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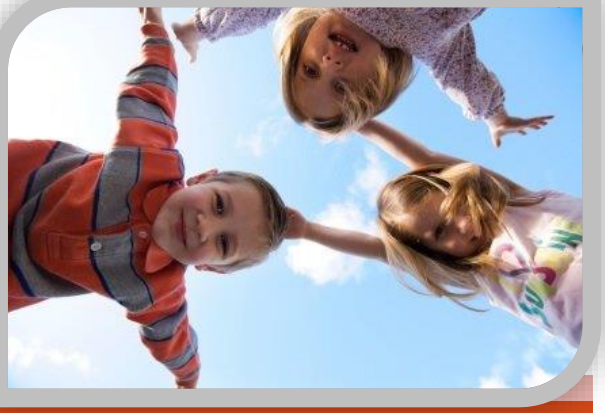

Update on HAPINZ 3.0

He rangi hauora he iwi ora

TKHE-EG Meeting

Tue 11 February 2020

The University of Auckland

University of Otago Te Whare Wānanga o Otāgo New Zealand

Resource Economics

The Workshop

GNS Science Te Pū Ao

cphr Centre for Public Health Research

JACOBS

Outline

- The **name**
- The **team**
- The **methodology**
  - Base year, pollutants, sources
  - Health endpoints & cohort study
  - Social costs & damage costs
- The **outputs** and **timing**
  - Deliverables
  - When?

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The name

HAPINZ = Health and Air Pollution in NZ

We're calling our project **HAPINZ 3.0** to differentiate it from:

- The original study - **HAPINZ 1.0** – Fisher *et al* 2007 (based on 2001)
- The last update – **HAPINZ 2.0** – Kuschel *et al* 2012 (based on 2006)

With the byline:

He rangi hauora he iwi ora

= Healthy air means healthy people

The team - us

Person	Role/Key Tasks
Jayne Metcalfe* Air Quality Scientist Emission Impossible Ltd Auckland	• source ambient monitoring, source apportionment & emissions mapping data • design & develop the exposure model • design & develop the health effects model
Dr **Gerda Kuschel*** Air Quality Scientist Emission Impossible Ltd Auckland	• manage the project team, costs & timing • single point of contact for steering group & reporting • assist with the design of the exposure model • assist with design of health effects model • primary author/editor compiling the final report
Louise Wickham/Surekha Sridhar Air Quality Scientist Emission Impossible Ltd Auckland	• source ambient monitoring, source apportionment & emissions mapping data • assist with development of exposure & health effects models

* Part of the HAPINZ 2012 (HAPINZ 2.0) team

The team – health stats & #s

Person	Role/Key Tasks
Dr **Simon Hales*/June Atkinson** Epidemiologist Dept Public Health University of Otago, Wellington	• confirm appropriate ERFs • investigate ethnicity impacts
Dr **Alistair Woodward*** Epidemiologist School of Pop'n Health University of Auckland	• provide internal review & advice on ERF/ethnicity • assist with estimations of co-benefits associated with reductions in greenhouse gas emissions
Kylie Mason Statistician Centre for Pop'n Health Research Massey University, Wellington	• supply health incidence & population statistics • assist with the estimations of years of life lost • link with other environmental health indicators datasets

* Part of the HAPINZ 2012 (HAPINZ 2.0) team

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The team – sources, $ & messages

Person	Role/Key Tasks
Keith Hastings GIS Consultant Jacobs Wellington	• provide NO_2, other emissions & traffic mapping data • advise on use/application of GIS to establish exposure • assist with mapping/representation of outputs
Dr **Tim Denne** Economist Resource Economics Ltd Auckland	• cost the health endpoints e.g. VoLY, VoSL & hospitalisations • develop damage costs
Dr **Perry Davy** Atmospheric Chemist GNS Science Ltd Wellington	• supply source apportionment data from the central repository, including As and BC data • advise on application of relevant data
Dr **Jess Berentson-Shaw** Policy & Comms Researcher The Workshop Auckland	• advise on innovative science communication strategies • assist with the development of key messages

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Method – base year/spatial unit

