What does the future look like?

Dr Andrew Quinn

Climate change impact assessment

Climate change

Socio-Economic-Technical change

	Current climate	Future climate
	Current climate Current transport	Future climate Current transport
	Current climate Future transport	Future climate Future transport

**Difference is impact
of climate change**
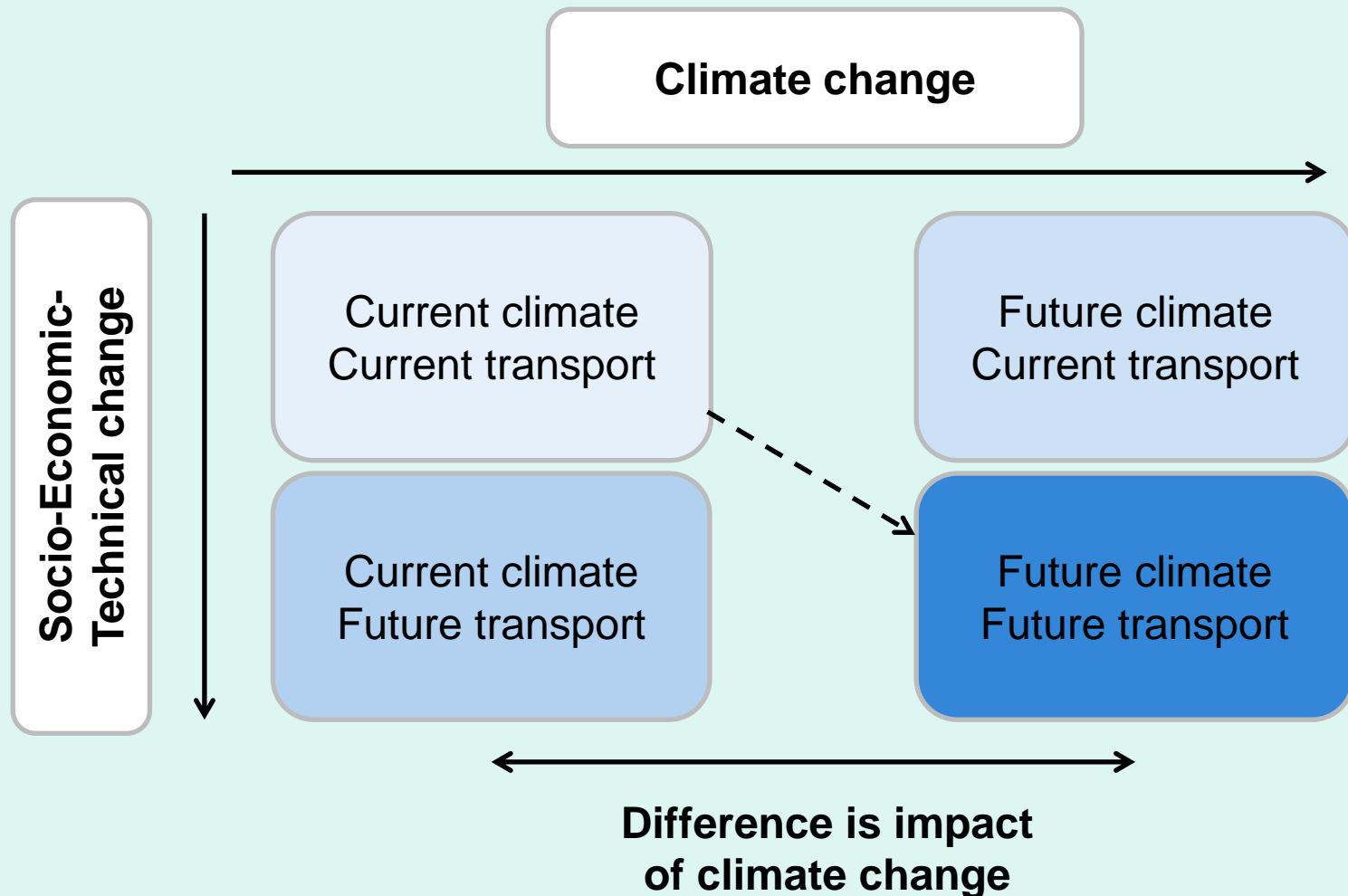
Going beyond Assessment, enabling Adaptation, requires new tools and perspectives in planning
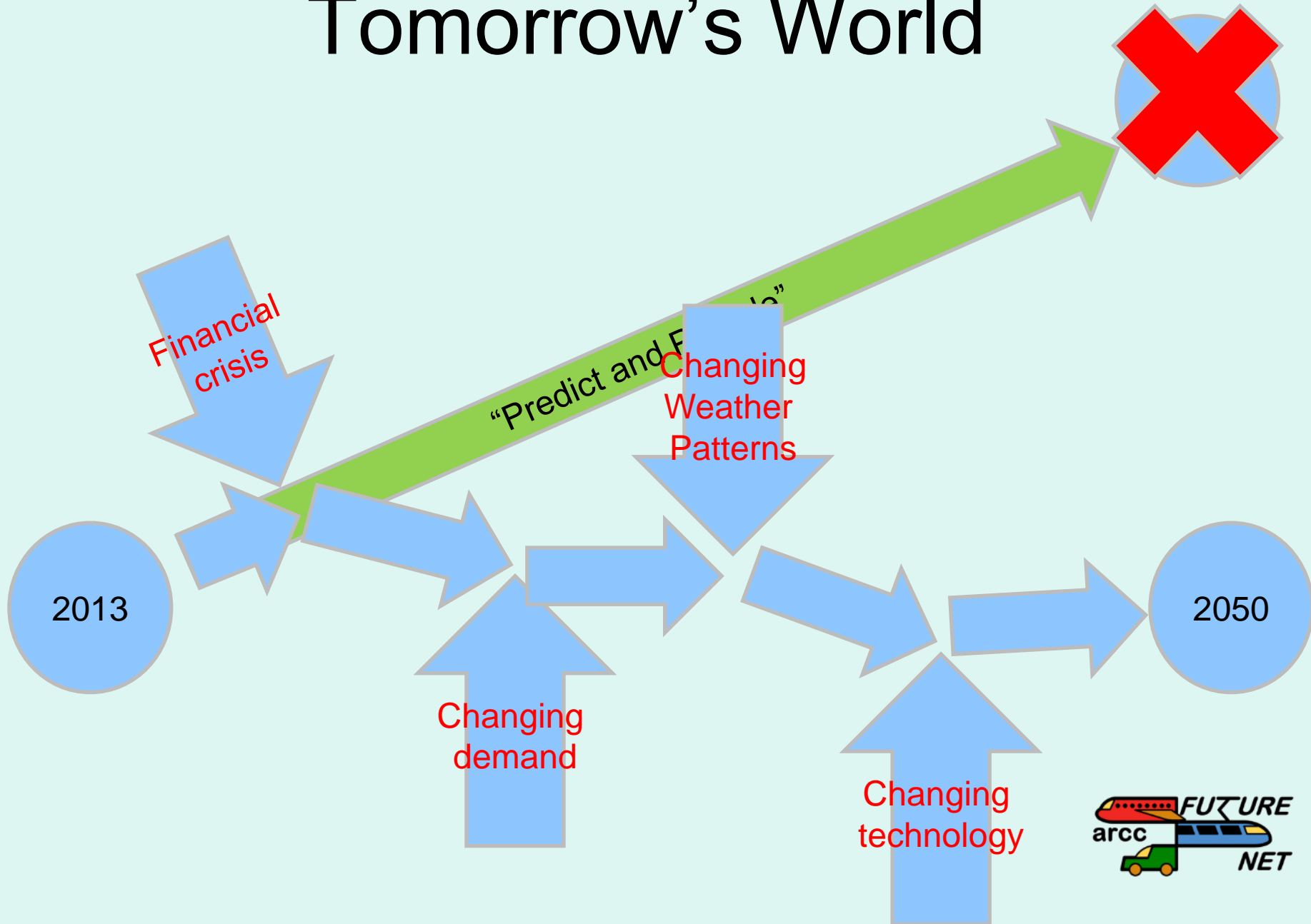
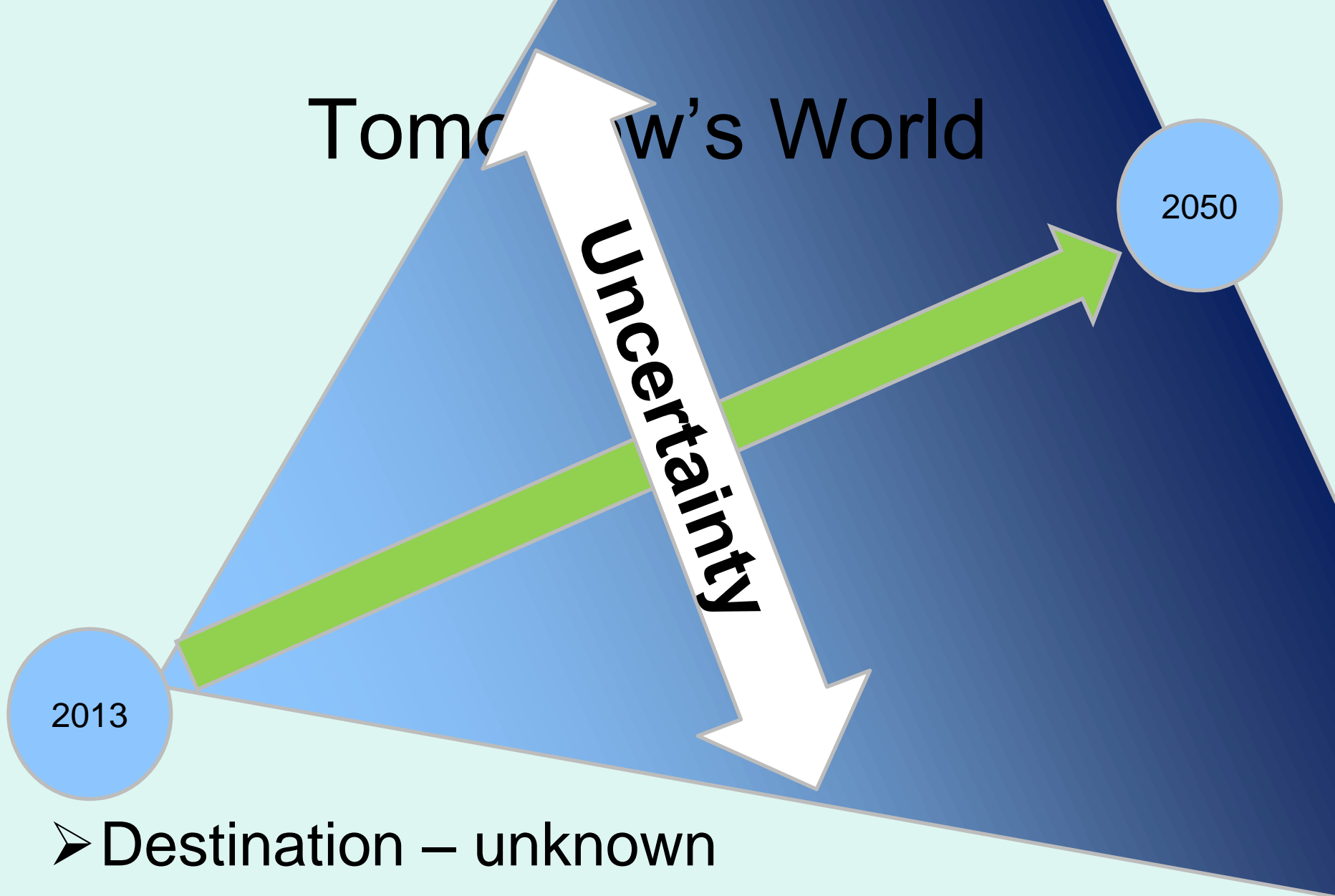# Prediction is very difficult, especially about the future (Niels Bohr)

