ECONOMICS of RESILIENT INFRASTRUCTURE

Presentation to NATIONAL LIFELINES FORUM 5 NOVEMBER 2014

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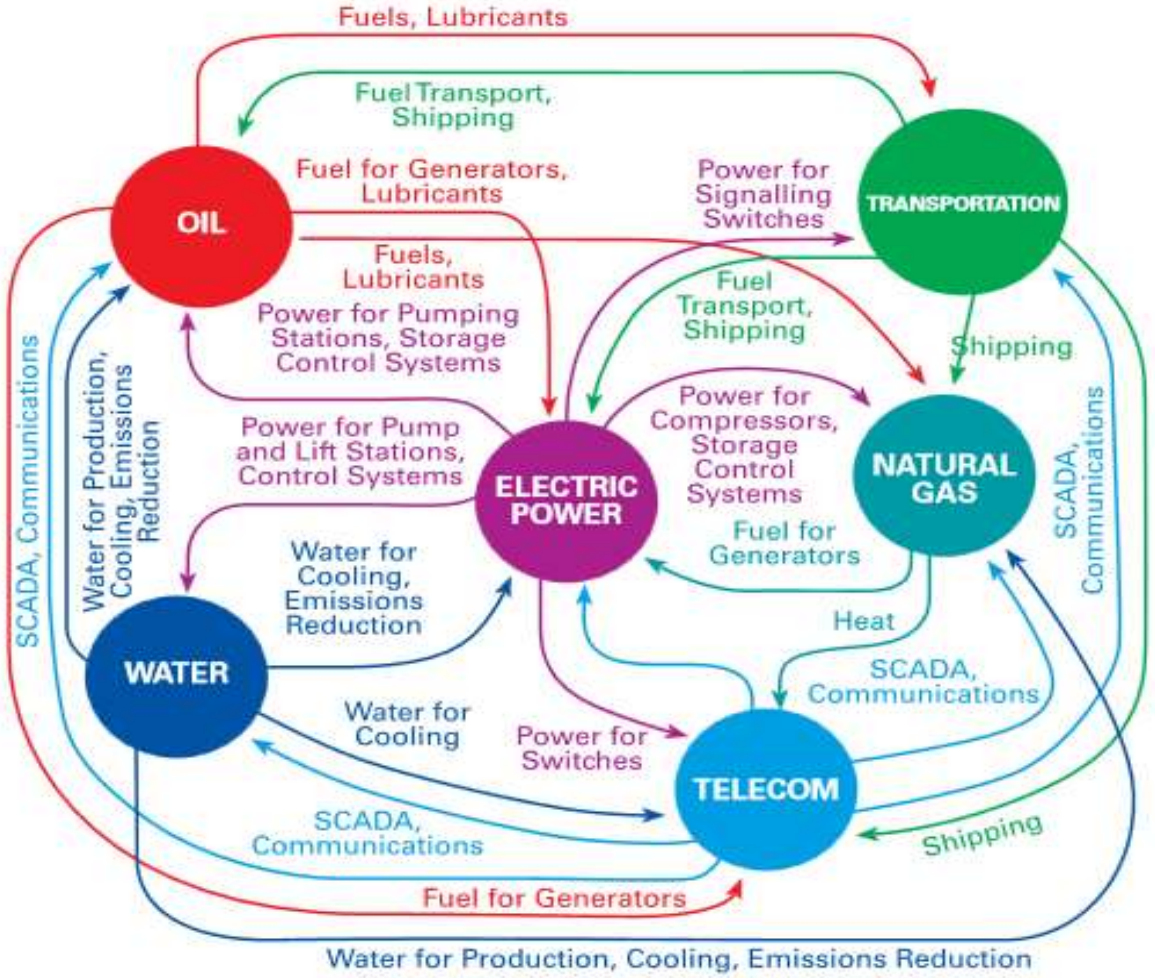
- Definitions and Setting
- Historical (recent)
- *Economics of Resilient Infrastructure* research programme
- Interdependencies module (demonstration of prototype)
- Next steps

