bushfire&natural HAZARDSCRC

PRE-DISASTER MULTI-HAZARD DAMAGE AND ECONOMIC LOSS ESTIMATION MODEL

Estimating Economic Impacts of Natural Disasters

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AFAC and Bushfire and Natural Hazards CRC Conference
Date: 02 September, 2014

An Australian Government Initiative

CRC AUSTRALIA

THE UNIVERSITY OF MELBOURNE

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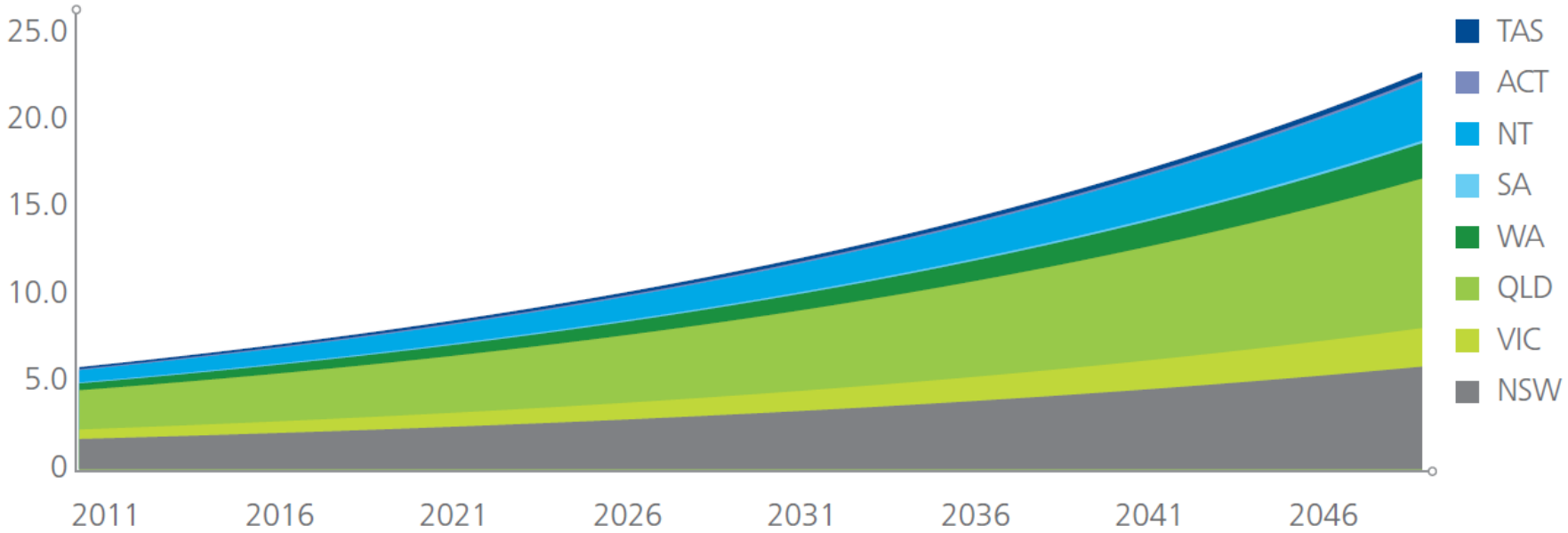
PROBLEM STATEMENT

In 2012 alone, the total economic cost of natural disasters in Australia is estimated to have exceeded $6 billion. Further, these costs are expected to double by 2030 and to rise to an average of $23 billion per year by 2050 (Deloitte Access Economics, 2013).