➤ So what future should we plan for?

➤ "Resilience"

  ➤ Resistance to change?

  ➤ Flexibility to change?

➤ Destination?

  ➤ Utopia?

  ➤ the Past?

  ➤ Mornington Crescent?

Tomorrow's World

Financial crisis

"Predict and Provide"

Changing Weather Patterns

2013

Changing demand

Changing technology

2050

FUTURE arcc NET

Tomorrow's World

2050

Uncertainty

2013

➢Destination – unknown

➢Flexibility not Resistance

Transport Infrastructure

➢ Long capital replacement cycle
  ➢ but with regular maintenance cycles
➢ How to plan for flexibility and adaptability under unknown conditions?
➢ Most current tools focus on a linear pathway rather than on meeting a range of possibilities
  ➢ or effectively 'discount' the future out of the calculation

Transport Infrastructure

➢ What is the cost-benefit of adaptability?

➢ How do you quantify resilience?

    ➢ CCRA and others give priorities, not values

➢ Need for a more varied set of tools to inform decision-making

➢ Restore informed judgement to balance technical and financial calculation

What is Transport?

➢Physical networks
  ➢Inc. bridges, tunnels
➢Vehicles
  ➢Operators / Owners
➢Users

➢So what is resilience?

User-centred resilience

➢ Users are concerned with mobility rather than particular travel modes

   ➢ Choice of mode and evolving technical possibilities (e.g. self-driving vehicles, virtuality)

➢ Mobility is embedded in a wide range of social relationships

   ➢ Not just economic

      ➢ although may have economic consequences

   ➢ e.g. Support for an ageing population

Plausible Futures

➤ Although we don't know the destination we know the factors that could change:

  ➤ Social drivers for transport demand

  ➤ Economic supply and demand for transport

  ➤ Environment and Climate of UK

➤ These need to be included in any analysis

➤ Multiple perspectives on resilience are also required
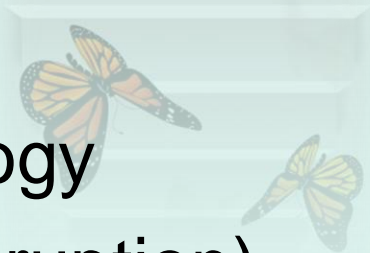
Climate and Weather

➢ UK Climate Projections (UKCP09)

  ➢ presents probabilities of different future climates

➢ Weather Generator

  ➢ statistical method of creating sequences of future daily (or hourly) weather that are consistent with climate change projections

  ➢ **for a particular location**

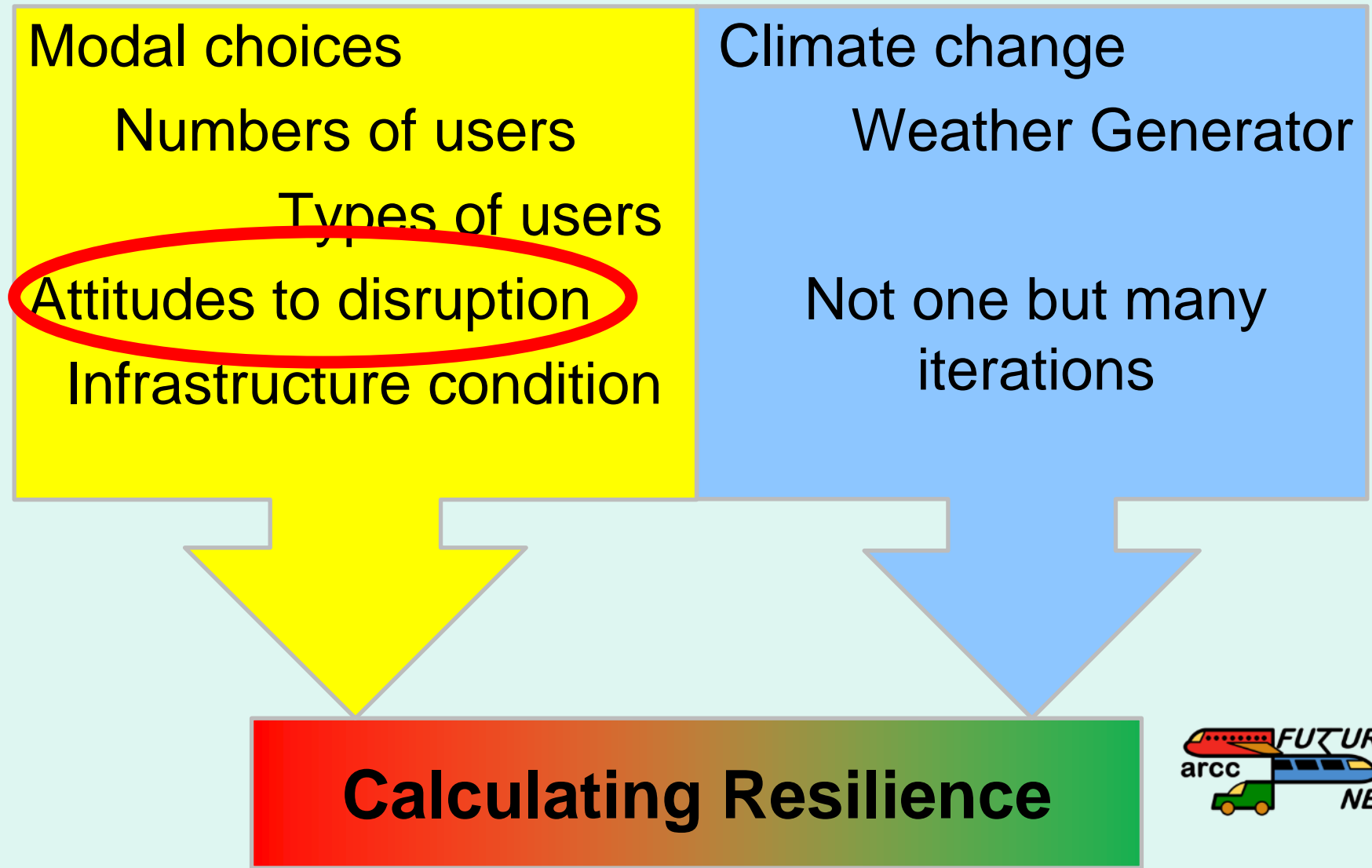2050s: 33%/67% probability level
Summer & Winter mean precipitation
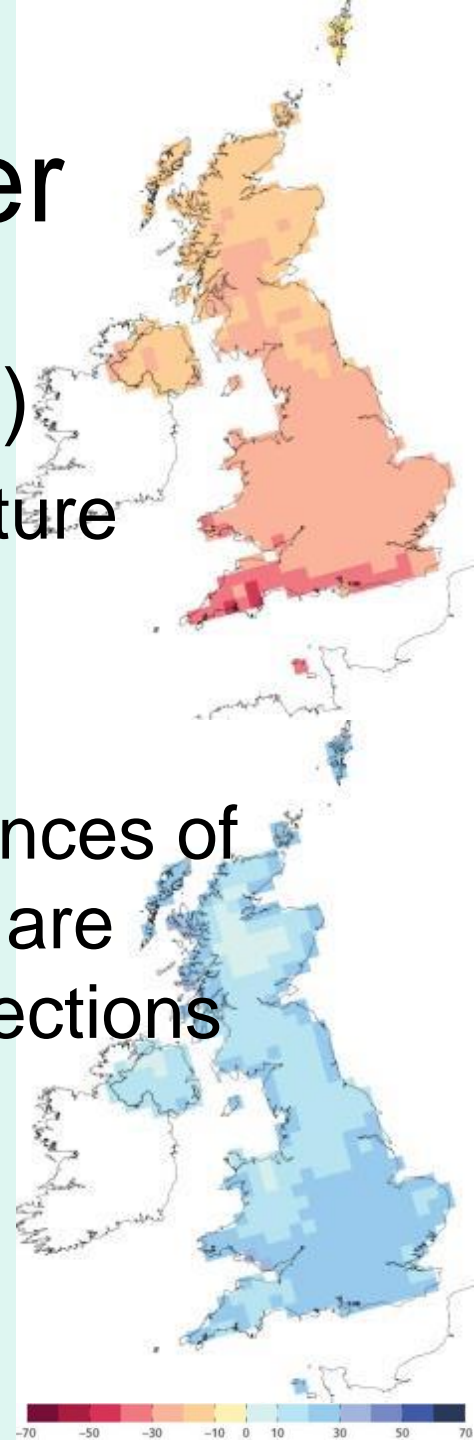
Social and Economic

