanks*	*Potential rupture of drinking water and sewage lines, sewage storage tanks, Failure of frozen-core dams on tailing ponds due to thawing and differential settlement*
Extreme precipitation - flood # of days R≥30- 50mm/day, average annual precipitation Rmax_7day, Evapotranspiration, runoff, Total daily precipitation	*poor maintenance or landslides to the reservoir, flooding*	*Stormwater infrastructure more frequently exceeded, Urban drainage systems could fail, causing problems such as sewer backups and basement flooding, require increased capacity on wastewater treatment facilities, potential impact on the strength in wastewater systems, pipeline ruptures, buildings, tankage, housed process equipment affected by flooding*
Landslides (R≥ 150-200 mm/24h)		
Duration and extent of snowcover	*water storage capacity*	***(Dams, Reservoirs, Aquifers, Hydroelectric Generators) **(Treatment Facilities, Culverts, Sewers, Storm Drains, Pipes)**
Sea level rise, sea storm	*Saltwater intrusion in groundwater aquifers*	
extreme winds, wind gusts(6h): WG ≥ 17 m/s , WG ≥ 25 m/s	*movement of trees and roots*	

Risk (/asset) matrix

Risk Scenario impact Weighted Impact (Ws) Average	Risk scenarios likelihood 1	2	3	4	5
5	M	H	H	VH	VH
4	L	M	H	H	VH
3	L	M	M	H	H
2	VL	L	M	M	H
1	VL	VL	L	L	M

Security Risk Assessment Methodology, GIE 2015

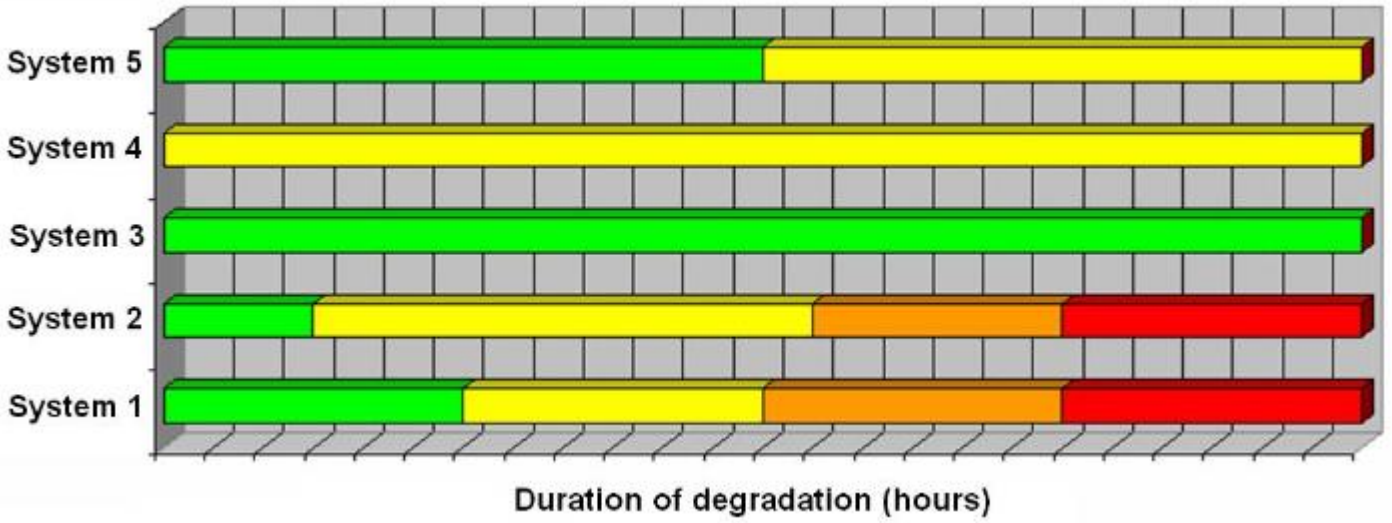
Risk /threat scenario-asset classification

Threat class:	Asset 1 Risk value	Asset 2 Risk value	Asset 3 Risk value	Asset 4 Risk value	Asset ... Risk value	Asset n Risk value
Threats related to Earthquake (shock waves, earth cracks, etc.)						
Threats related to Land slide (landslide, mudslide, etc.)						
Volcanic eruption threats						
Wind Strength related threats (tornado, wind storm, etc.), including Material Movement (dust / sand storm, etc.)						
Snow related threats (from sky, from mountains, etc.)						
Threats related to Hail (grandine)						
Water (dynamic) related threats - Tidal Wave / Tsunami						
Water (dynamic) related threats - Flood						
Water (dynamic) related threats - Water Spout (tromba marina o tromba d'acqua)						

Security Risk Assessment Methodology, GIE 2015

Consequence/damage curves (down time)

Impact on an asset or CI operations of an asset used in degraded mode, depending on the duration of the degradation (levels of operability/delay to failure)