DEFINITIONS

- Interdependencies defined: Reliance of sector A on sector B (basically a 'supply chain' concept)
- Other 'related' concepts:
  - Hotspots – colocation v 'supply chain' (not to be confused – our focus is the latter)
  - Pinch points – single points of failure (not a main focus in interdependency work)
  - Cascading interdependencies
  - Turning points

A PERSPECTIVE ……



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RECENT GNS SCIENCE WORK

- GNS work is part of Post Earthquake Cities (PEC) research programme
- PEC has a different focus ERI, focusing on detailed interdependencies modelling – no economic considerations
- The models have included Bayesian Networks and Agent-Based simulations

ECONOMICS OF RESILIENT INFRASTRUCTURE WORK PROGRAMME

- What – building a model (Modelling the Economics of Resilient Infrastructure Tool - MERIT) to assess the economic impact of infrastructure outages
- Who – GNS Science, Market Economics, ResOrgs, others
- Funded by – MBIE $2.8 m

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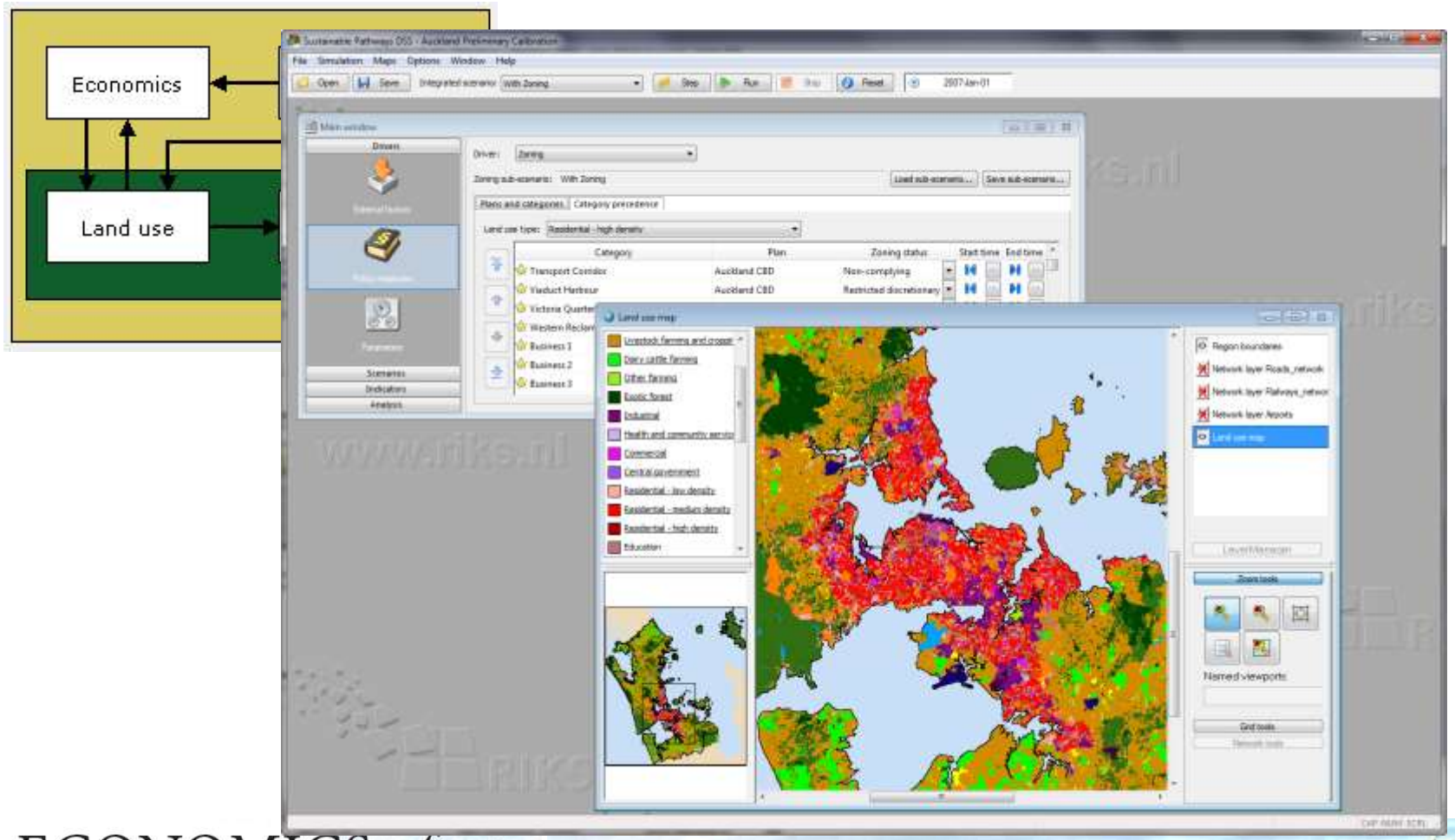
MODELLING THE ECONOMICS OF RESILIENT INFRASTRUCTURE TOOL (MERIT)