Chart i: Forecast of total economic cost of natural disasters: 2011 – 2050



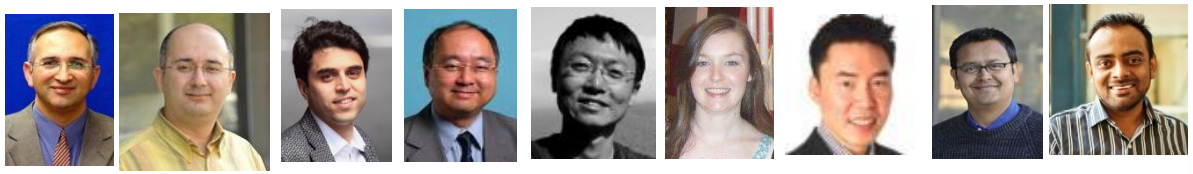
Source: Deloitte Access Economics (2013)

PROBLEM STATEMENT

- The research consortium formed for this project identifies two major requirements that seek immediate attention to bridge the related gap –

  - First, a disaster risk assessment system that provides quantifiable potential *damages* as a result of different types of disasters for regions of Australia, and
  - Second, a method that will estimate the indirect economic *losses*.
  - Third, *spatial distribution* of economic losses as result of a natural disaster

Chief Investigators and Research Fellows



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Dr Martine Woolf	Geoscience Australia
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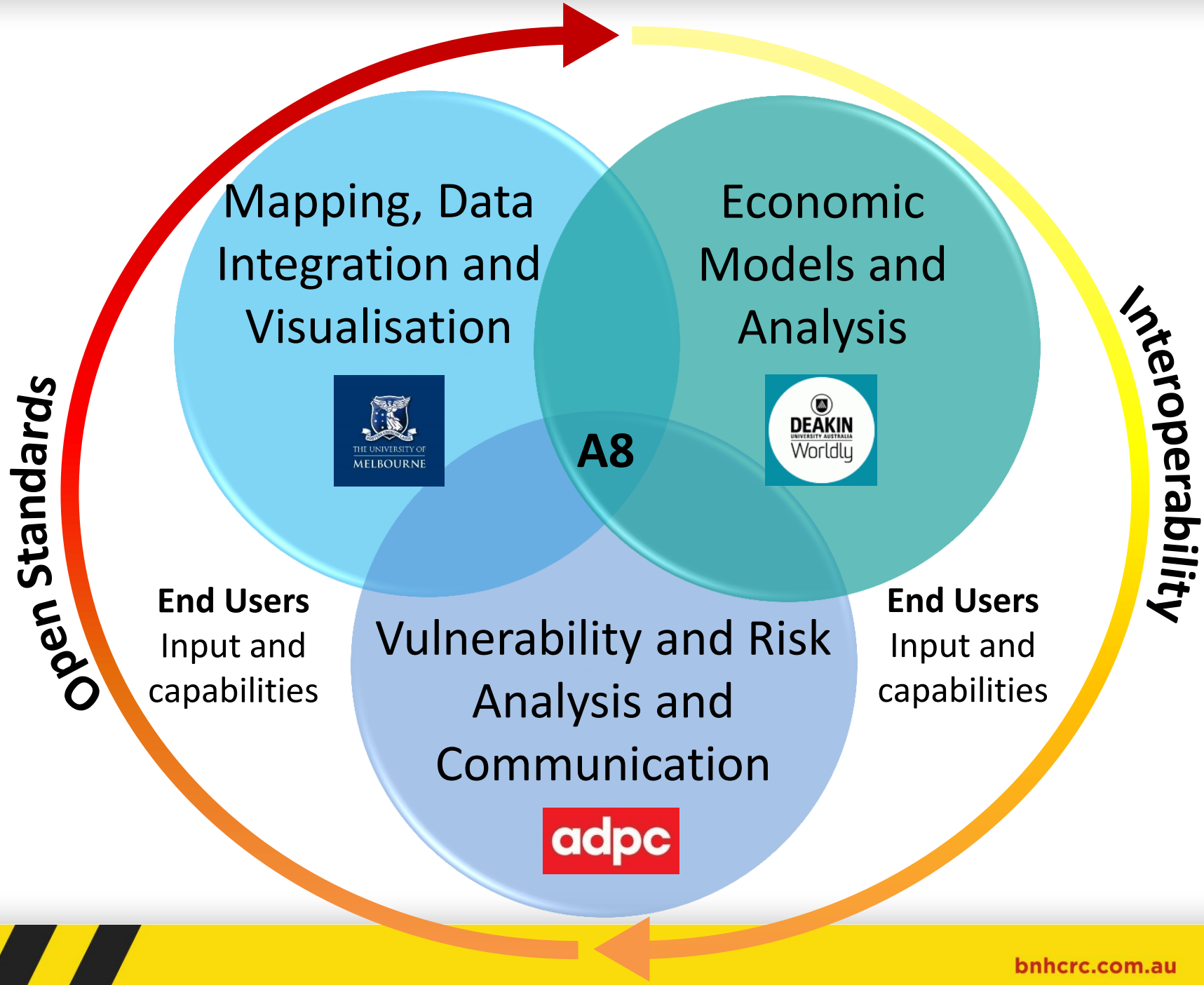
RESEARCH INITIATIVE: 2014 – 2016