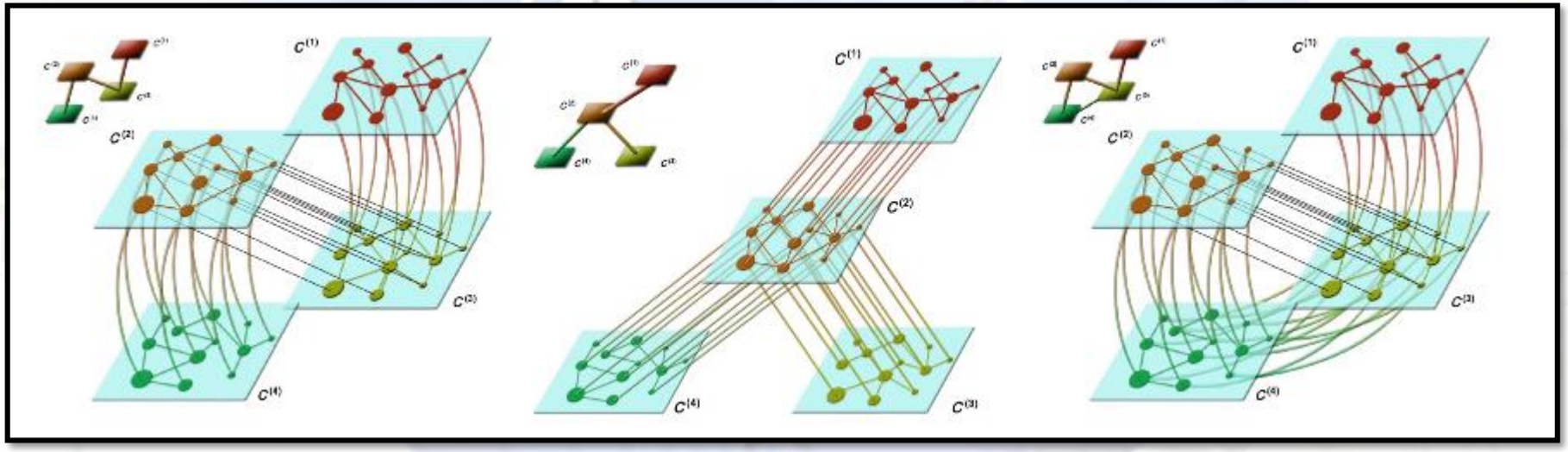
Centre risqué & performance (CPR) 2014

Indicators of CI's level of operability

- **Green**: the system is **functioning normally** with resources it uses on an ongoing basis or without the contribution of one or more of its regular resources
- **Yellow**: the system is using a degraded resource in one or more of its infrastructures and has implemented alternative measures or resources to offset the degradation of the resource such that the system's mission is **not considered to be endangered** (in the short term)
- **Orange**: The system is using a deficient resource in one or more of its infrastructures. The palliative measures put in place to offset the degradation of the resource are not sufficient and the system's mission is **considered to be endangered** (in the short term)
- **Red**: The **system's mission has been affected** in one location in the study zone. An infrastructure belonging to another CI has been deprived of this resource