Base year	2016 for population*
Spatial resolution	**Calculations** undertaken using 2013 census area unit boundaries **Results** reported by 16 regional councils, 71 airsheds, 74 territorial local authorities and 139 urban areas
Population covered	100% of 2016 population

- **Base year** currently guaranteed as 2015 (for 2014-2016) but hope to get good quality 2017 provisional mortality data to extend to **2016** (shown as * above)
- Health incidence data uses domicile codes which relate to **CAUs**
- Assumes results reported to same **spatial resolution** as HAPINZ 2.0

Method - pollutants

Pollutants	**Priority pollutants** • particulate matter (PM_{10} and $PM_{2.5}$) • nitrogen dioxide (NO_2)

- We have good monitoring data (or representative models) covering NZ for **PM_{10}, $PM_{2.5}$, NO_2** together with reasonably robust exposure-response functions for relevant health outcomes
- **Black Carbon, PAHs, As, and Pb** were investigated but insufficient information available currently to do them justice
- Greenhouse gas co-benefits to be addressed by incorporating **CO_2** in damage costs

Method - exposure assessment

Exposure assessment	**PM_{10} and $PM_{2.5}$**: ambient monitoring data averaged for 2015-2018 covering the majority of urban areas in New Zealand, with proxy monitoring used in unmonitored areas **NO_2**: modelling estimates from the NZ Transport Agency NVED exposure tool*

For PM

- Monitored locations, will use **ambient data** averaged 2015-2018 with the concentration applied to entire airshed (using judgment)
- Unmonitored locations, will use **proxy** data (similar locations)

For NO_2

- Will opt for the best available model at the time of analysis out of either **NVED exposure model** & Transport Impact Model

Method – source contributions

Source attributions	**PM_{10} and $PM_{2.5}$** using source apportionment data: marine aerosol, biomass burning, motor vehicles, secondary PM, crustal material **PM_{10} and $PM_{2.5}$** using emissions inventory data: industry*, open burning* **NO_2**: motor vehicle exhaust emissions only

For PM

- **PM speciation** will provide marine aerosol, biomass burning (urban DFs), MVs (exhaust, brake/tyre wear & re-entrained road dust), secondary PM, crustal material (construction)
- **Inventory data** will estimate industry & possibly open burning
- **Aviation, shipping, and rail** will be investigated further

For NO_2

- Assessment will cover motor vehicle exhaust only

Method - health endpoints

Health endpoints	**Primary health outcomes** • **mortality** and years of life lost (YLL) from long-term **$PM_{2.5}$** for all adults 30+ years, all ethnicities and for Māori/Pasifika* • **mortality** and YLL from long-term **NO_2** for all adults 30+ years, all ethnicities • **cardiac admissions** from long-term **$PM_{2.5}$** for all ages, all ethnicities • **respiratory admissions** from long-term **$PM_{2.5}$** for all ages, all ethnicities • **respiratory admissions** from long-term **NO_2** for all ages, all ethnicities
Health endpoints (cont.)	**Secondary health outcomes (for comparison with HAPINZ 2.0)** • **mortality** from long-term **PM_{10}** for all adults 30+ years, all ethnicities and for Māori/Pasifika* • **mortality** from long-term **PM_{10}** for all infants, aged 1 month to 1 year • **restricted activity days** from long-term **$PM_{2.5}$** for all ages, all ethnicities **Other outcomes** • childhood asthma*

- **Childhood asthma** ERFs are available and will develop proxy indicators from health incidence data

Method – cohort study

Already funded to

- Develop a set of improved PM exposure-response functions for **all adults plus Māori/Pasifika** based on 2013-2017 data

Currently seeking additional funding to

- Extend exposure to **2006-2017** to improve robustness
- Undertake finer scale assessment of **NO_2 effects**
- Extend PM mortality cohort to cover **PM morbidity**

Method - social costs

Social costs	**Valuation of mortality costs** • by change in mortality multiplied by current NZ Value of a Statistical Life (**VoSL**) • by change in total life years multiplied by a NZ Value of a Life Year (**VoLY**) **Valuation of morbidity costs** • cardiovascular hospital admissions • respiratory hospital admission • restricted activity days **Development of a suite of NZ-specific damage costs** for consistent assessment of benefits to society in reducing harmful emissions and greenhouse gases

