A-*void*-ing the deadlock: make space for the future

Professor Rob Roggema

School of Architecture, University of Technology Sydney

Meet the Energy Leader – Delft University of Technology – 3 October 2018

Inside the void (source: 3D-methods)

Elders identified the following qualities as critical for resilience

Connection. A sense of belonging and connection to family, community and culture, with Elders as givers and receivers of culture, respect and care

Sharing. A willingness to help anyone who needs it, even if you don't have much yourself

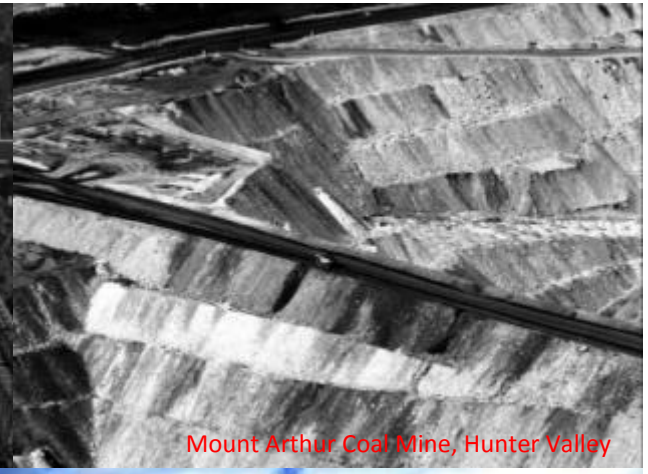
Participating. A strong work ethic – just getting on with it

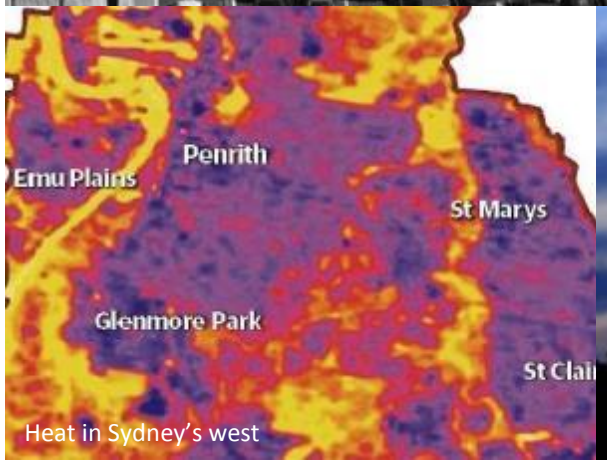
Identity. Visibility of culture and support for young people – from the Indigenous and wider community.

Source: Resilient Sydney, A strategy for city resilience 2018

Fixed


Sydney Harbour Bridge


Mount Arthur Coal Mine, Hunter Valley



Heat in Sydney's west


Bayswater power station

In current systems (urban, political, societal) many things are fixed: this makes change very difficult

- Housing market: affordability
- Transport systems; highways and car based
- Energy grid: central grid, coal based
- Supermarkets: food miles, unhealthy food
- Climate: hot, dry and wet
- Urban development: Oran Park

Oran Park

People living in the **4-2-2** formula: four bedrooms, two bathrooms and a double garage. The ‘town’ as it is called in the Master Plan has: ‘one of the State’s biggest **Woolworths**, a **public primary** school, Catholic and Anglican schools nearby that go from **kindergarten to year 12**, three floors of **offices** including a “**smart work hub**”, two **artificial lakes**, pedestrian **walkways and cycleways**, an **aged care center** and a new **library** and **community resource center** that opens soon’

(Maddox, 2018)

Impact

Water: Treated centrally in waste water treatment plant. Polluting oceans and rivers, vulnerable for (flash)flooding.

Energy: Mainly coal fired power plants, centrally distributed. Carbon emissions, heating surface water, depletion of resources disturbing ecosystems and the landscape.

Food: Large scale produced, supplied centrally through the supermarket. Vulnerable for diseases and market change, ruin the landscape, *foodmiles*, waste produced during and after consumption. Leads to inequity.

Biodiversity: Nature as protected space in ‘reserves’, being destroyed for production (forestry, energy, urban development). Limited biodiversity in cities. No trees, no cover: heat islands

Climate: efficient urban design increases vulnerability for disasters (flooding, fire, drought, heat).

Resilient?

- Black roofs: hot
- No trees - no shade: hot
- AircON: energy bill
- Two cars per house: energy bill
- No garden – no nature
- No community, individualism
- No health: obesity, mental illness, violence
- No mercy

How can we let people live like this?

Centralised





Not only is change difficult

These centralised, short-term practices create an environment in which people are more:

- Unhealthy
- Stressed
- Violent
- Obese
- Mentally ill
- Unsafe

Really, how much prove do we need?

New Normal

The change will however take place, no matter what we do

This imposes new requirements to the way we design our city

Those requirements are difficult to achieve for politics, society and the city

Deadlock

There is no choice when all seems perfect as it is, yet raging fire and epic storms tear at our being to face and forward us towards new beginnings (suntwirl).

This is the deadlock: a fast change is needed while we are still locked-in in our current *rusty* systems

TOO SLOW, TOO LATE? IGNORANT?

INDEPENDENT

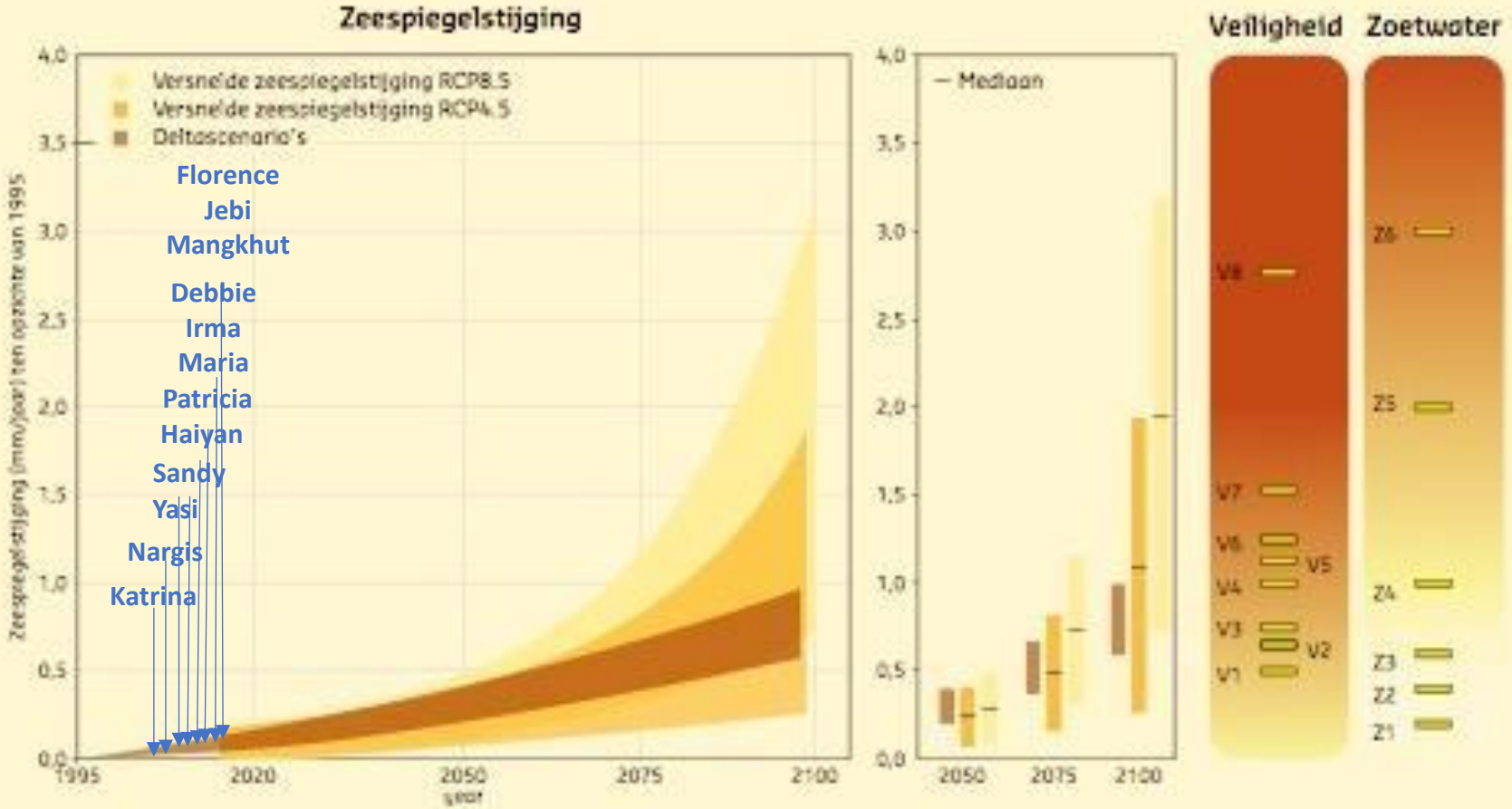
Australia pulls out of climate change targets agreed at Paris conference

‘Cheaper power has always been our number one priority’

Harry Cockburn | | 20 comments

22 August 2018

Florence, North Carolina, September 2018



V1: Sluitfrequentie Maeslantkering is eens per 3 jaar
V2: Herhalingstijd ontwerppeil Maeslantkering is 100 jaar
Sluitfrequentie Oosterschelde is 10 keer per jaar
Spuien IJsselmeer beperkt effectief (bij huidig streefpeil)
V3: Sluitfrequentie Maeslantkering is eens per jaar
V4: Sluitfrequentie Maeslantkering is 3 keer per jaar
V5: Herhalingstijd ontwerppeil Oosterscheldekering is 100 jaar
V6: Herhalingstijd ontwerppeil Haringvlietdam is 100 jaar
Spuien IJsselmeer beperkt effectief (bij 0,6m hoger streefpeil)
V7: Sluitfrequentie Oosterschelde is 100 keer per jaar
V8: Herhalingstijd ontwerppeil Afsluitdijk is 100 jaar

Z1: Onzeker Spijkenisse voldoende betrouwbaar alternatief is voor Bernisse
Z2: KWA jaarlijks ingezet, eens in 5 jaar 20 dagen
Z3: Lek steeds vaker tientallen m³/s nodig op bruikbaar te houden
Z4: KWA structureel ingezet. Capaciteit vergroting mogelijk nodig. Hollandsche IJssel mogelijk niet meer bruikbaar en dus aanvoer nodig.
Z5: Bernisse regelmatig niet meer bruikbaar. Spijkenisse geen alternatief.
Z6: Significant grotere watervraag aan IJsselmeer door toename doorspoelbehoefte als gevolg van toename zoutvracht

0-5cm SLR:

2005: Katrina, New Orleans
2008: Nargis, S-E Asia
2011: Yasi, Queensland
2012: Sandy, New York
2013: Haiyan, Philipines
2015: Patricia, Mexico
2017: Debbie, Queensland
2017: Irma, Caribbean
2017: Maria, Caribbean,
2018: Florence, N Carolina
2018: Jebi, Osaka
2018: Mangkhut, Macao & HK

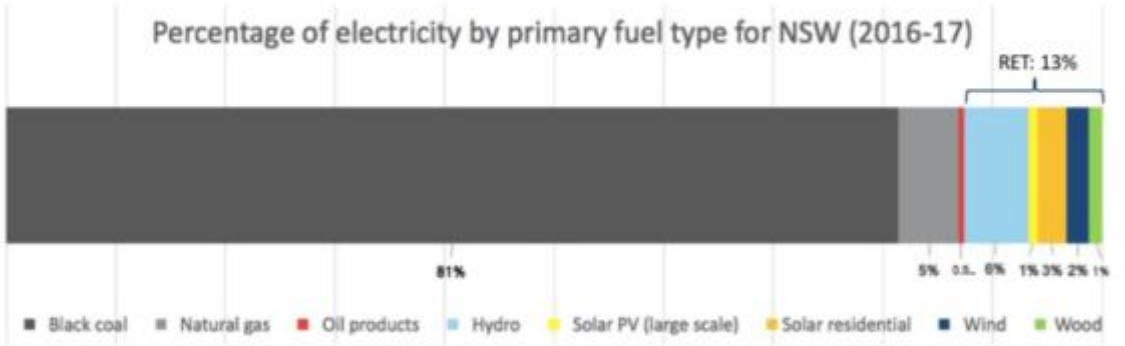
These hurricanes(at 0-5cm SLR caused serious damage. What happens if SLR rises further?

2100: max 3m.
2200: 5-8m.

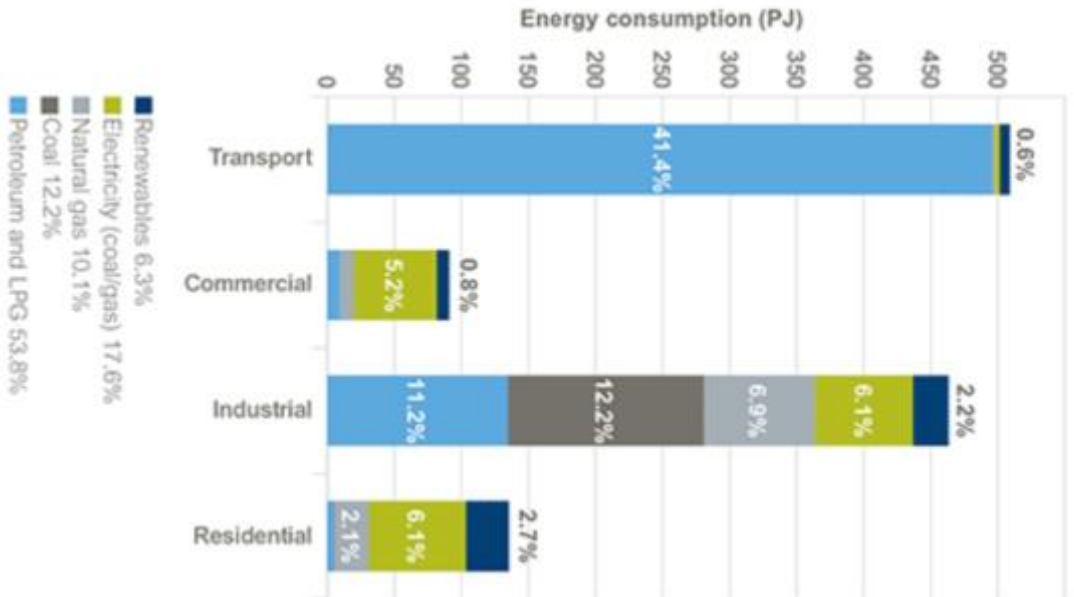
This means we've only seen 2% SLR of the max scenario 2100: 98% to come

Deltares, 2018

NSW



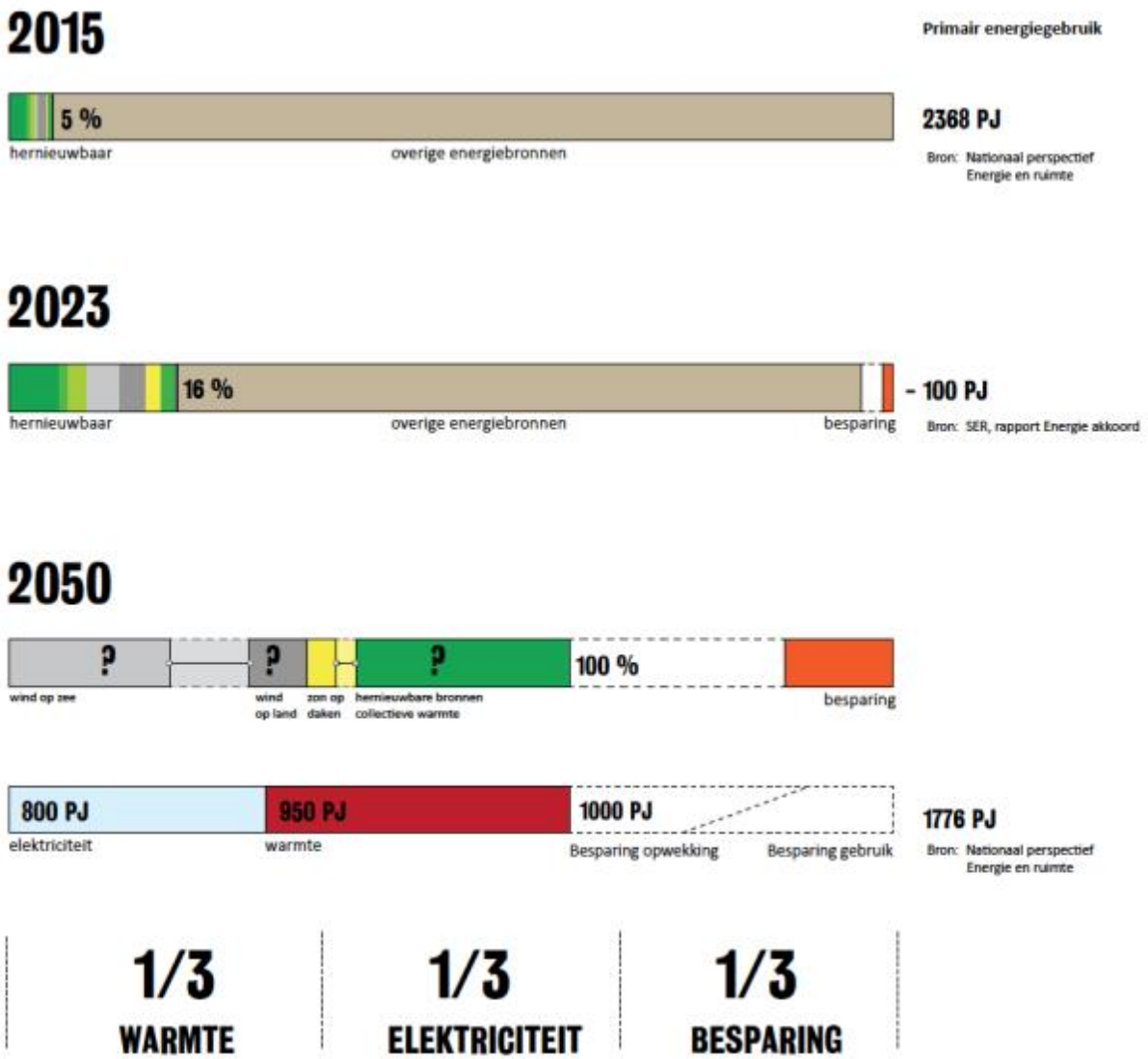
93.5% to go



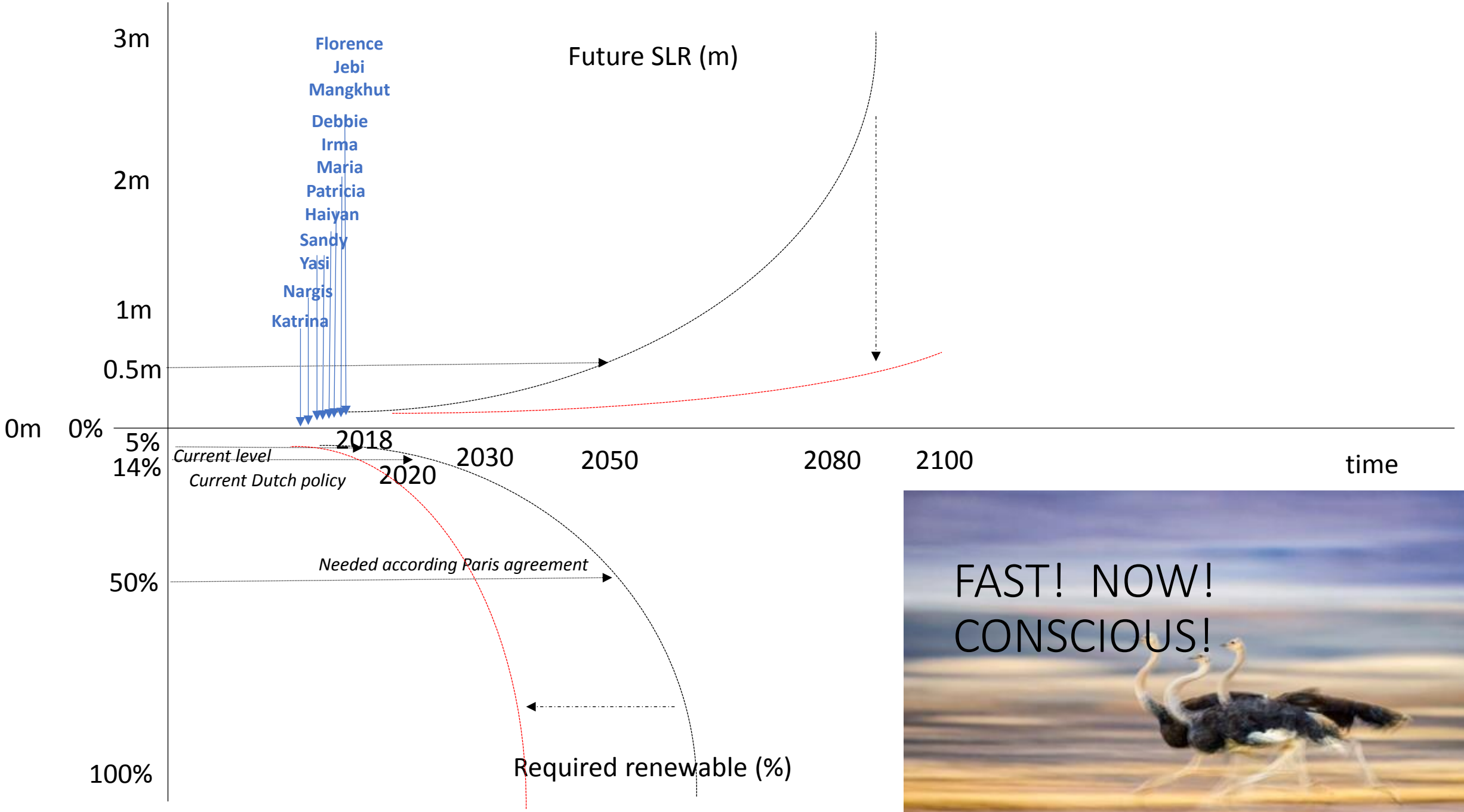
Fransen, 2018

The Netherlands

ToDo: 95% renewables



VenhoevenCS architecture+urbanism, 2018

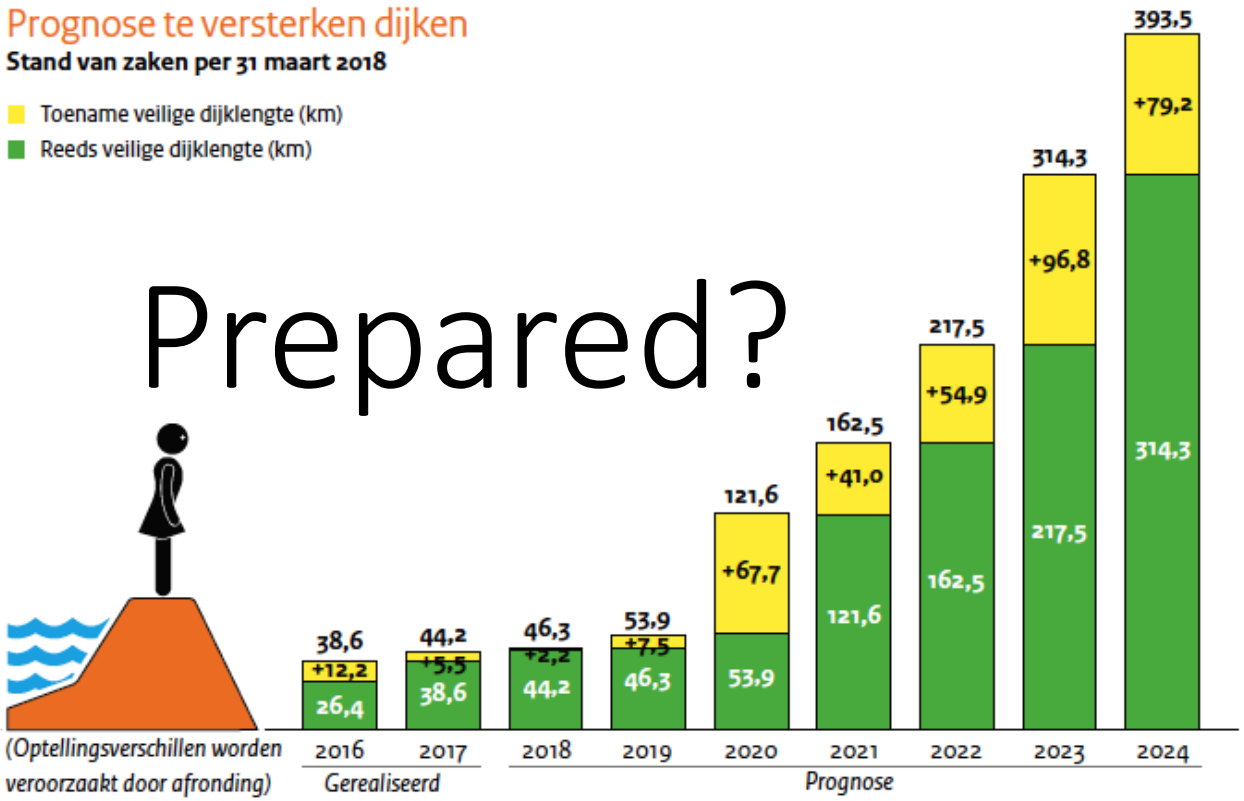

3m
2m
1m
0.5m
0m
0%
5%
14%
50%
100%
Florence
Jebi
Mangkhut
Debbie
Irma
Maria
Patricia
Haiyan
Sandy
Yasi
Nargis
Katrina
Future SLR (m)
2018
2020
2030
2050
2080
2100
time
Current level
Current Dutch policy
Needed according Paris agreement
Required renewable (%)

FAST! NOW!
CONSCIOUS!

Prepared?

Prognose te versterken dijken

Stand van zaken per 31 maart 2018



Tabel 5: Potloodprogrammering 2025-2030

Potloodprogrammering 2025 - 2030			2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Nr. op kaart	**Project-nummer**	**Naam project**												
601	02H	Sterke Lekdijk: Klaphek-Jaarsveld												
602	02J	Sterke Lekdijk: Vreeswijk-Klaphek												
603	02G	Sterke Lekdijk: Salmsteke-Schoonhoven												
604	27E	IJsselmeerdijk												
605	17D	Kerkhovenpolder-Duitsland												
606	27F	IJmeerdijk-Almere Poort												
607	27C	Kunstwerken Noordoostpolder												
608	13S	's Hertogenbosch-Heusden												
609	21AI	Spijk-Westervoort												
610	22BJ	Everdingen-Ravenswaaij												
611	22BK	Heerewaardense Afsluitdijk												
612	22BI	Gorinchem-Sliedrecht												
613	22AT	Gameren												
614	22BL	Sliedrecht-Kinderdijk												
615	13H	Boxmeer-Cuijk												
616		Maasboulevard Cuijk												
617	03L	Helderse zeewering												
618	03Q	Dijkvak Markermeer (D22) Schardam												
619	03P	Dijkvak Markermeer (D18)												
620	34AL + 34AM	Vecht Noord Zwartewaterland												
621	34AR + 34AS	Vecht-Oost												

Legenda: Verkenning Planuitwerking Realisatie * * *

* De in geel, blauw en oranje weergegeven projecten zijn als reservering overgeheveld naar de 'potloodprogrammering' van het programma, omdat nog niet een beoordeling is doorlopen die aan alle aspecten van de wet voldoet. Voor de grijs getinte projecten geldt dat nog geen ILT oordeel is ontvangen maar deze wel zijn opgenomen in de planning van de ILT. Programmeren van deze projecten is momenteel nog niet mogelijk, omdat een bevestiging van een onvoldoende beoordeling door de ILT een voorwaarde is om opgenomen te kunnen worden op het Hoogwaterbeschermingsprogramma. De projecten zijn als kansrijk te bestempelen en derhalve als reservering meegenomen.

Deltaprogram, 2018, Ministry of Infrastructure and the Environment

What next?

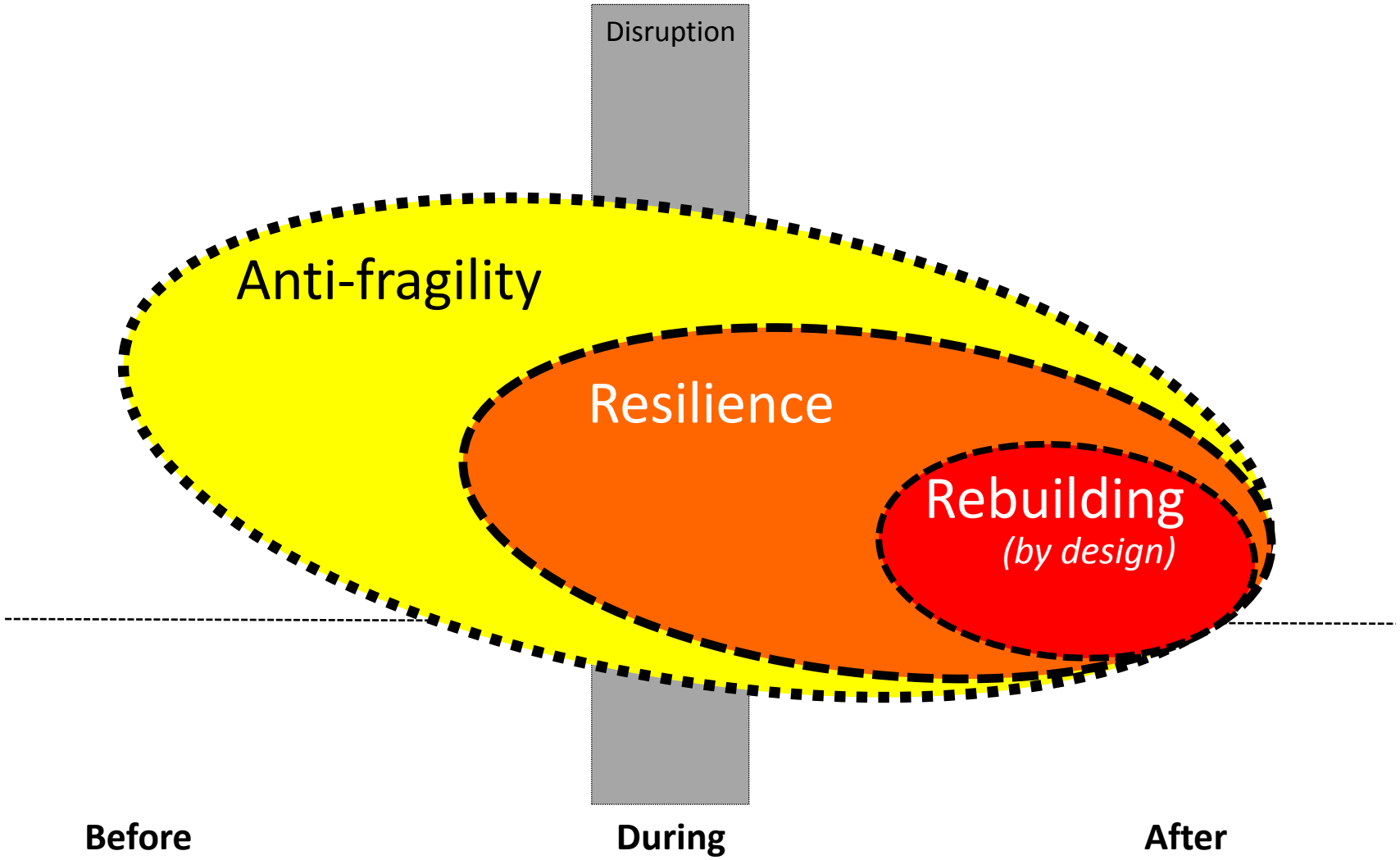
What do we need to do?

Create space for the future

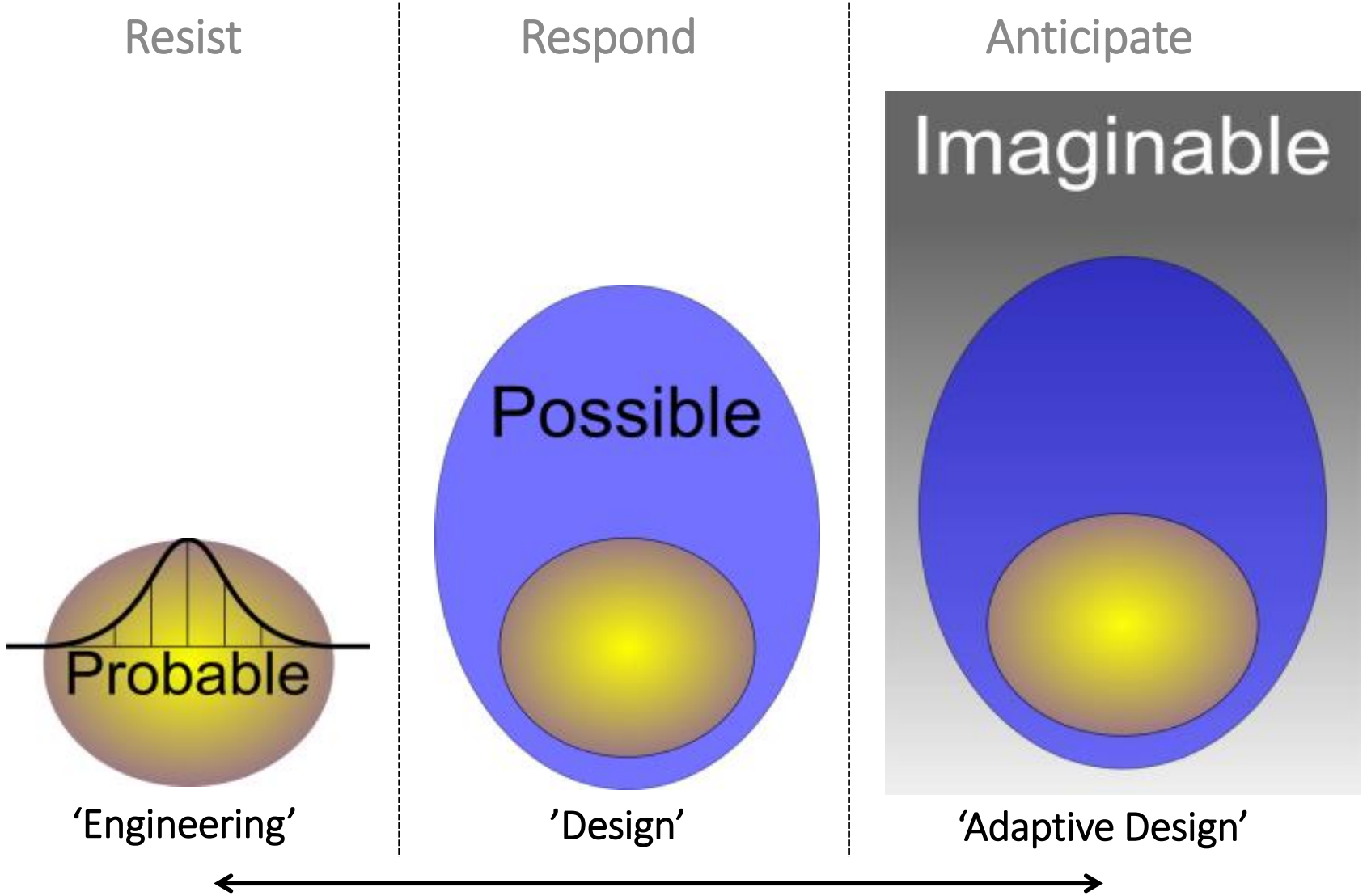
The future demands two things:

1. Dealing with sudden, surprising, unprecedented, change
2. Secure the supply of resources (FEW)

Timing


Disruption
Anti-fragility
Resilience
Rebuilding
(by design)
Before
During
After

Imagine



After: De Jong, 2012

3 Paces

Fast Urbanism

Housing
Economy
Traffic
Parking

Calculation

Slow Urbanism

Ecology
Food/Urban Agriculture
Nature/ecology
Culture

Creation

Suddenism

Flood
Fire
Earthquake
Tsunami

Intuition

Source: Roggema, 2015

Voids

Team-S, Athens

This means we need to design our cities fundamentally different

Instead of determining the land use in detail (as is common habit in land use planning)

Create the voids in the current urban landscape to be able to develop the uses needed in the future, and make space for the unknown future

Prevent ourselves from getting locked-in

Thinking in options and potentials

Redundancy

Redundancy is needed to allow for initiatives to be taken. Without space to develop, there is no opportunity. This can only happen if in the area spatial voids are ‘planned’: unplanned space (Roggema, 2012).