- **Expected Outcomes:**
  - ***National Level:*** Identifying the nexus between natural disasters and economic development in Australia
  - ***State Level:*** ❶ Spatially enabled hazard specific risk assessment information (physical damage assessment for bushfires, floods);

    ❷ Pre-disaster natural hazard economic loss estimation and geographic distribution of it

    ❸ Identification of optimum economic policy for reducing disaster risks

    ❹ Publication of a paper on natural disasters risk and economic growth of Victoria


Mapping, Data Integration and Visualisation
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Economic Models and Analysis
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Vulnerability and Risk Analysis and Communication
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End Users
Input and capabilities
End Users
Input and capabilities
Open Standards
Interoperability

OUR APPROACH

Disaster Risk Assessment: Calculating Potential Damage

★ **Hazard Assessment**

- ➢ Consolidate existing catalogs of hazard maps for bushfire, and flood

★ **Exposure Assessment**

- ➢ Identify existing exposure
- ➢ Develop a database by asset types
- ➢ Analyze each asset type

★ **Vulnerability Assessment**

- ➢ Identify existing vulnerability assessment
- ➢ Classify exposed assets into vulnerability types
- ➢ Develop asset-specific vulnerability functions
- ➢ Prepare disaster vulnerability maps

★ **Disaster Risks Assessment**

- ➢ Overlay hazard, exposure & vulnerability maps, and calculate scenario-specific *potential* damage

Economic Model: Estimating Economic Losses

★ **Model Specification**

- ➢ Identify existing macroeconomic models
- ➢ Finalise econometric estimation framework

★ **Disaster Impact Estimation**

- ➢ Estimate overall economic losses by sectors using potential damage scenarios for each disaster type

★ **Policy Implications**

- ➢ Identify the effects of different policy options for DRR
- ➢ Analyse the prevailing risk financing strategies to mitigate disaster effects

Spatial distribution of loss

★**Spatial analysis of disaster impact**

- ➢ Prepare a scenario based hazard-specific economic losses matrix by economic sectors
- ➢ Spatially enabling Destination Zones (DZNs), Journey to Work (JTW) and planning zones
- ➢ Spatially enabling economic sectors based on JTW units
- ➢ Spatially enabling scenario based hazard-specific economic losses matrix by economic sectors