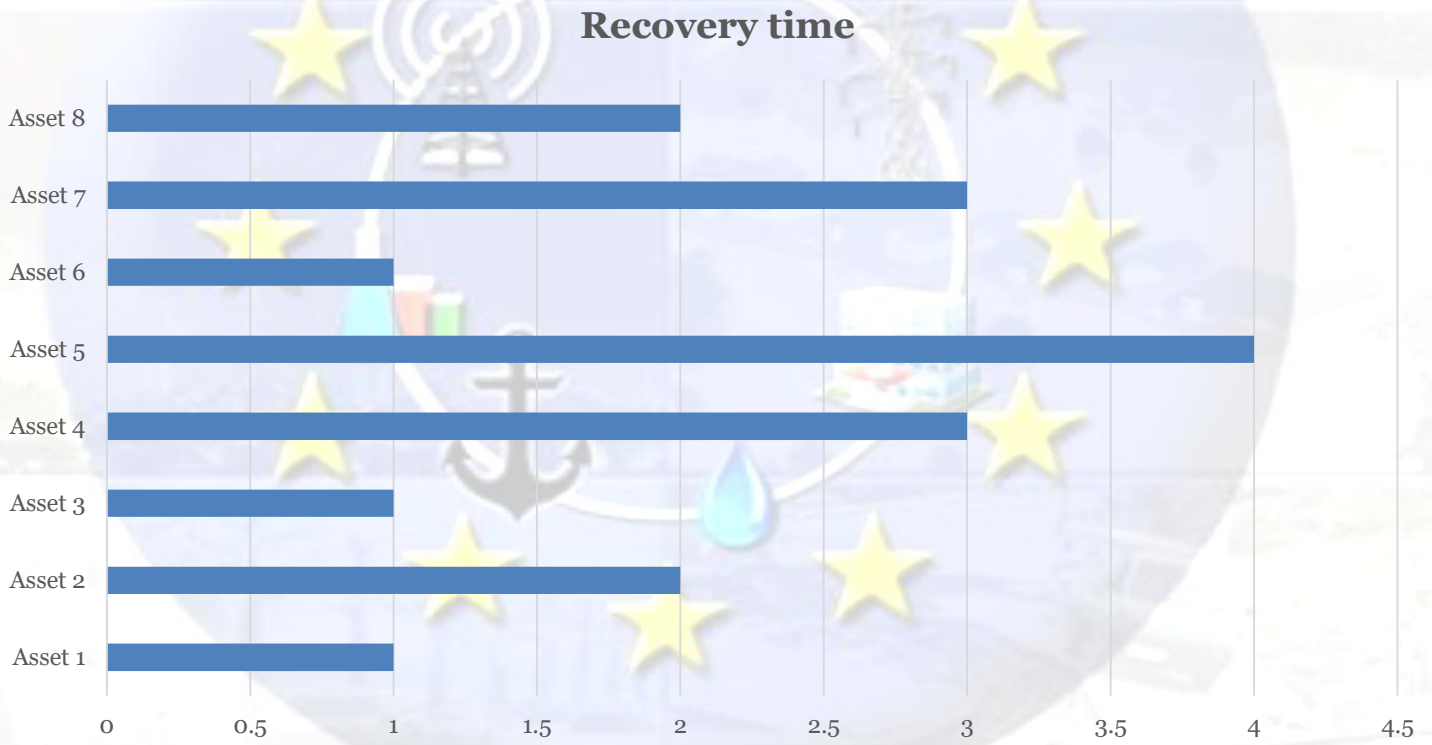
Interdependent CI networks

Representation of different topologies of multi-layered CI network (and the corresponding network of layers as an inset in the top-left corners). Each interlayer edge connects a node with one of its counterparts in another layer. Such relations/connections have to be defined.