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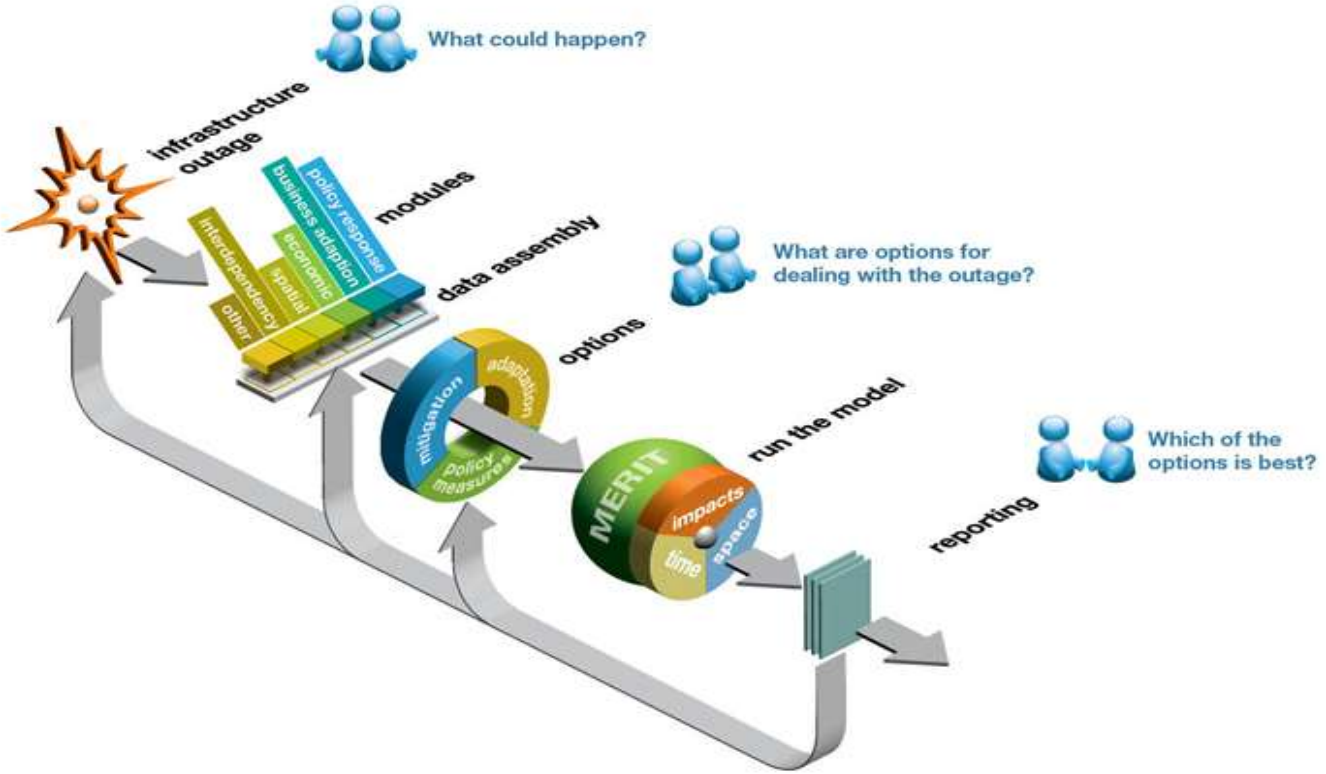
ECONOMICS OF RESILIENT INFRASTRUCTURE SCHEMATIC