DISASTER RISK ASSESSMENT

INTELLIGENT DISASTER DECISION SUPPORT SYSTEM

THE UNIVERSITY OF MELBOURNE
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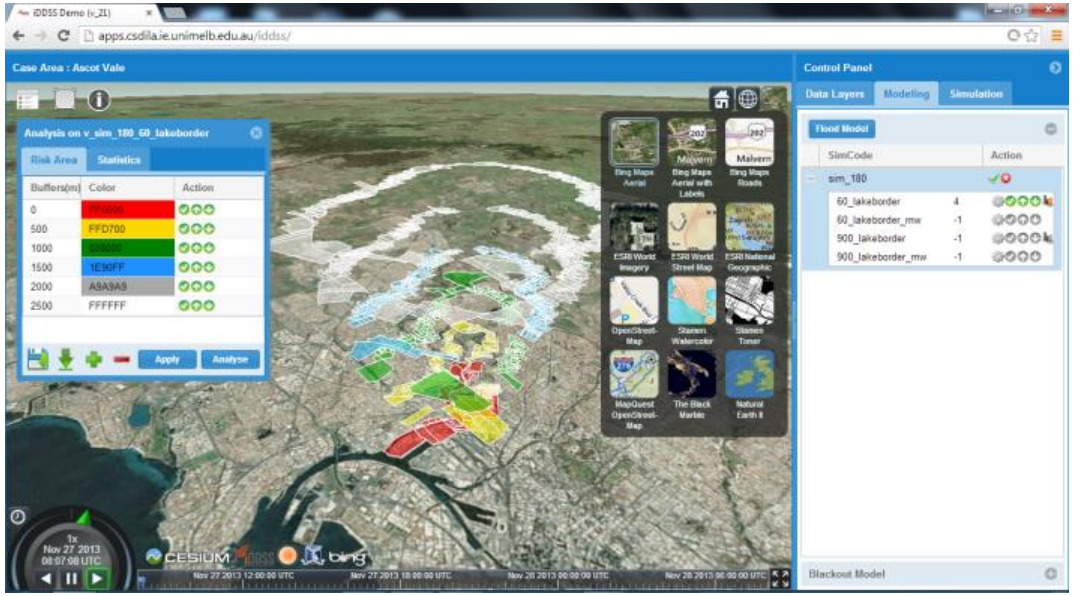
DISASTER RISK ASSESSMENT

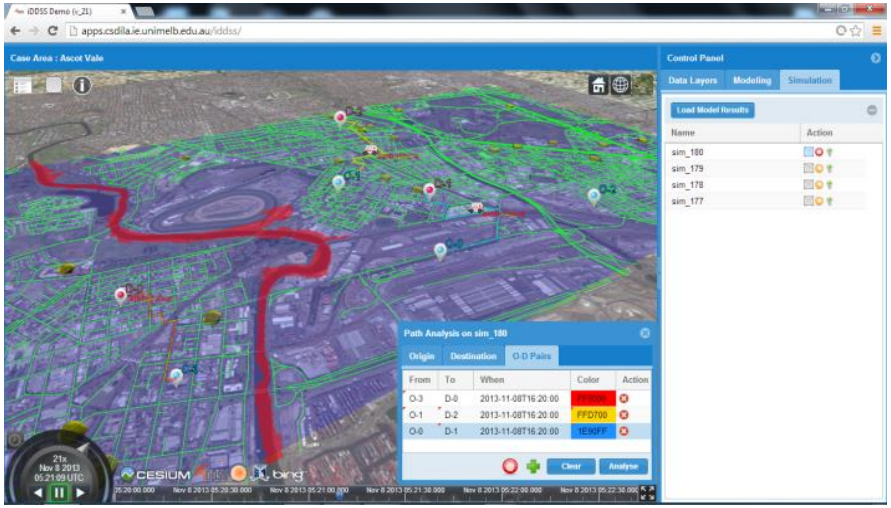
Features of the IDDSS SYSTEM

- Webmapping component
- Modelling component
- Optimisation component
- Access to authoritative information
- Crowd sourcing component