For mortality

- will produce a range of **VoLYs** based on **VoSL** & typical discount rates

For damage costs

- will use HAPINZ 3.0 output with inventory data to develop **harmful emission** damage costs for areas with diff pop densities
- will examine marginal abatement cost curves for NZ and/or review other social cost of **carbon** values

Outputs – combined model

Proposed modelling outputs

- A combined exposure/health effects model (in Excel)
- A prototype GIS tool, which will be available online. This tool will make key results available spatially and will allow users to undertake sensitivity analysis for key variables.

- Approach will be similar to HAPINZ 2.0 but with refinements:
- **Simplifying** the model, reflecting the accuracy of the source data
- **Improving "update-ability"**, making it easier for end-users to update key datasets more frequently
- **Extending the scenario testing**, enabling assessment of reductions in pollutant concentrations by individual sources

Model – example

HAPINZ - DRAFT user interface idea *Draft 6 June 2019*

Select a pollutant:	PM10	*µg/m3 (annual)*
Select a source:	Total	

Health effects	**Default**	**Scenario**	**Range**	
Premature mortality 30+ yrs	0.07	0.1	*(0.03-0.10)*	*per adult per year*
Premature mortality Maori 30+ yrs				
Premature mortality babies 0-1 yrs				
Cardiac hospital admissions, all a				
Respiratory hospital admissions, a				
Respiratory hospital admissions, c				
Respiratory hospital admissions, c				
Restricted activity days, all ages				

Spatial resolution

Select a region, city OR airshed (de

Results

INPUT

RESULTS

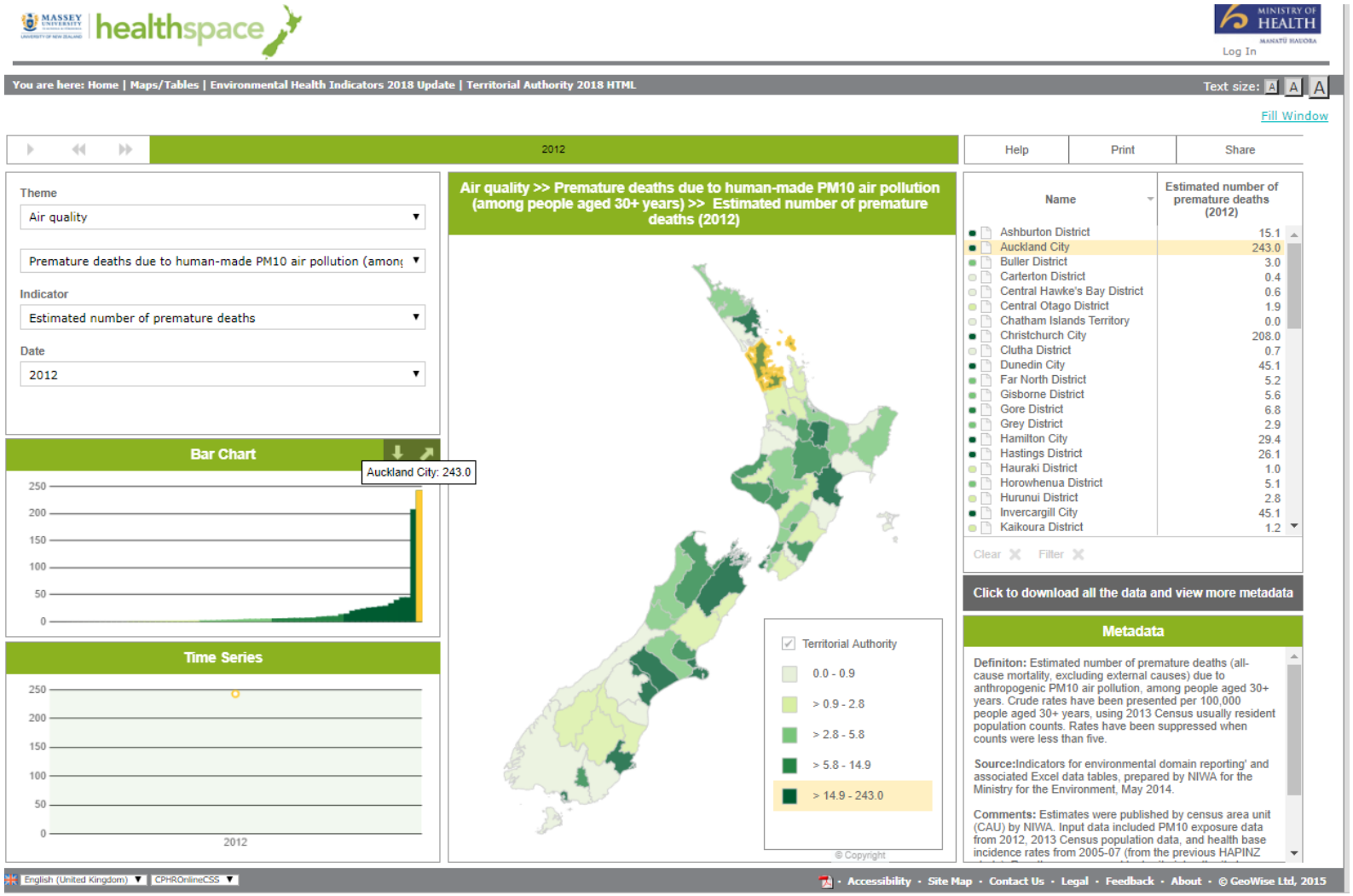
Health Effects		**Health effects (cases)** Domestic fires	Motor vehicles	Industry	Open burning	Natural	Total	**Social cost ($million /annum)**
Mortality Adults 30+ yrs		653	255	123	139	1,136	2,307	8,211.4
Mortality Adults Maori 30+ yrs		105	41	19	31	228	422	1,504.1
Mortality Babies 0-1 yrs		2.2	1.0	0.3	0.6	4.7	8.8	31.2
Cardiac Hospital Admissions: All ages		130.8	50.9	21.1	29.3	216.5	448.6	2.8
Respiratory Hospital Admissions: All ag		202.7	91.2	33.5	47.4	356.0	730.8	3.3
Respiratory Hospital Admissions: Childı		67.5	31.5					
Respiratory Hospital Admissions: Childı		41.6	18.4					
Restricted Activity Days		817,582	352,342	128,				
TOTAL POPULATION	4,027,902	$ 2,384.2	$ 934.8	$ 44				