To enhance serendipity (the opportunity to develop ‘as it comes’, oblique, indirect, planning is needed.

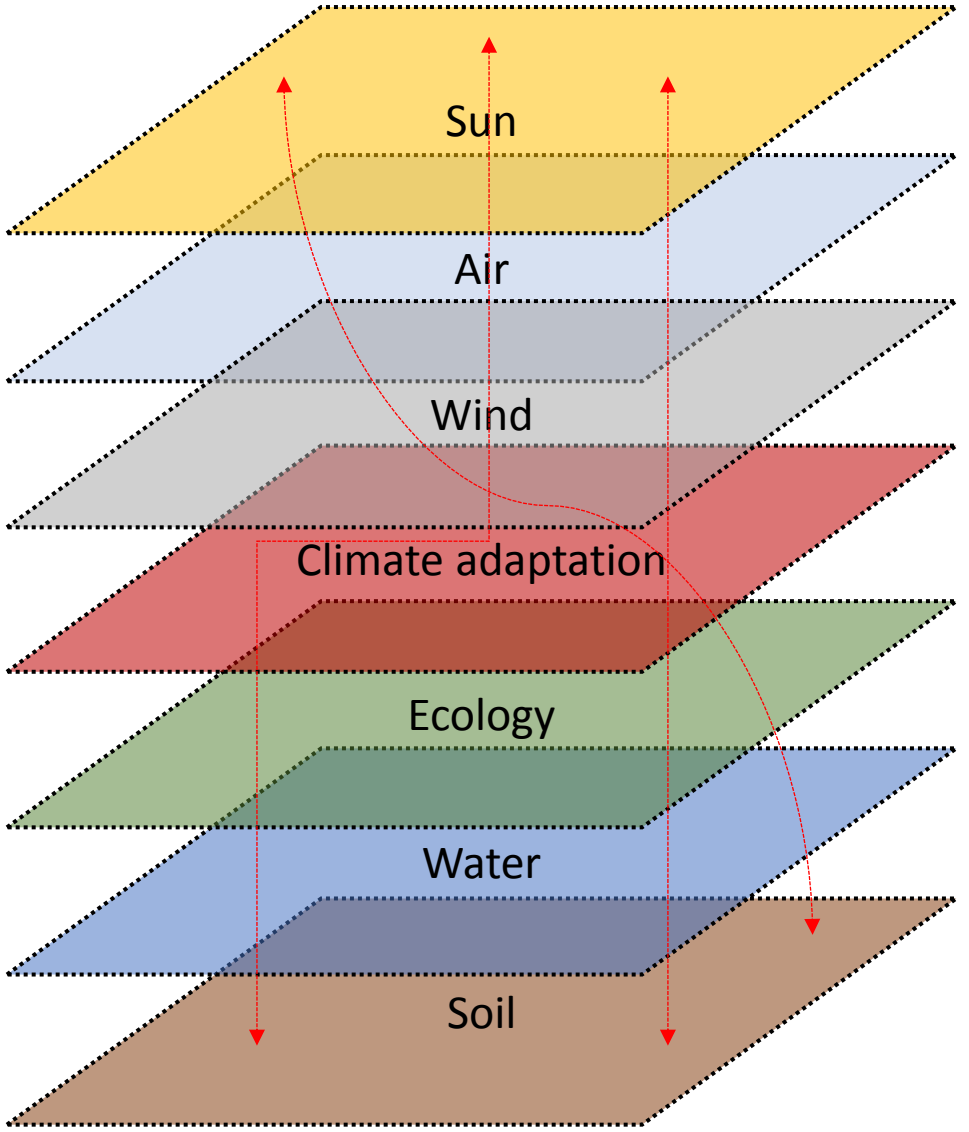
Places that can be developed at a later stage, when the benefits for everyone are evident. For instance when space is needed to accommodate climate impacts, migrants, energy generation, or ecological quality.

These potentials need to be mapped so we can make conscious decisions.

Mapping

- Redundancies
- Voids
- Potentials

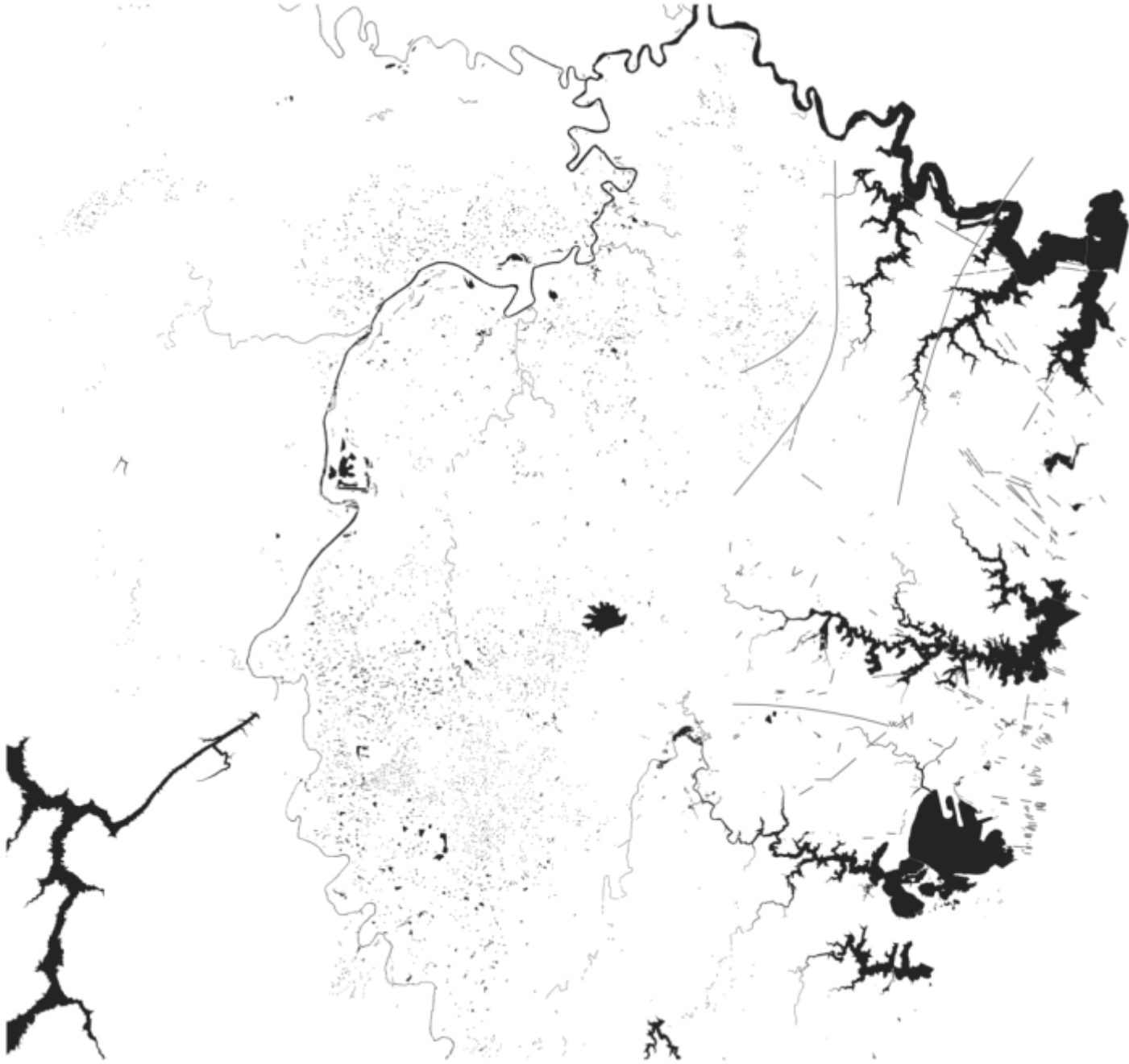
Sun, Air, Wind, Climate, Ecology, Water and Soil




Water

Water system

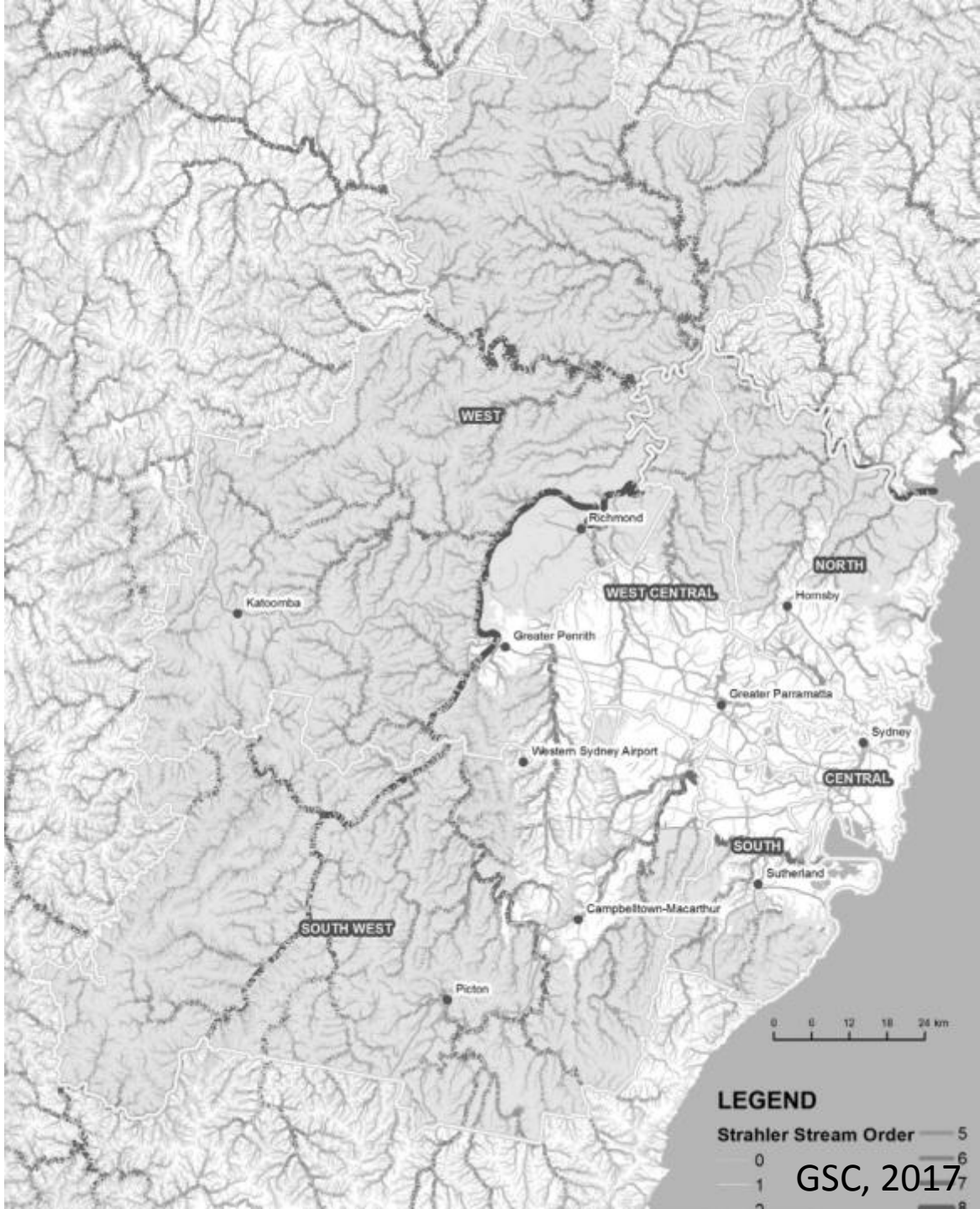
Sydney basin



GSC, 2017

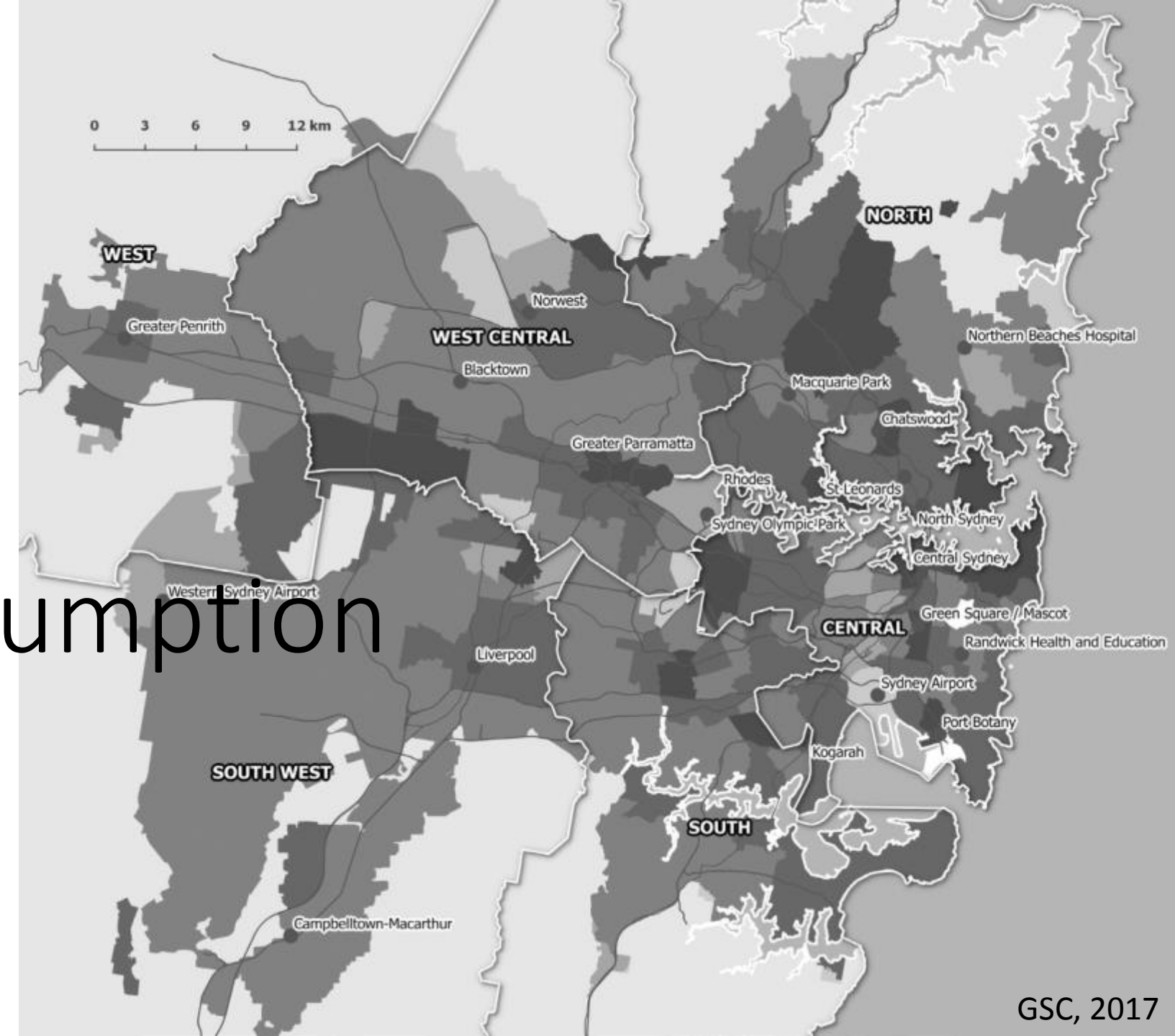
Waterways

Creeks and rivers Sydney basin



GSC, 2017

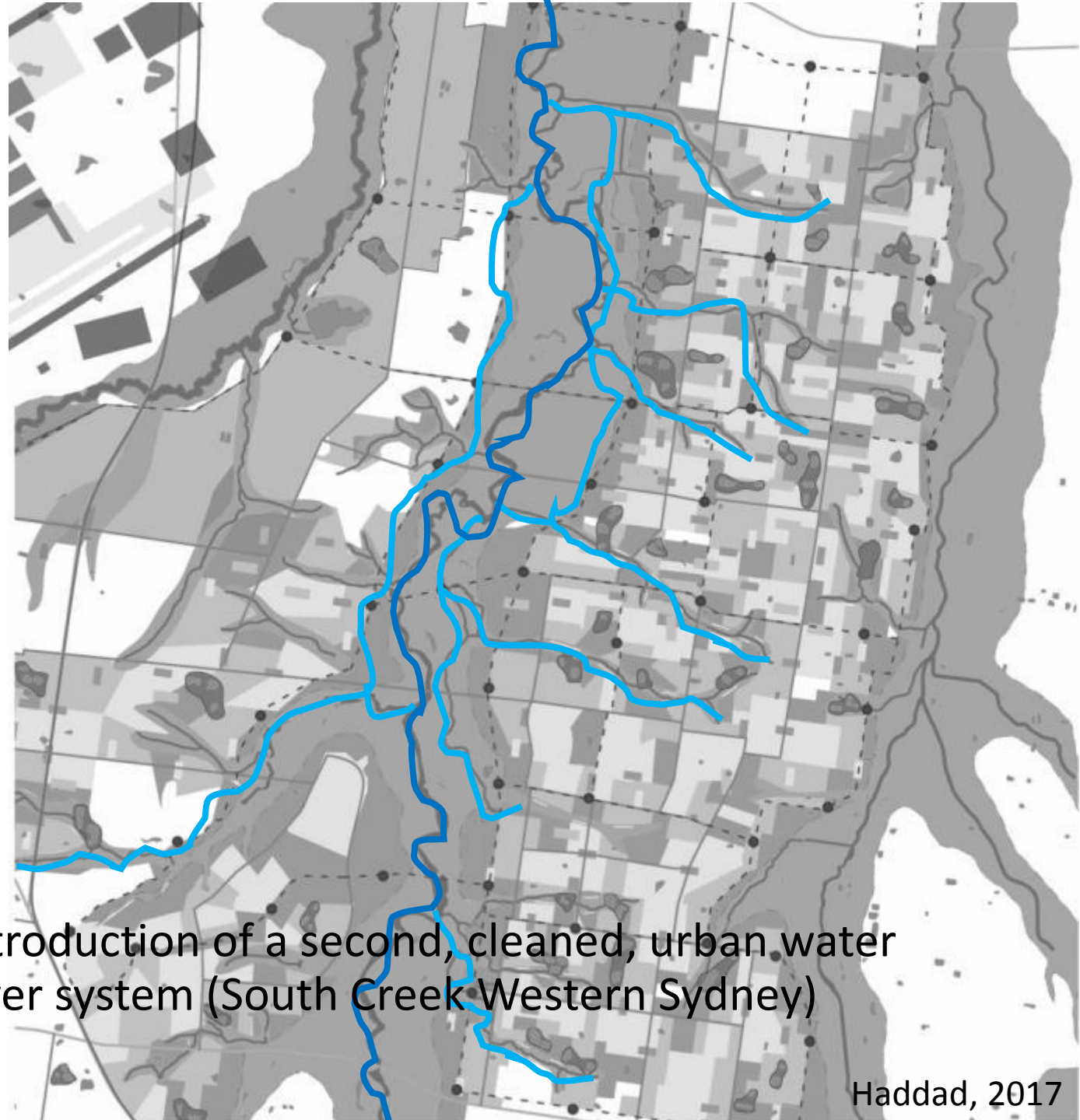
Water consumption



GSC, 2017

Water

Potential for urban water features: Introduction of a second, cleaned, urban water system to supply the natural creek/river system (South Creek Western Sydney)



Haddad, 2017

Secondary, urban, treated, water system

Transform city design

Veringa, 2017

Greywater treatment

Blackwater treatment

Portland

Water storage and retention

Delft, the Netherlands


Benthemplein


Benthemplein


Energy

Supporting action

ACTION 11

Enable affordable access to renewable and resilient energy

Strengthen: Research began 2018

Access to secure, clean energy supply was a key concern for our community, particularly during extreme weather when network failures are most likely to occur. They saw renewable energy as a key solution, emphasising the importance of affordability for vulnerable people.

This action has began, bringing new partners together to collaborate and develop a large scale renewable energy and energy storage model for take up byhouseholds in the city. The model will encourage institutional investment in household energy to make solar power accessible and affordable for more people.

This is especially necessary in the hottest areas of our city where access to cheaper air conditioning can be lifesaving. Investment in complementary battery technology has the potential to provide local energy backup in times of peak demand, whilst also reducing our contribution to climate change.

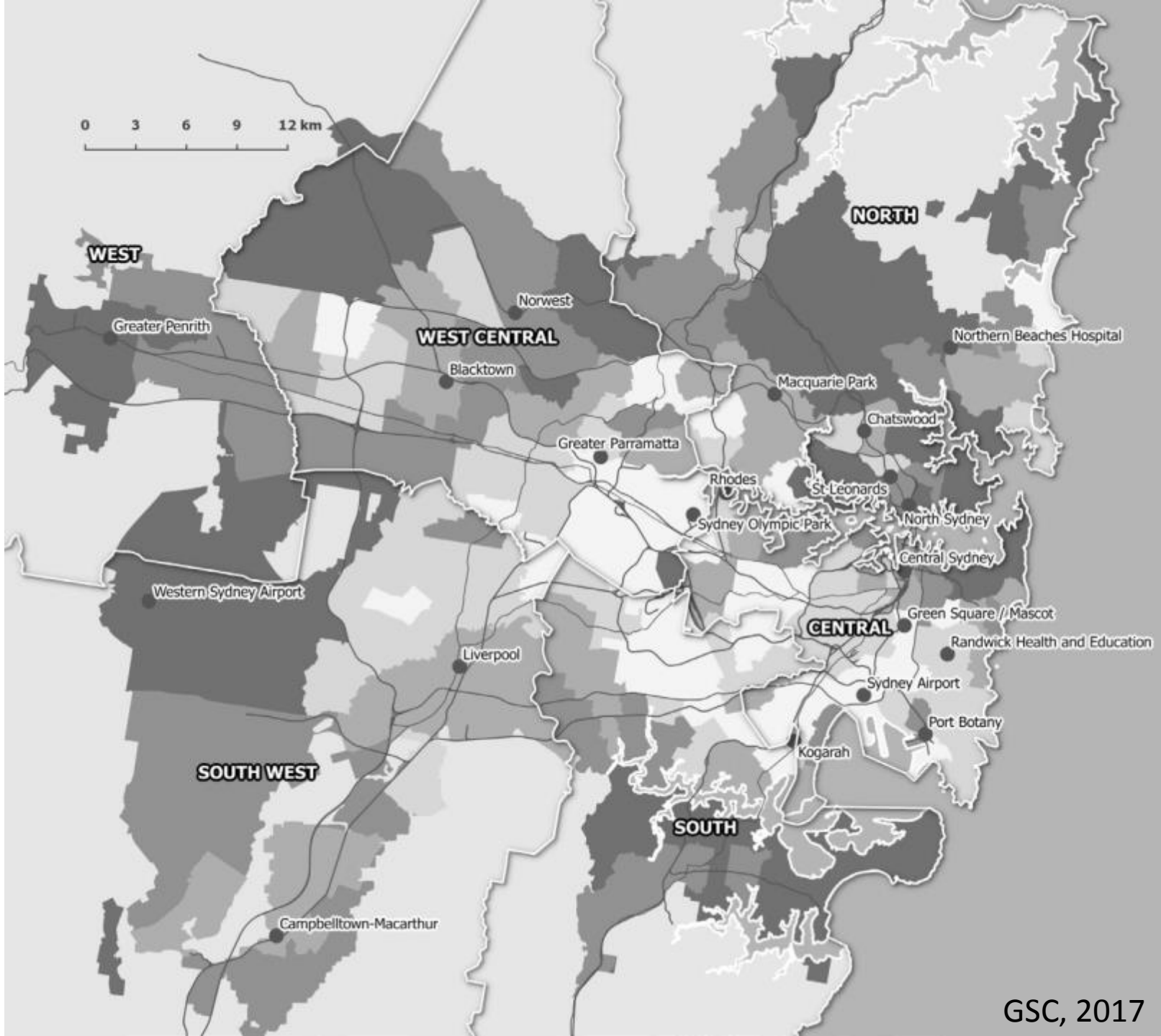
The number one concern of local communities in Sydney metro