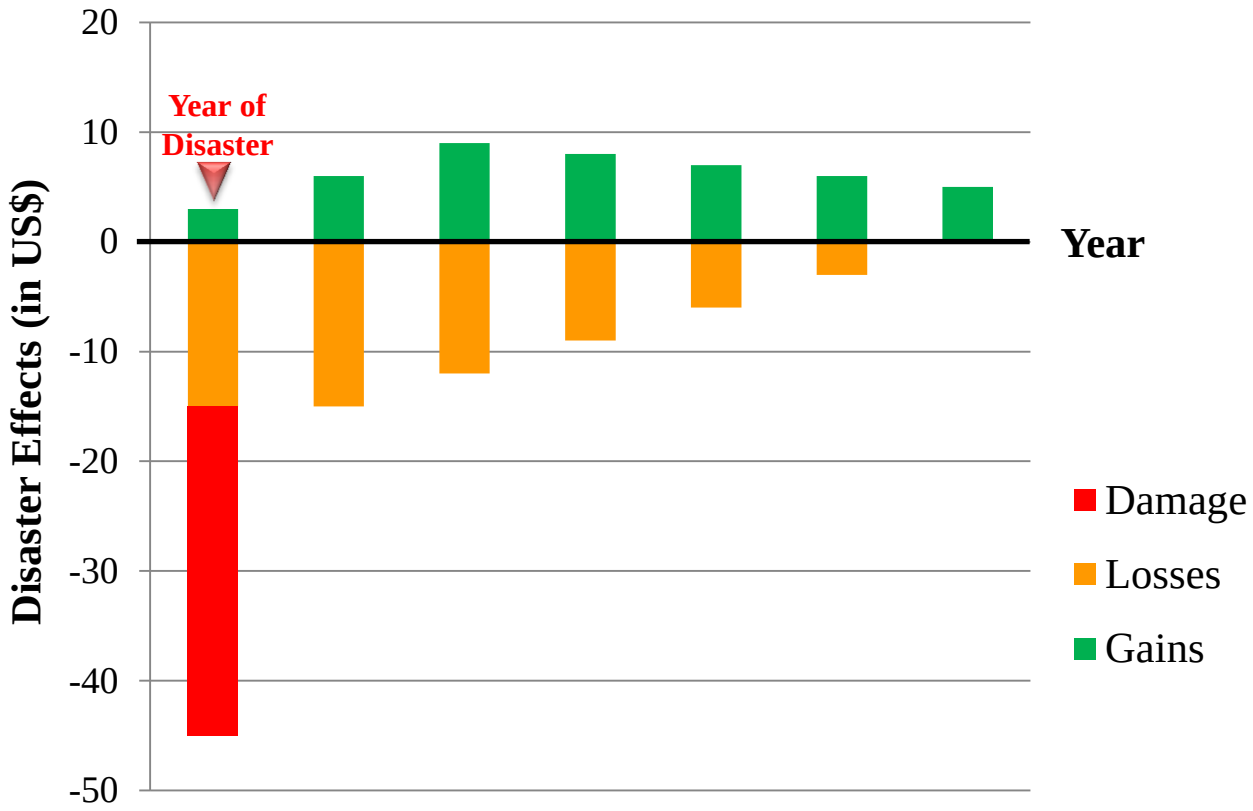
SPATIAL DISTRIBUTION OF LOSSES

1) Data integration
   a) Australian Businesses (ABR, CLUE) in post code level
   b) Generalise and identify the dominant sectors of economy
   c) Sector specific GDP at the state level 1990-2013
2) Spatial Analysis
   a) Spatio-temporal analysis
      - Estimate sector specific GDP at post code level area occupied based on the size of the business (workforce/land size, building size), proximity (restaurants source from a closer producer) and sectoral inter-linkages
   b) Spatio-economic analysis
      - Spatial cross-sectoral relationship
      - Impact of natural disasters