➤Many different organisations do forecasts

➤Only sure fact is all of them are wrong

➤Key is the ability to include:

　➤Change in behaviour (modal shift)

　➤Change in infrastructure and technology

　➤Change in attitude (acceptance of disruption)

　➤Change in population (and demographics)

　➤Change in economy (demand and supply)

　➤Change in technology

What could be considered?

Modal choices

    Numbers of users

      Types of users

Attitudes to disruption

Infrastructure condition

Climate change

    Weather Generator

Not one but many iterations

Calculating Resilience

Where to start?

➢ Major study of travel behaviour

  ➢ Over 2000 respondents

  ➢ What do people currently do?

  ➢ What would people do in the event of disruption?

    ➢ When has a journey failed?

People do the funniest things…

➢35% do not mind travelling in heavy rain

➢24% do not mind travelling in snow

➢20% do not mind travelling when icy

➢58% look at a lot of travel information

➢**22%** will attempt to travel even when an official warning of 'not to travel unless absolutely necessary' is in place

"We travel for fulfilment" (Hilaire Belloc)

➢ On average long distance travellers decide not to travel if likely delays exceed 2 hours

➢ 'Failure' of public transport

    ➢ Exceeding 45 minute delay

    ➢ Overnight rescheduling without a hotel/refund

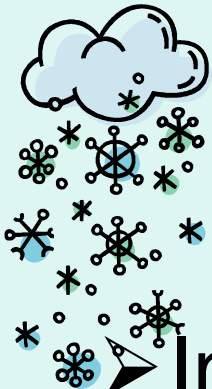   ➢ Toilet facilities / heating are not working

"Half the fun of the travel is the aesthetic of lostness" (Ray Bradbury)

➢ Less likely to cancel

➢ 'Failure' with private transport

　➢ Exceeding 60 minute delay

　➢ Road closures

➢ 42% would not know exactly which route to follow from London-Glasgow
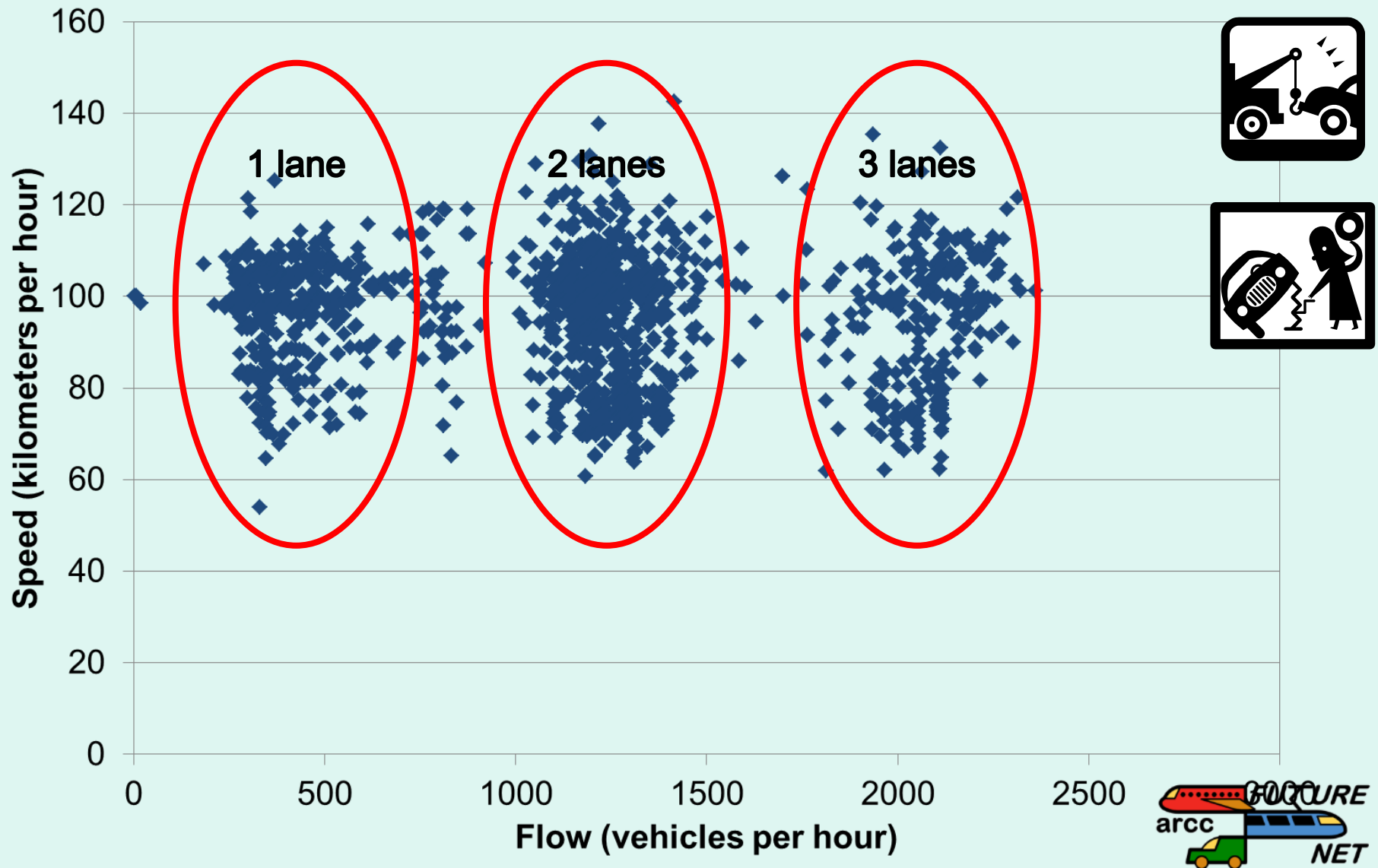
　➢ (c.f. 27% rail travellers)