Source: Resilient Sydney, A strategy for city resilience 2018

Emissions

Residential

Electricity and gas

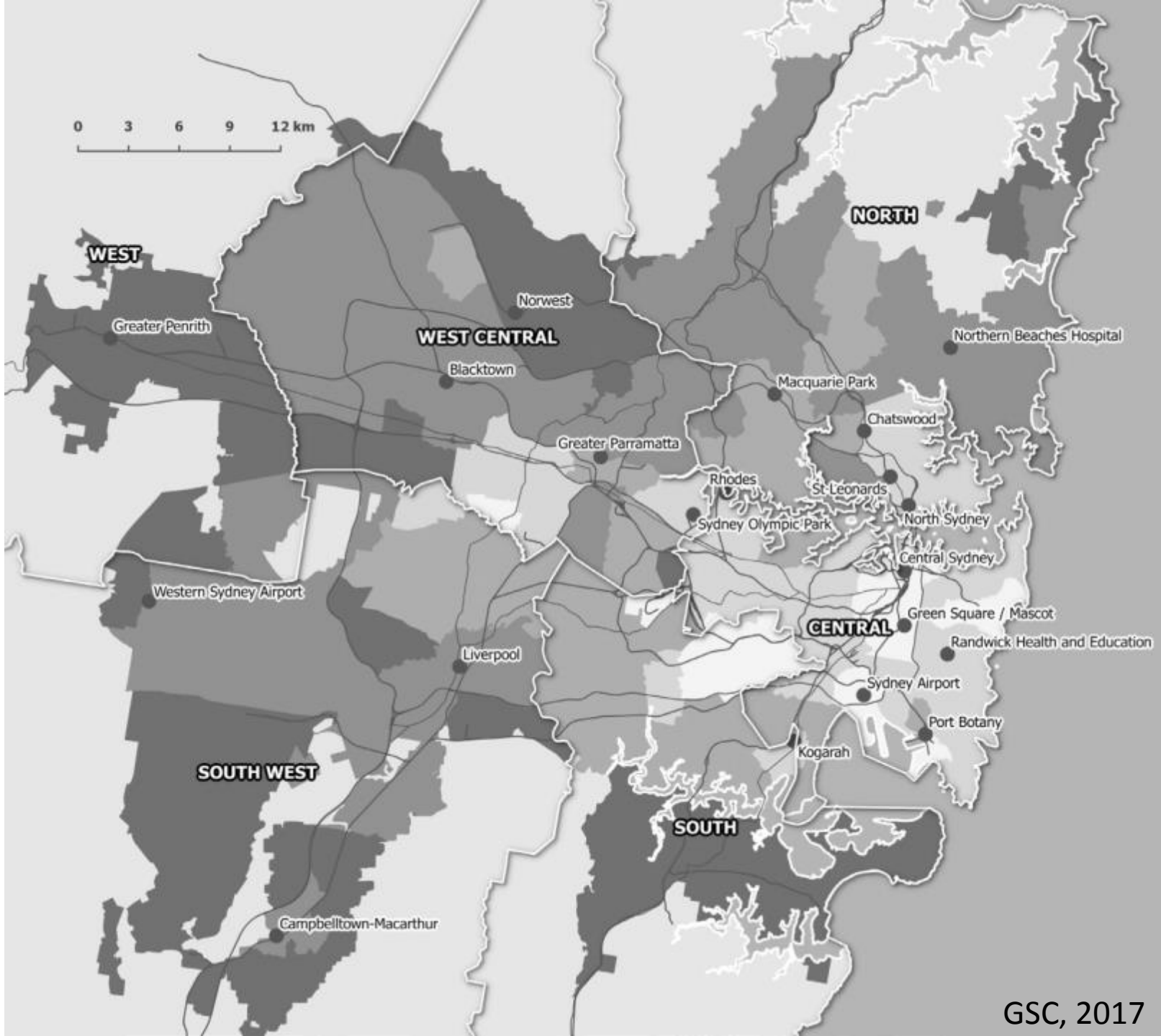


GSC, 2017

Emissions

Residential

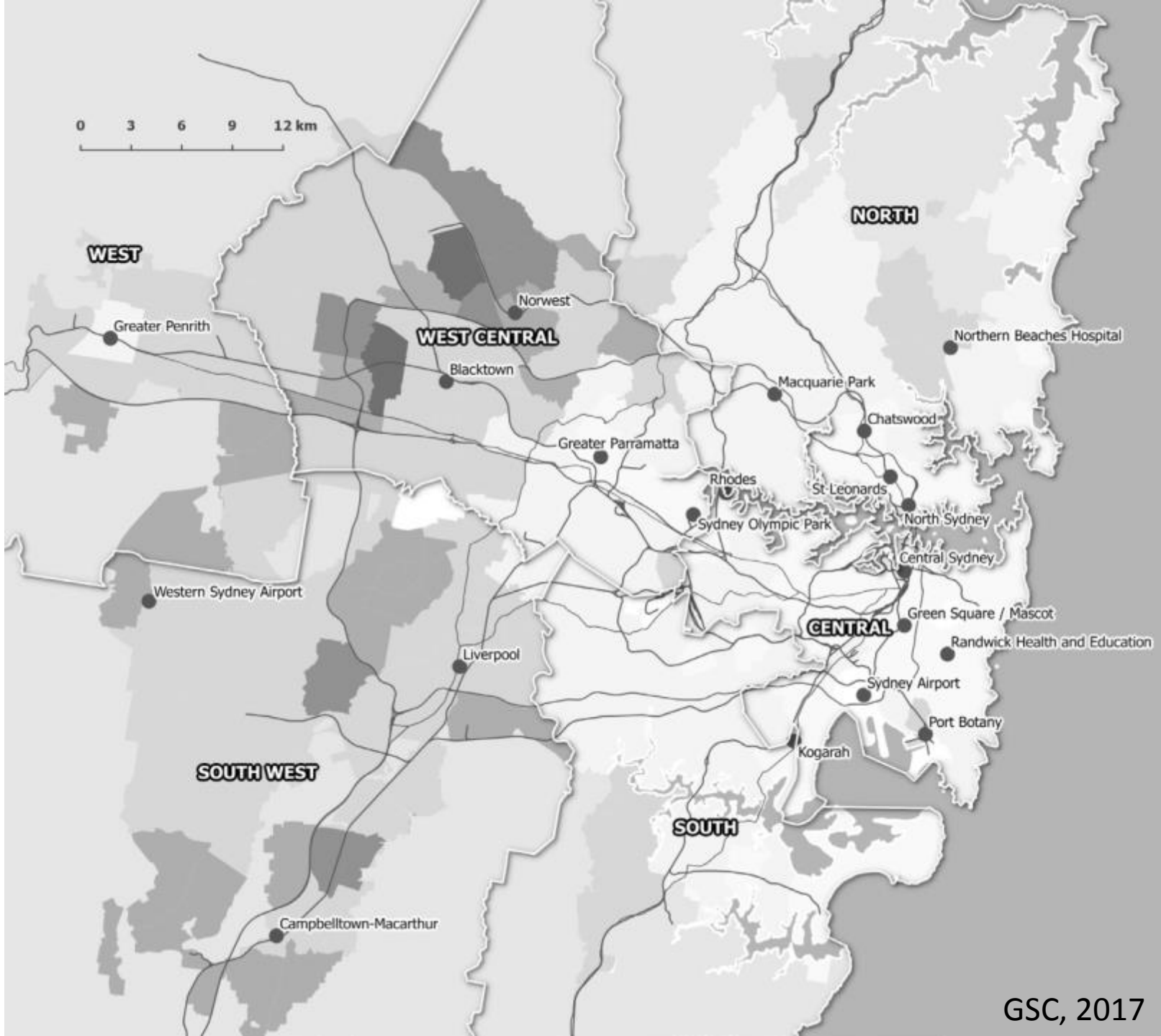
Transport



GSC, 2017

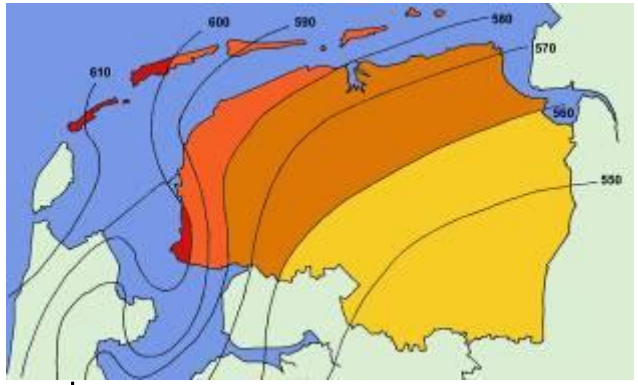
Solar-PV installed

A solar desert



GSC, 2017

Grounds for Change: Energy-potentials Northern-Netherlands



solar

wind

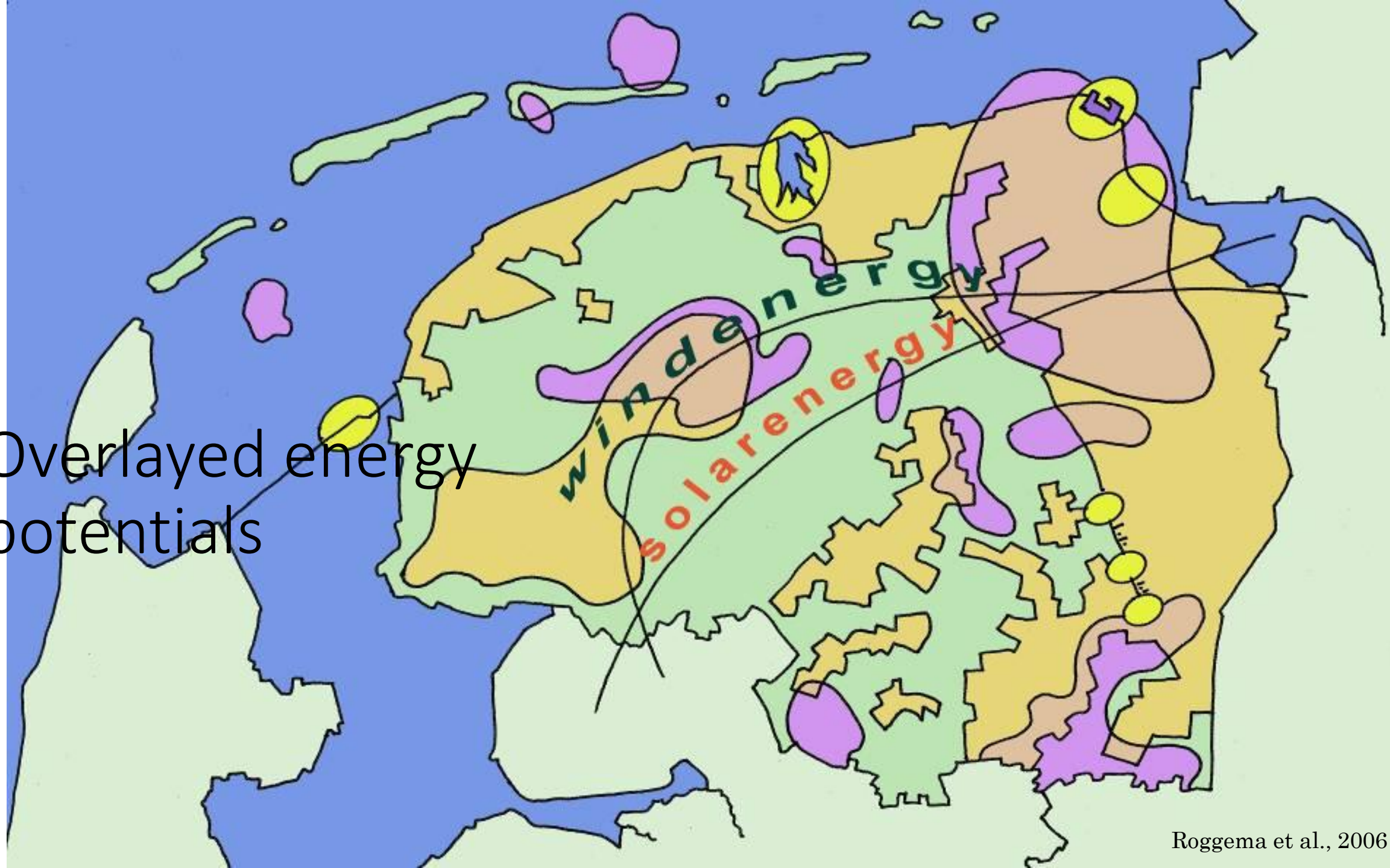

hydro


biomass

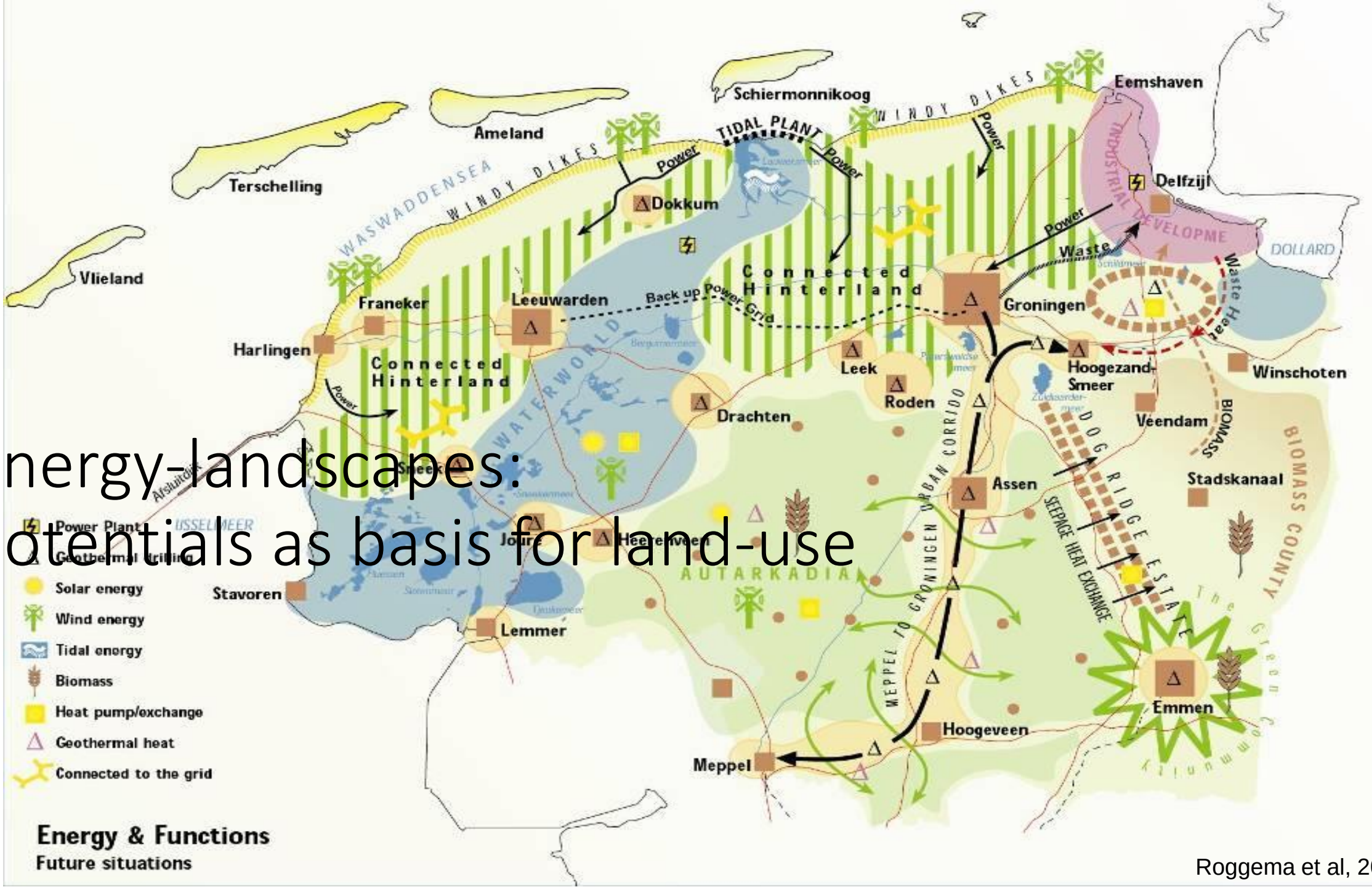

geothermal

Roggema et al, 2006

Overlayed energy potentials



Roggema et al., 2006

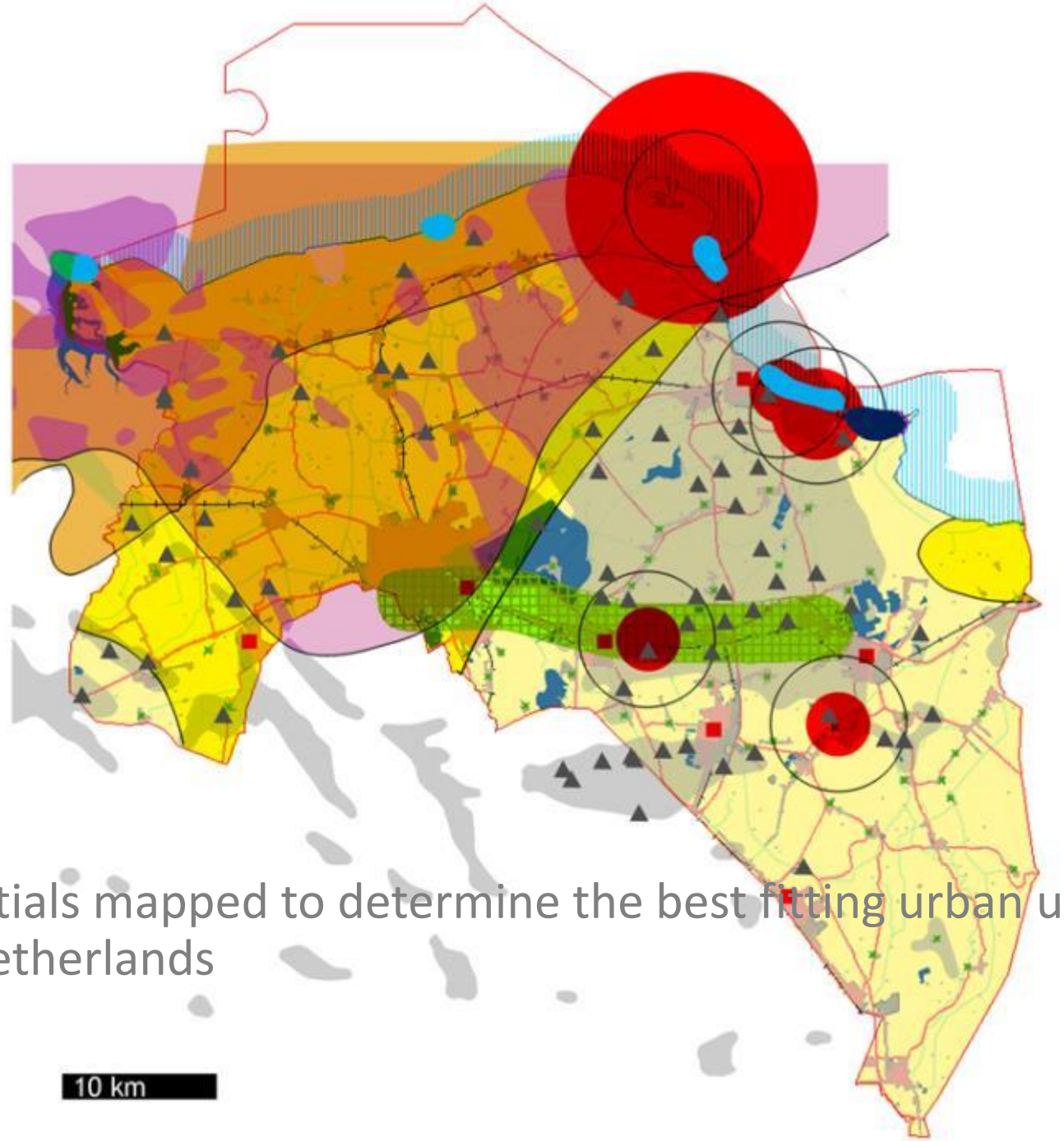


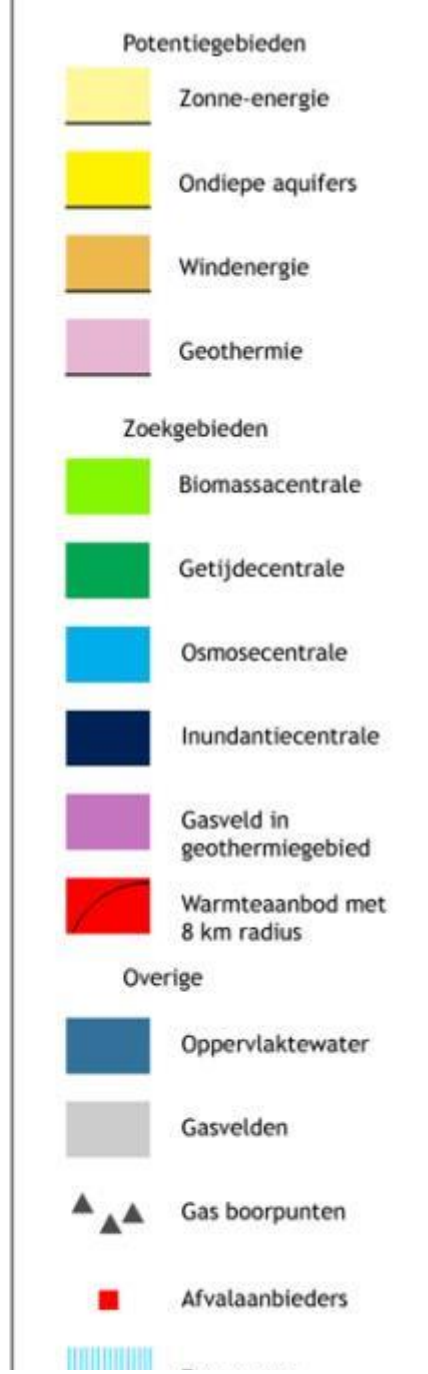
Energy-landscapes: potentials as basis for land-use

Roggema et al, 2006

Energy

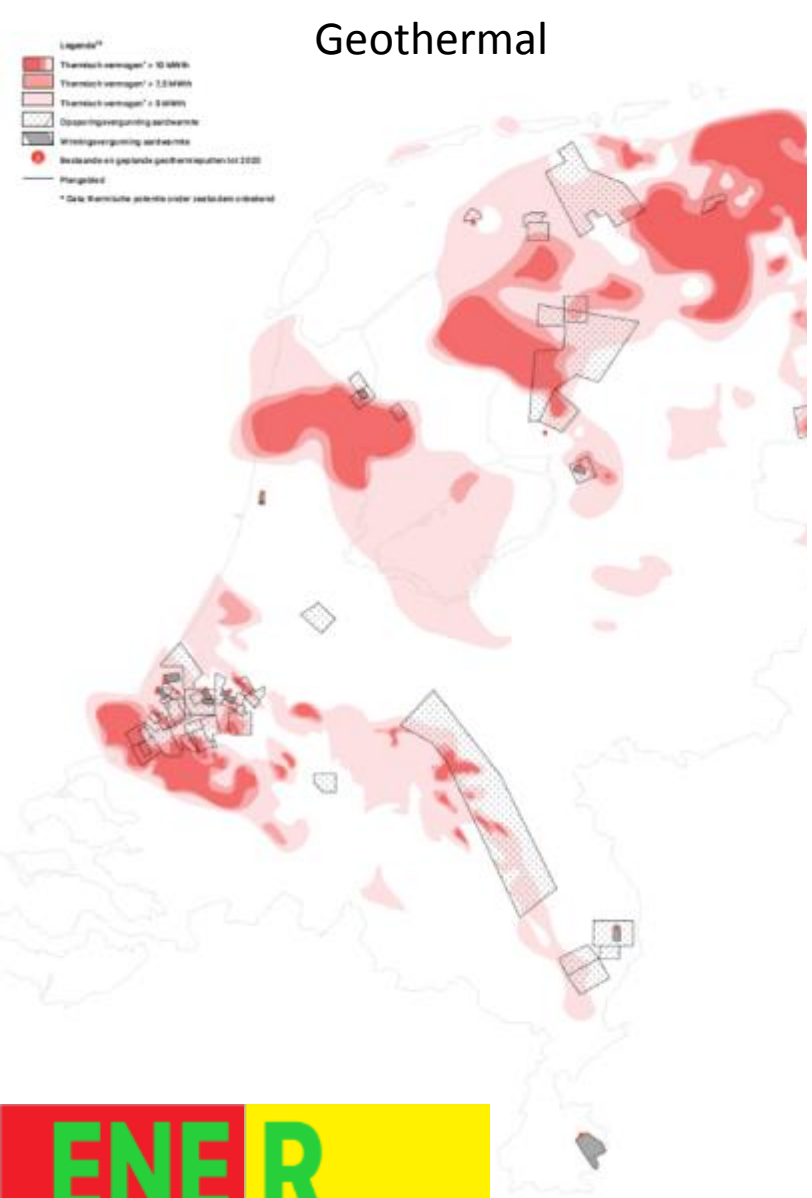
Renewable potentials mapped to determine the best fitting urban use
Groningen, the Netherlands



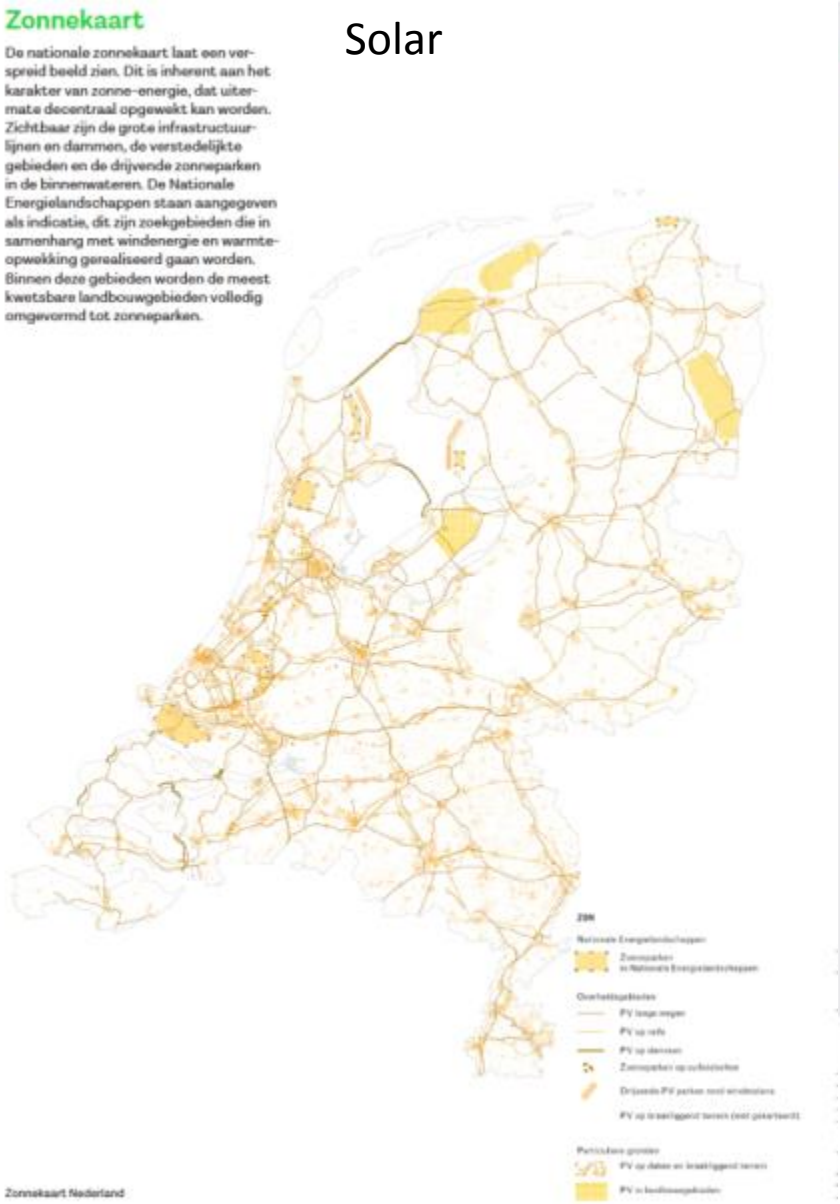


Roggema, et al., 2011

Geothermal



Solar

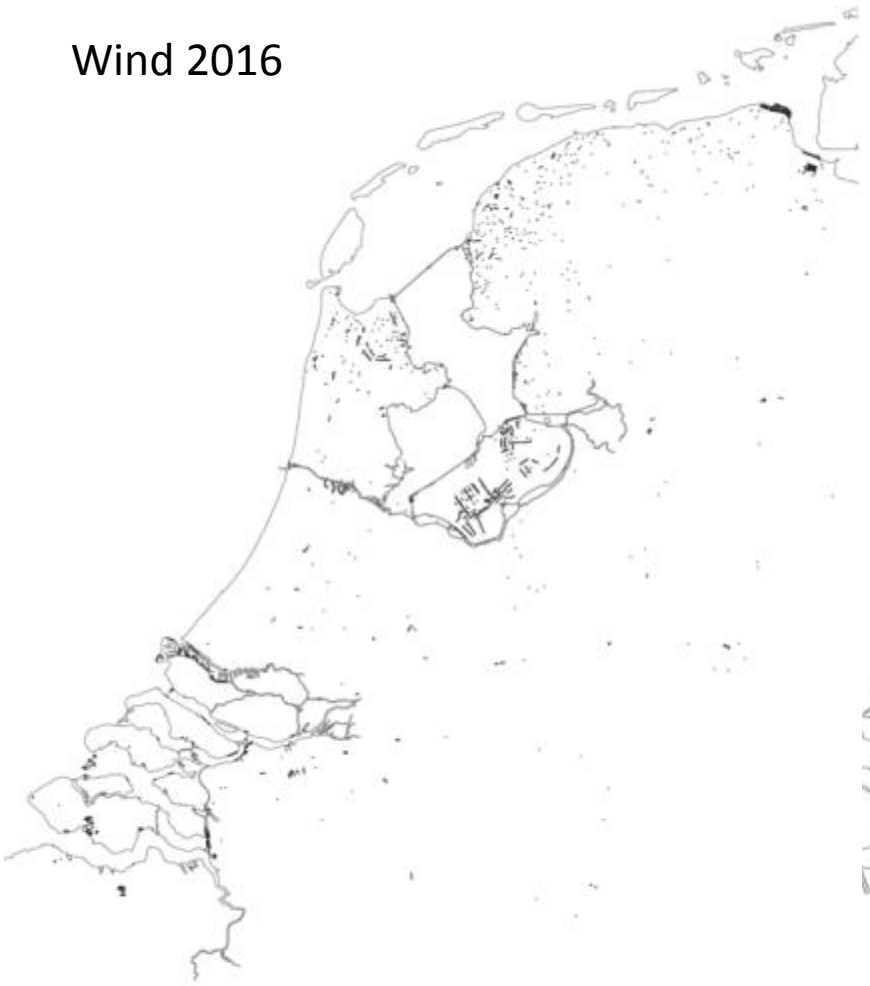


Carbon

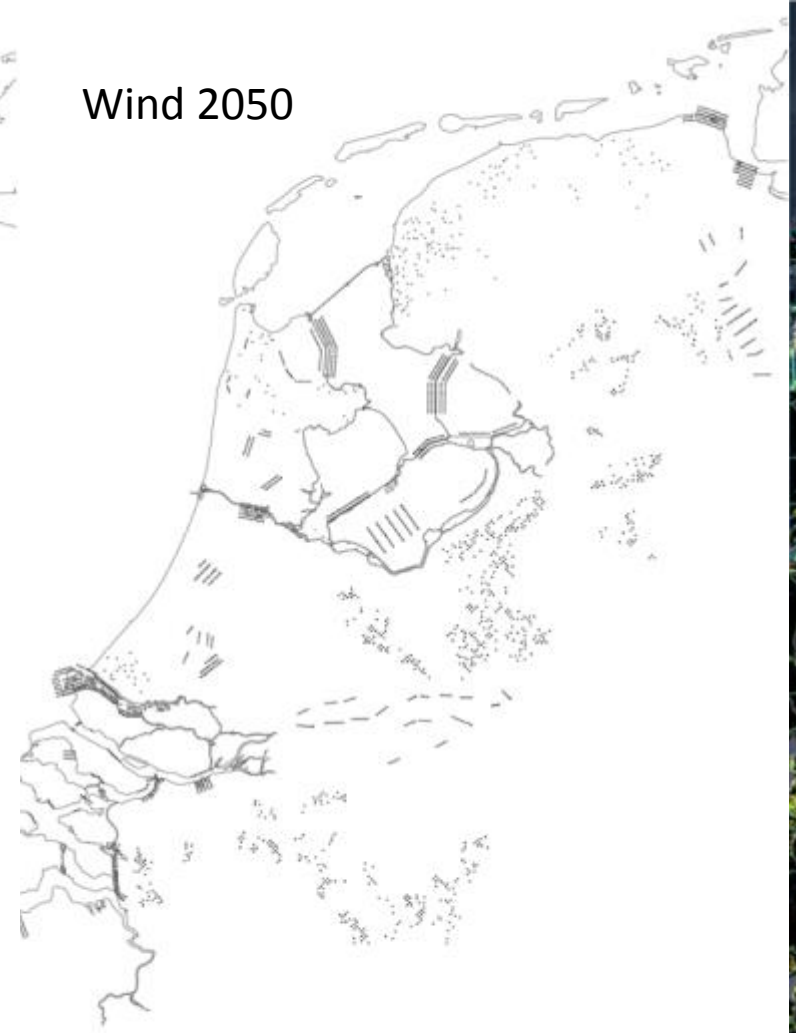
ENERGIE RUIMTE

Energie & Ruimte, Sijmons et al., 2017

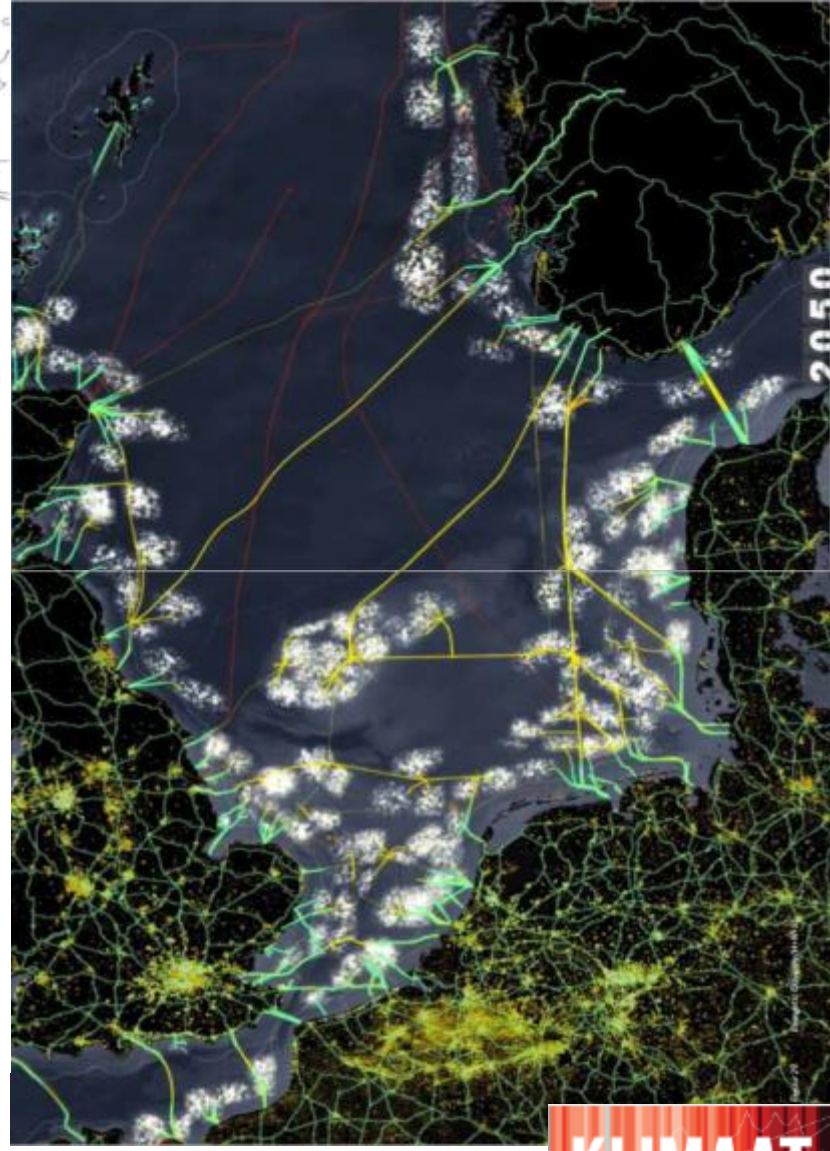
Wind 2016



Wind 2050



Energie & Ruimte, Sijmons et al., 2017

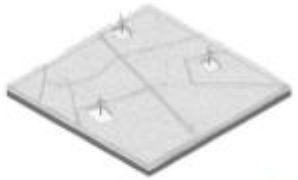


Energetic Odysse (H+N+S)

Prosad et al., 2018

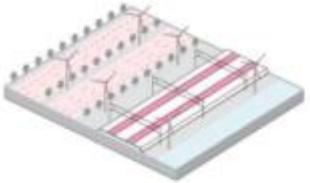
ENERGIE RUIMTE

KLIMAAT ENERGIE RUIMTE

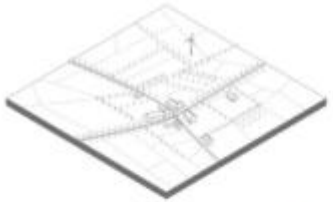


Potential areas for Wind forests

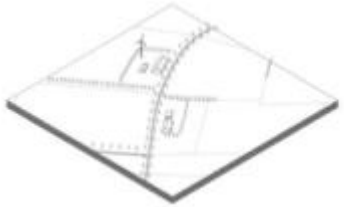
Potential areas meadows



Potential areas along infrastructure



Every town its own windturbines

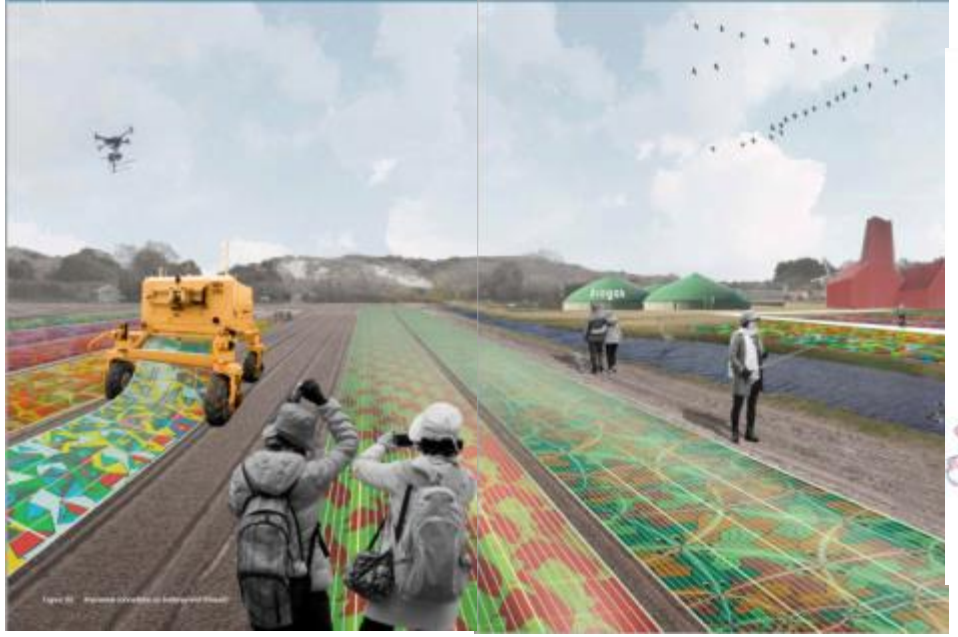


Every farm its own windturbine

Prosad et al., 2018

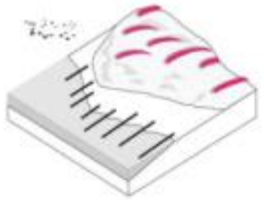
KLIMAAT
ENERGIE
RUIMTE

Solar on roofs

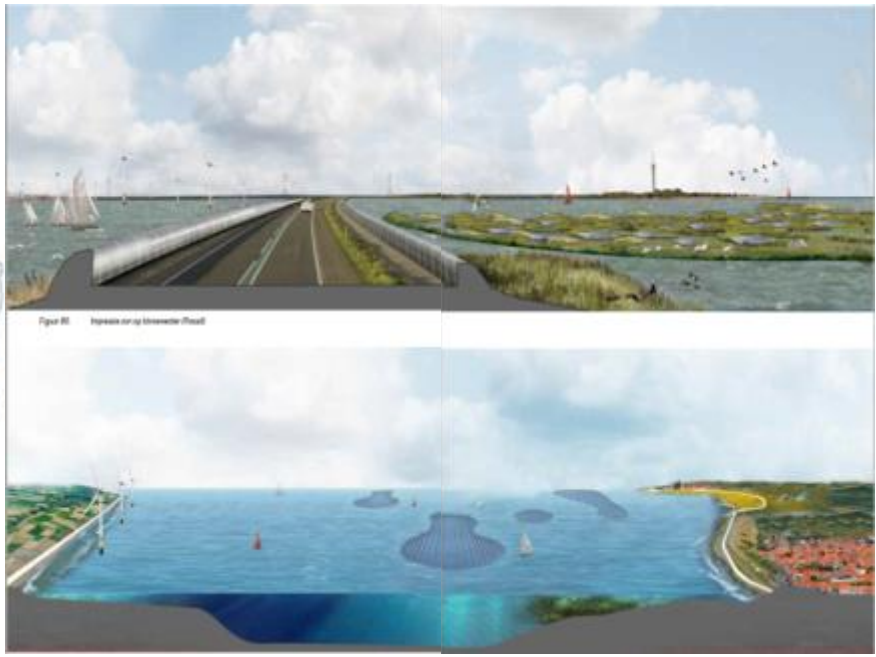


Solar foil on solar meadows

Meadows in saline soils



Solar energy in dune areas

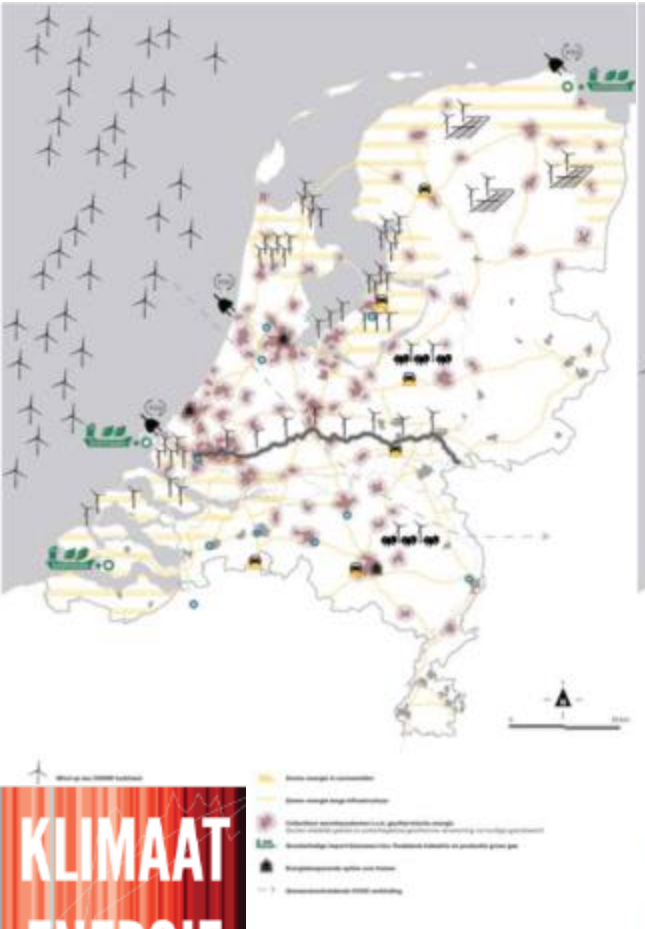


Solar on surface water

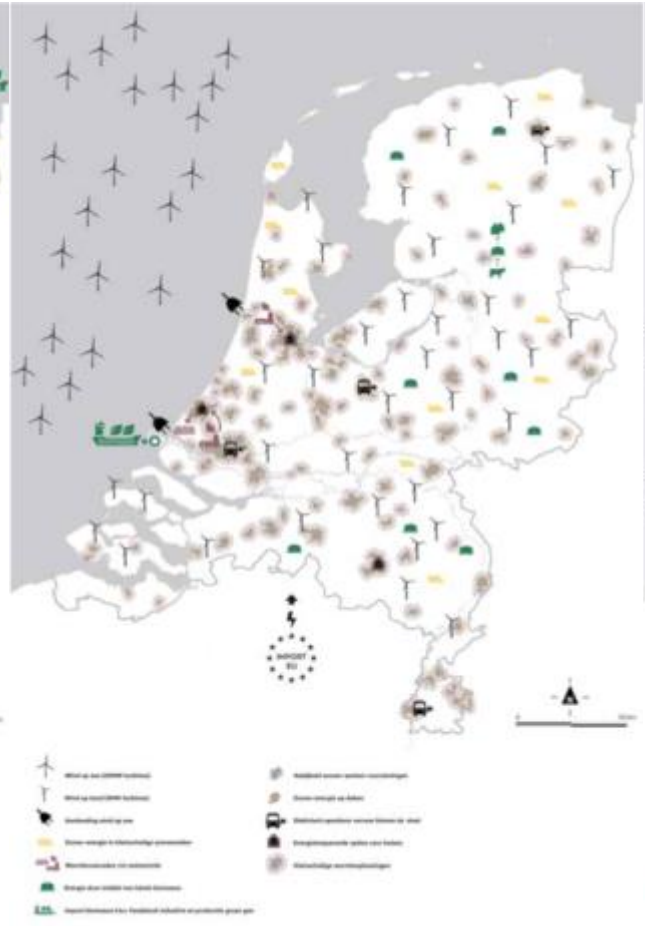
Prosad et al., 2018

KLIMAAT
ENERGIE
RUIMTE

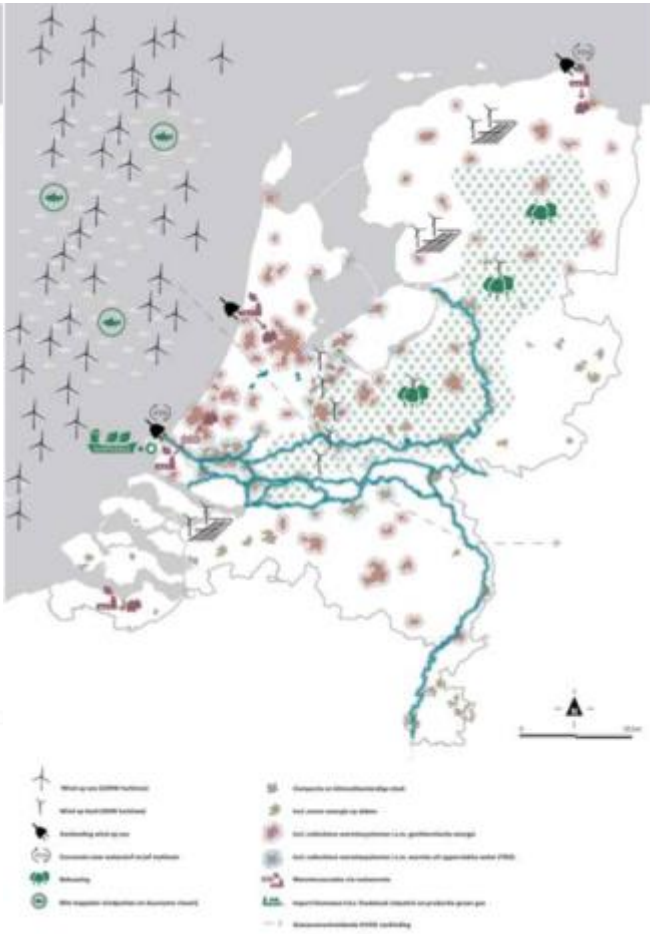
National energy perspectives



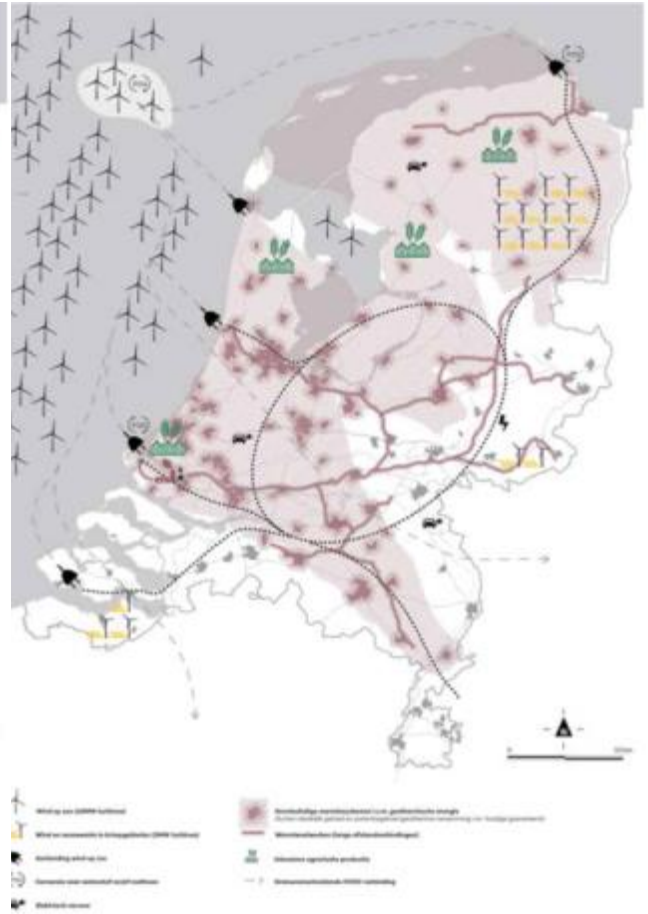
top-down - Large-scale



Bottom-up from the regions



Inclusion of energy in the urban landscape



Energy directs the urban landscape

Prosad et al., 2018

Zero-Carbon Sydney

Zero Carbon Sydney workshop
UTS, School of Architecture, 22-25 May 2017

Prof. Rob Roggema, Prof. Andy van den Dobbelsteen & students

Zero-Carbon

Can we create a zero-carbon society?