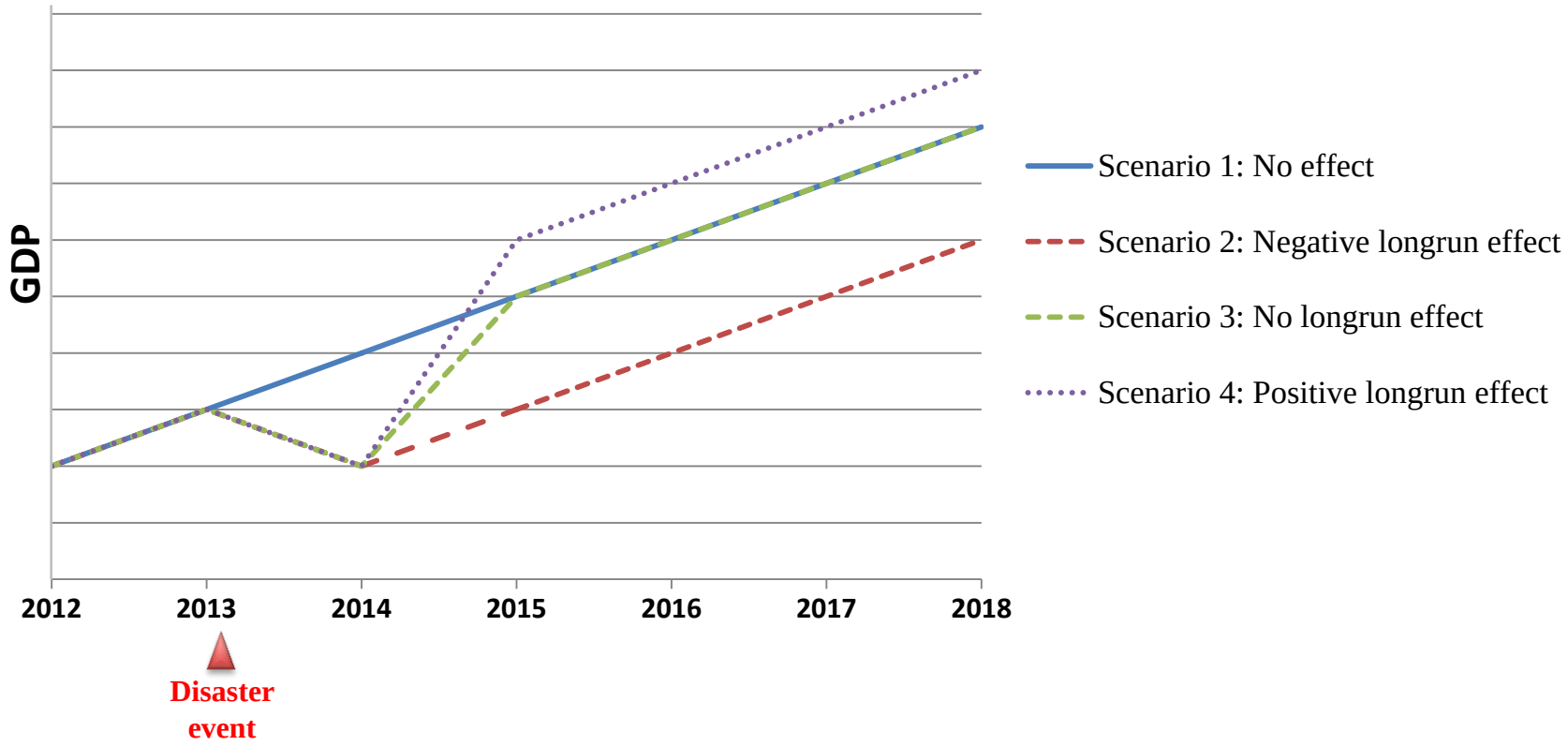


POTENTIAL EFFECTS OF NATURAL DISASTERS

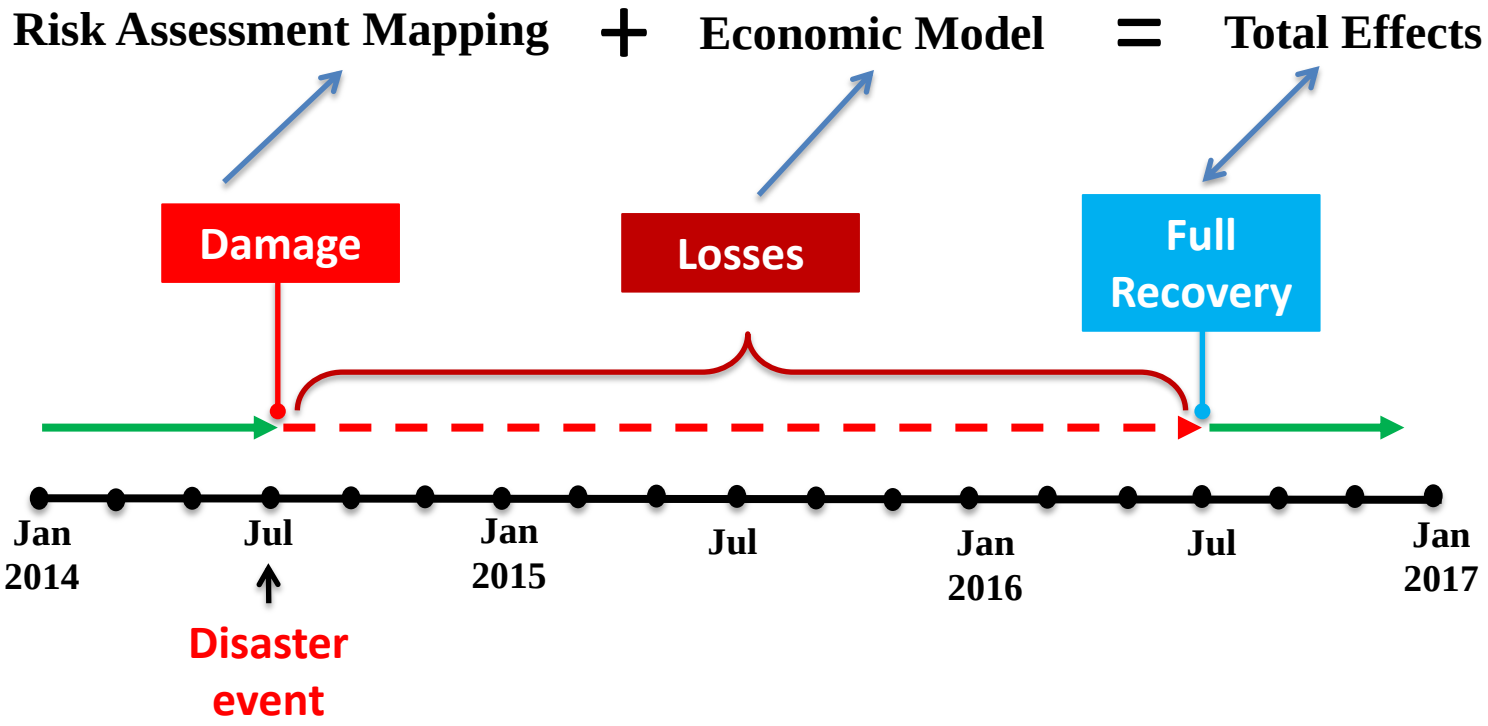
DISASTER EFFECTS: HYPOTHETICAL SCENARIOS



POTENTIAL IMPACT OF NATURAL DISASTERS ON GDP



TIMELINE OF DISASTER EFFECTS



METHODS OF DAMAGE AND LOSSES ESTIMATION

METHODS OF DAMAGE AND LOSSES ESTIMATION

- ATC-13/HAZUS (Hazard in the U.S.)
- Advanced Component Method (ACM)
- CAPRA: Probabilistic Risk Assessment

- Damage and Losses Assessment (DaLA)
- Cost and Benefit Analysis (CBA)
- Catastrophe Simulation (CatSim) Model
- Input-Output Model
- Econometric Models (e.g., VAR & COPS/ORANI Model)

DAMAGE AND LOSS ASSESSMENT (DALA) METHOD

Widely accepted method over the last 40 years.