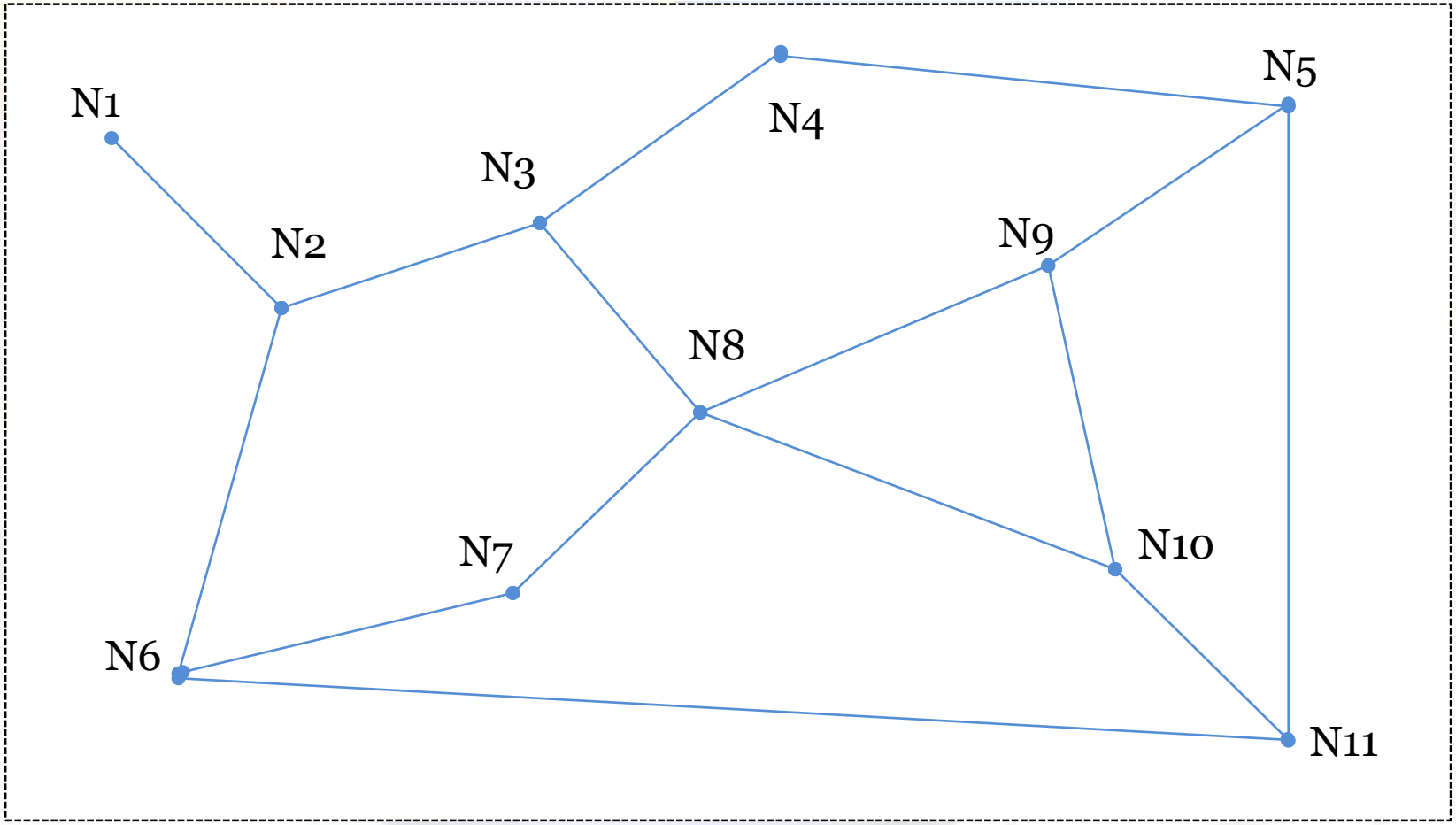


Recovery time/asset/functioning level

- Time needed for restoring the operationality of the asset



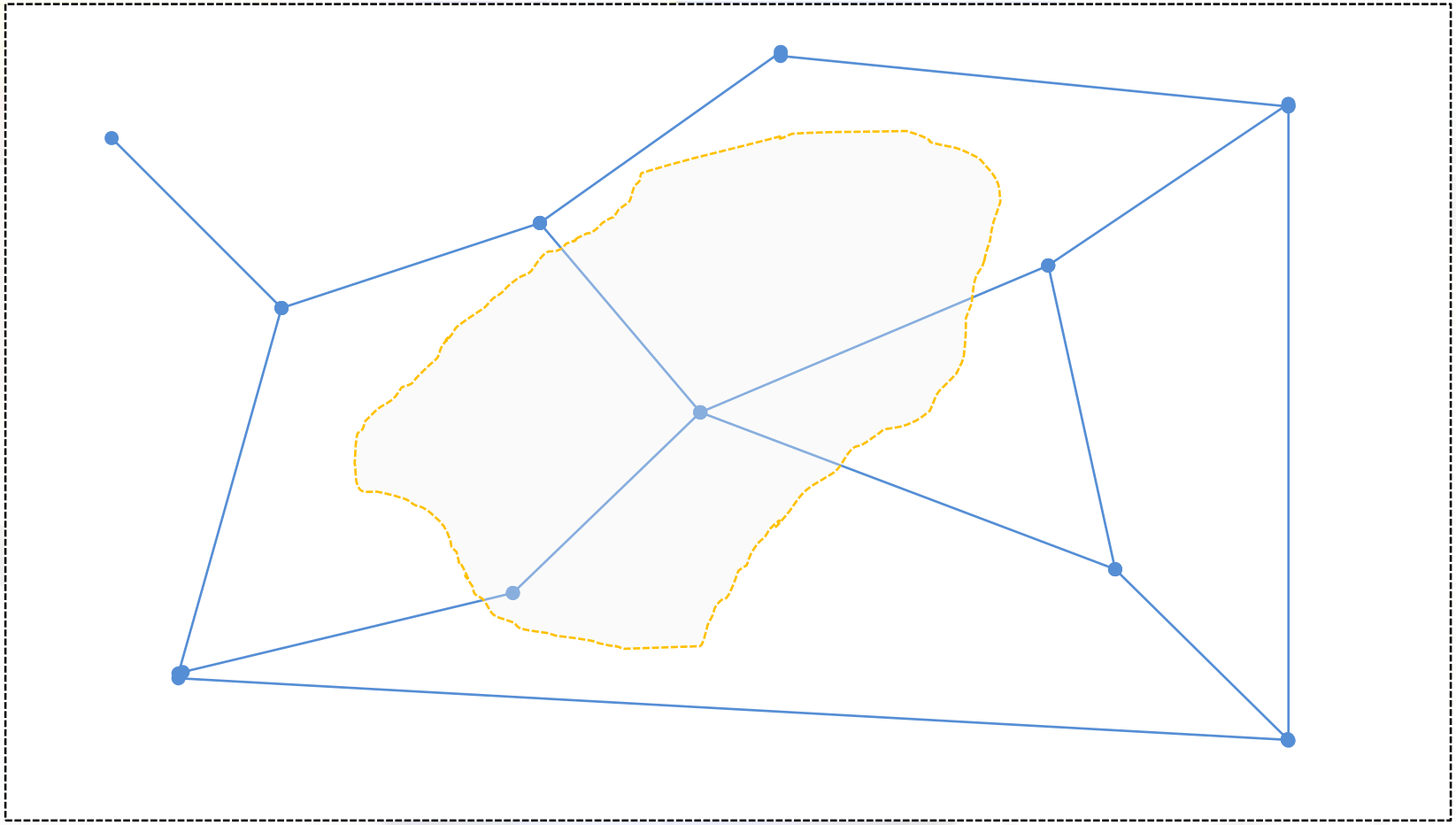
As an example: Network/Exposure



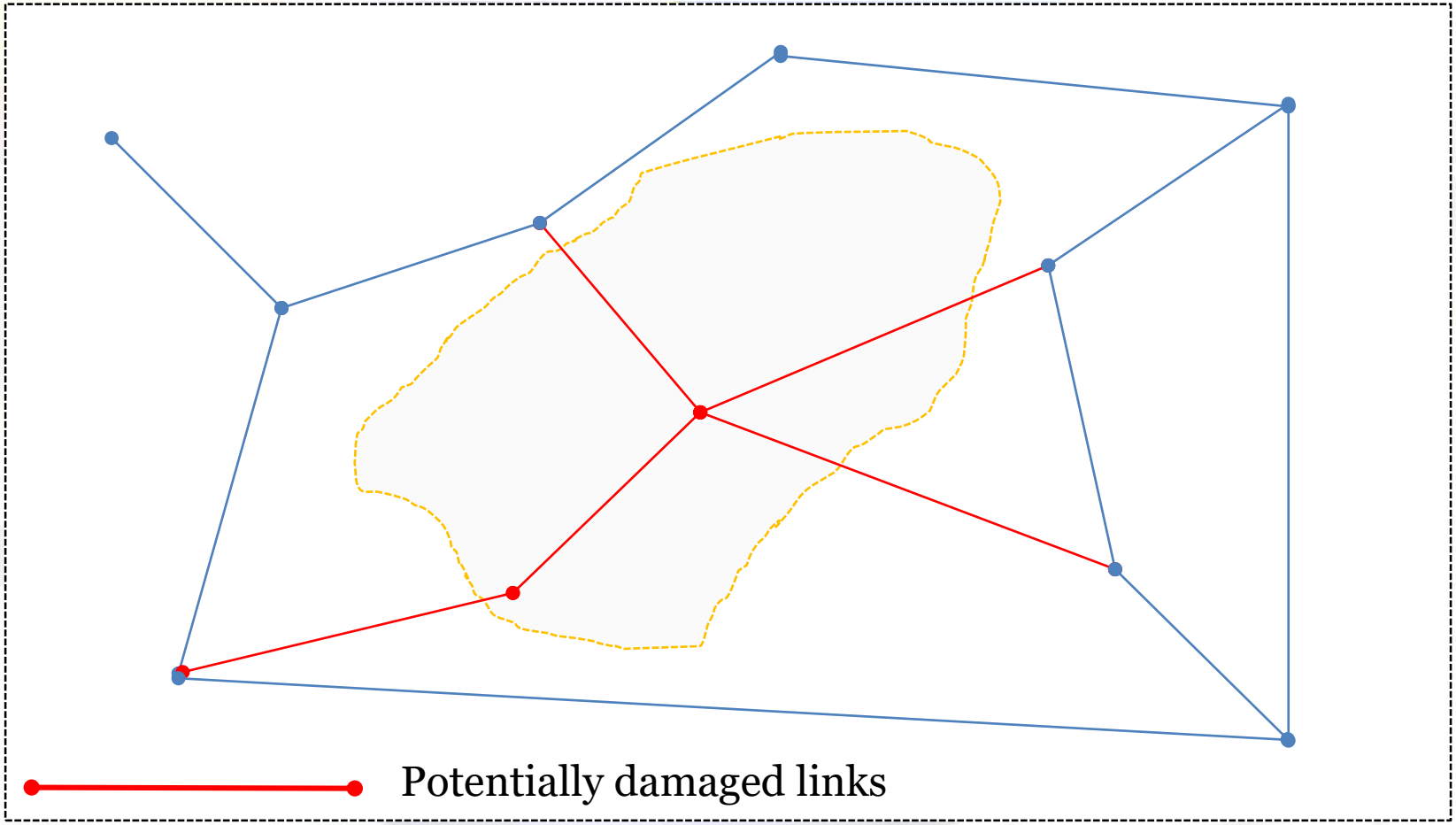
Network description

	Type	Direction	Placement	Recovery time (d)	Consequence time (h)
N1-N2	Electricity	Bidirectional	Above ground	5	0
N2-N3	Electricity	Bidirectional	Above ground	2	0
N3-N4	Electricity	Bidirectional	Above ground	3	0
N4-N5	Electricity	Bidirectional	Above ground	5	0
N5-N11	Electricity	Bidirectional	Above ground	1	0
N11-N6	Electricity	Bidirectional	Above ground	1	0
N6-N2	Electricity	Bidirectional	Above ground	3	0
N6-N7	Electricity	Bidirectional	Above ground	1	0
N7-N8	Electricity	Bidirectional	Above ground	1	0
N8-N3	Electricity	Bidirectional	Underground	2	0
N8-N9	Electricity	Bidirectional	Above ground	1	0
N9-N10	Electricity	Bidirectional	Above ground	1	0
N8-N10	Electricity	Bidirectional	Underground	3	0
N10-N11	Electricity	Bidirectional	Above ground	2	0