Maybe the question should rather be a statement:

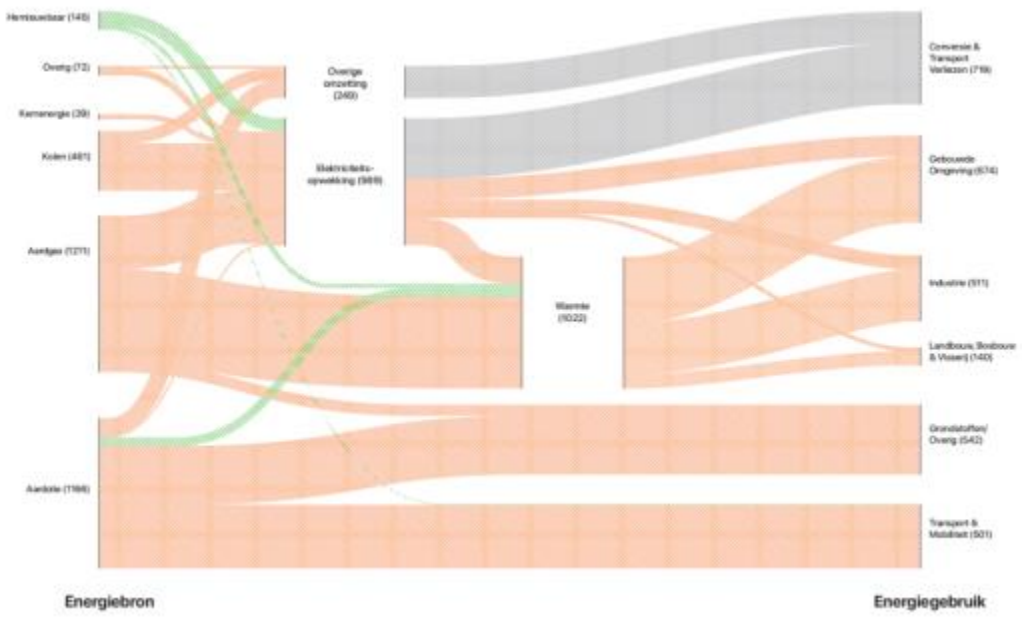
We have to create zero carbon societies!

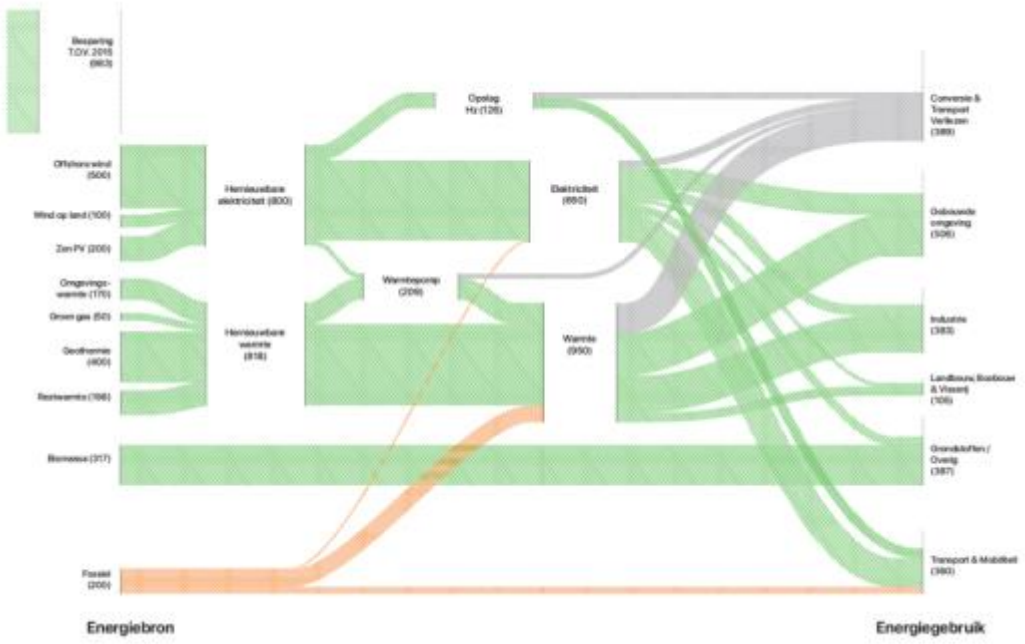
An average Sydney household

Total energy demand (household and transportation) of a household: 34.0 Mwh_{prim}

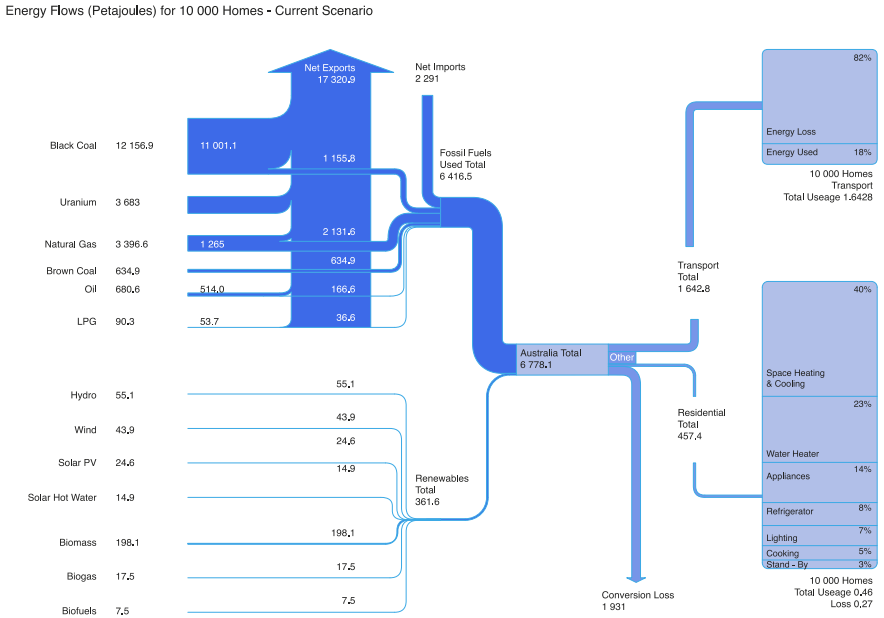
Total demand all-electric (electric car, electric cooking): 11.4 MWh_{electr} (from renewable resources)

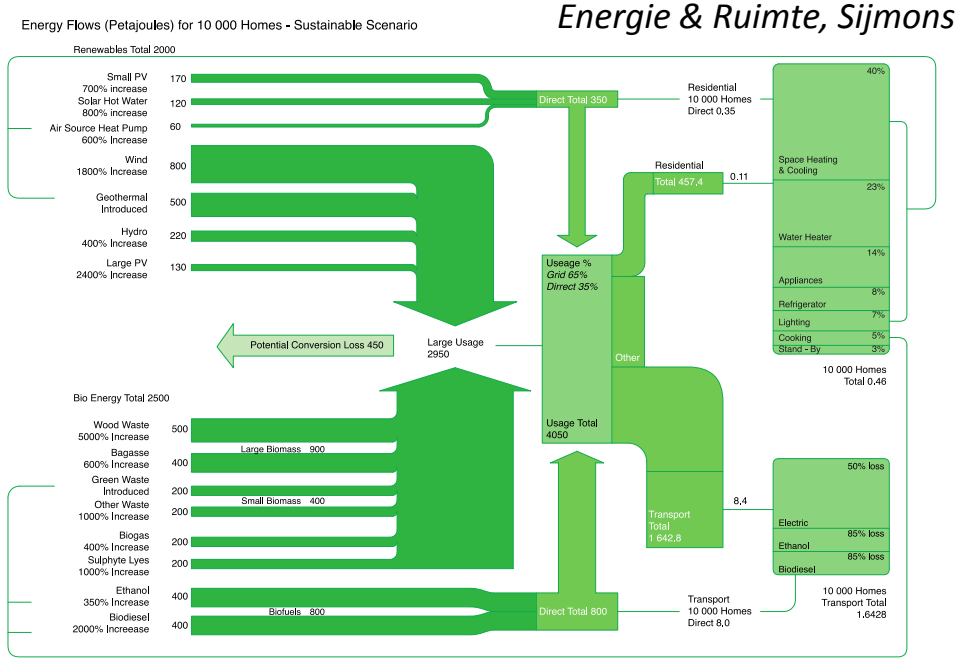
If the household had an energy-efficient dwelling and use mainly public transport and (electric) bikes → the area of PV could be reduced to 35 m^2





Energie & Ruimte, Sijmons et al., 2017



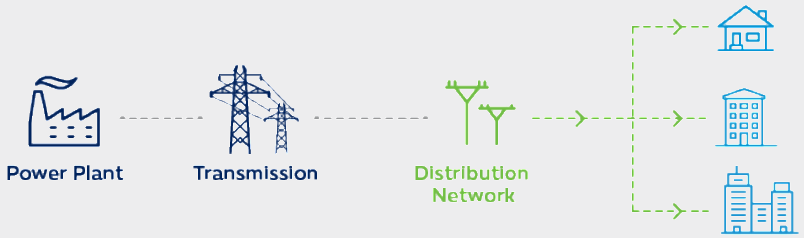


Roggema, Simpson: GO BALLS! UTS Master Design Studio, March-July 2018

Linear -> circular system

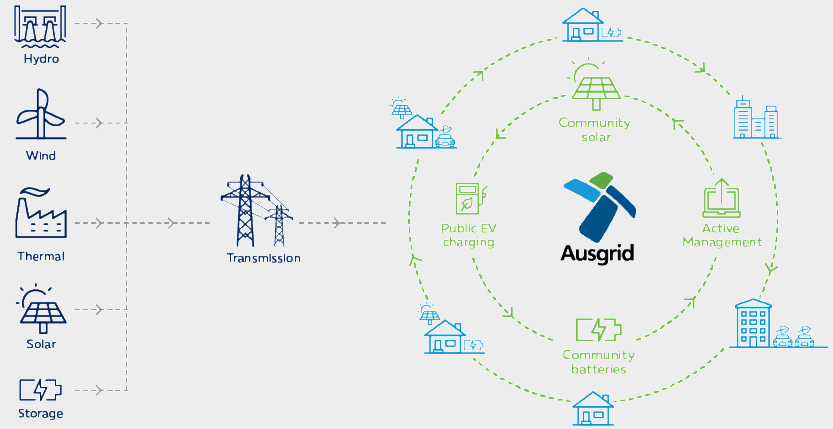
Sharing has long represented the best outcome for customers…

- ✓ Shared assets more efficient
- ✓ Utility scale cheaper than distributed



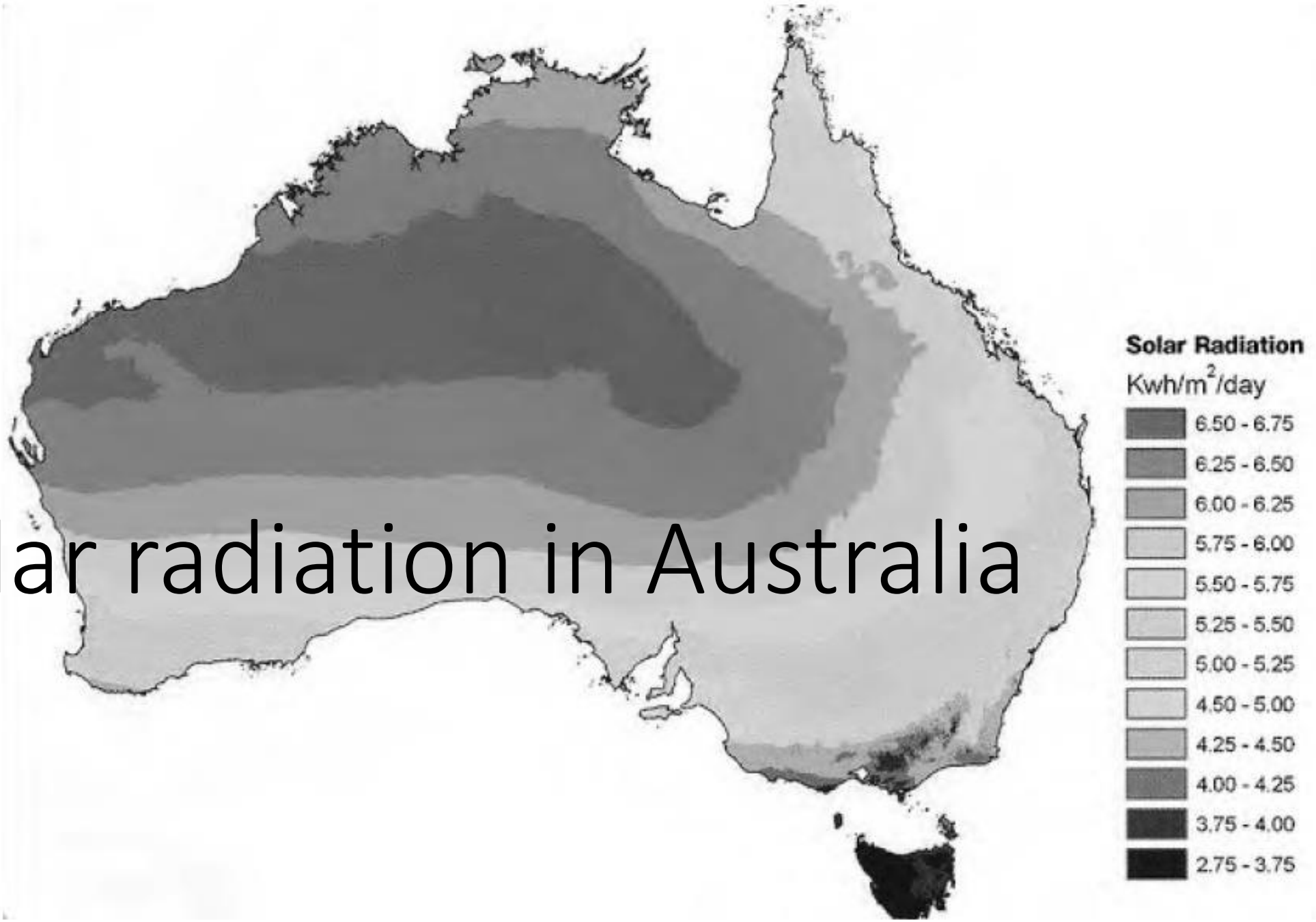
Increasing today its *connectivity* that delivers customer value…

- ✓ Shared assets more efficient
- ✓ Utility scale cheaper than distributed
- ✓ Being ***connected*** creates value



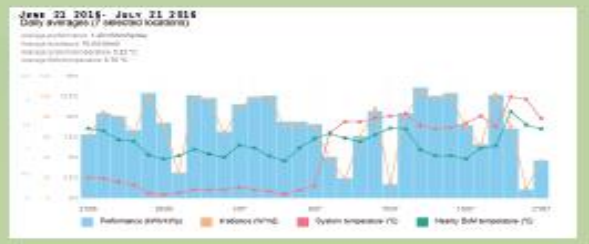
Source: Ausgrid, 2018

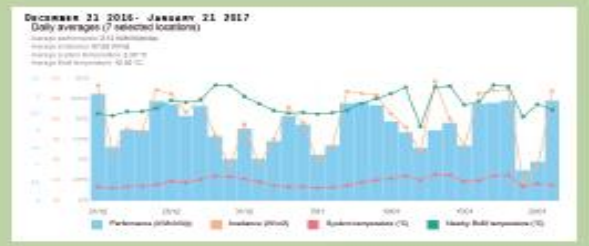
Solar radiation in Australia



Solar energy potential map

Sydney





Expected average to Power a Sydney Home
22.2MWh Primary Energy (including Gas Heating)
6.45MWh Solar (Excluding Gas Heating)
26sqm of PV required
8.5 MWh Annually Solar (Including Heat Pump)
34sqm of PV required

Expected Average Daily Performance (MJ per hour/per m2/ Annually)
5949-6095

Existing Solar PV

Expected Average Daily Performance (kWh/kWp/day)
3.73-4.14

LGA	Area (km2)	People (Per Hectare)	Total Dwellings	Detached Houses	Medium Density	High Density	Gas (GJ/Year)	Electricity (KwH Per Year)	Biomass Potential (Tonnes)	Solar PV Potential (km2)
Bayside	50	33	54,457	58.70%	15.00%	25.90%	21-24	5000-6000	626.53	7.90
Blacktown	240	15	100,779	82.50%	13.20%	3.80%	19-21	7000-8000	132.93	25.16
Burwood	7	51	11,886	51.40%	20.10%	27.70%	21-24	4000-5000	232.55	2.08
Camden	201	4	19,339	91.00%	7.80%	0.20%	19-21	7000-8000	598.46	18.82
Campbelltown	312	5	51,285	79.60%	18.40%	1.70%	19-21	6000-7000	310.62	14.95
Canada Bay	20	45	32,103	43.40%	19.90%	36.00%	17-19	5000-6000	1439.03	5.59
Canterbury-Bankstown	110	35	56,931	60.60%	27.40%	11.10%	19-21	4000-5000	1234.50	23.84
Cumberland	72	45	36,463	60.20%	24.40%	15.00%	19-21	5000-6000	898.50	14.01
Fairfield	102	20	60,193	73.60%	18.30%	7.70%	19-21	6000-7000	813.03	18.90
Georges River	38	39	25,400	57.20%	17.20%	25.60%	19-21	5000-6000	602.35	10.36
The Hills Shire	401	4	47,346	84.10%	12.40%	3.50%	21-24	6000-7000	643.07	16.01
Hornsby Shire	462	3	57,094	74.20%	10.80%	14.00%	21-24	6000-7000	54.18	15.79
Hunter's Hill	6	26	5,[illegible]	43.40%	19.90%	36.00%	24+	8000+	762.55	1.05
Inner West	35	15	15,664	34.00%	42.80%	23.20%	13-17	4000-5000	448.11	9.57
Ku-ring-gai	86	15	39,658	77.70%	9.20%	13.10%	24+	8000+	129.19	14.70
Lane Cove	11	35	15,[illegible]	51.40%	21.60%	27.00%	24+	6000-7000	738.58	1.83
Liverpool	306	7	59,835	73.80%	15.40%	10.80%	21-24	6000-7000	112.55	33.63
Mosman	9	35	12,891	37.40%	24.20%	38.40%	24+	6000-7000	255.38	2.59
North Sydney	257	16	67,6[illegible]	28.00%	17.70%	23.70%	21-24	5000-6000	1079.99	40.71
Northern Beaches	11	70	34,887	12.90%	25.70%	60.80%	13-17	4000-5000	884.47	3.68
Parramatta	84	28	74,572	12.90%	25.70%	60.80%	19-21	5000-6000	731.71	22.25
Penrith	405	5	63,744	80.50%	14.80%	4.10%	19-21	7000-8000	528.85	17.97
Randwick	36	41	55,421	29.20%	25.80%	44.50%	17-19	4000-5000	422.45	7.64
Ryde	41	30	41,678	51.40%	21.60%	26.50%	19-21	5000-6000	144.27	9.23
Strathfield	14	29	12,723	47.80%	18.30%	33.50%	21-24	5000-6000	864.53	2.70
Sutherland Shire	370	6	82,688	65.20%	16.90%	17.40%	19-21	7000-8000	694.97	21.04
Sydney	25	79	94,346	3.50%	24.50%	70.20%	17-19	4000-5000	696.47	10.13
Waverley	9	79	30,794	18.40%	31.70%	49.00%	19-21	4000-5000	260.29	2.99
Willoughby	23	34	28,019	48.40%	13.80%	37.50%	21-24	5000-6000	276.15	5.82
Woollahra	12	41	25,875	22.50%	29.50%	47.40%	21-24	7000-8000	213.84	3.86
									Total: 16830.10	**Total:** 384.80

With 25% of all roofs covered with PV panels residential areas can provide themselves with energy for houses and transportation

LGA energy statistics

- Total energy used: $1.92*10^6$ hh * 34 MWh/hh = $65.3*10^6$ MWh = 65.3 TWh_{prim}
  (for domestic energy: house and car)
- Solar potential: $384.8*10^6$ m^2 * 200 kWh/m^2 = $77.9*10^9$ kWh = 77.9 TWh_{elec}
- Bio-energy potential: $1.92*10^6$ hh * 626 kWh/hh = $1.2*10^9$ kWh = 1.2 TWh_{elec}

Solar energy potential of Sydney

Everywhere, whenever possible

- Large (industrial) roofs
- Flat roofs of apartment blocks
- Sloped individual roofs of terrace houses
- Vertical surfaces with high-rise buildings
- New urban canopies: parking lots, public squares

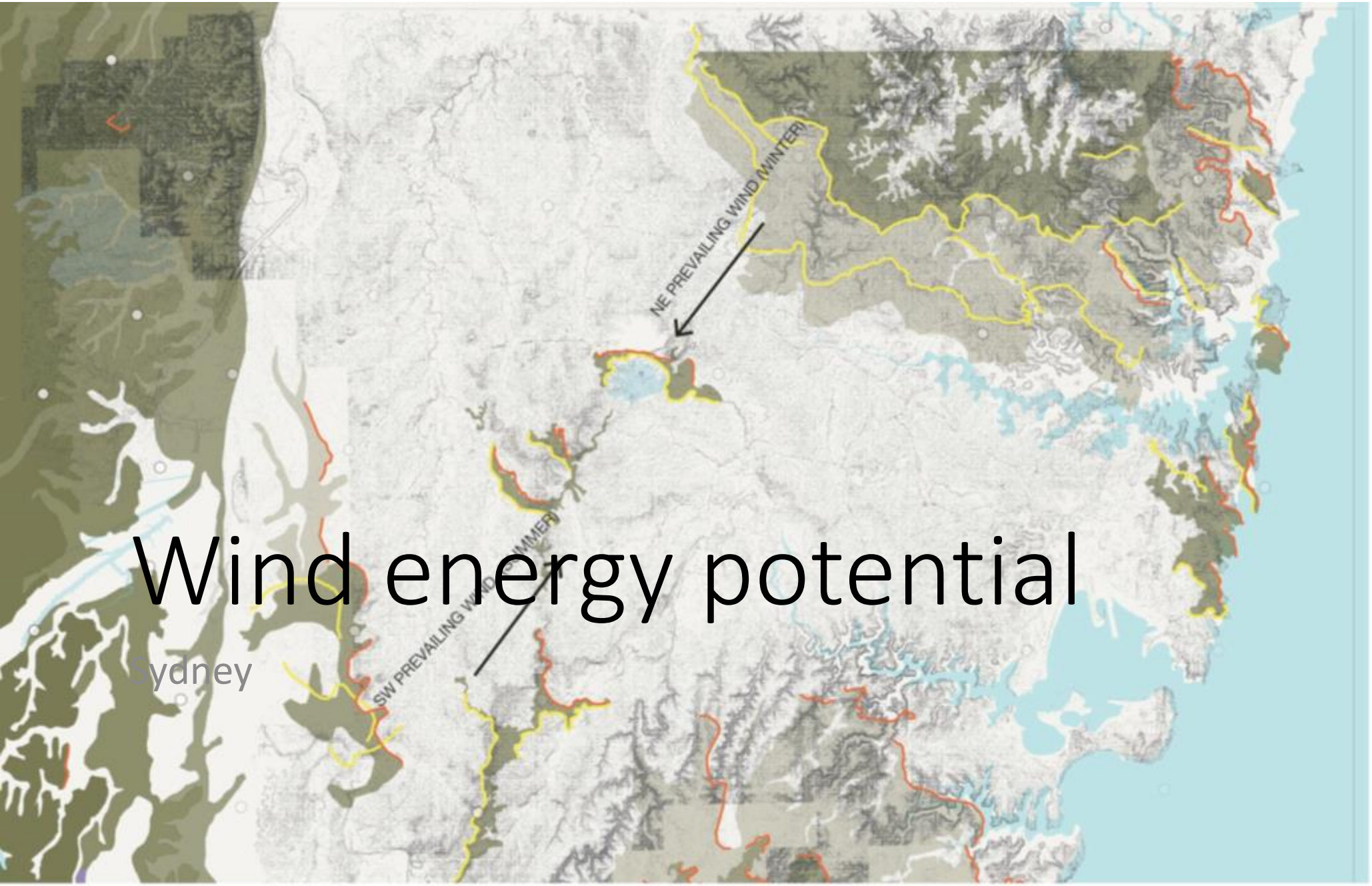
- Excessive production to be stored
  - Hydrogen
  - Industrial methane
  - Heat
  - Batteries

The potential area of all Sydney council precincts suited for PV was estimated at around 385 km^2, a quarter of the entire roof surface, potentially producing a total solar yield of 75.1 TWh, which is more than the current quantity of domestic energy used (65.3 TWh)

Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017

Wind energy potential

Sydney



WIND POTENTIAL
CURRENTLY IN SYDNEY

POTENTIAL WIND TURBINES
ORIENTATED TOWARDS
NE PREVAILING WINDS

POTENTIAL WIND TURBINES
ORIENTATED TOWARDS
SW PREVAILING WINDS

0 - 50m ABOVE SEA LEVEL
50 - 150m ABOVE SEA LEVEL
150 - 250m ABOVE SEA LEVEL
250 - 400m ABOVE SEA LEVEL
400m + ABOVE SEA LEVEL

Image: Hamish McKenzie/Louisa King

Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017

Wind energy potential of Sydney

Off-shore wind parks

5 – 7.5 MW per turbine; Up to max 30 km out of shore

→ Potentially everywhere except in front of Sydney harbour bay

On-shore wind turbines

Oriented to predominant wind directions (SW/NE); 1–5 MW per turbine

→ On steep slopes and ridges (funnel effect)

Micro-turbines in the urban environment

On tall buildings in the CBD and individual plots with energy-inefficient areas

By estimation around 840 km length of ridge in the Sydney metropolitan can be used for wind turbines. Assuming 2 MW turbines with a rotor diameter of 100 m, the turbines should be positioned at a distance of 600 m from one another, enabling a total of 1400 turbines. Assuming a common full load time of 2190 hours a year, the annual yield of one 2 MW turbine will be 4380 MWh. Therefore, the total potential of onshore wind turbines will be 6.13 TWh.

Coastal wind farms

Sydney

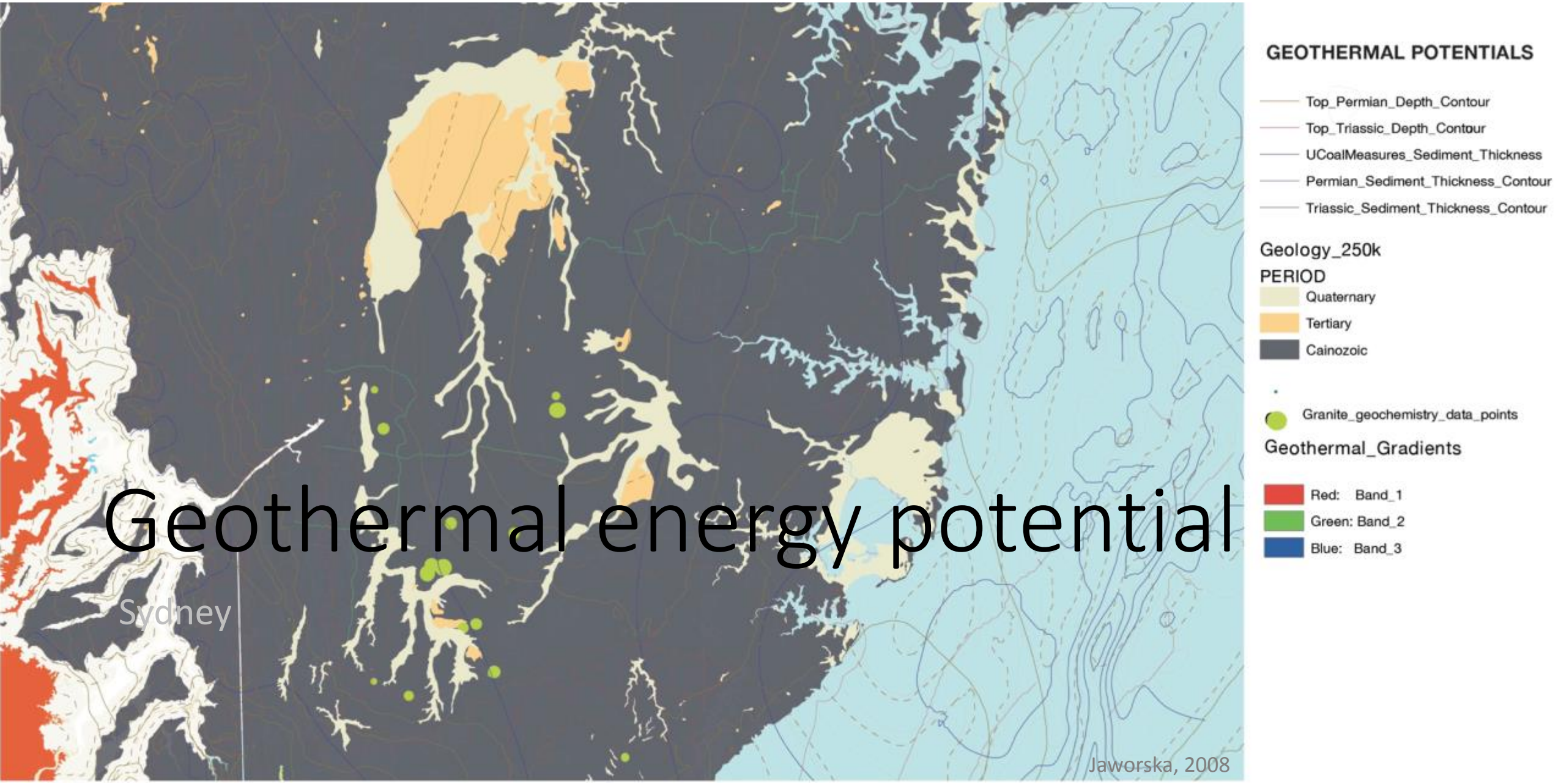
Image: Rocco Furfaro

Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017

Manly headland

Image: Rocco Furfaro

Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017



Geothermal energy potential

Image: Louisa King

Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017

Geothermal energy potential of Sydney

Shallow geothermal heat

Using heat pumps and closed loops

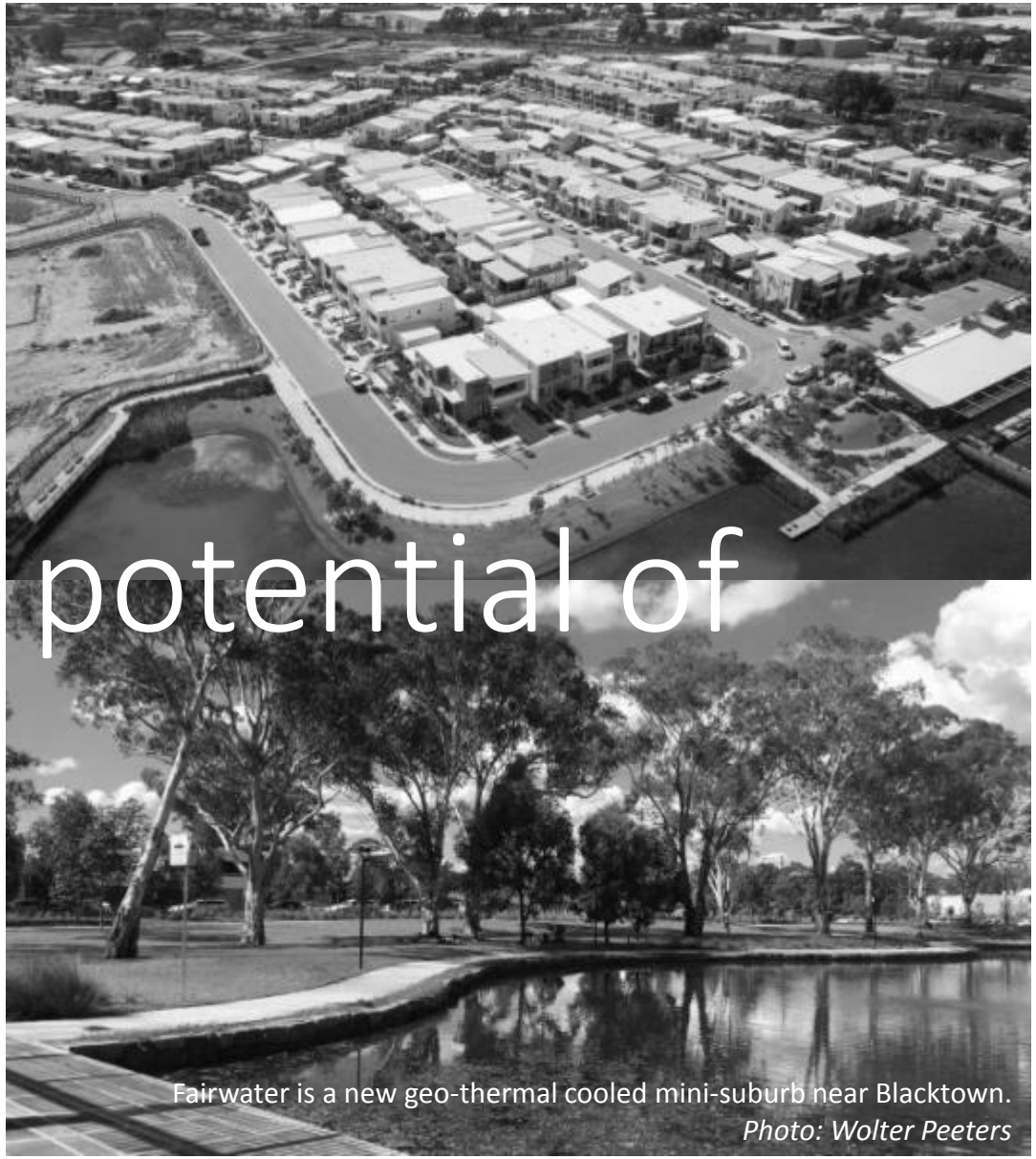
→ Larger water surfaces such as Botany Bay area, Bayside West (around the airport)