SCENARIO RESULTS

Health Effects		Domestic fires	Motor vehicles	Health Indust
Mortality Adults 30+ yrs		653	255	
Mortality Adults Maori 30+ yrs		105	41	
Mortality Babies 0-1 yrs		2.2	1.0	
Cardiac Hospital Admissions: All ages		130.8	50.9	
Respiratory Hospital Admissions: All ag		202.7	91.2	
Respiratory Hospital Admissions: Childı		67.5	31.5	
Respiratory Hospital Admissions: Childı		41.6	18.4	
Restricted Activity Days		817,582	352,342	128,
TOTAL POPULATION	4,027,902	$ 2,384.2	$ 934.8	$ 44

INPUT RESULTS

Outputs – links to other work e.g.



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Outputs – damage costs e.g.

Pollutant	Costs in NZD/tonne	Value Base Date
CO_2	$65.99	2015
PM_{10}	$451,123	2015
NO_X	$16,031	2015
CO	$4.16	2015
HC	$1,318	2015

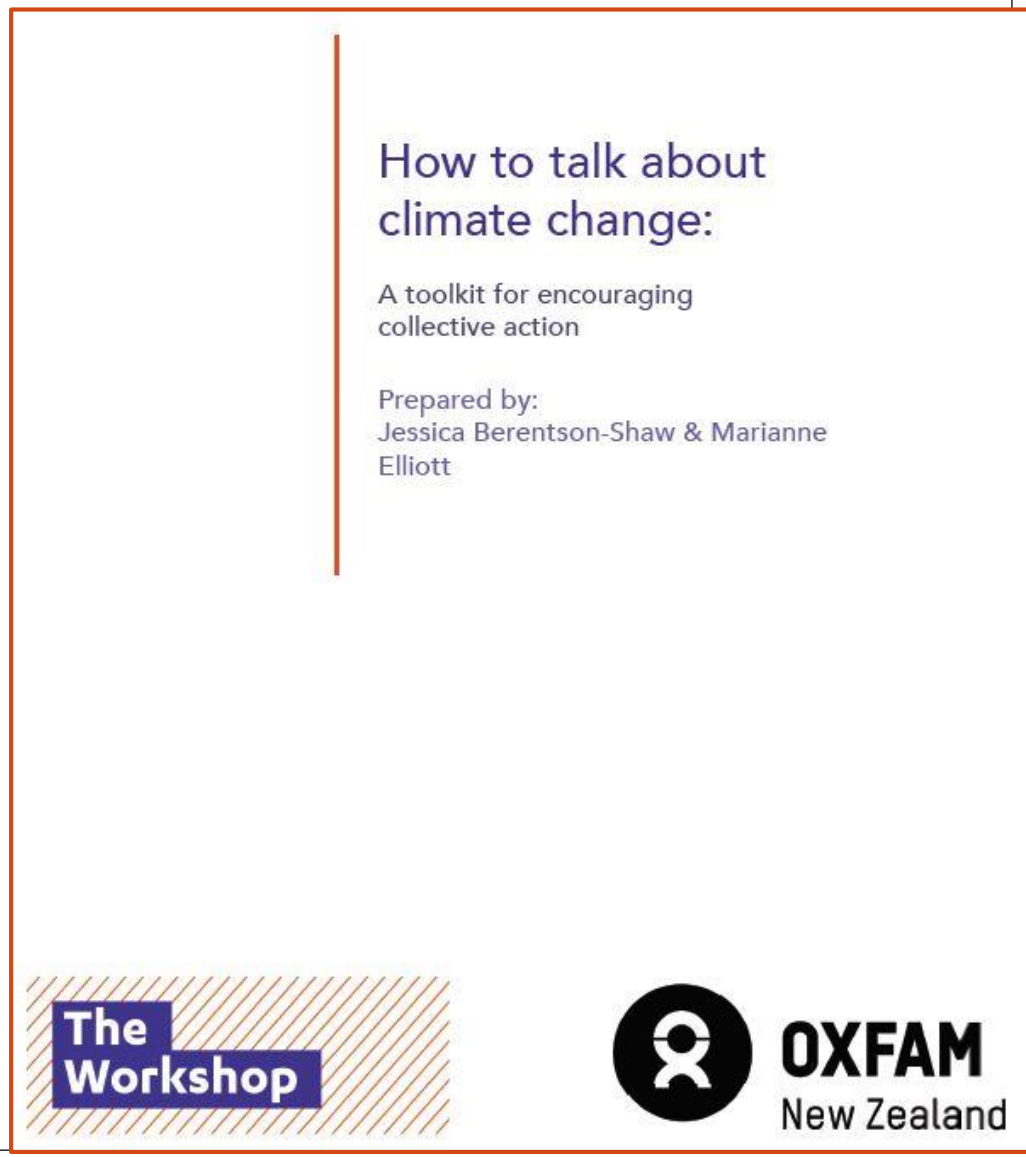
Outputs - messaging

Already funded to

- Develop a **draft messaging guide** viz. *How to Talk About Climate Change: A Toolkit for Collective Action*

Currently seeking additional funding via EnviroLink to

- Offer **sectoral training**
- Map the landscape of **narratives and understanding**
- Test **new strategies**



The timeline – what next?

Stage	Description	Completion by
1	**Lit review/methodology***	**Mid Dec 2019**
2	*Draft models, reports & tools*	*Mid Oct 2020*
3	*International peer review*	*End Nov 2020*
4	*Final models, reports & tools*	*End Jan 2021*
5	*Outreach material, messaging*	*Mid May 2021*

* Peer-reviewed by (1) Dr Xavier Querol from the Institute of Environmental Assessment and Water Research in Spain and (2) Dr Mike Holland from Ecometrics Research and Consulting (EMRC) in the UK

Thanks for listening and any questions?

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