Modal shift

- In heavy snow and ice
  - +25% people do not travel
  - Rail is a preferred mode
- In heavy rain
  - +6% people do not travel
  - Rail is the preferred mode
- In very hot weather
  - +4% people do not travel
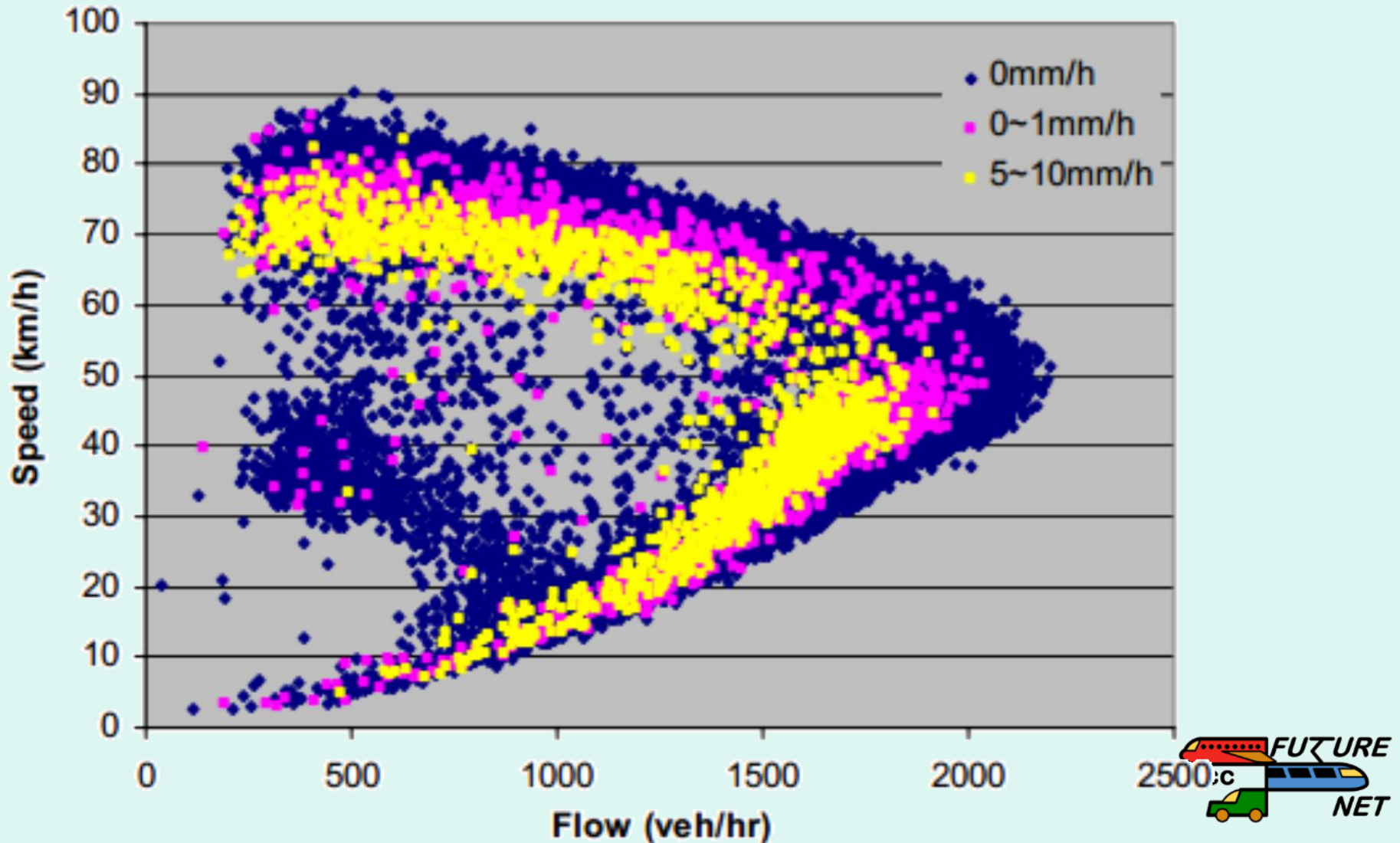 - Air is the preferred mode
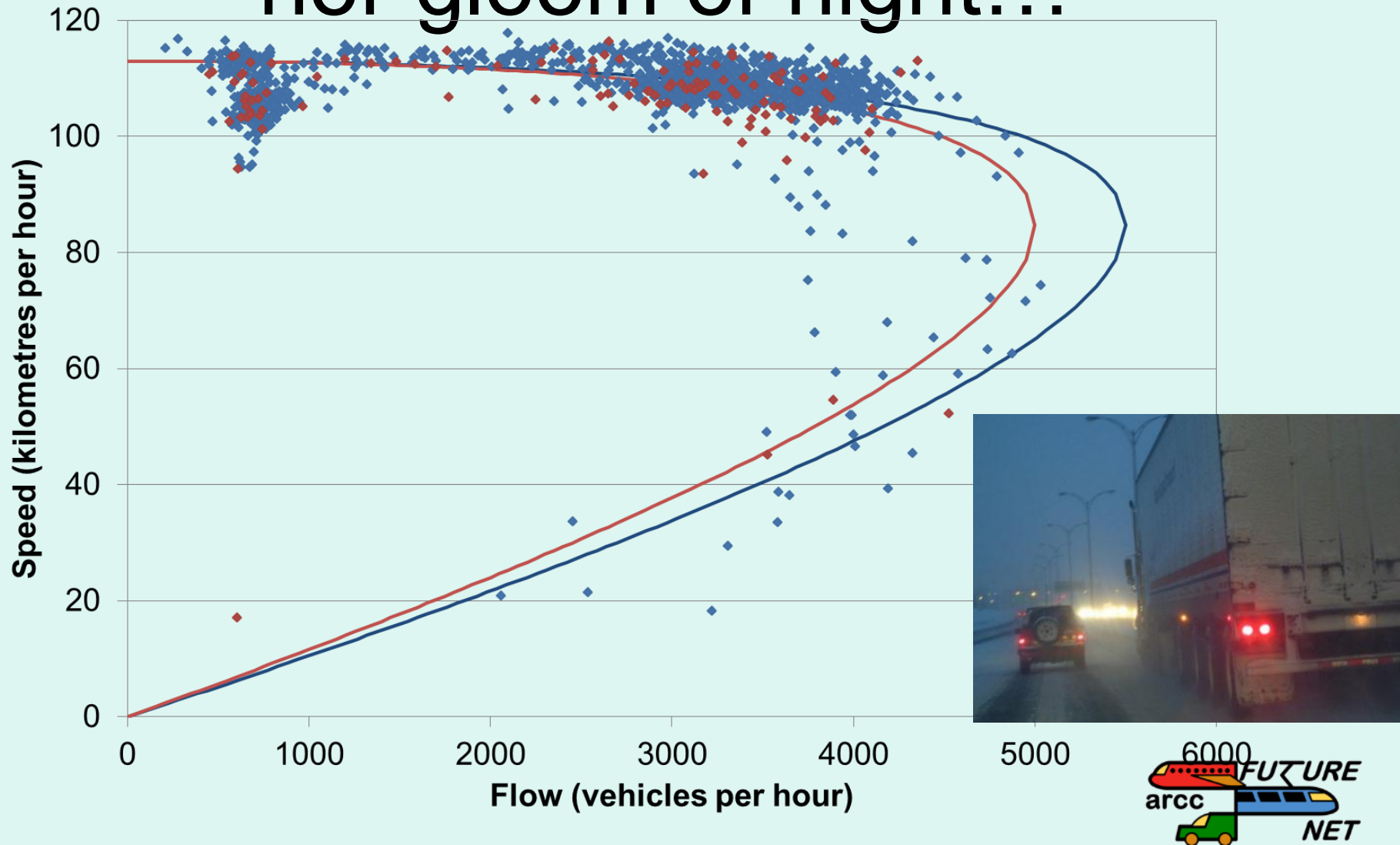
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Once your journey has begun...