Deep geothermal heat

Steam from deep layers of sandstone

To be used for hot water purposes or electricity

→ Sydney centre area



Fairwater is a new geo-thermal cooled mini-suburb near Blacktown.
Photo: Wolter Peeters

Old powerplants and gas grid of Sydney

- Gas-fired powerplants become the flexible producer next to renewables
- Shift from natural gas to biogas, artificial methane and hydrogen
- Biogas production from anaerobic fermentation of organic waste
- Methane and hydrogen produced from excessive solar power
- Powerplants and gas grid become the storage of energy (gas)

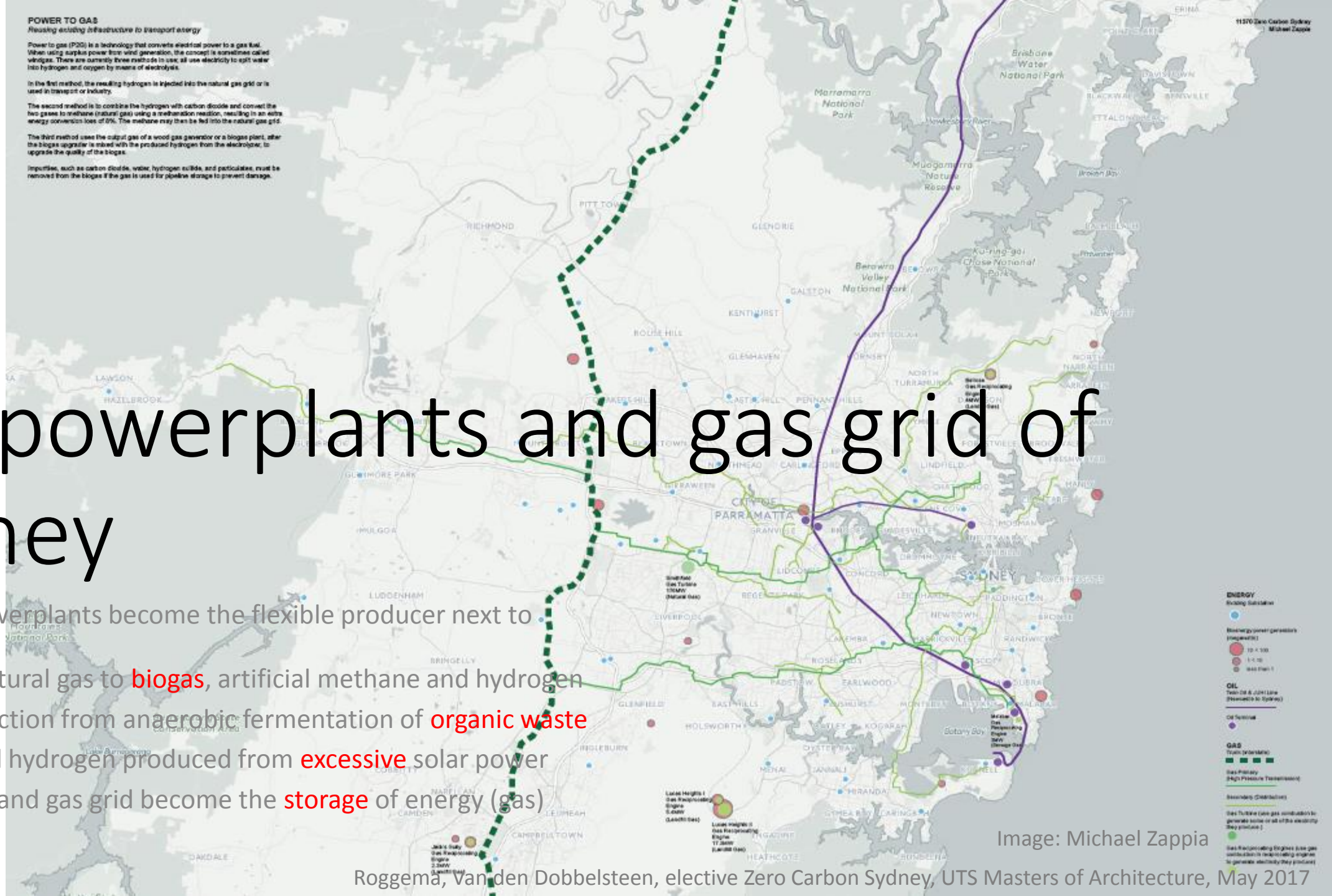
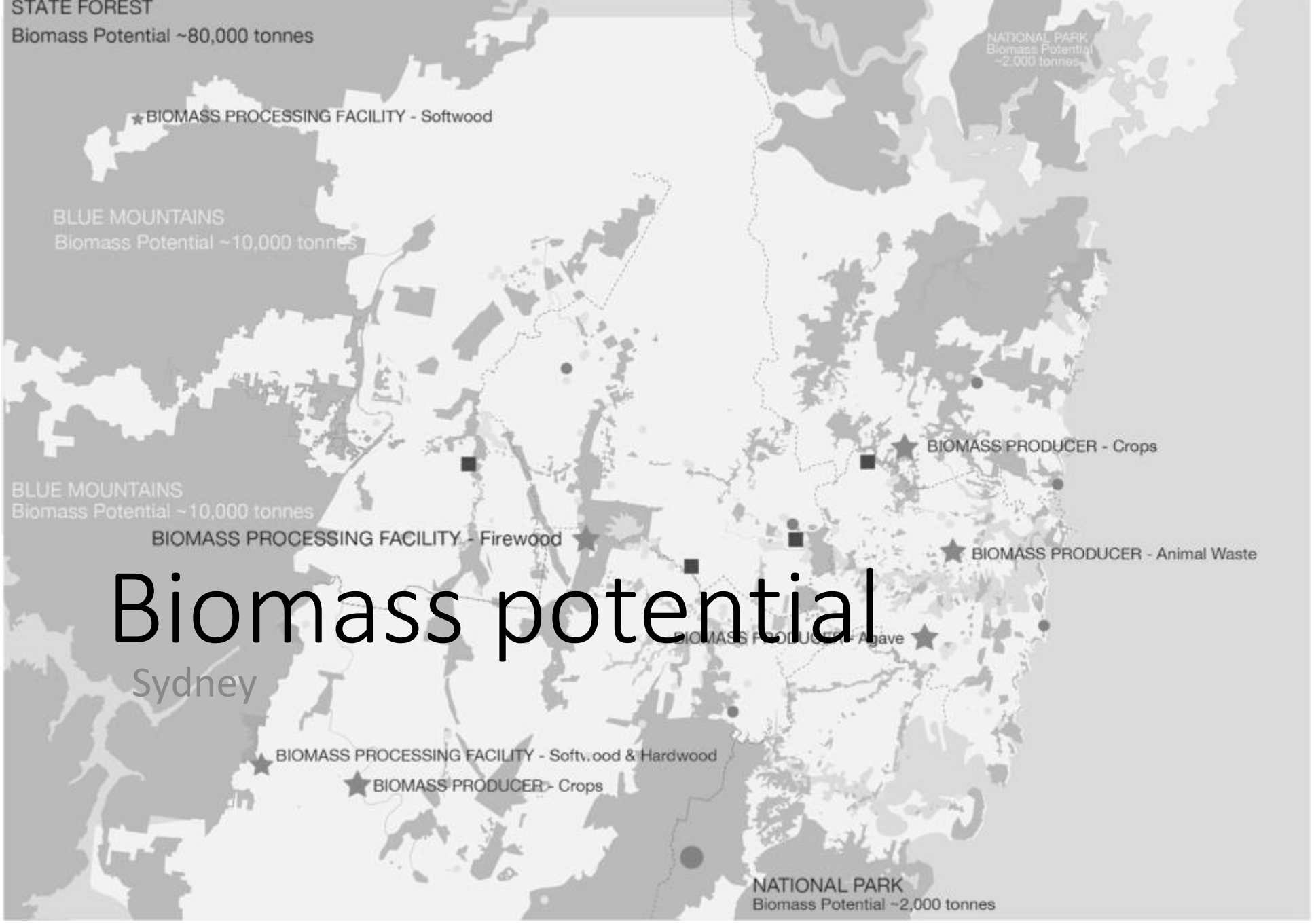


Image: Michael Zappia

Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017

Biomass potential

Sydney



BIOMASS POTENTIAL CURRENTLY IN SYDNEY

AVERAGE HOUSEHOLD GENERATES APPROXIMATELY

10.5KG OF REUSABLE/ORGANIC WASTE PER WEEK

BIOMASS POTENTIAL IN 2030 (KILOTONNES PER YEAR)

1000 < 2000

Existing Waste Management Facility

CHP Cogeneration Facility

Bioenergy power generators (megawatts)

10 < 100

1 < 10

less than 1

Image: Michael Zappia/Louisa King

Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017

Bio-energy potential of Sydney

Urban green

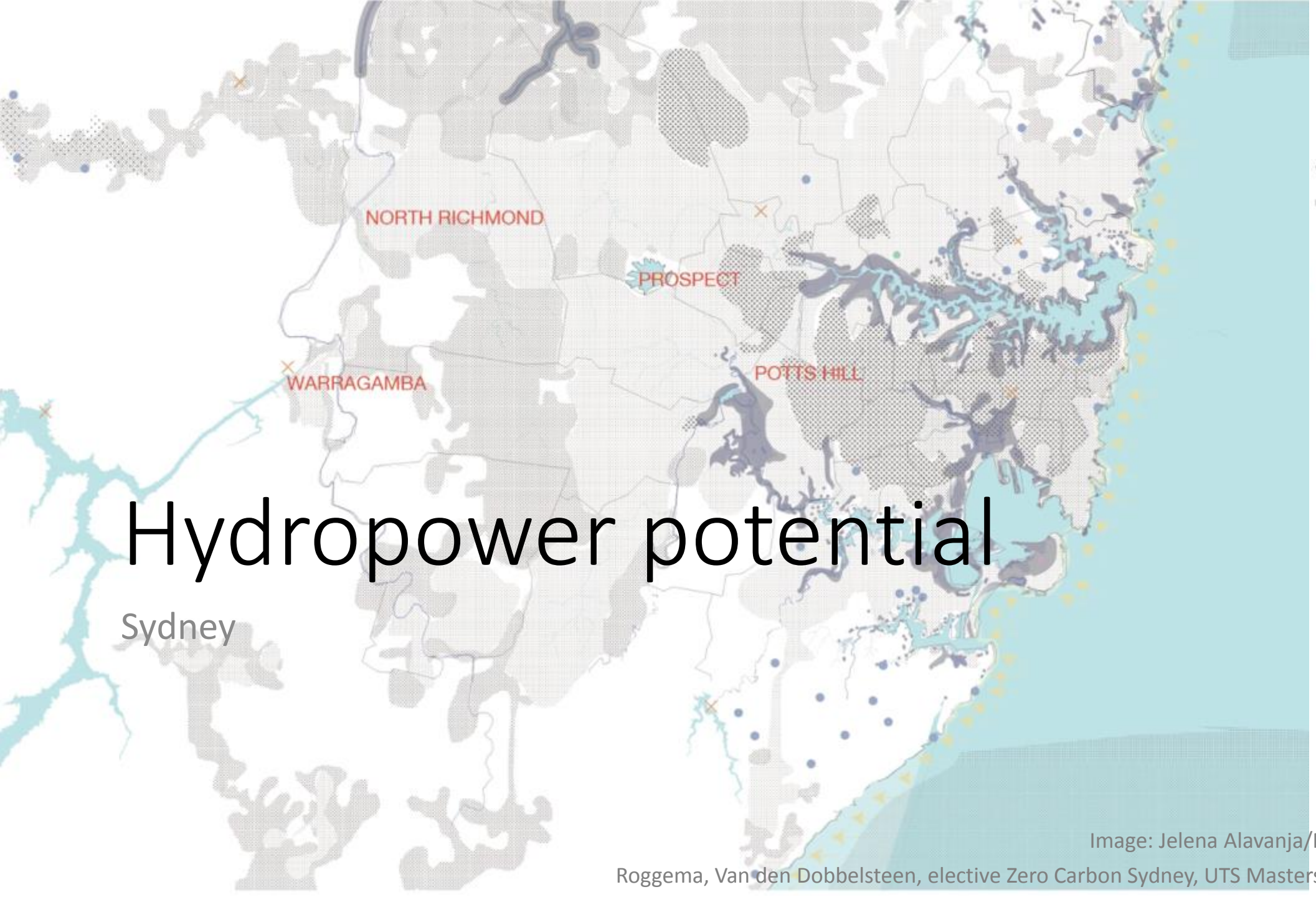
For biomass production (cuttings), for carbon sequestration and compensation, for travel

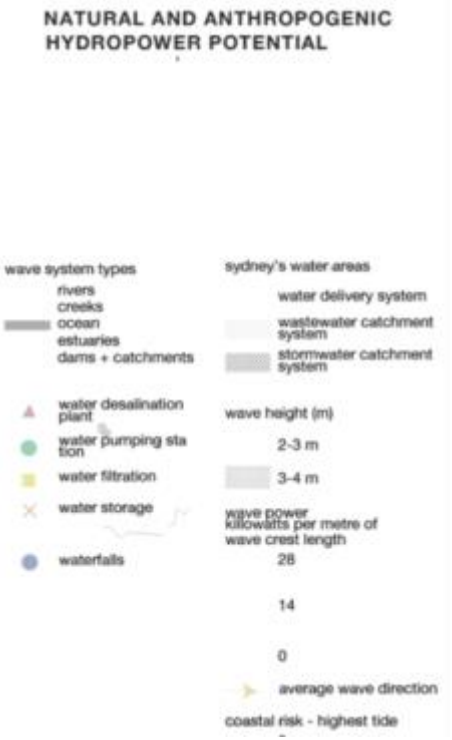
→ Urban forests, parks, avenues, wooded zones

Algae arrays

For purification of waste water and for production of biofuels (bio-diesel, bio-kerosene)

→ Botany bay (airport), new development areas





Hydropower potential

Sydney

Image: Jelena Alavanja/Nadine Haddad/Louisa King

Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017

Water energy potential of Sydney

Tidal energy

At the entrance of estuaries

→ Sydney harbour bay entrance, Botany bay entrance

Wave energy

New reefs in front of the coast, where storm safety is desired, with reef openings where wave power is to be concentrated for surfing and wave power generators are in full operation with storms

→ Manly surfer's nirvana, Sydney harbour bay entrance, Bondi beach

Blue energy

Reverse osmosis membrane technology, where fresh water meets salt water: where rivers flow into estuaries

→ Sydney harbour estuary, Botany estuary

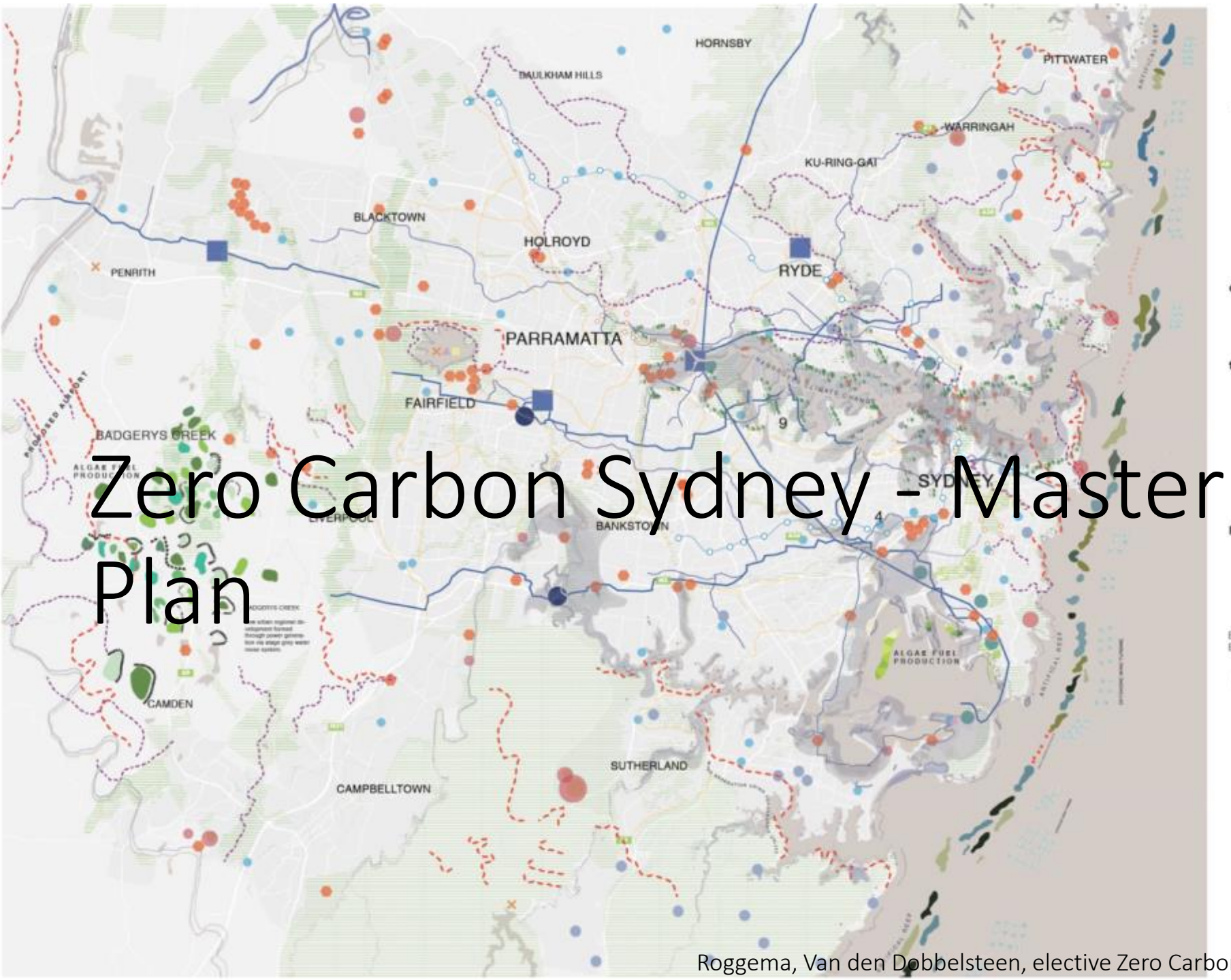
Water as source of heat and cold

To be reaped via heat exchangers and heat pumps

→ Sydney harbour bay, Botany bay, estuaries, rivers

Parramatta Lake, Parramatta

Zero Carbon Sydney - Master Plan



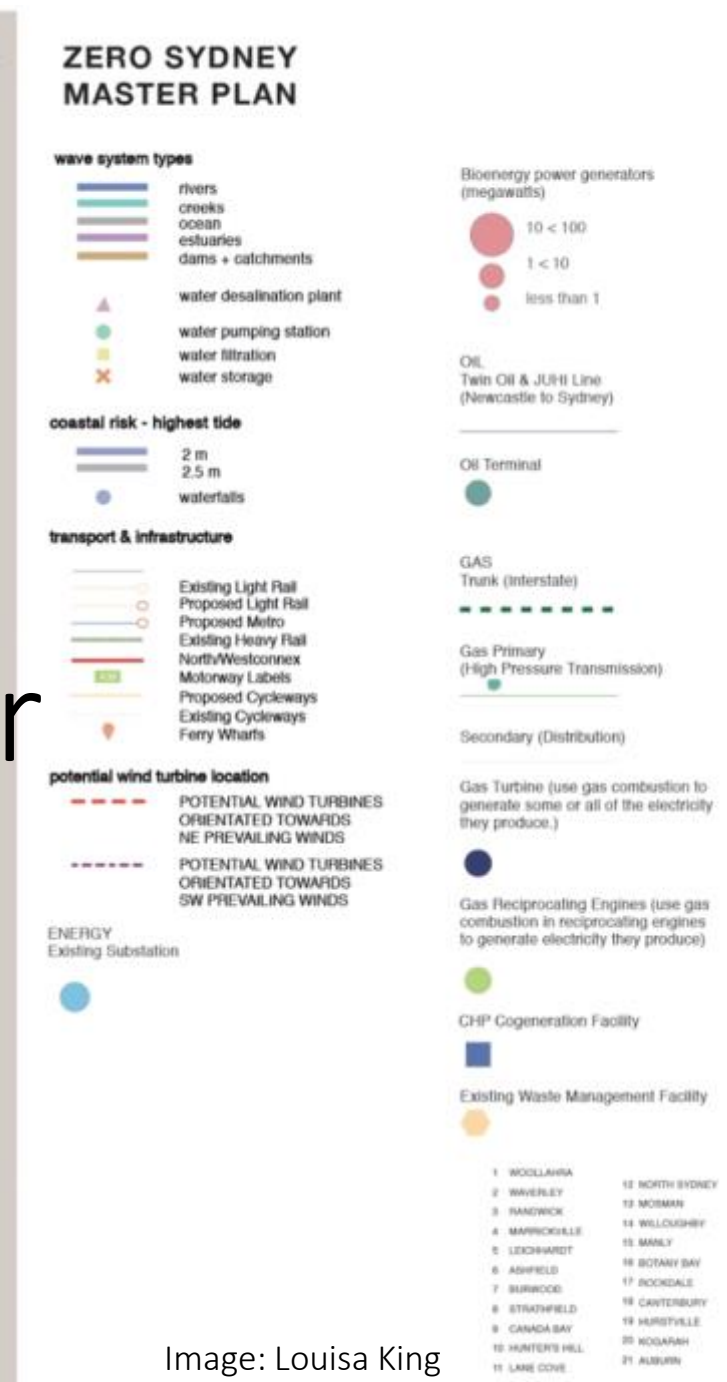
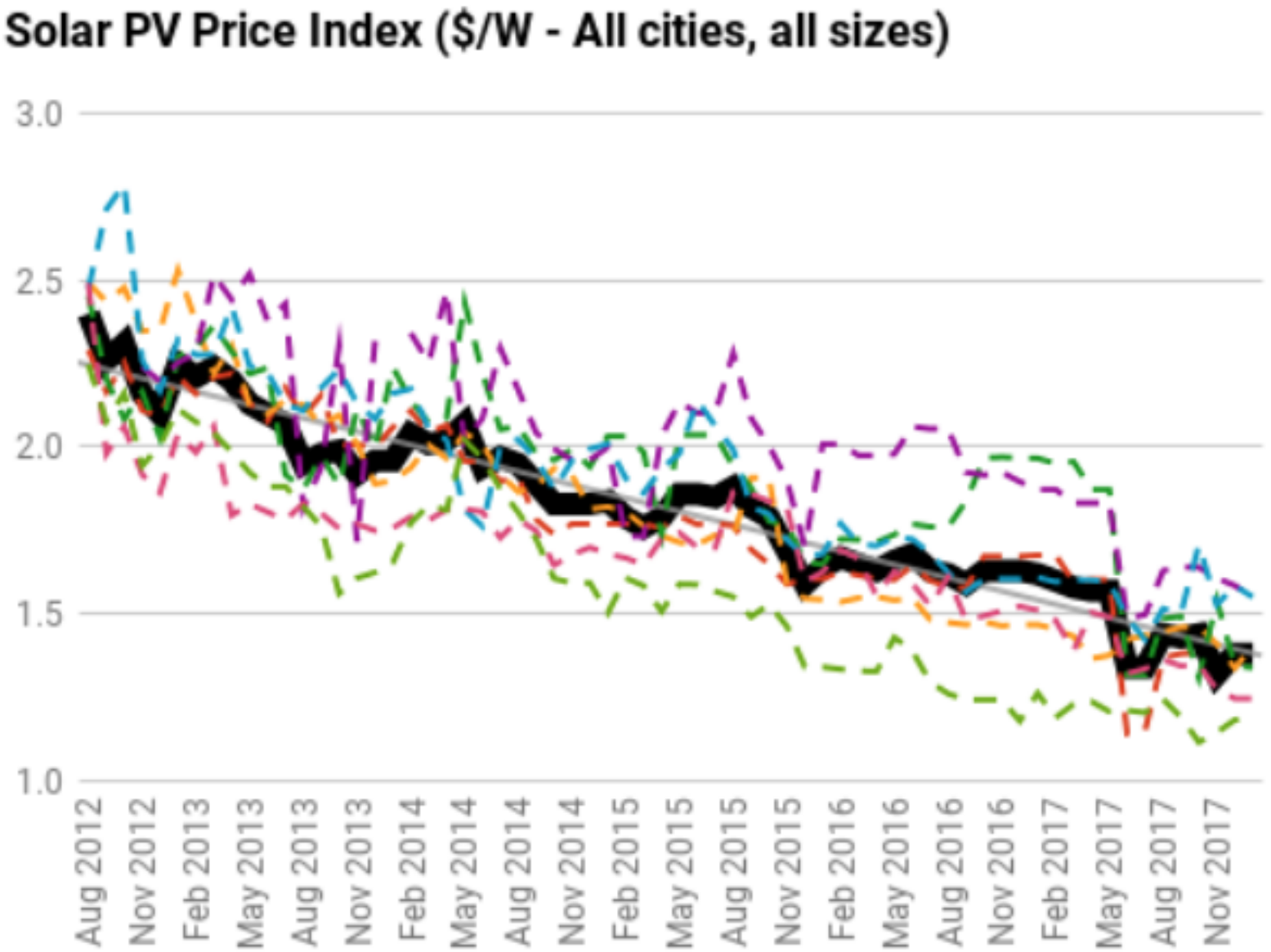


Image: Louisa King

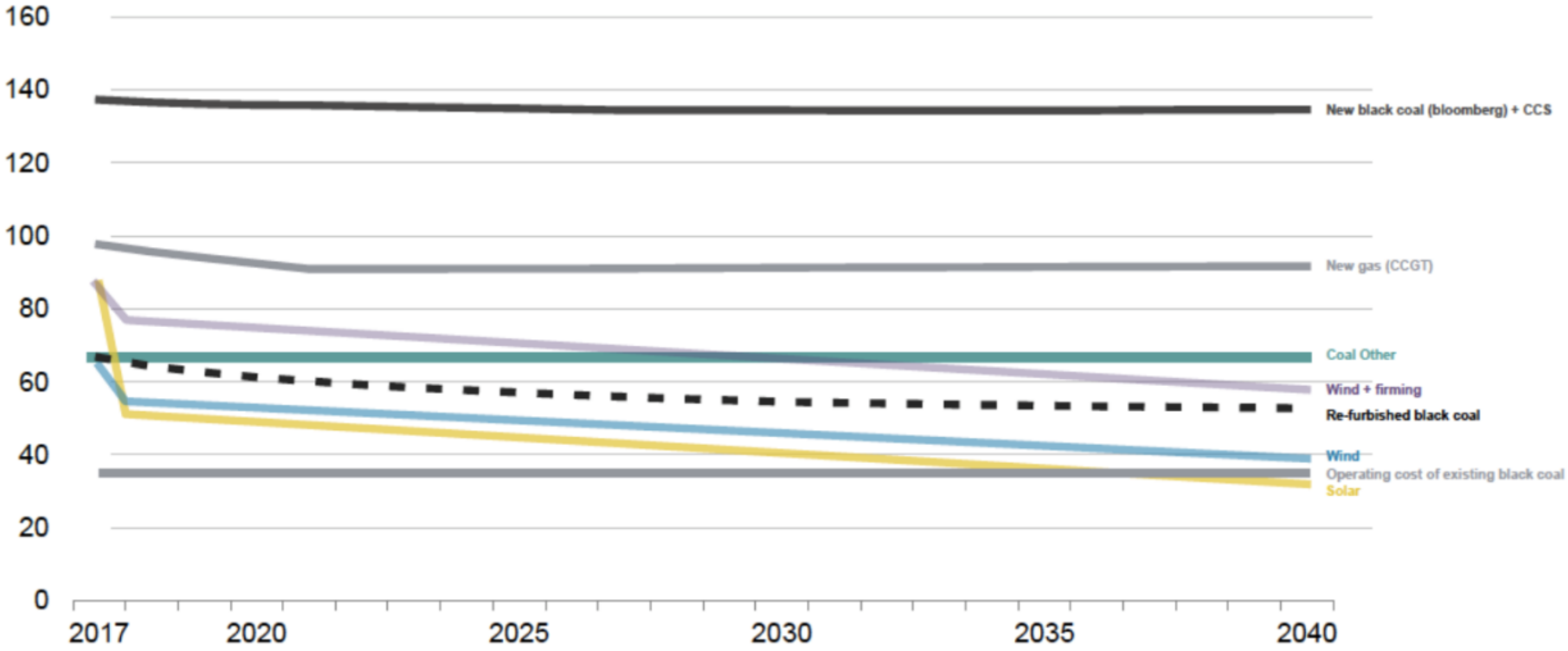
Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017



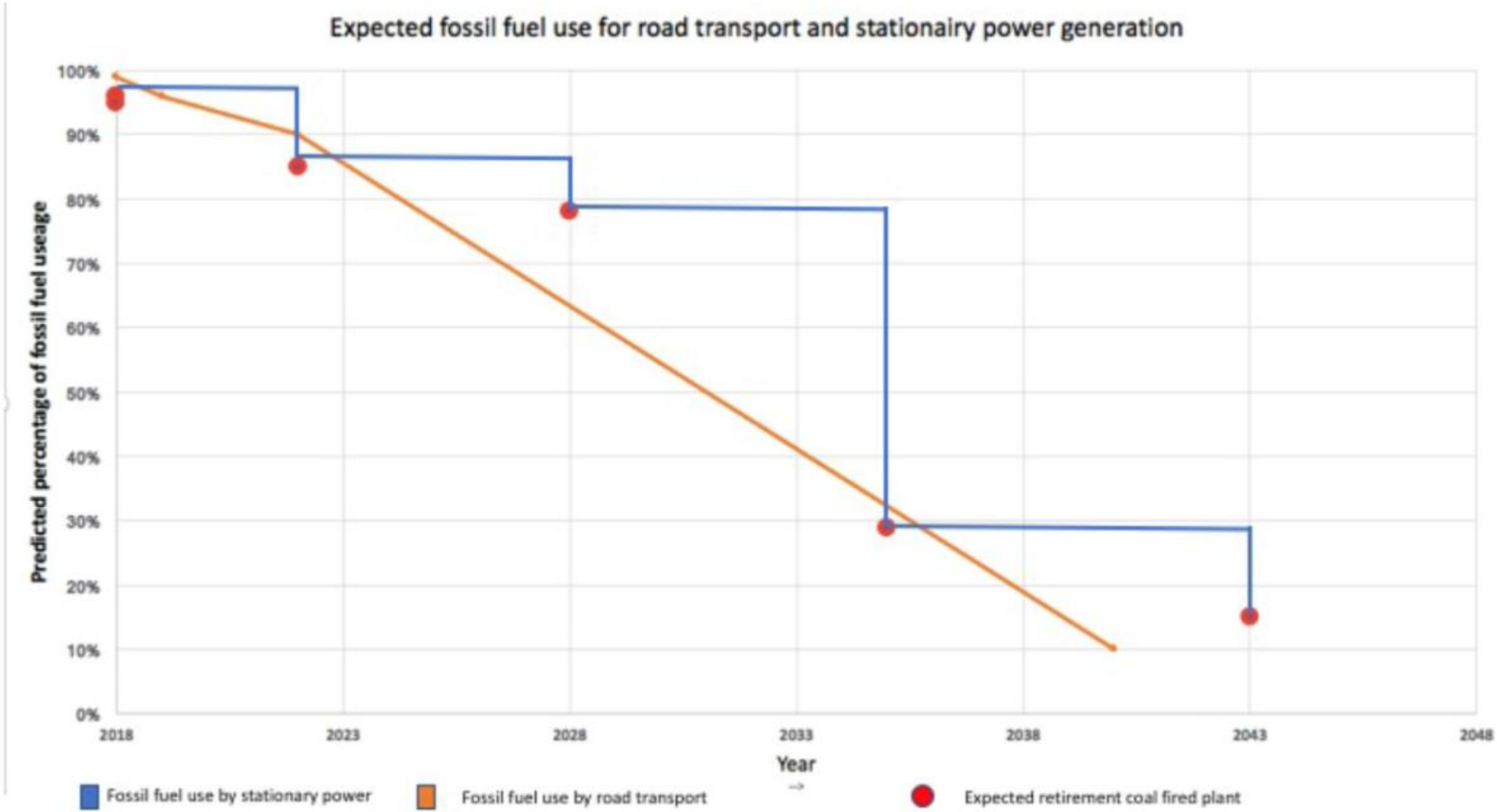
Fransen, 2018

Levelized cost of generation in Australia

Real 2018 A$/MWh



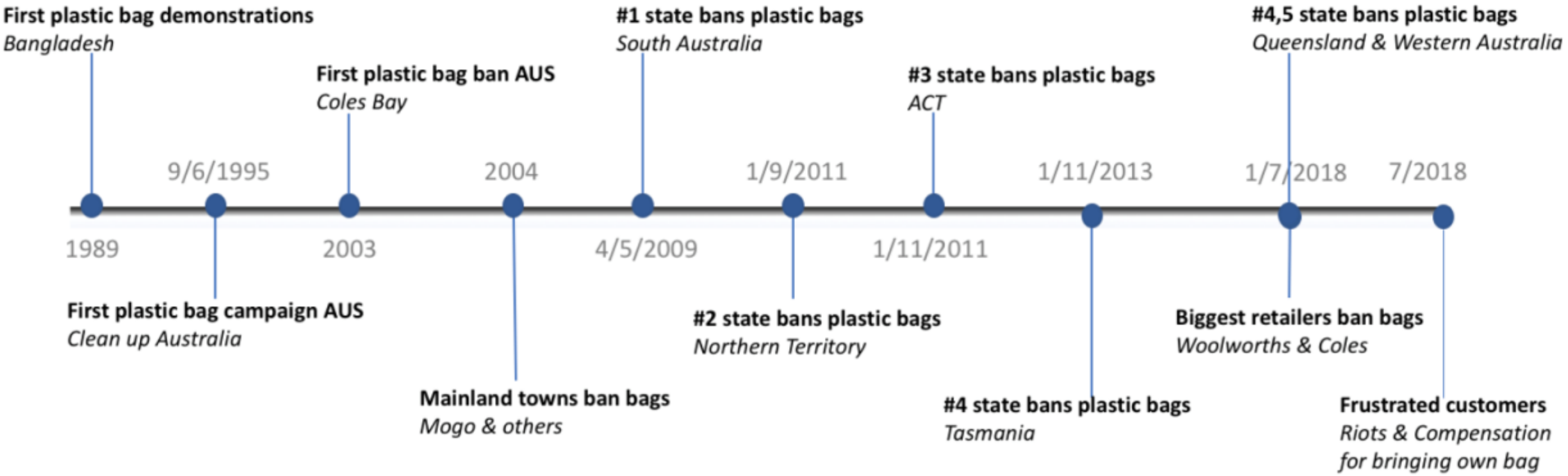
Fransen, 2018 adaptation of Bloomberg New Energy Finance (2017)