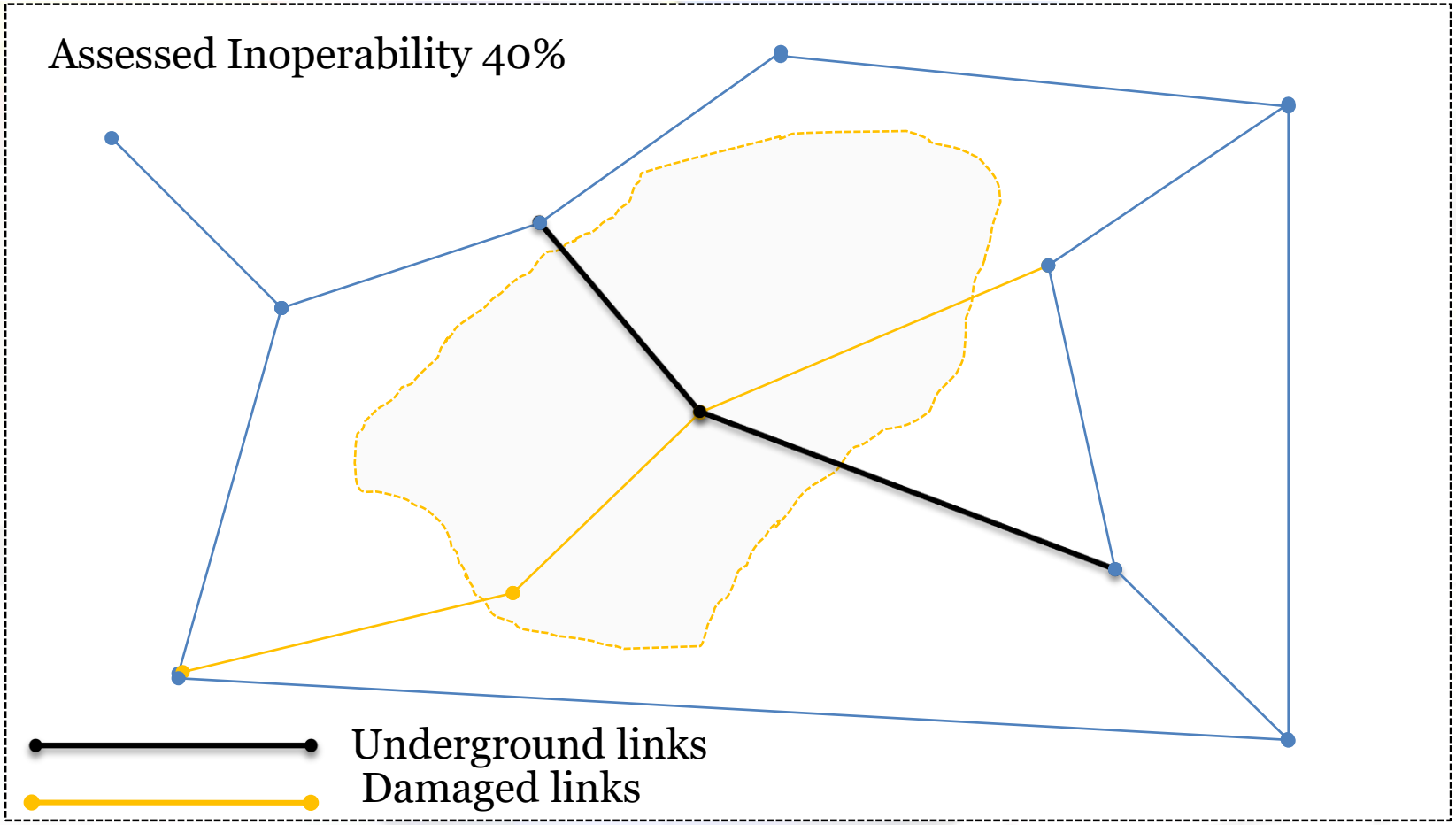
Hazard/CC risk scenario = Wildfire