Speed-Flow diagram for M1 (J1 to J2)

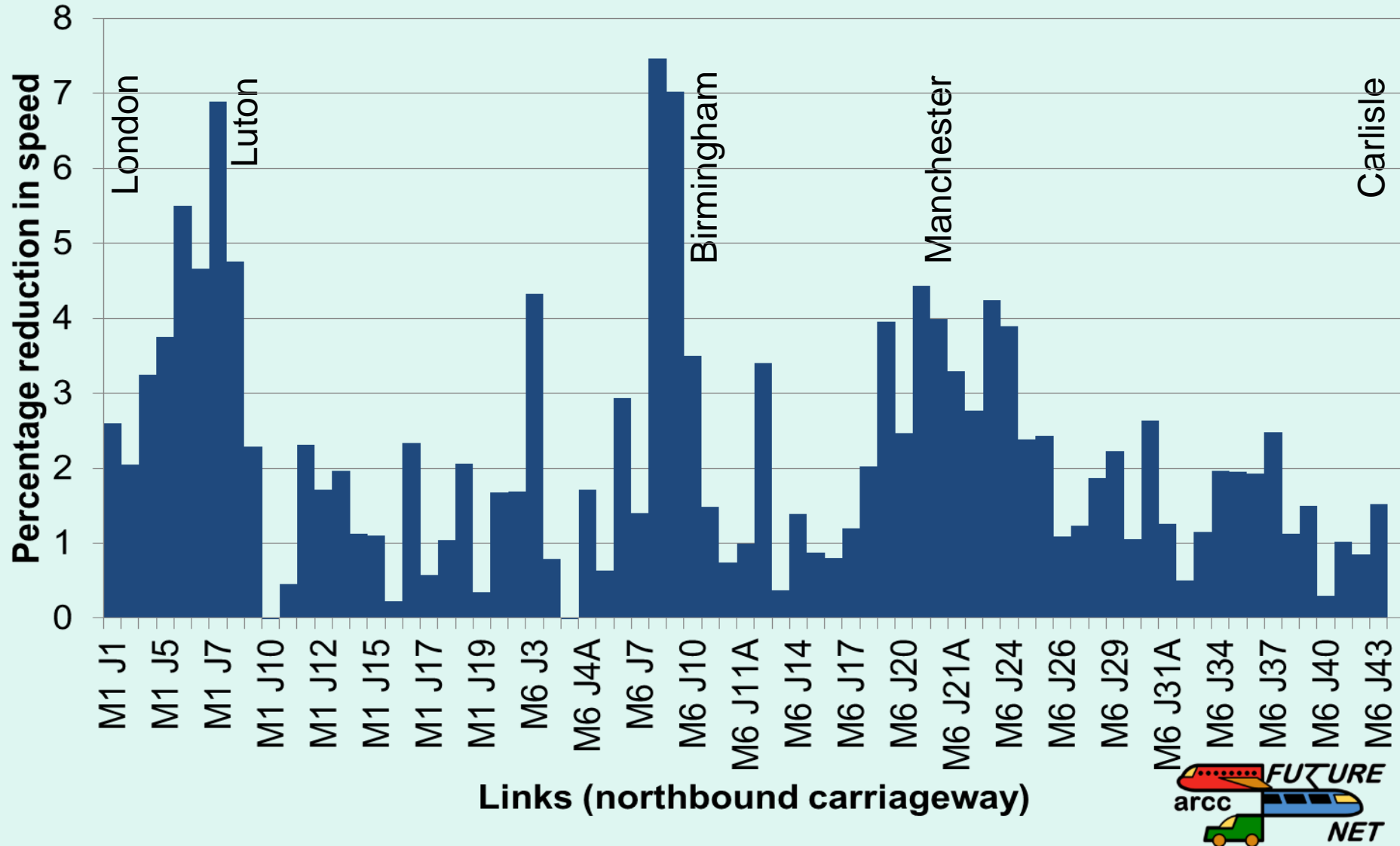# Speed flow curve at Hamasakibashi Junction, Tokyo for different rainfall (Chung et al 2006)