Fransen, 2018

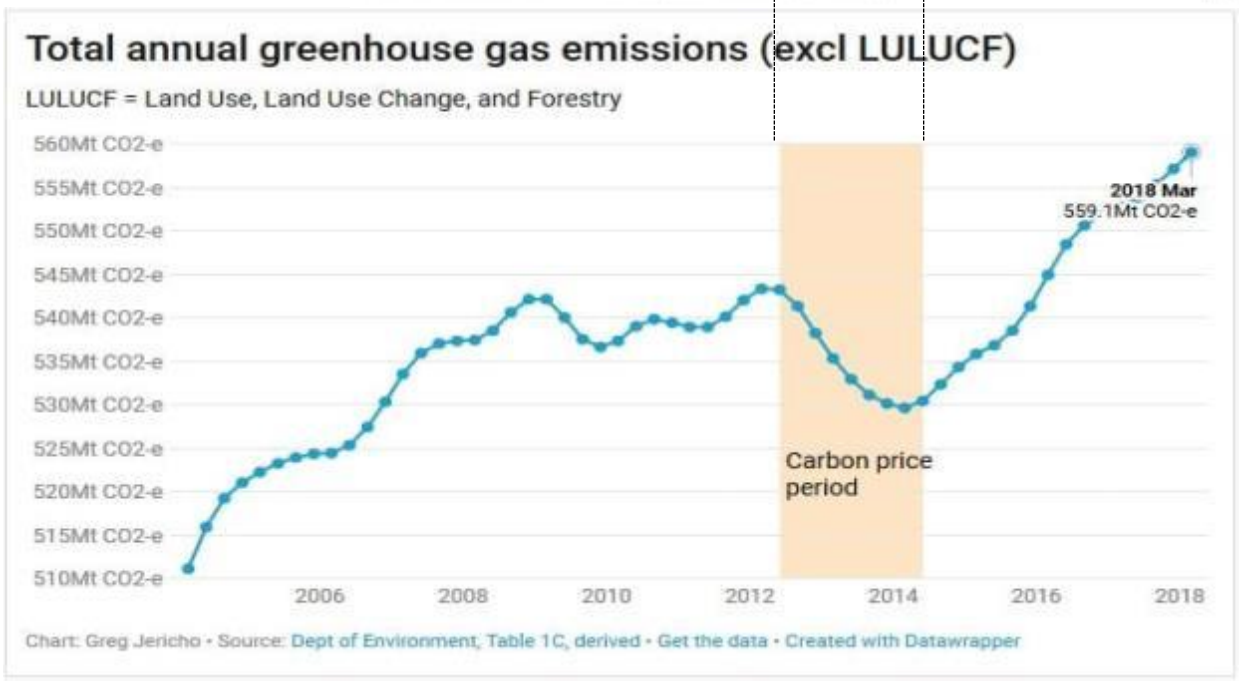
Public acceptance

From first campaign to final ban on plastic bags: 23 years



Fransen, 2018

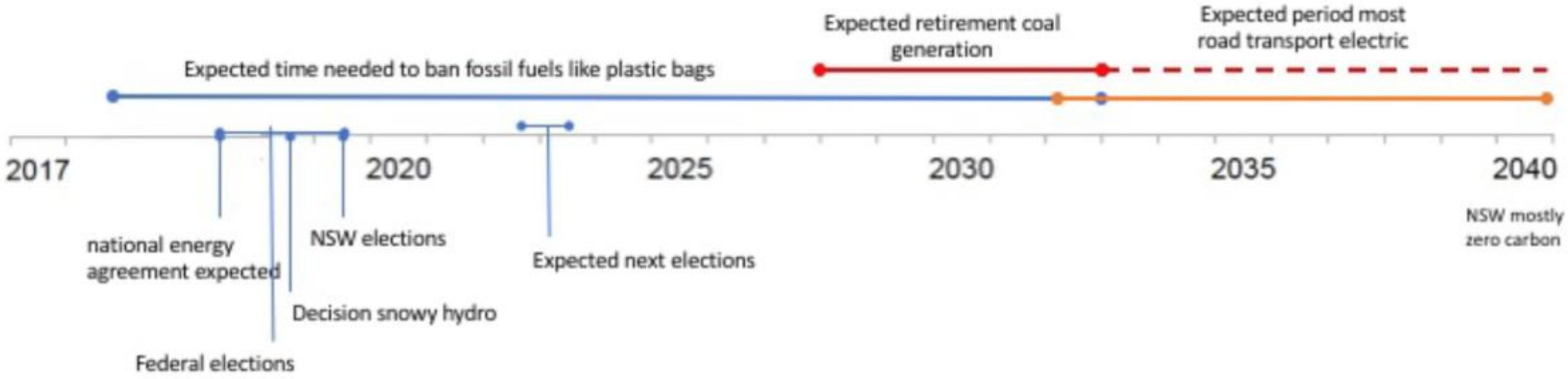

Climate Chaos
Australia's energy policy has fallen victim to political turmoil
Labor
Liberal-National
Kevin Rudd
Julia Gillard
Kevin Rudd
Tony Abbott
Malcolm Turnbull
Scott Morrison
2007
2017
2018
May 2009
Rudd introduces Carbon Pollution Reduction Scheme bill
April 2010
Rudd shelves CPRS
July 2012
Gillard's carbon price starts
July 2014
Abbott axes carbon price
Oct. 2014
Abbott's direct action plan becomes law
Dec. 2016
Government begins review of climate policy
March 2017
Turnbull threatens gas export curbs
Sept. 2017
Turnbull demands Liddell plant remains open
August, 2018
RET-scheme to be dismantled
Sources: National Archives of Australia, data compiled by Bloomberg
Bloomberg


Total annual greenhouse gas emissions (excl LULUCF)
LULUCF = Land Use, Land Use Change, and Forestry
560Mt CO2-e
555Mt CO2-e
550Mt CO2-e
545Mt CO2-e
540Mt CO2-e
535Mt CO2-e
530Mt CO2-e
525Mt CO2-e
520Mt CO2-e
515Mt CO2-e
510Mt CO2-e
2018 Mar
559.1Mt CO2-e
Carbon price period
2006
2008
2010
2012
2014
2016
2018
Chart: Greg Jericho • Source: Dept of Environment, Table 1C, derived • Get the data • Created with Datawrapper

When the stars align

- Prices of renewables drop and coal plants retire
- Public acceptance of renewables
- Political change moments (2019, Federal and NSW; 2022-2023) and election results fall in favour of renewables

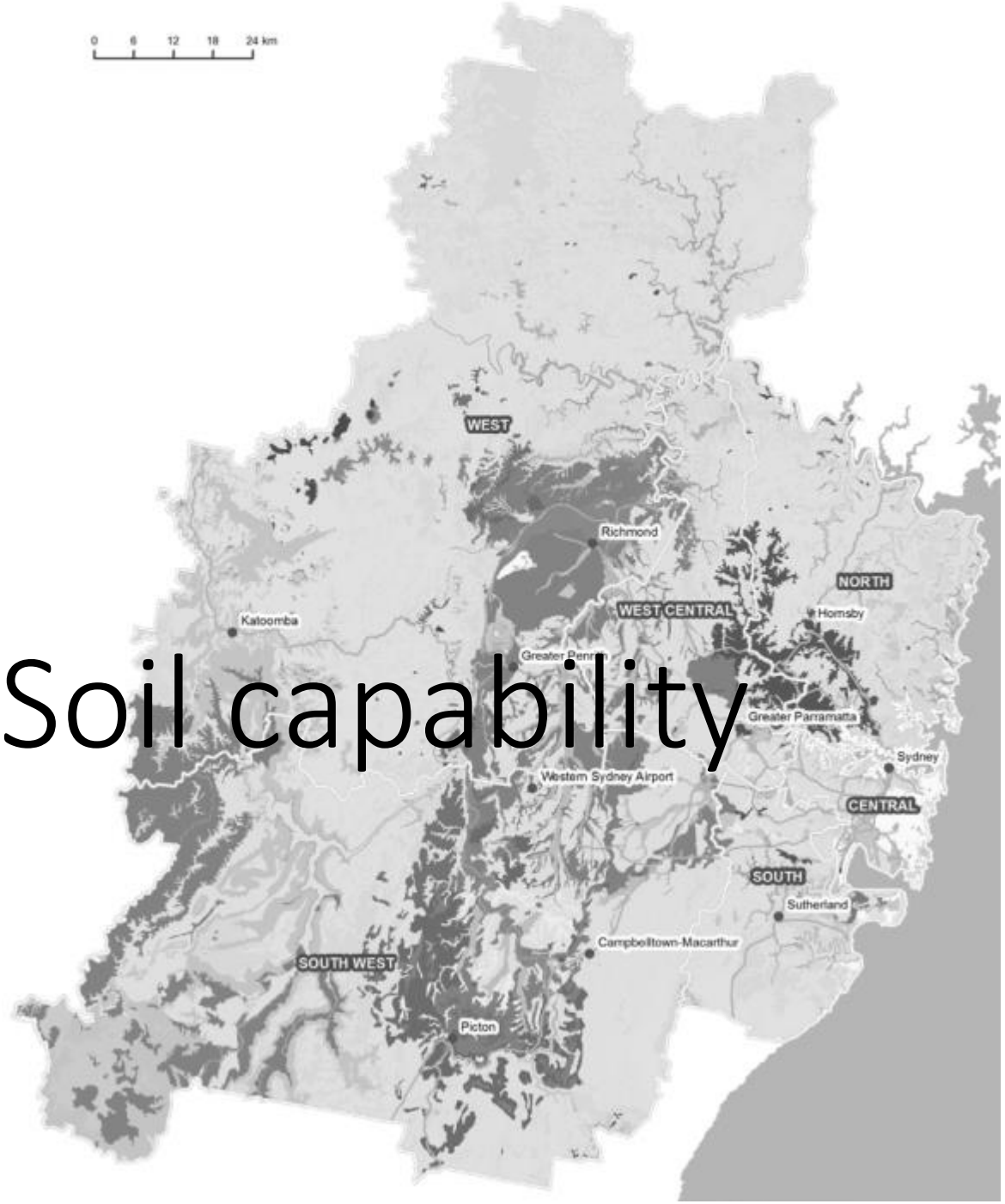
Together will determine the moment we could probably achieve a Zero Carbon Sydney



Fransen, 2018

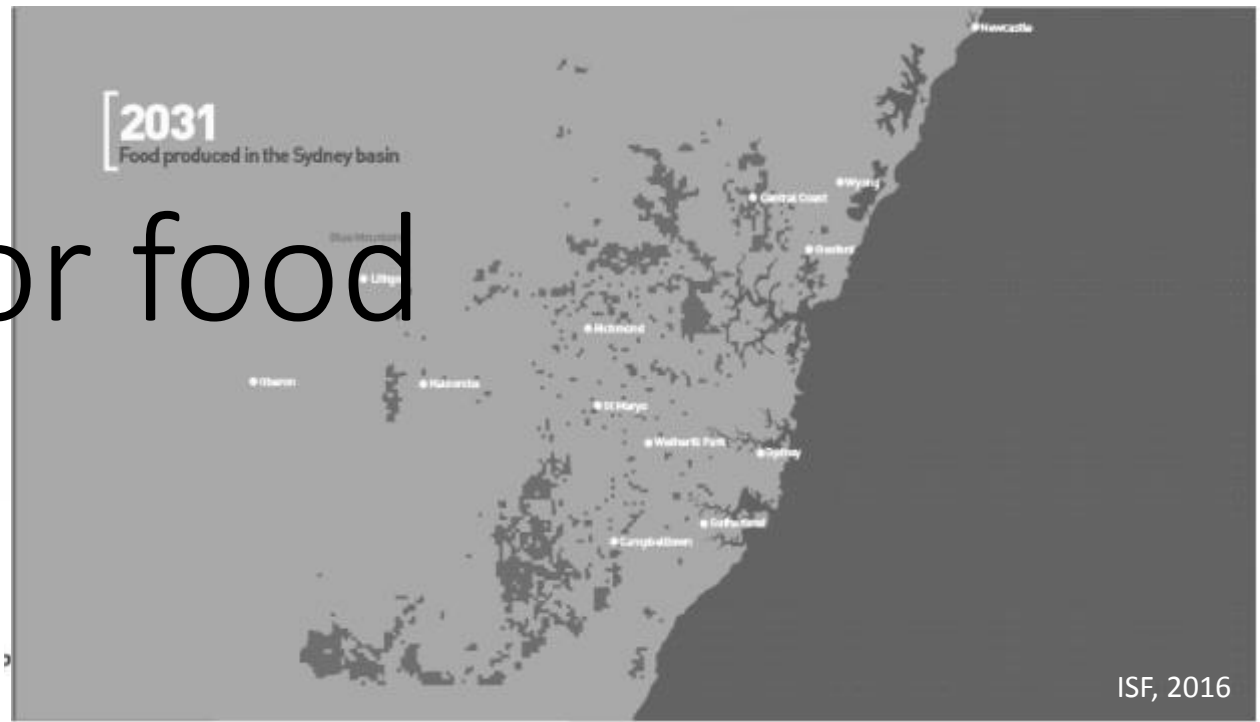

Food

Soil capability



GSC, 2017

Food production
Shrinking space for food

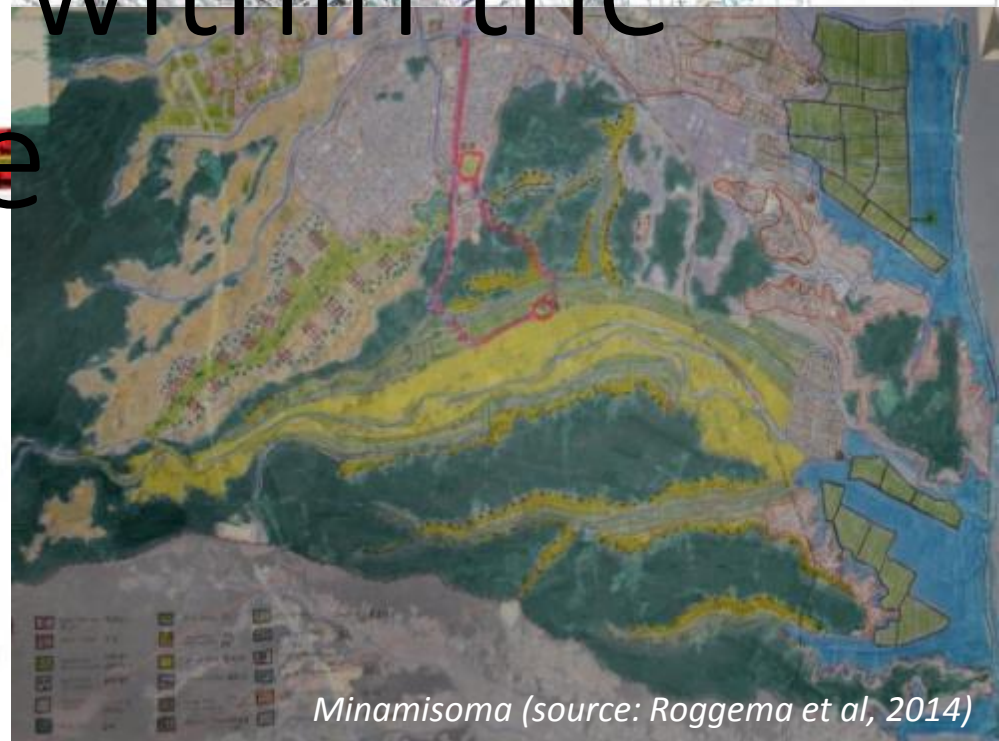


ISF, 2016

Potential to be found within the city: urban agriculture

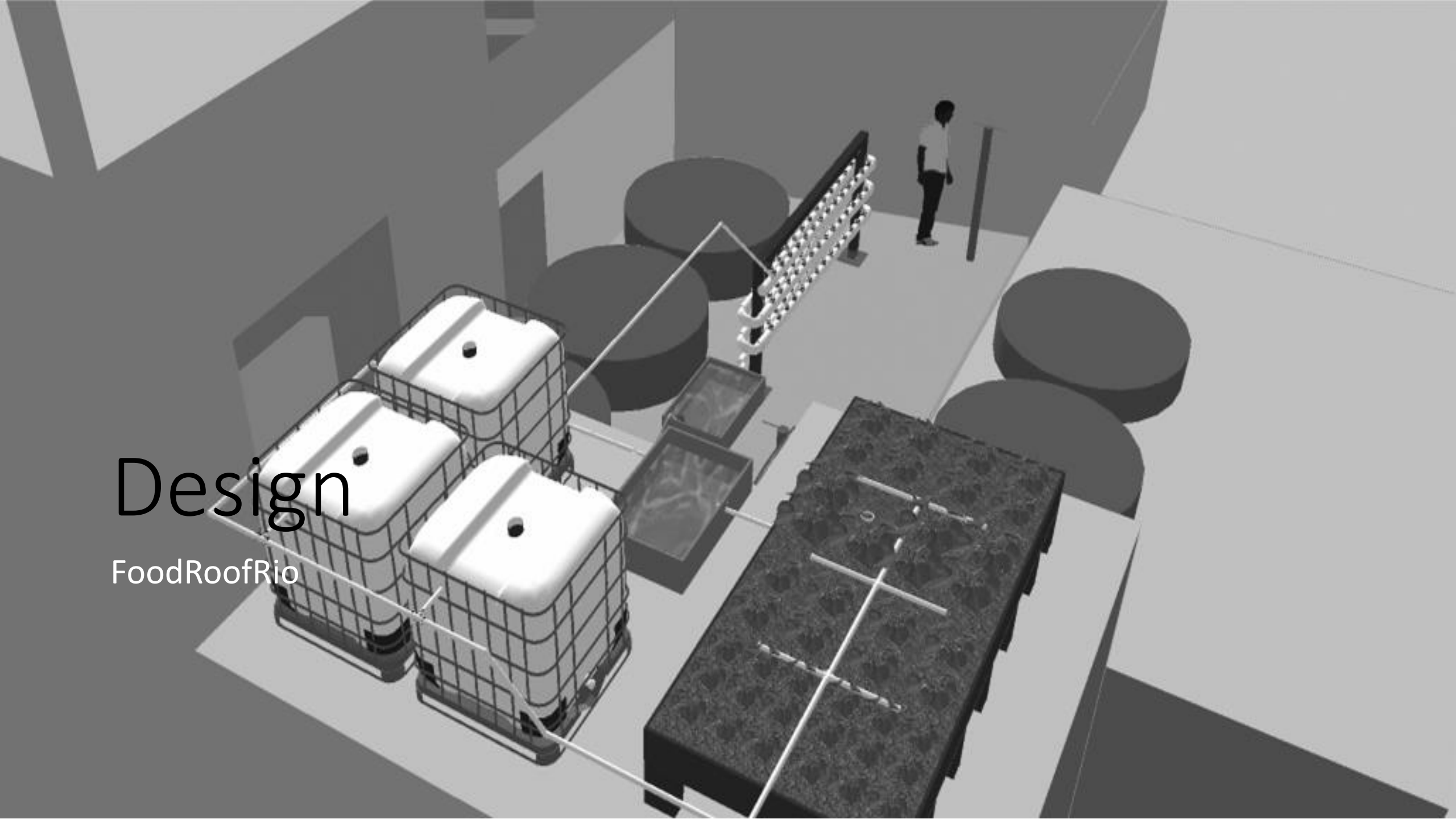
Middlesbrough (source: Viljoen, 2012)

Milano



Minamisoma (source: Roggema et al, 2014)