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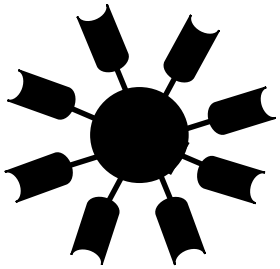
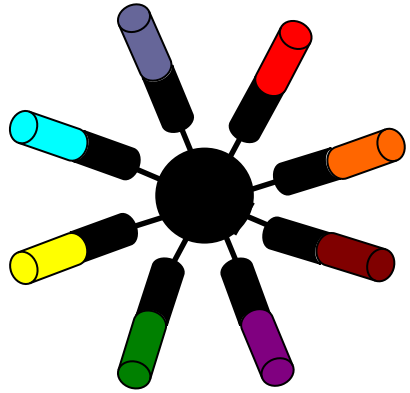
MERIT MODULES AND LEVERS



Geonamica®
integration platform

* 3 economic modules – inoperability (short term focus), fully dynamic (short to medium term focus), and spatial dynamic (medium to long term focus)

- Economic module *
- Population module
- Spatial module
- Interdependency module
- Business adaptation levers
- Policy and strategic response levers
- Outage scenarios
- Other models



MERIT

Infrastructure embedded throughout modules

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INTERDEPENDENCIES MODULE

Assumptions and context:

- Top down approach
- National / sector level
- Main supply-chain relationships (adjusted for back-ups)
  - Extension: roads, rail and ports (freight)
  - Deals with single and multiple outages in different sectors simultaneously
- Timing matters
- Consequence, not likelihood

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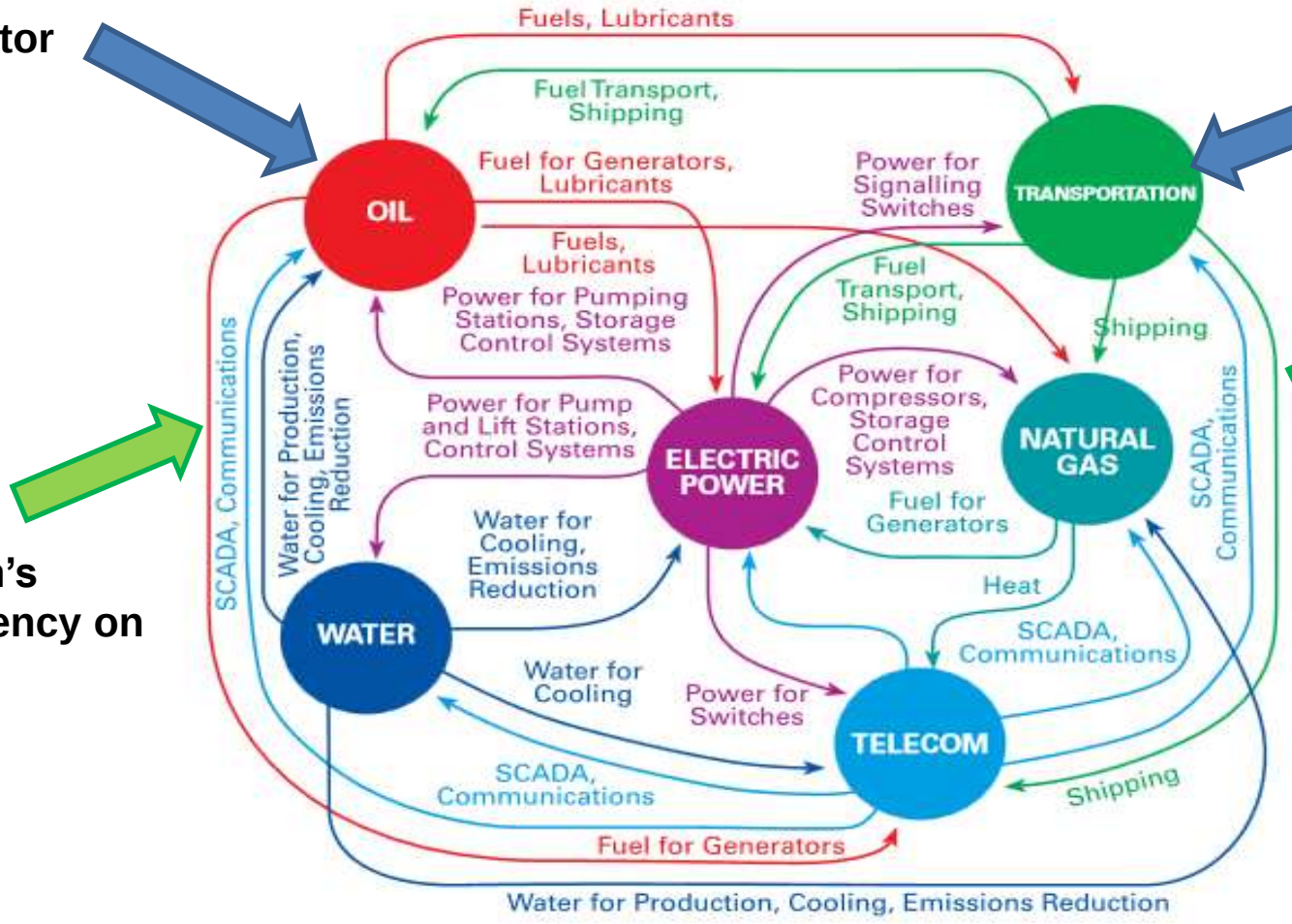
INTERDEPENDENCIES