- Develop baseline for assessment
- Develop potential-disaster scenarios
- Estimate direct and indirect losses with regard to forecasted scenarios on a sector-by by-sector fashion
- Estimate total value of direct and indirect losses
- Estimate macro-economic impact of direct and indirect losses

Drawbacks

- It does not consider inter-sectoral linkages
- It cannot estimate pre-disaster economic losses
- It excludes the positive effects of natural disasters

LOSS ASSESSMENT PRACTICES IN AUSTRALIA

Emergency Management Australia

DISASTER LOSS ASSESSMENT GUIDELINES

EMA

Queensland Government Department of Emergency Services

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Economic Costs of Natural Disasters in Australia

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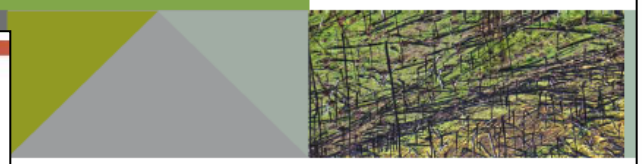

SEPTEMBER 2011

VICTORIA PREPARED:
AN ACTION PLAN

Message from the Deputy Premier

Victoria's emergency management framework is nearly 30 years old and no longer meets the needs of our State. Our recent experience of natural disasters includes: droughts, bushfires and floods. These events have resulted in a devastating loss of lives, destroyed many

The community has a critical role to play in its own safety. Therefore, the Victorian Government aims to assist communities to become more resilient. Households, businesses and community organisations need to be informed, fully and effectively engaged in planning for emergencies, and better equipped and prepared to act.

Victoria

Figure 1. Step-by-step loss assessment process. (From Queensland Government 2002a.)

1. Identify the purpose of the loss assessment
2. Consultation and information collection
3. Define the area and time frame of the assessment
4. Select the type of assessment to be made
5. Obtain information about the hazard
6. Obtain information about the people, assets and activities at risk
7. Identify the types of losses
8. Measure the extent of losses from all sources
9. Decide whether to count 'actual' or potential losses
10. Calculate annual average damages if needed
11. Assess benefits to region of analysis
12. Collate and present the results of the loss assessment

State-wide Natural Hazard Risk Assessment

Report 6: Australian natural disaster losses and climate change: Implications for disaster risk Management

Prepared by
Risk Frontiers

for

Queensland Department of Community Safety

March 2011

Funded by

Queensland Government

Australian Government
Attorney-General's Department

ECONOMIC MODELS

MACROECONOMIC MODELS

1) Macroeconomics was born with Keynes's 1936 General Theory

2) Economists began to measure macroeconomic variables (Kuznetts) and to try to model the macroeconomy (Klein)

3) In 1950, Lawrence Klein developed the first macro-econometric model of the U.S. economy, widely known as ***Klein Model I***.

BUILDING A MACRO MODEL

Typically, a Macro Model can be built in two ways:

1. Non-structural approach and
2. Structural approach

VECTOR AUTO-REGRESSIVE (VAR) MODEL: A NON-STRUCTURAL APPROACH

Pros:

1) can examine how a shock to one variable affects all other variables
2) can see how important one variable is in affecting movements of other variables
3) Do not require strong theoretical assumptions - model is rather based on actual trends in data
4) Impulse responses describe reaction of variables on exogenous shocks

Cons:

1) hard to use them to interpret historical events
2) Primarily used for short-term forecasting (up to 4 periods)
3) models lack structure, so the channels through which exogenous shocks affect GDP are not visible clearly

SIMULTANEOUS EQUATIONS MODEL (SEM): A STRUCTURAL APPROACH

Pros:

1) Advantage of structural interpretation, detail, *what-if* scenarios
2) Usually models are too large to estimate simultaneously—potential parameter bias

Cons:

1) Given its enormous sizes, typically it's difficult to tease out *causality* among the variables
2) Its hard to attain *identification condition* for solving the model
3) Traditional macro equations may include parameters that are not invariant to changes in the environment—The *Lucas critique*
4) Large models are expensive to maintain

RECENT TREND IN THE LITERATURE

1) Exogenous shocks such as natural disasters are modelled using single-equation estimators instead of system settings (Cavallo et al 2010, Dell, Jones, and Olken, 2014)

2) Our Team of Economists will model and estimate potential losses of natural disasters using a set of single-equation models by highlighting on the requirements of our End-users

THANK YOU