WeCANtagalo
Rio de Janeiro



Design

FoodRoofRio

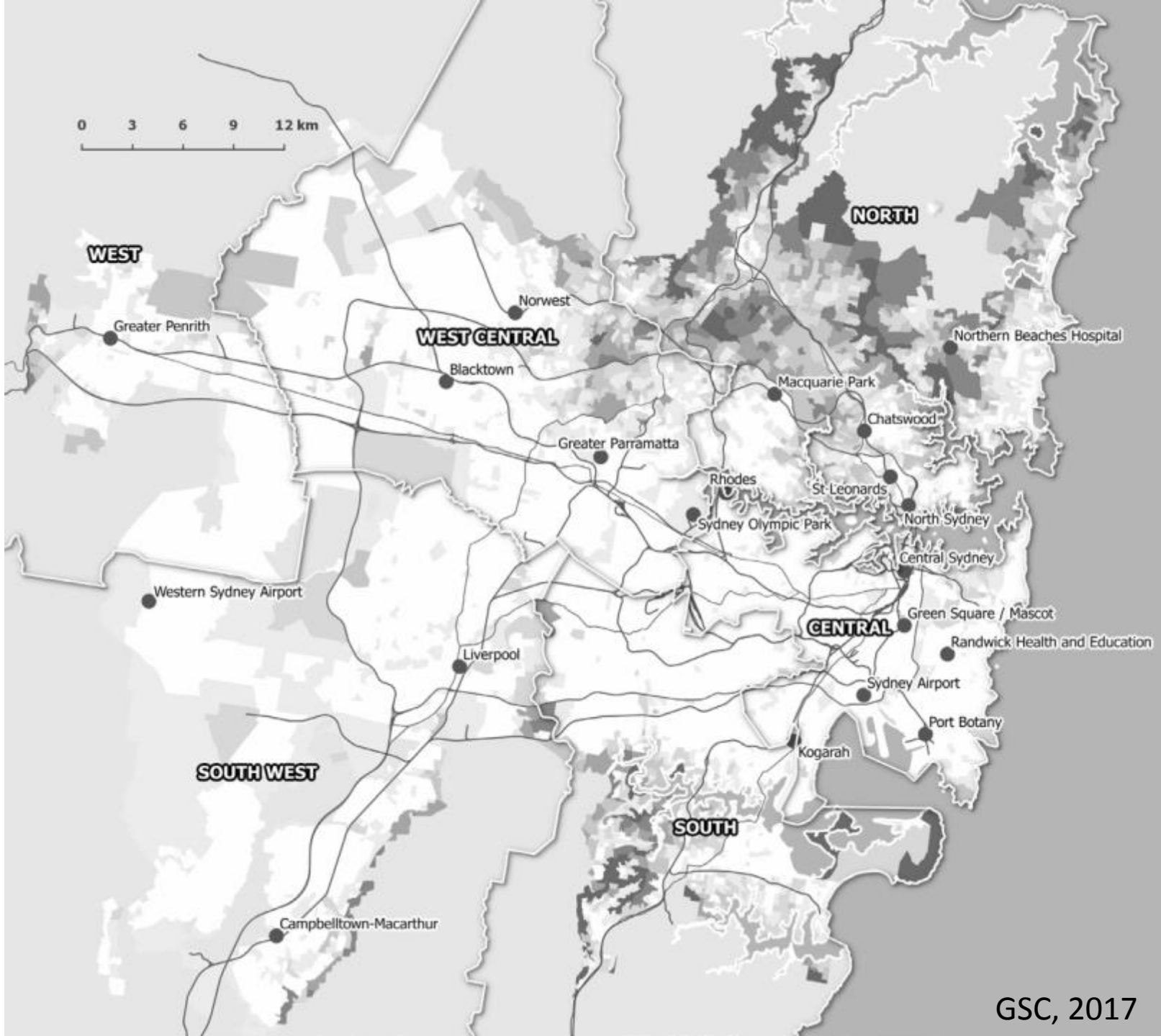
FoodRoofRio

Rio de Janeiro, Brazil


Nature

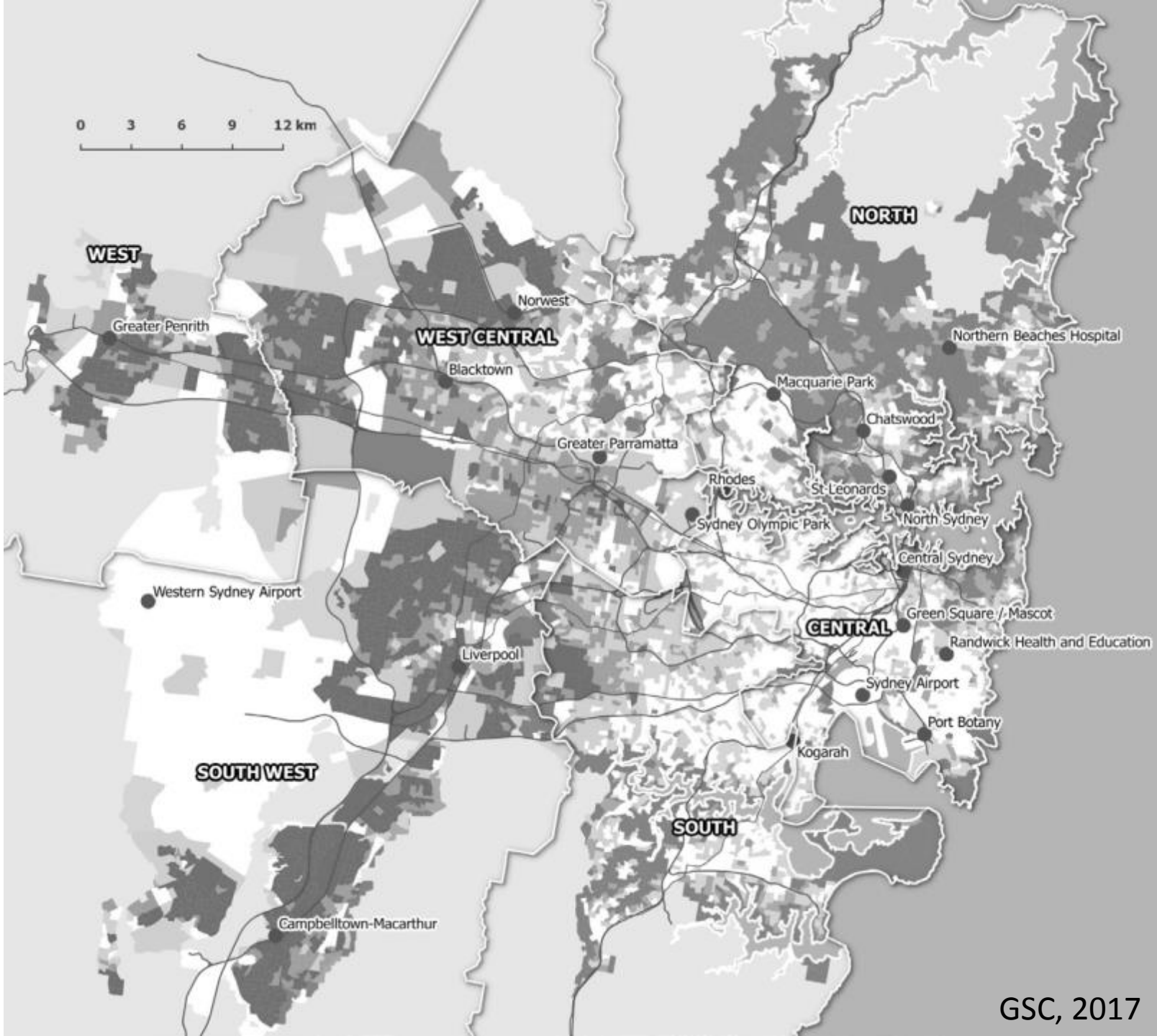
Tree cover

Tree desert



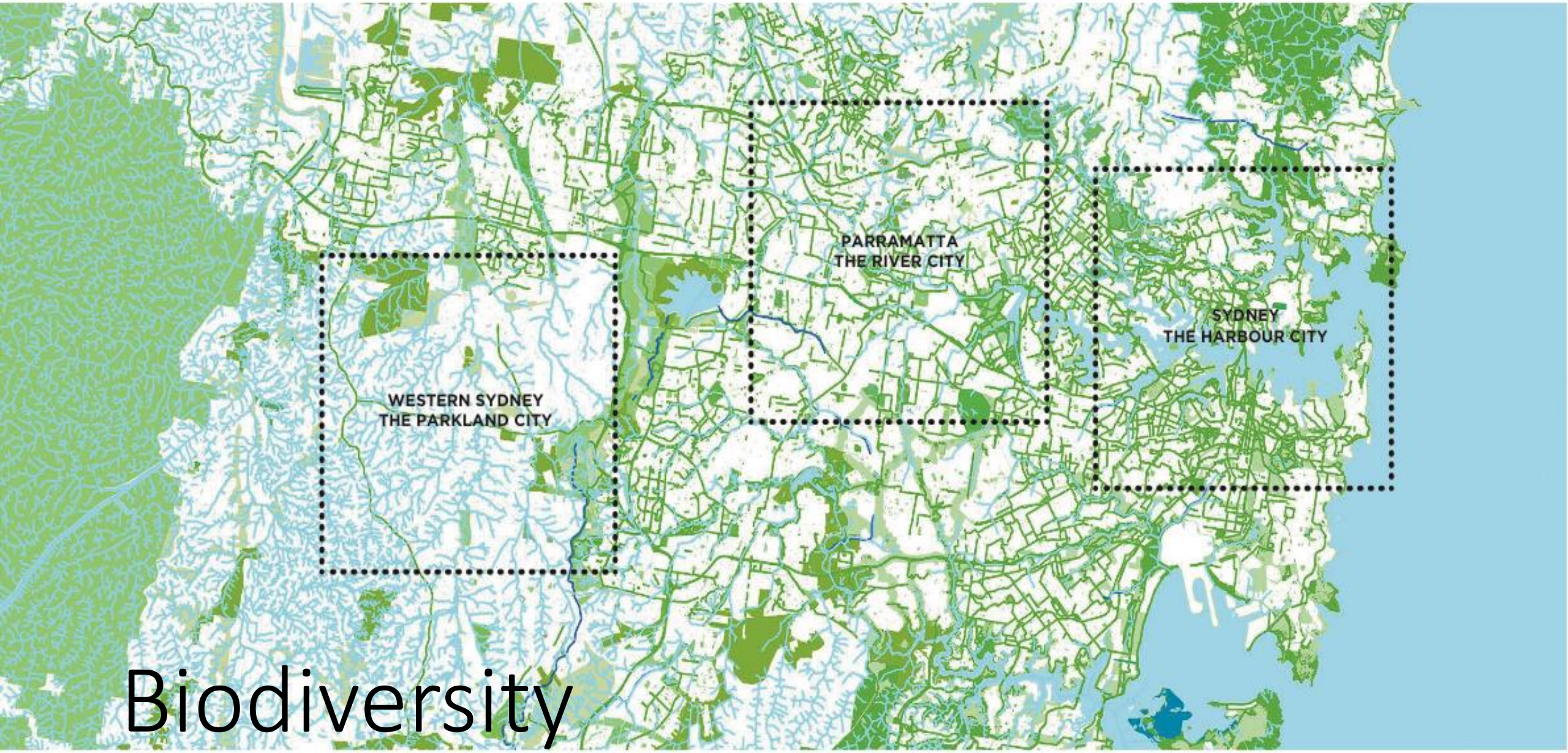
GSC, 2017

Urban Heat



GSC, 2017

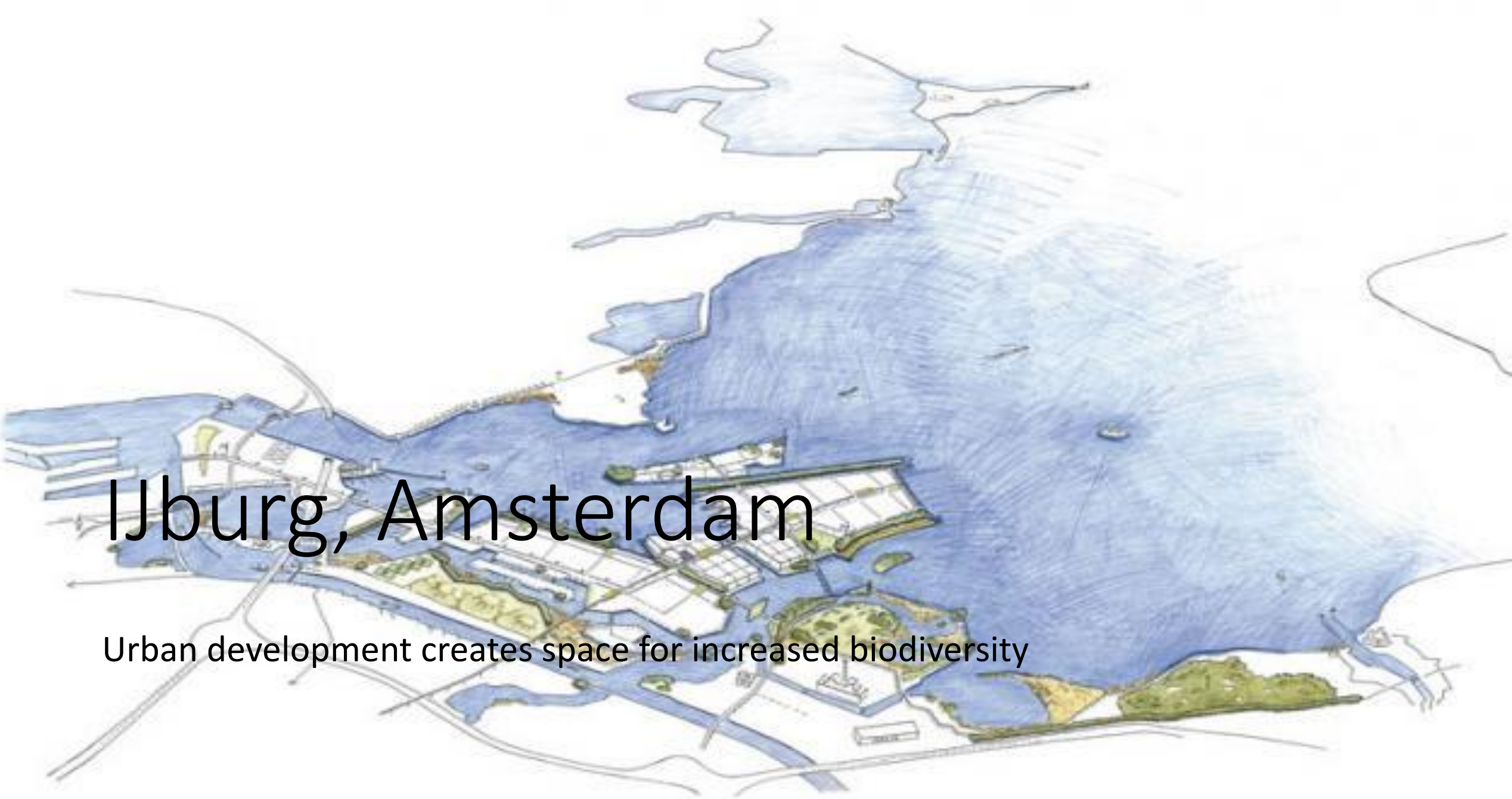

Trees



Biodiversity

Determine the best options for green and nature in Greater Sydney

GANSW, 2016

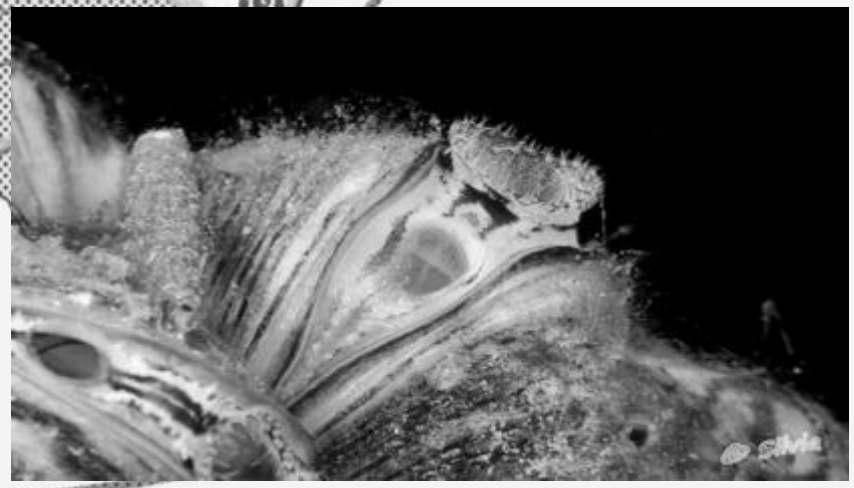


IJburg, Amsterdam

Urban development creates space for increased biodiversity

Nature strategy

IJburg Amsterdam



Driehoeksmossel; Dreissena-polymorpha/Triangle Mussel

Ringslang; Grass Snake


Water’s edge

Urban nature pockets


Facade nesting

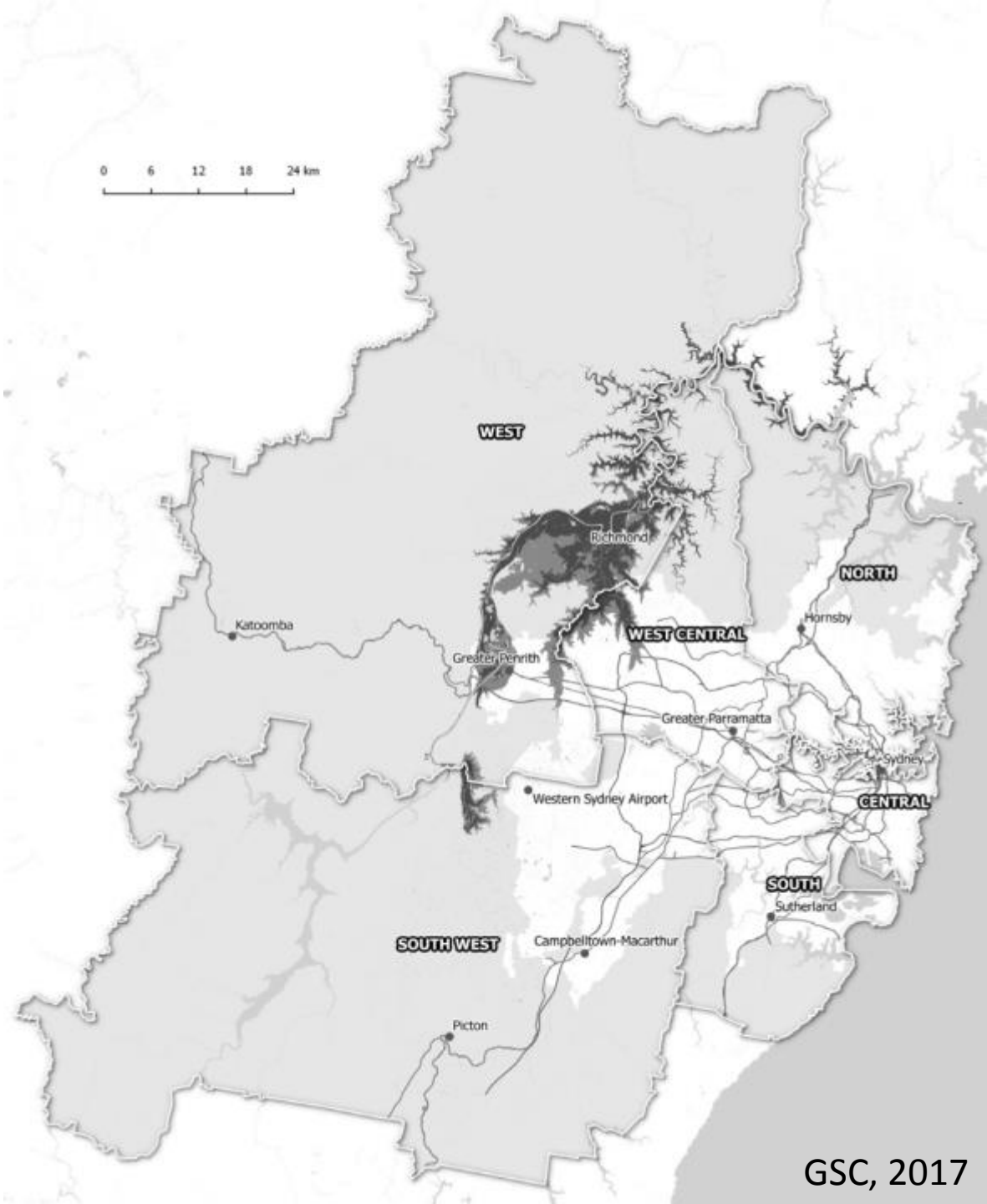
Green covered housing

IJburg, Amsterdam

Climate adaptation

Flood risk

Hawksbury-Nepean



GSC, 2017

Floodable Eemsdelta

In 2006 nearly flooded
Historic landscape with articficial hills
Increase resilience, adaptive capacity
Anticipate future weather extremes (e.g. flooding)
Use threat as an incentive for the design
Create space for self-organisation and growth


North Sea storm
©PA

Eemshotel

Weakest link in the coast. Not to protect influences the entire system

Roggema, 2012

+ 0.3m sea level rise

Roggema, 2012

+ 0.6m zeespiegelstijging

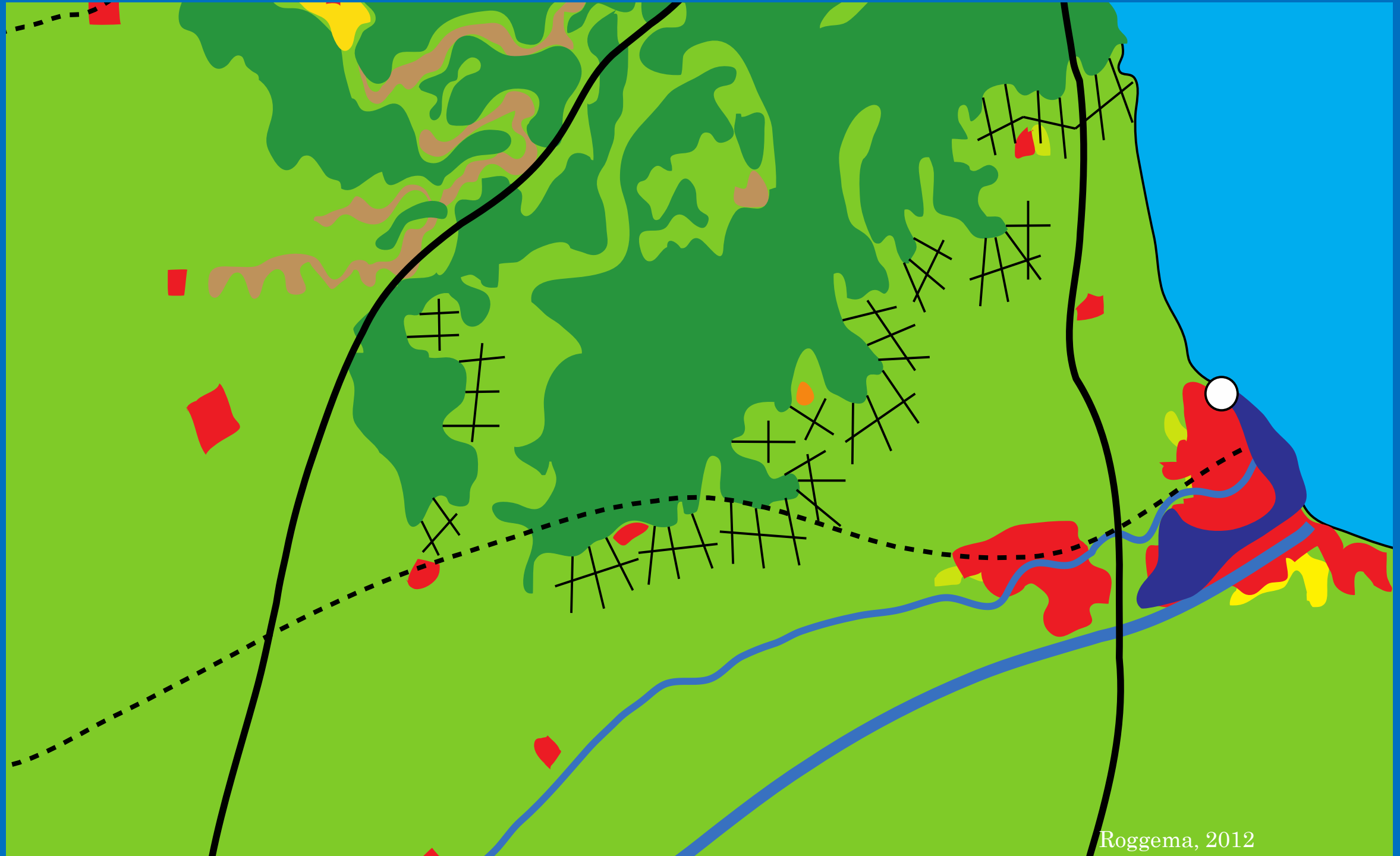
Roggema, 2012

+ 0.9m zeespiegelstijging

Roggema, 2012

+ 1.2m zeespiegelstijging

Roggema, 2012


Roggema, 2012

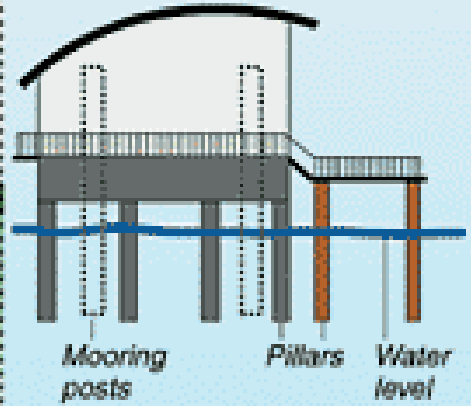
Roggema, 2012

Flood protection: Floating home

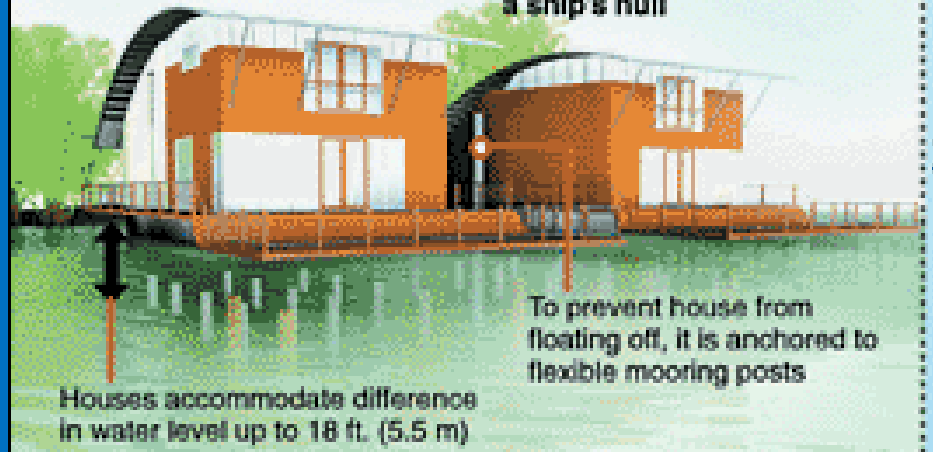
Besides structural measures such as dikes and levees, the Netherlands has developed a new concept in flood protection: houses that float.

Normal water level → House and concrete body rest on pillars

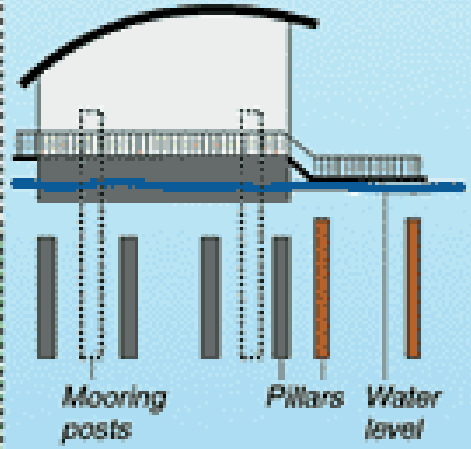
Side view



High water level → House floats; hollow concrete body acts like a ship's hull



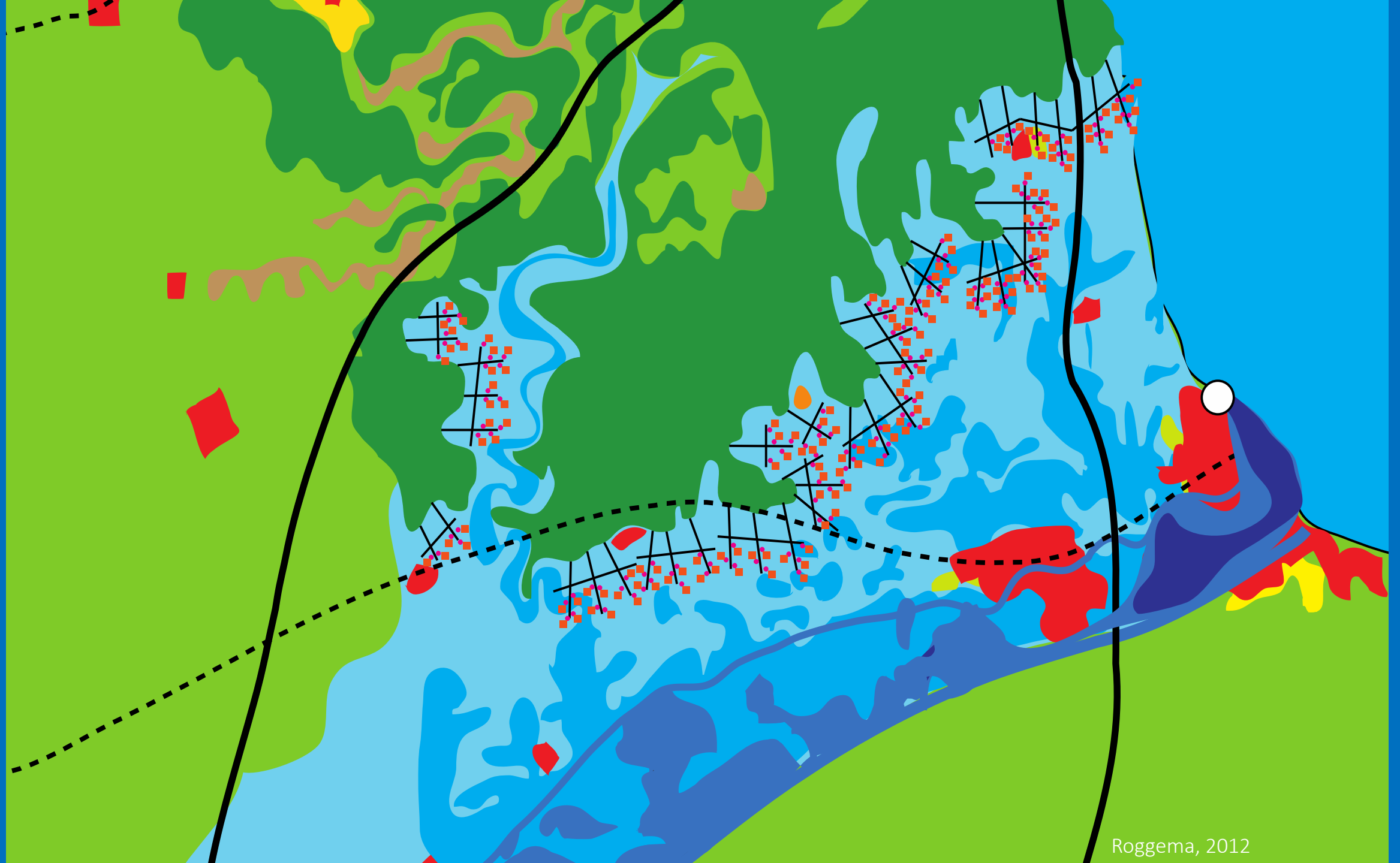
Side view

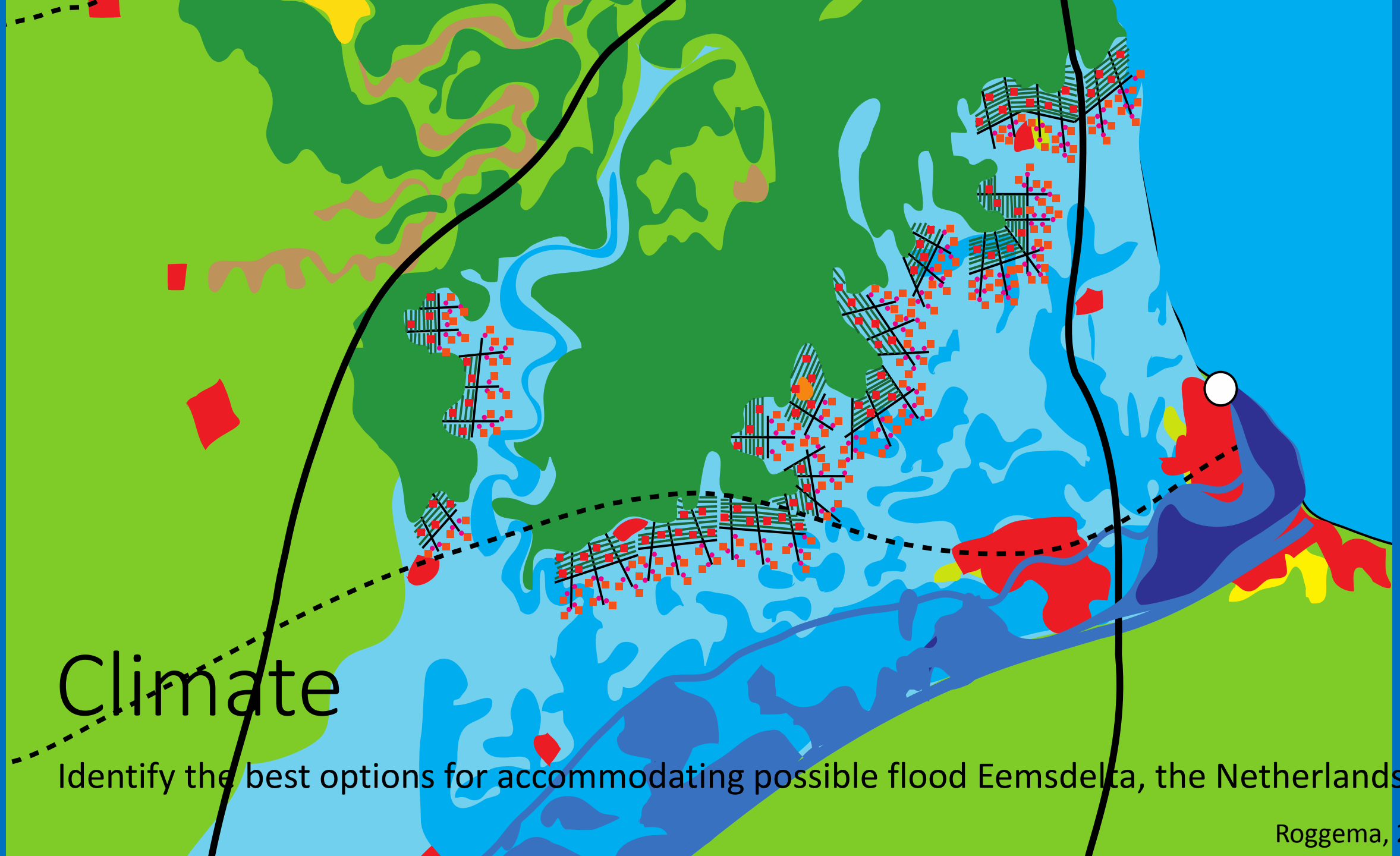


Source: Dura Vermeer Graphic: Elsebeth Nielsen, Morten Lynne

Roggema, 2012


Roggema, 2012


Roggema, 2012



Climate

Identify the best options for accommodating possible flood Eemsdelta, the Netherlands

Roggema, 2012

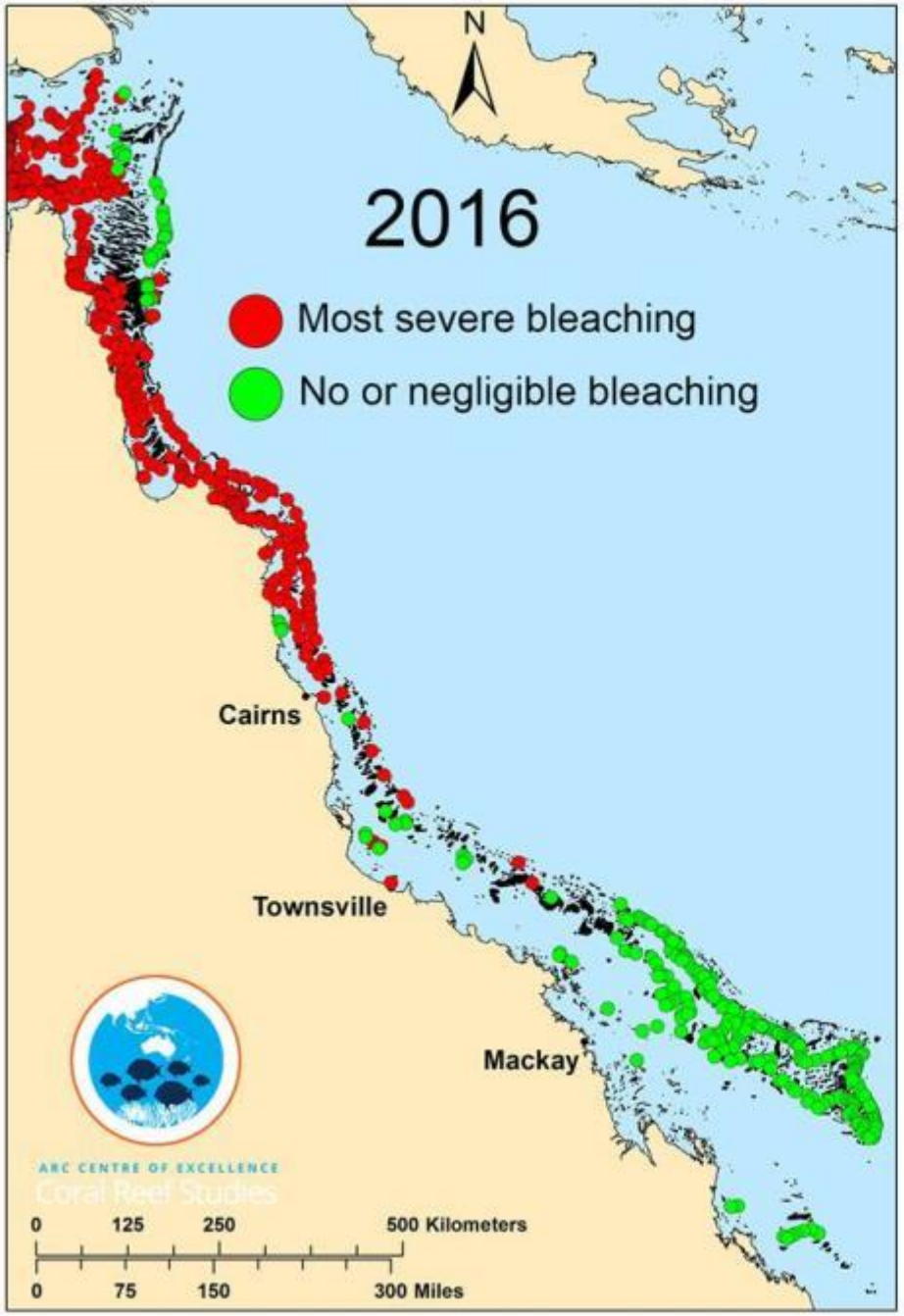
Delta program 2014

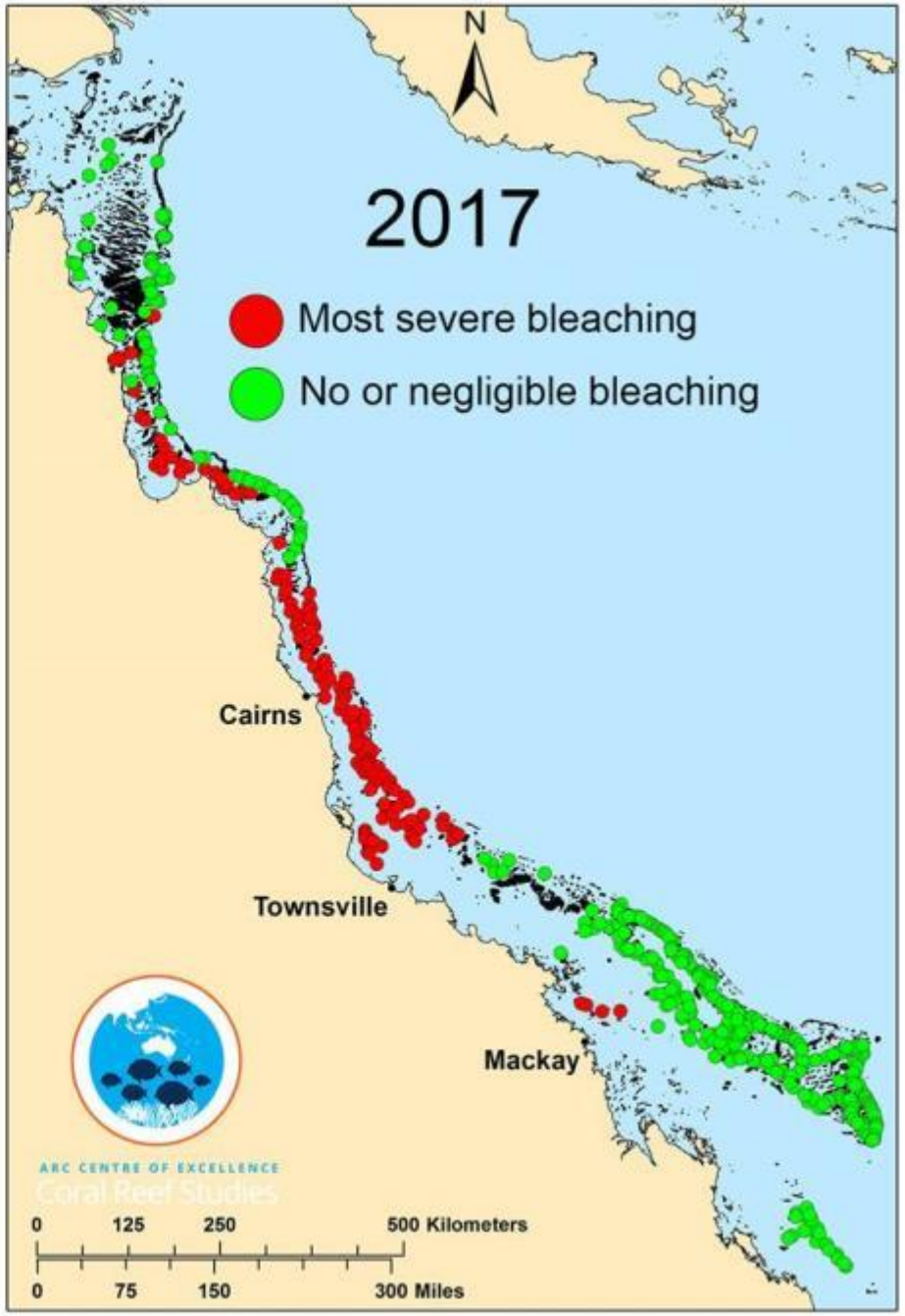
Deltaprogramma, Ministry of Infrastructure and Environment, 2014

SYDNEY

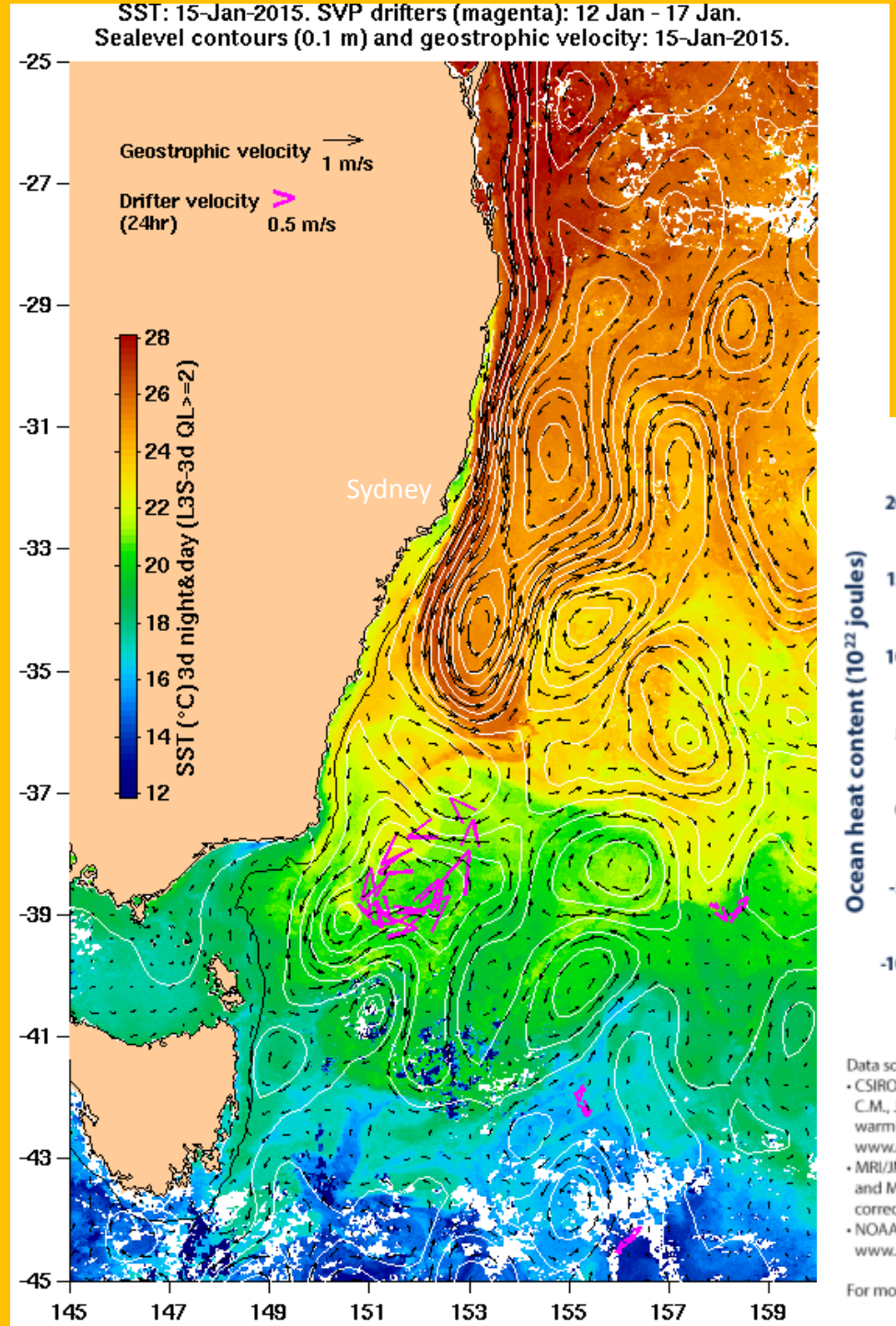
A Sydney Barrier Reef?