Oil sector

Transportation sector



Telecom's dependency on oil

Telecom's dependency on transportation

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INFRASTRUCTURE SECTORS

ID	Sector Name
1	Electricity
2	Petroleum
3	Gas
4	Telecoms
5	Roads
6	Rail
7	Ports
8	Airports
9	Water
10	Sewers

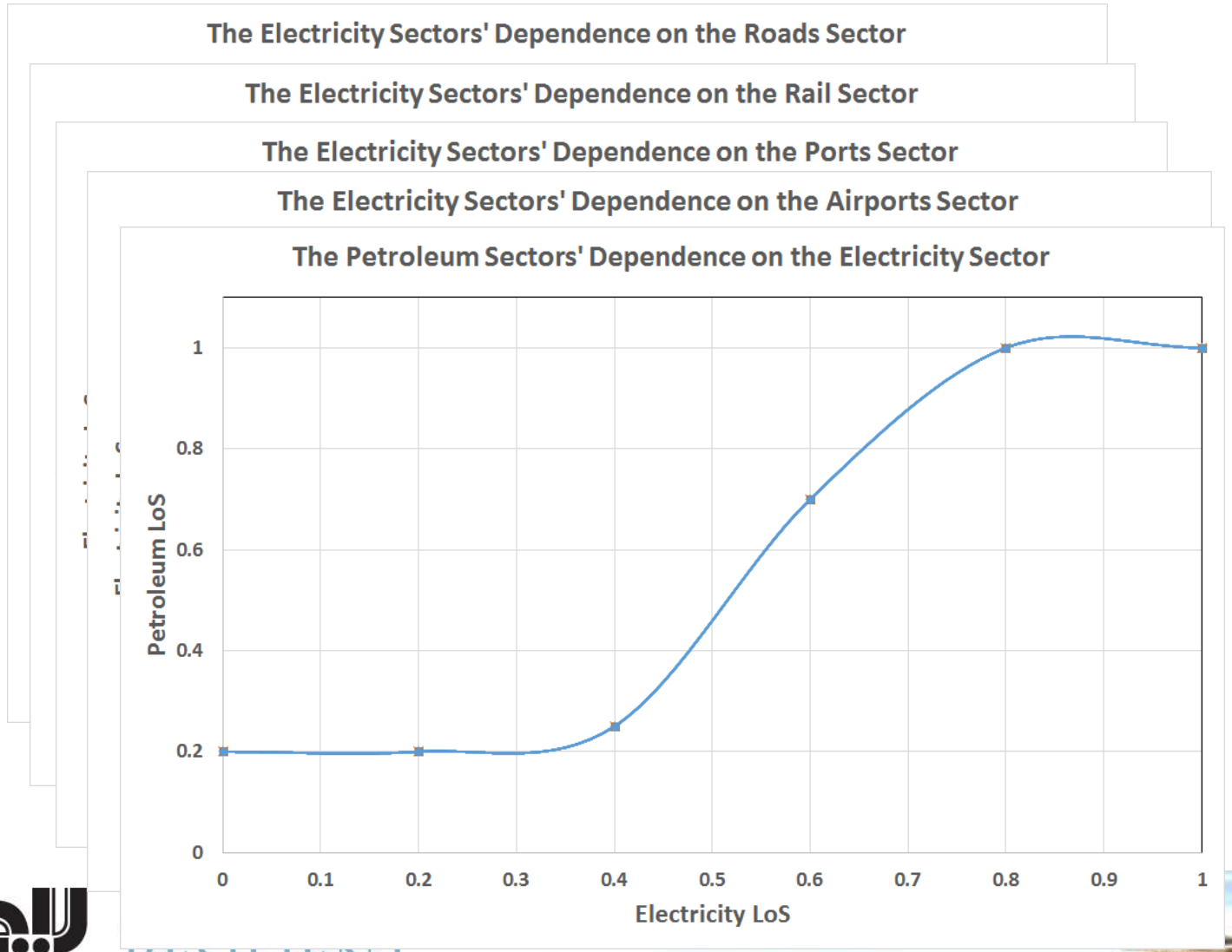
CLASSIFICATION OF INTERDEPENDENCIES

- 10 sectors x 10 sectors = 100 possible dependencies
- We have looked carefully at each of these dependencies and classified them as:
  - High [15 out of 100]
  - Medium high [16]
  - Medium [13]
  - Medium low [10]
  - Low (no dependence) [36]
  - Intra-sector dependencies [10]

LIST OF INTERDEPENDENCIES

ID	This sector depends	on this sector	Import-ance	Description
7	Elec	Roads	Med-high	Roads needed for vehicle access to many sites, some of them remote.
8	Elec	Rail	Med-low	Rail used occasionally for transport of heavy equipment. Huntly has own coal but also uses rail from Tauranga - however, coal not generally critical for NZ's electricity supply - Huntly usually runs on gas.)
9	Elec	Ports	Med-low	Ports used occasionally for landing heavy equipment. (Huntly has own coal but also uses Tauranga port - however, coal not generally critical for NZ's electricity supply - Huntly usually runs on gas.)
10	Elec	Airports	Low	Occasional use of air freight.
11	Ptrlm	Elec	Med-high	Refinery: Production relies on Transpower, but petroleum stocks in supply chain can be drawn down and new imports can arrive within 6 - 8 weeks. Refinery to Auckland Pipeline: Electricity required. Downstream petroleum supply: Very reliant on electricity (pumping at terminals and service stations).

LEVEL OF SERVICE



The graph shows the
how the level of service provision in one sector (X-axis) converts to level of service provision in another sector (Y-axis)

RESILIENT INFRASTRUCTURE

NEXT STEPS

- Still a work- in-progress
- Possible developments
  - Spatial version for EoRI
  - Web-based version for others
  - Stress testing
  - ….. Leading to a Mark II version?
- Further technical advice would assist, e.g. SCADA
- We'd like to hear from you if you
  - Have ideas, experience, knowledge
  - Would like to trial the interdependencies module

A thank-you to .....

MBIE

$2.8 m over 4-years granted in the 2012 Investment Round

Further information: http://www.naturalhazards.org.nz/NHRP/Hazard-themes/Societal-Resilience/Economics-of-Resilient-Infrastructure

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