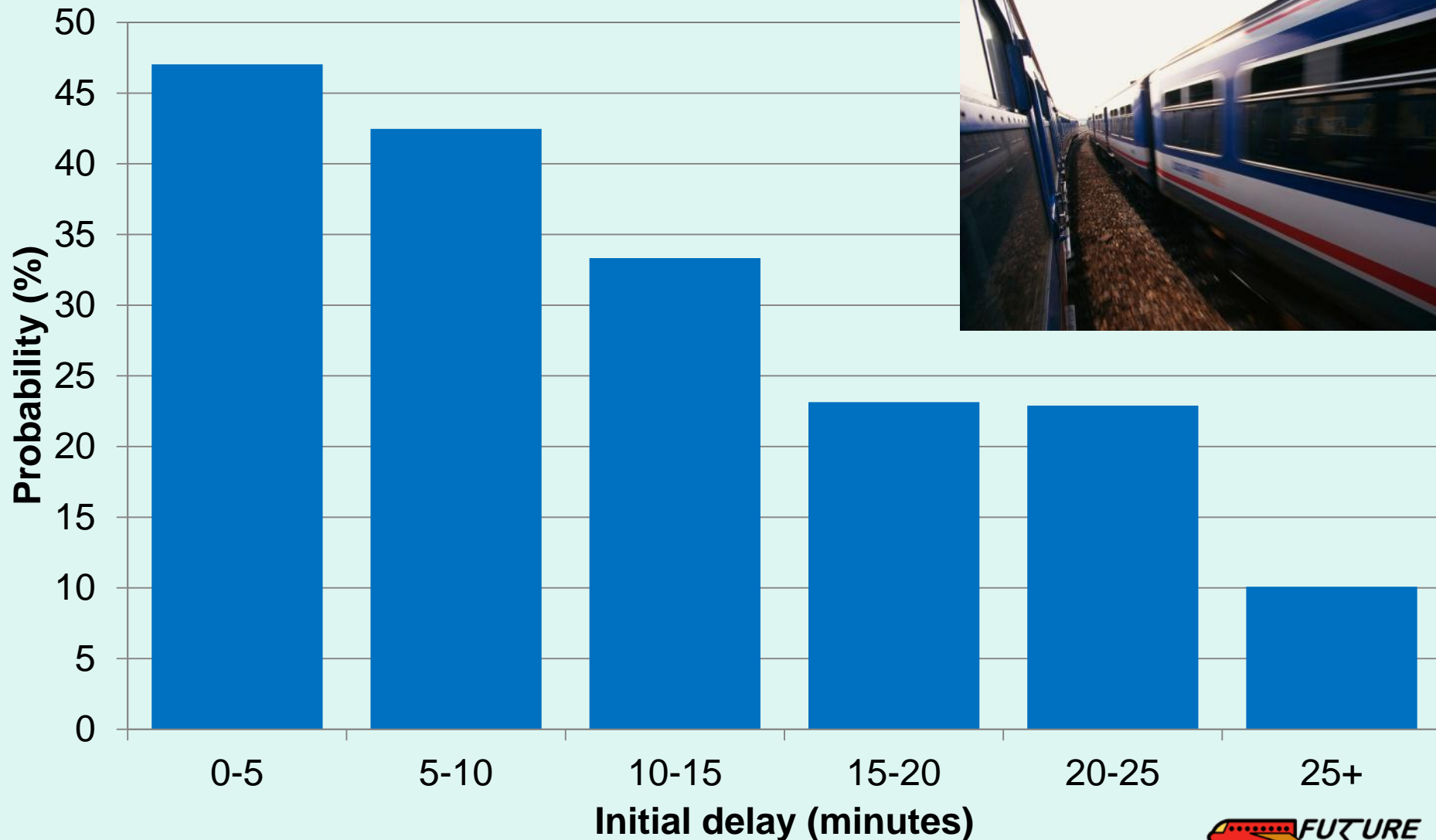# Neither snow nor rain nor heat nor gloom of night…

Speed-Flow diagram for M1 (J19 to J18)
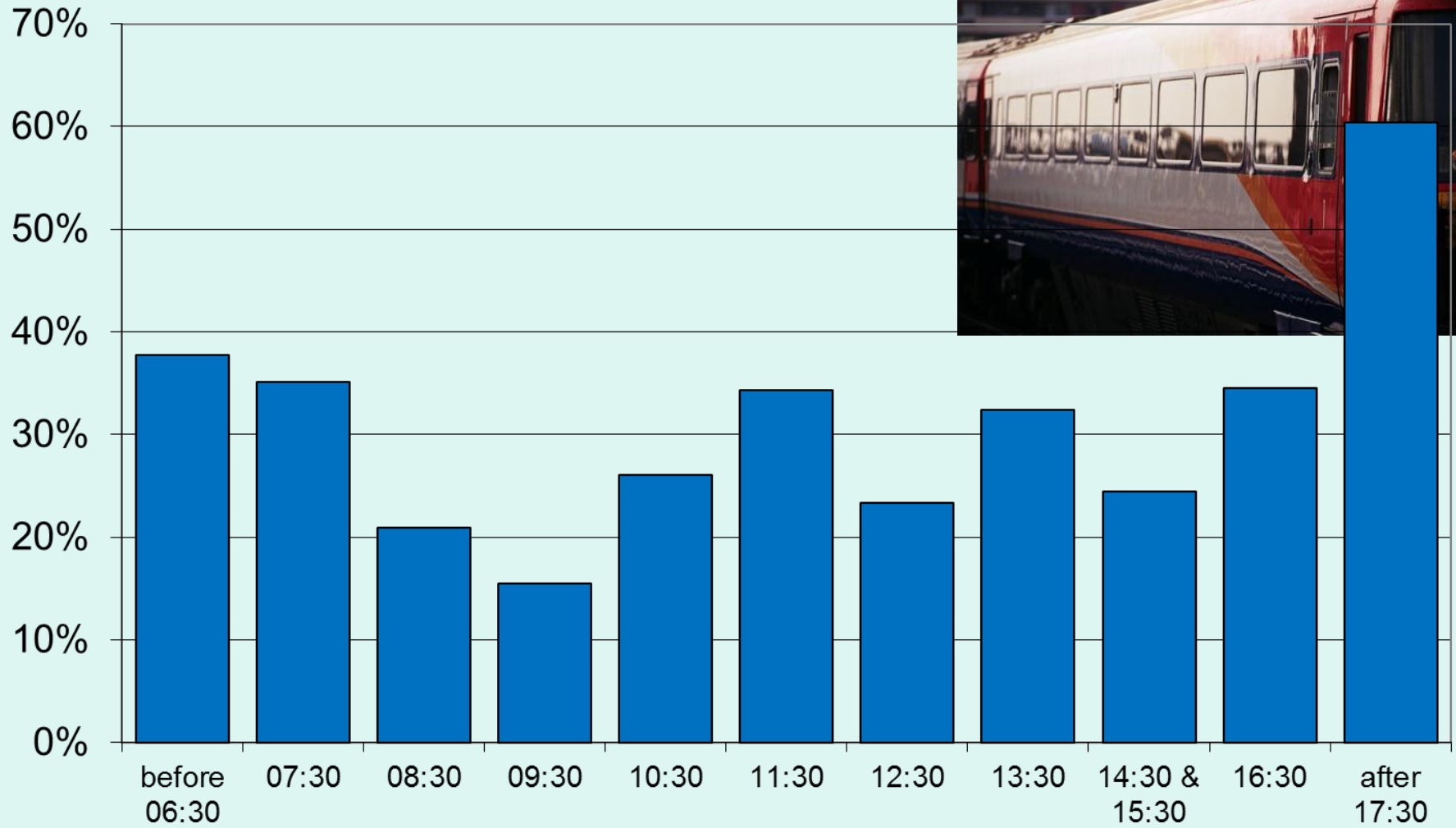
…but it may slow you down