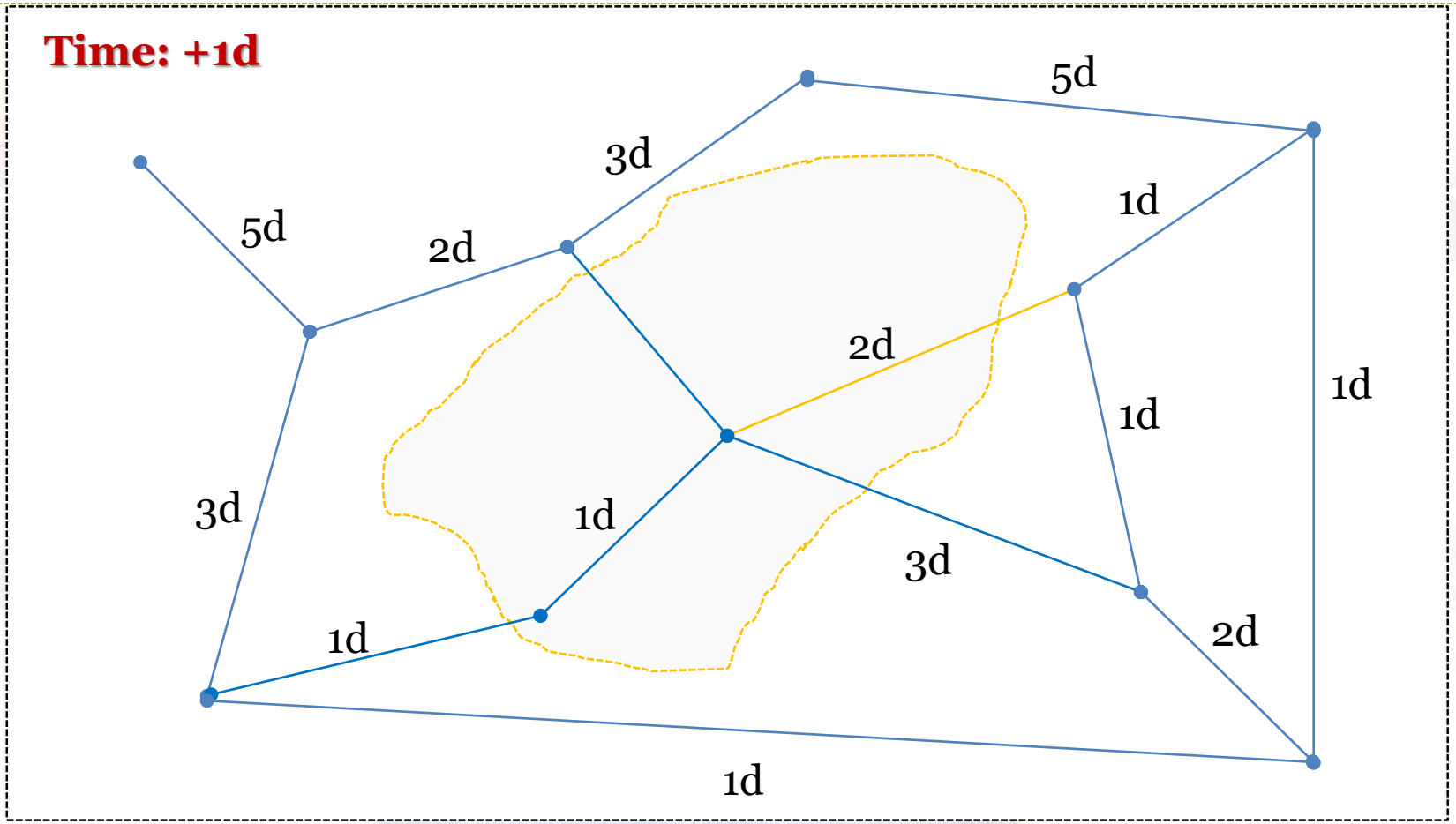
Potential Impact *(Pot. Inoperability 50%)*



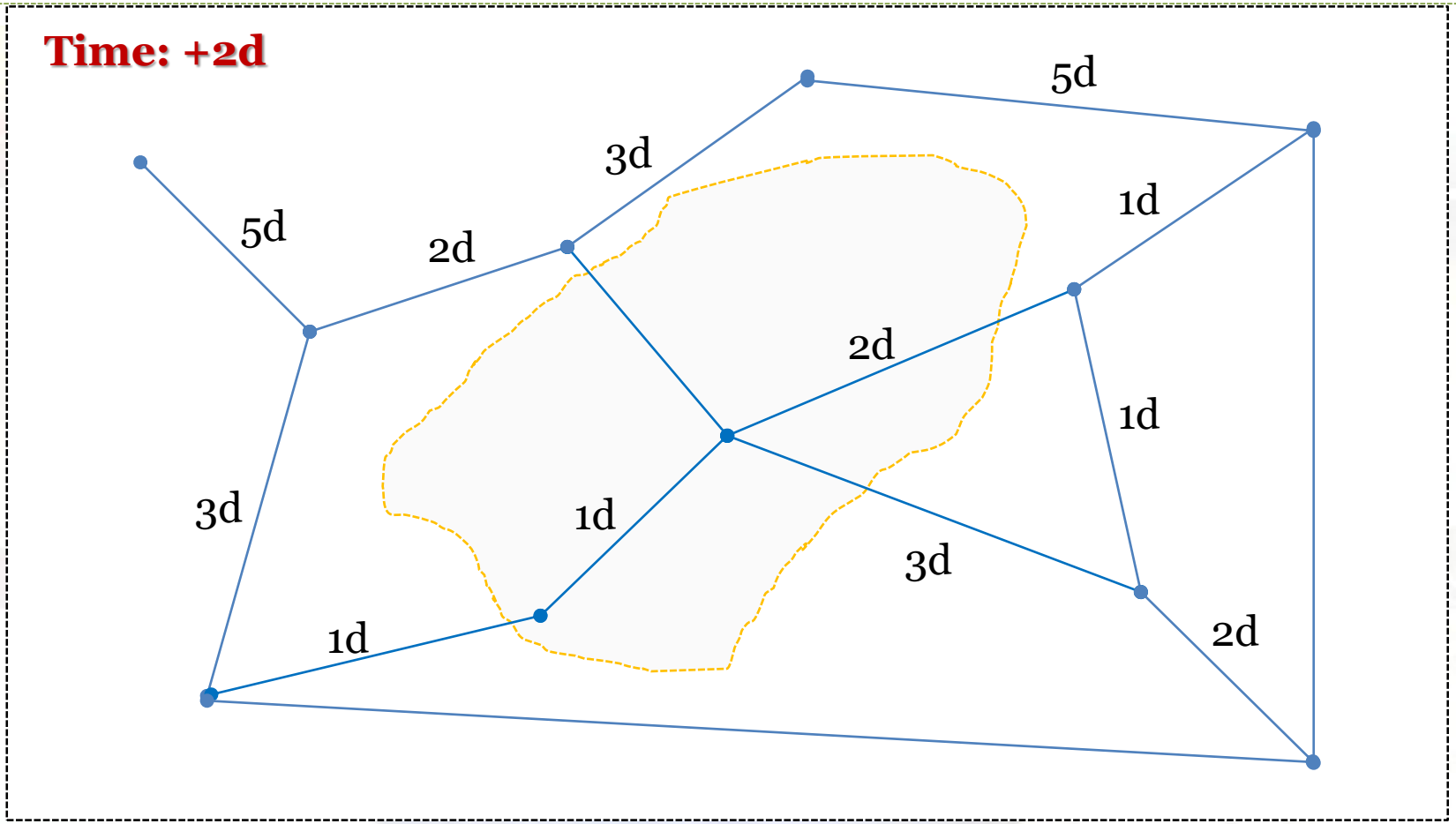
Vulnerability/Coping capacity



Network recovery *(Ass. Inoperability 25%)*



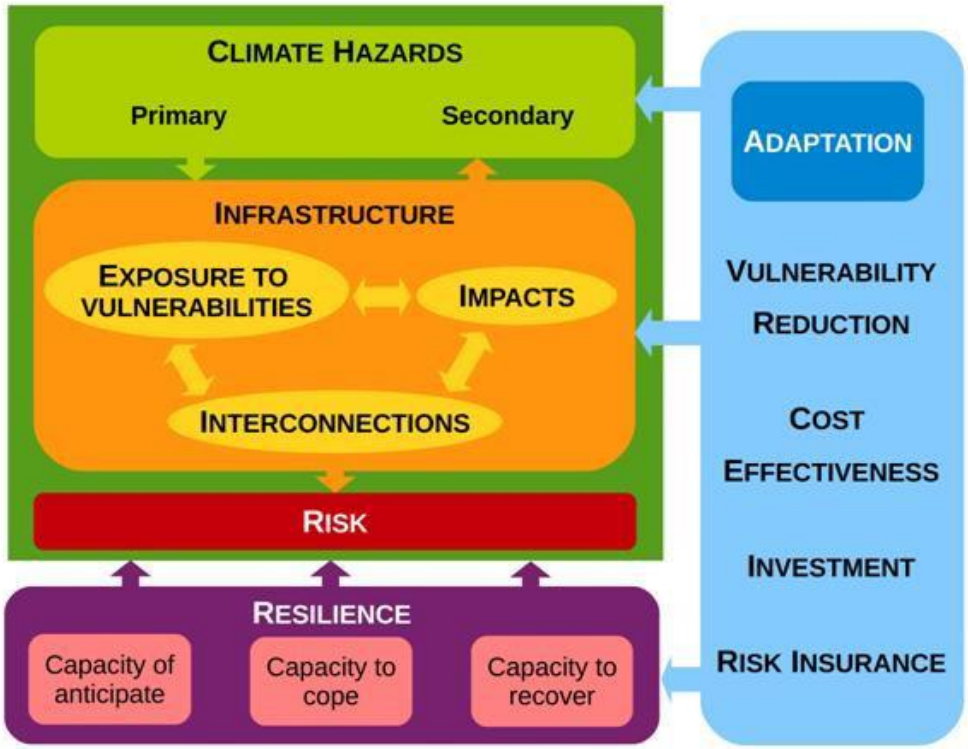
Network recovery *(Ass. Inoperability <5%)*



EU-CIRCLE support to CI operators and planners

1. Identify time periods within the next years/decades when predefined climate risk scenarios may occur
2. Assess the intensity/strength/size/extent of such risk scenarios
3. Assess the impact of climate change risk scenarios to the performance and the operationality of CI functioning
4. Estimate the consequences of risk scenarios in terms of time needed for recovery
5. Simulate the CI functioning status during an expected climate scenario related to climate change (eg extreme weather)
6. Plan mitigation and adaptation counter-measures in advance

Thank you for your attention



QUESTIONS ?

Center for Security Studies - KEMEA

g.eftychidis@kemea-research.gr