Percentage reduction in speed during precipitation events
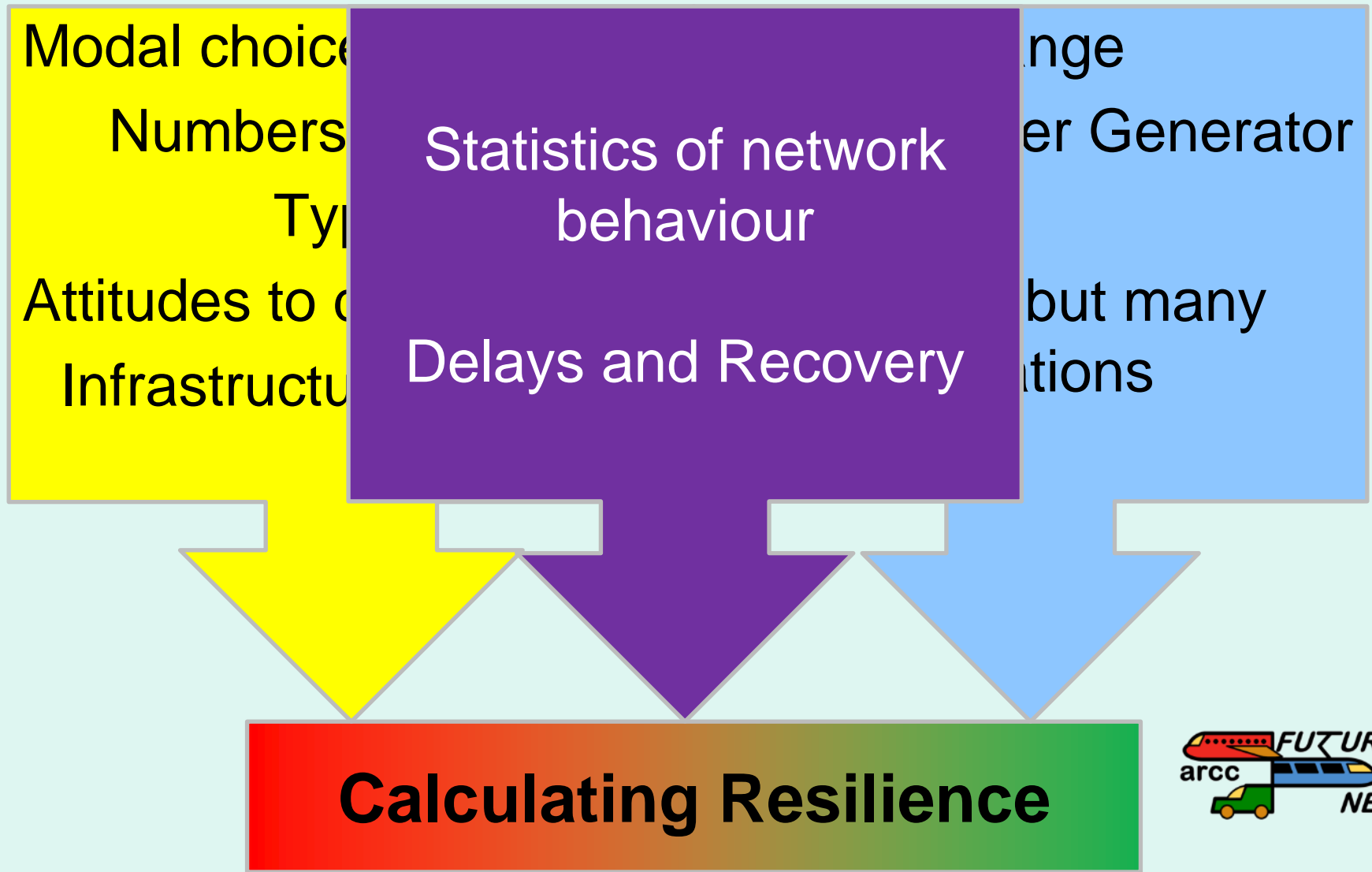
Train delay recovery

Probability of recovering any lost time following initial delays of different magnitudes

Recovery capacity through the day

Probability of recovering any lost time following initial delays of between 10-20 minutes throughout the day

What has been considered

Modal choice ... nge
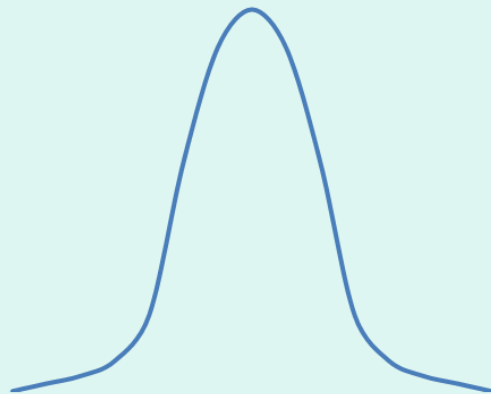Numbers ... er Generator
Typ...
Attitudes to ... but many
Infrastructu... tions

Statistics of network behaviour

Delays and Recovery

Calculating Resilience

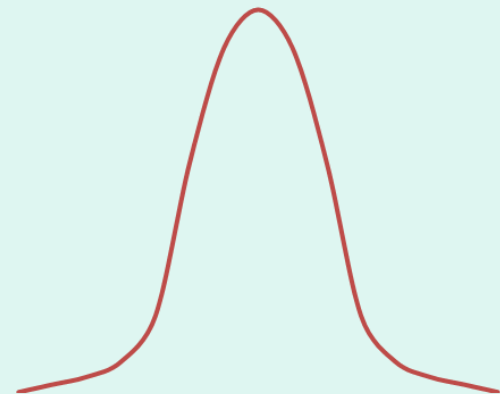# Calculating resilience

1000 journeys today

1000 journeys in 2050

Change in resilience

Measured as changing number of journeys considered to have 'failed'

Calculating resilience

➤ Social and economic factors are included
  ➤ as well as climate change
➤ Behaviour of the networks
  ➤ typical delays and recovery of service
➤ But this is all 'large' scale
  ➤ What about local problems?
    ➤ What about a landslip at Watford?
    ➤ or a flood at Carlisle?