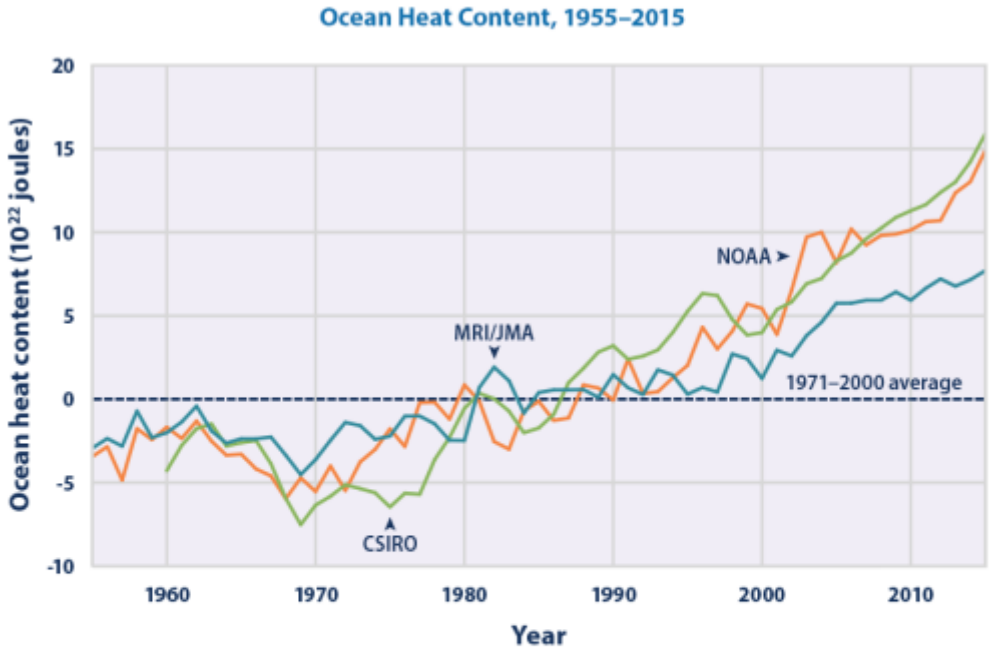
Great Barrier Reef


N
2016
Most severe bleaching
No or negligible bleaching
Cairns
Townsville
Mackay
ARC CENTRE OF EXCELLENCE
Coral Reef Studies
0 125 250 500 Kilometers
0 75 150 300 Miles


N
2017
Most severe bleaching
No or negligible bleaching
Cairns
Townsville
Mackay
ARC CENTRE OF EXCELLENCE
Coral Reef Studies
0 125 250 500 Kilometers
0 75 150 300 Miles

‘East Australia Current’ and rising temperatures of the southern Pacific

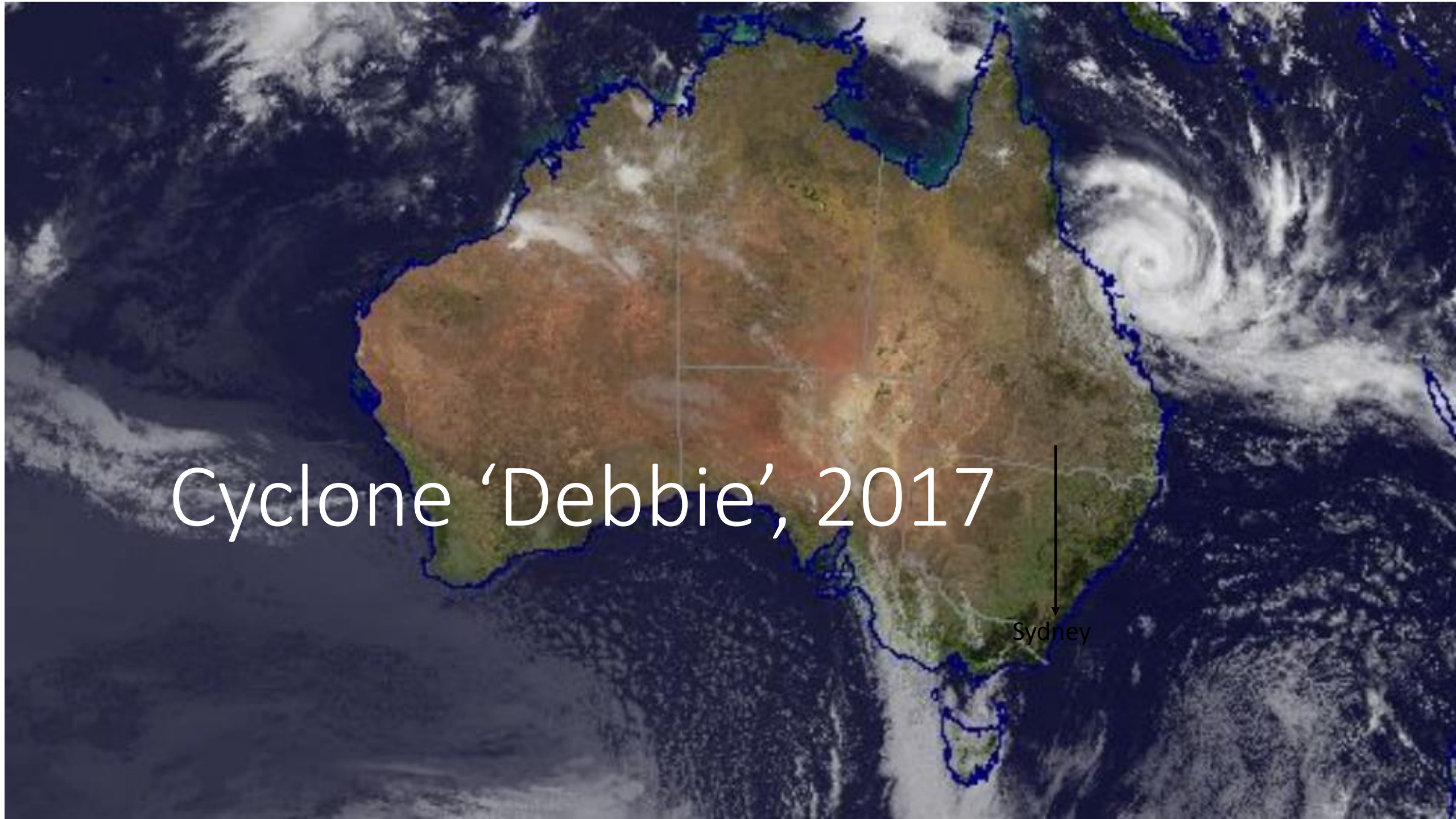




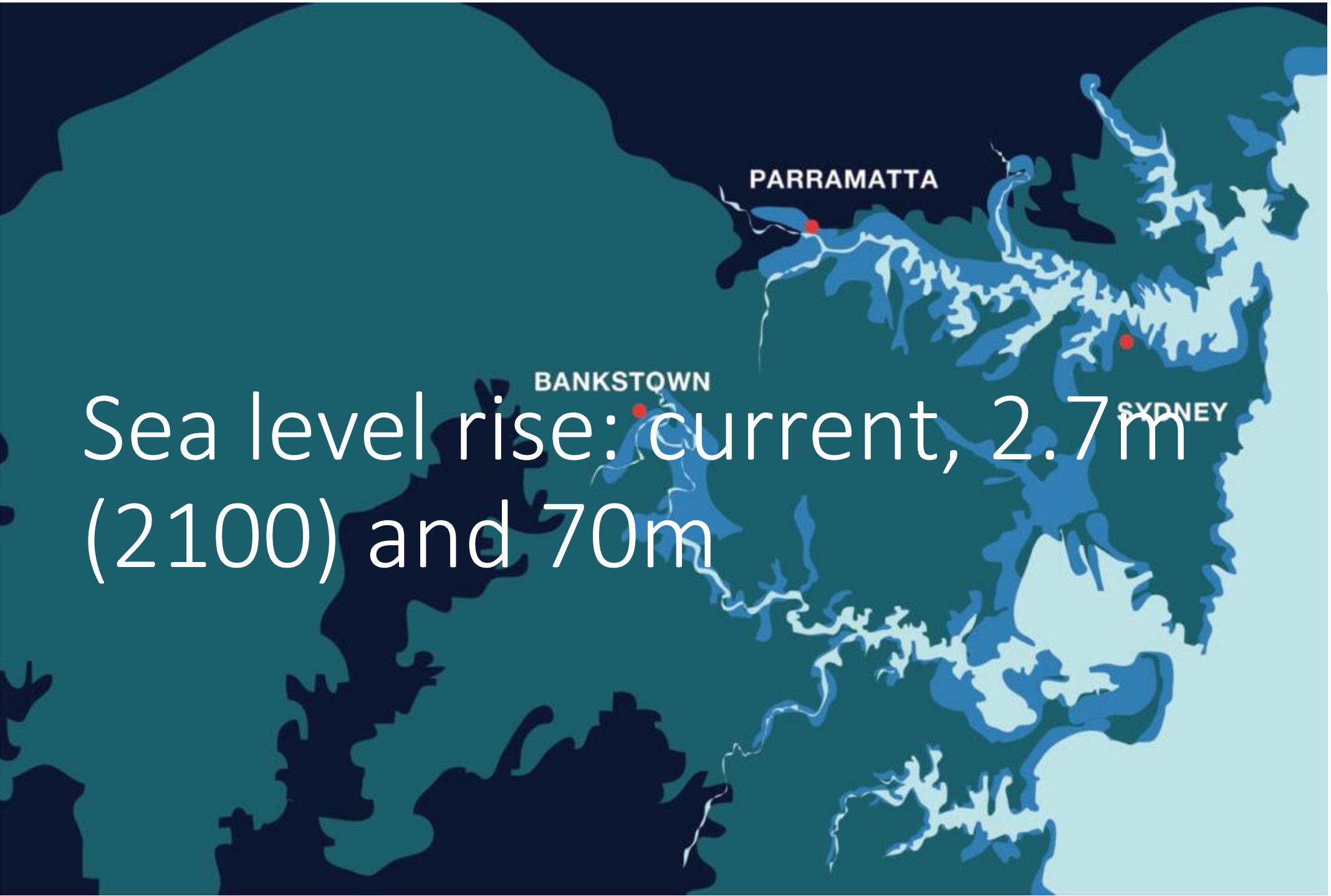
Data sources:

- CSIRO (Commonwealth Scientific and Industrial Research Organisation). 2016 update to data originally published in: Domingues, C.M., J.A. Church, N.J. White, P.J. Gleckler, S.E. Wijffels, P.M. Barker, and J.R. Dunn. 2008. Improved estimates of upper-ocean warming and multi-decadal sea-level rise. Nature 453:1090–1094. www.cmar.csiro.au/sealevel/thermal_expansion_ocean_heat_timeseries.html.
- MRI/JMA (Meteorological Research Institute/Japan Meteorological Agency). 2016 update to data originally published in: Ishii, M., and M. Kimoto. 2009. Reevaluation of historical ocean heat content variations with time-varying XBT and MBT depth bias corrections. J. Oceanogr. 65:287–299.
- NOAA (National Oceanic and Atmospheric Administration). 2016. Global ocean heat and salt content. Accessed May 2016. www.nodc.noaa.gov/OC5/3M_HEAT_CONTENT.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.


Cyclone ‘Debbie’, 2017
Sydney

Cyclone Debbie, Queensland



Sea level rise: current, 2.7m (2100) and 70m

Roggema, 2017


Bondi Beach, 2016


Abandoned oilrig

David Vaughan

Florida Keys

Micro-colony fusion

Coral expansion in Sydney and associated coral-reef fishes

David J. Booth & John Sear

Booth, D.J. & J. Sear (2018) Coral expansion in Sydney and associated coral-reef fishes. *Coral Reefs. Journal of the International Society for Reef Studies.*
DOI 10.1007/s00338-018-1727-5

Great Sydney Sea Barrier and Tidal Plant

Image: Andy van den Dobbelsteen

Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017

Tidal plant and surge barrier

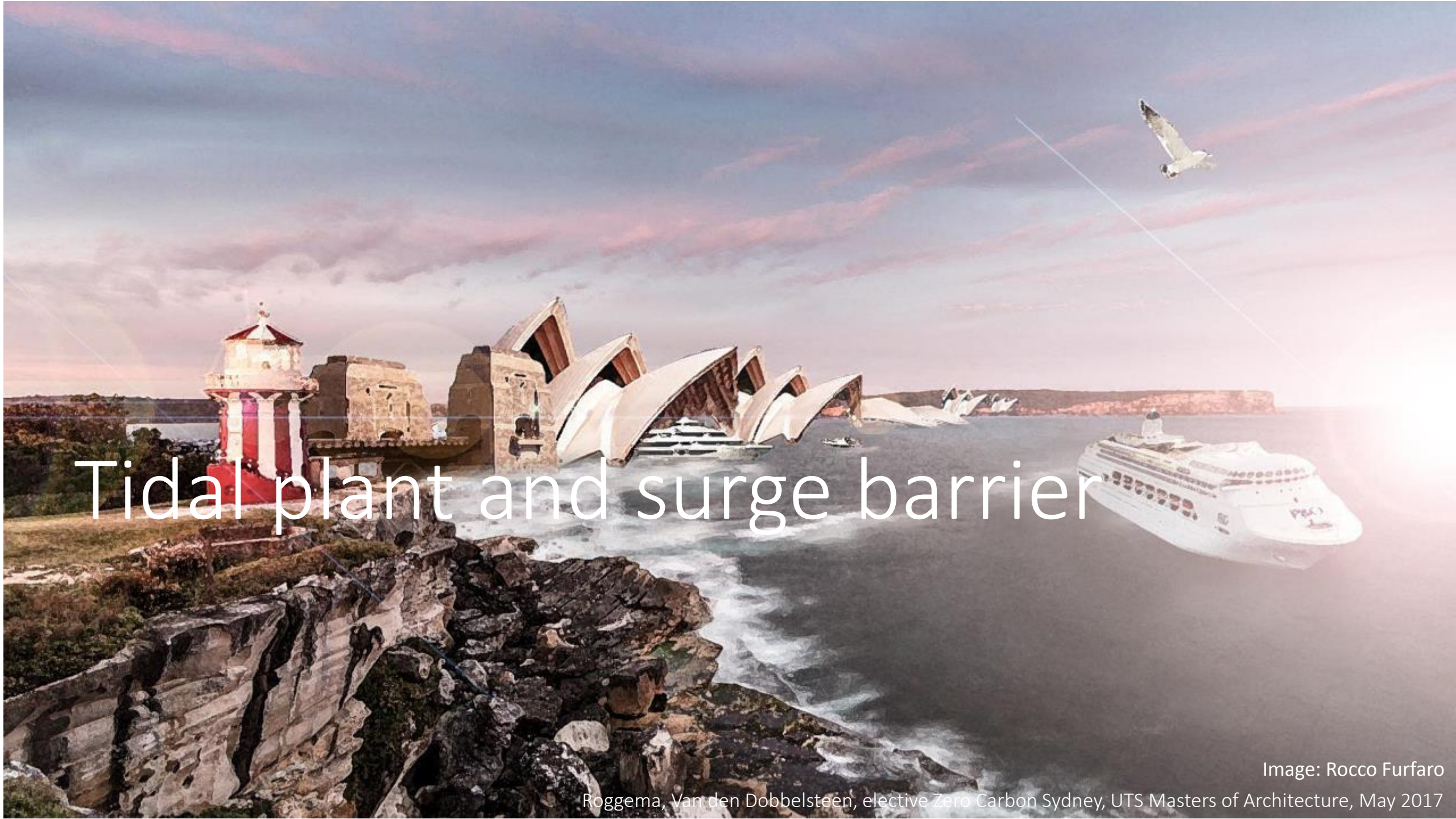
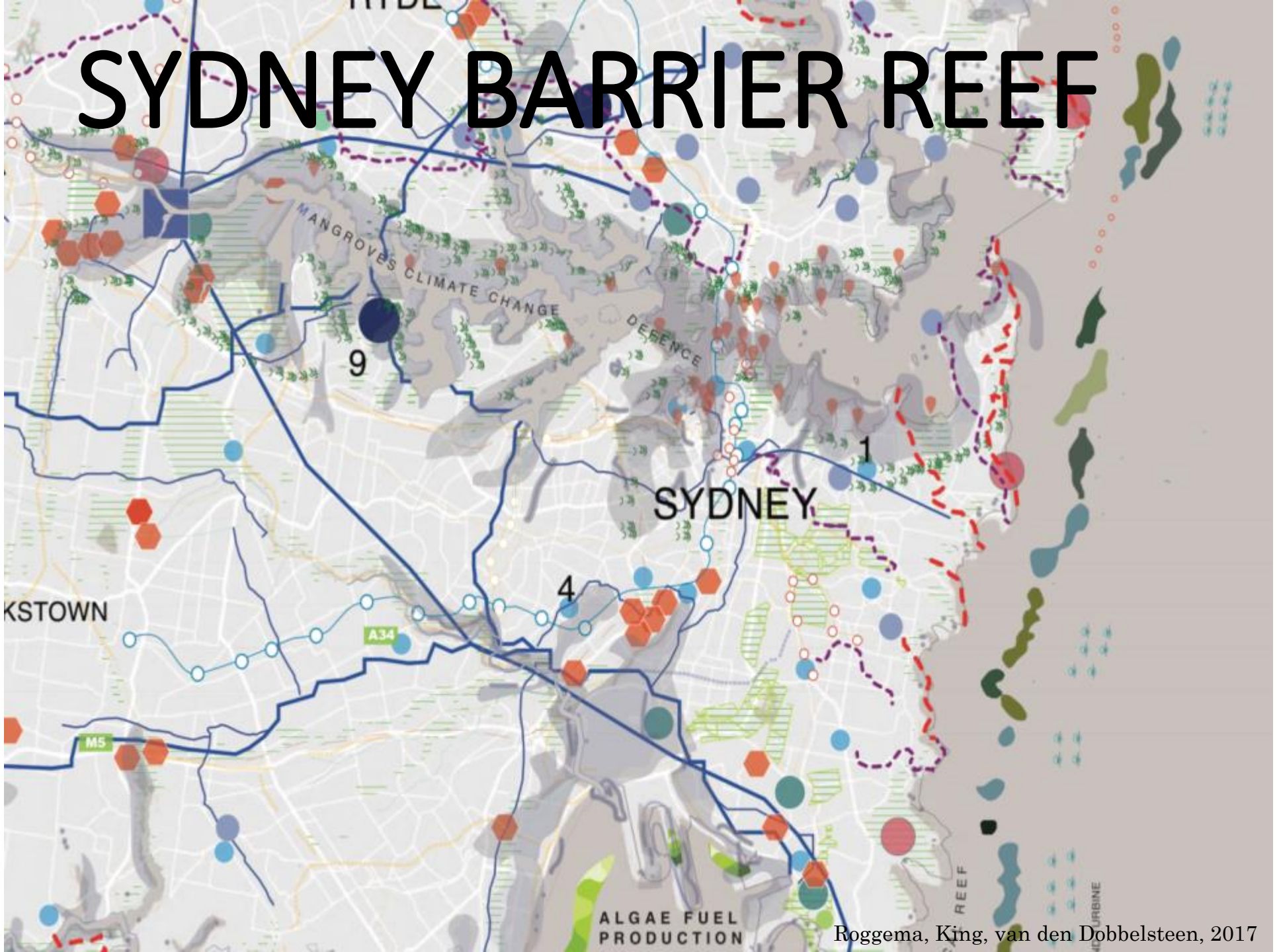


Image: Rocco Furfaro

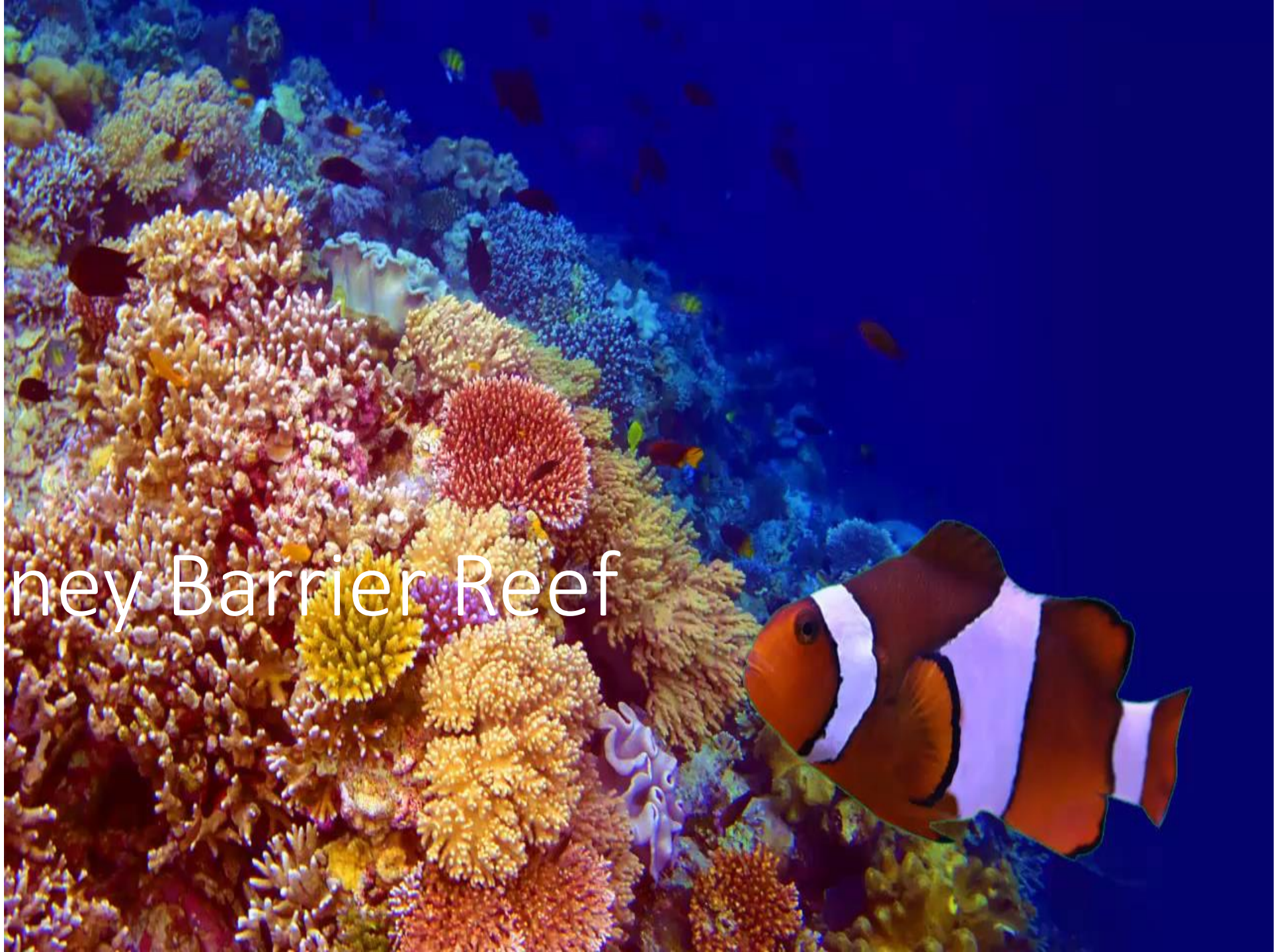
Roggema, Van den Dobbelsteen, elective Zero Carbon Sydney, UTS Masters of Architecture, May 2017

SYDNEY BARRIER REEF

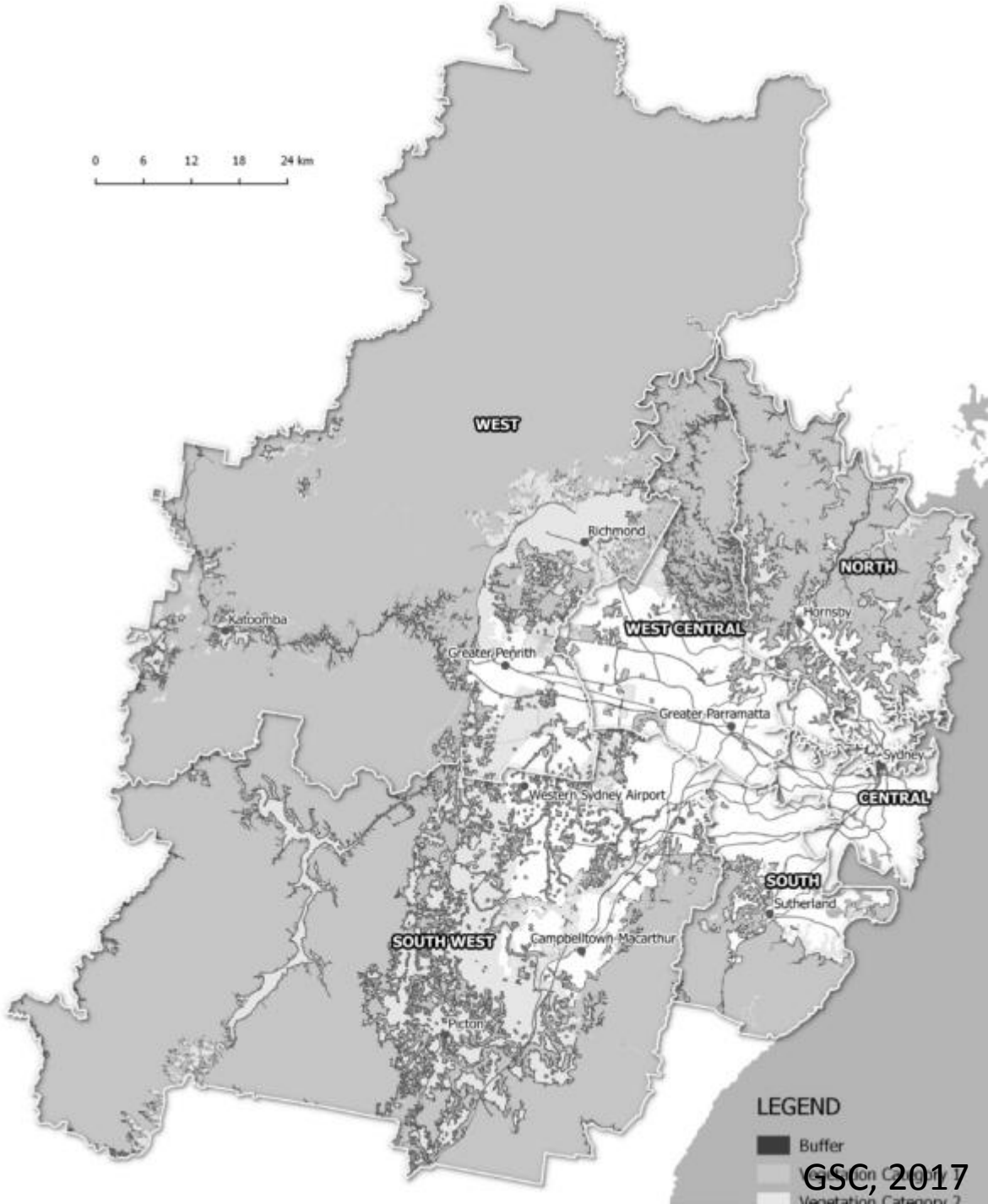


Roggema, King, van den Dobbelsteen, 2017

Sydney Barrier Reef



Bushfire risk



GSC, 2017

Bushfire

Black Saturday, 7 February 2009

Bushfire

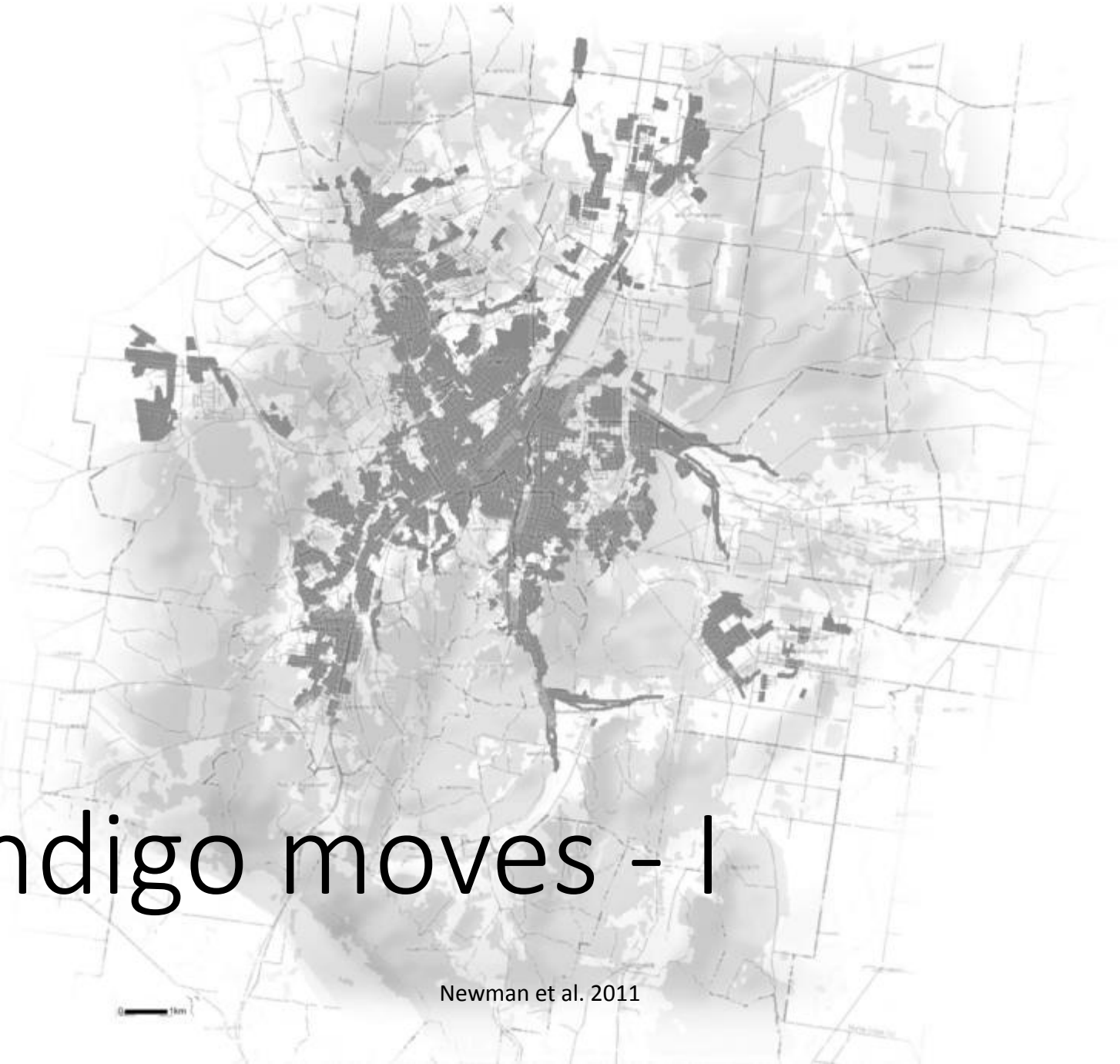
Melbourne, 7 February 2009

Spatial Strategy

Intervention not to rebuild influences the entire system

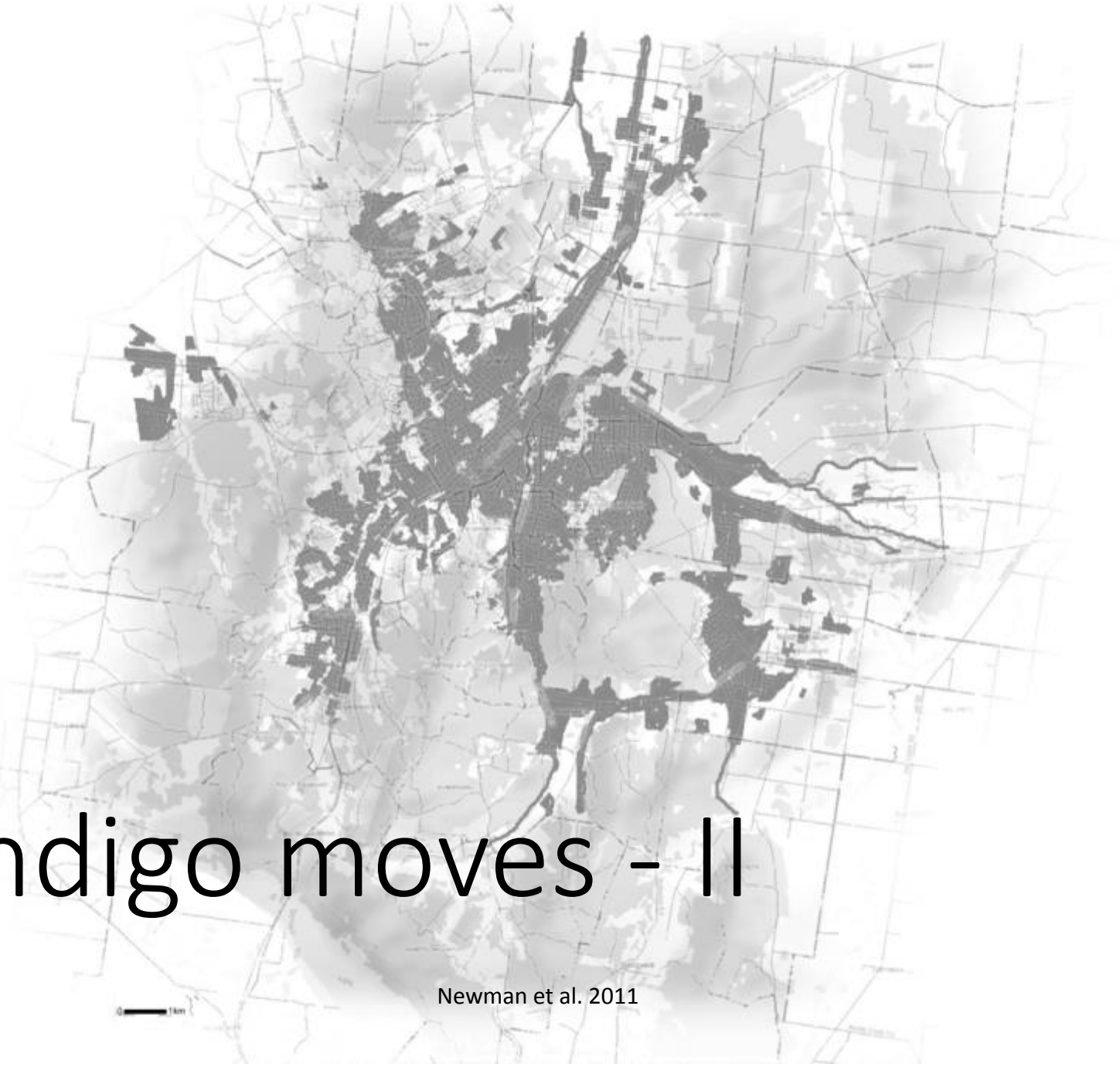
Bendigo’s Edge

Developing a protective shield, pillar after pillar



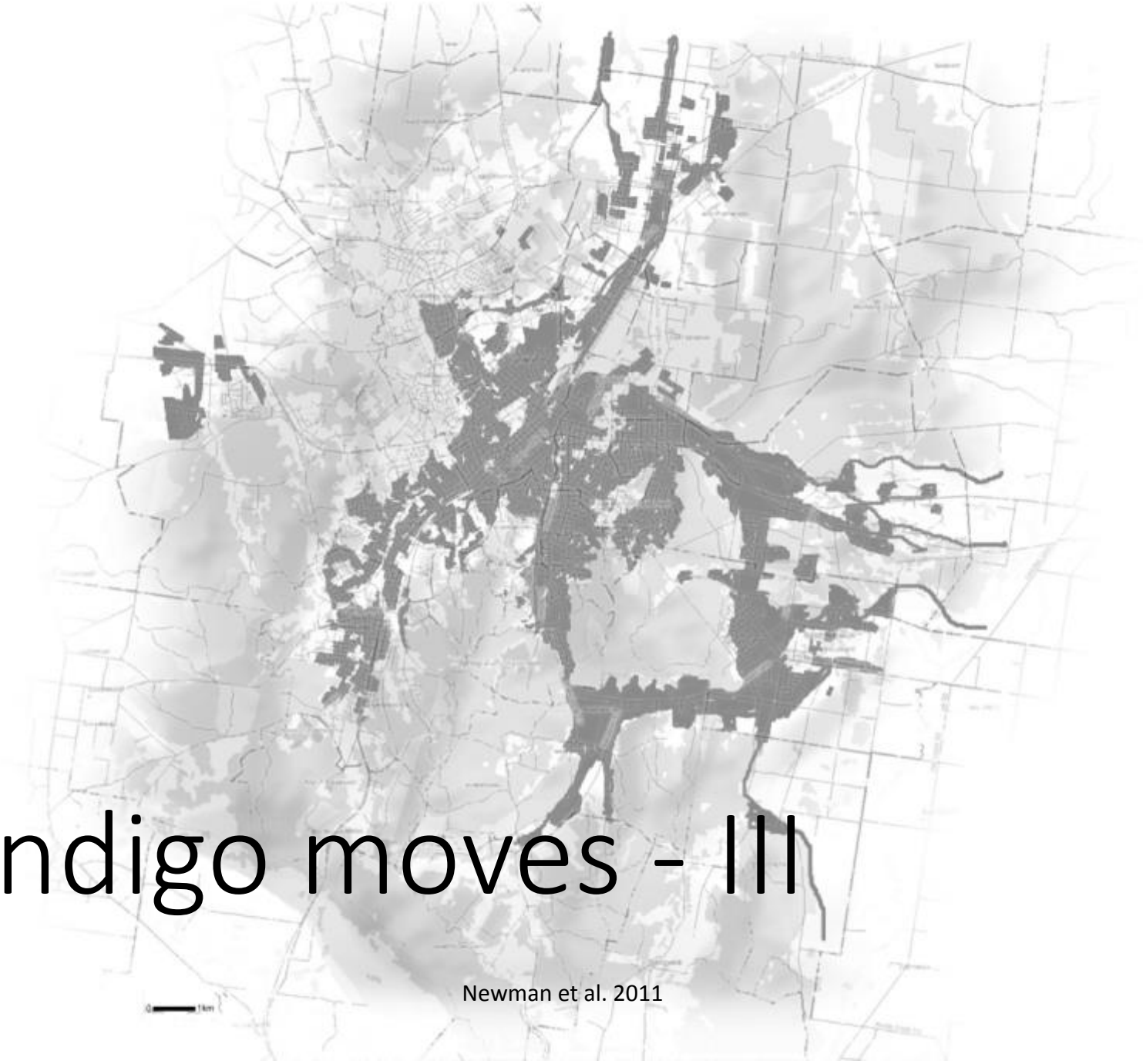
Bendigo moves - I

Newman et al. 2011



Bendigo moves - II

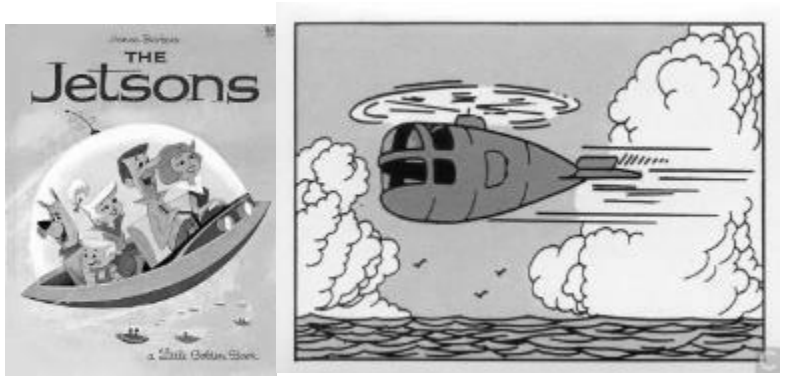
Newman et al. 2011



Bendigo moves - III

Newman et al. 2011


Air



Fantasy?

Jetsons, Suske & Wiske, Citti Citti Bang Bang

Back to the Future, Blade Runner, Star Wars

Reality!

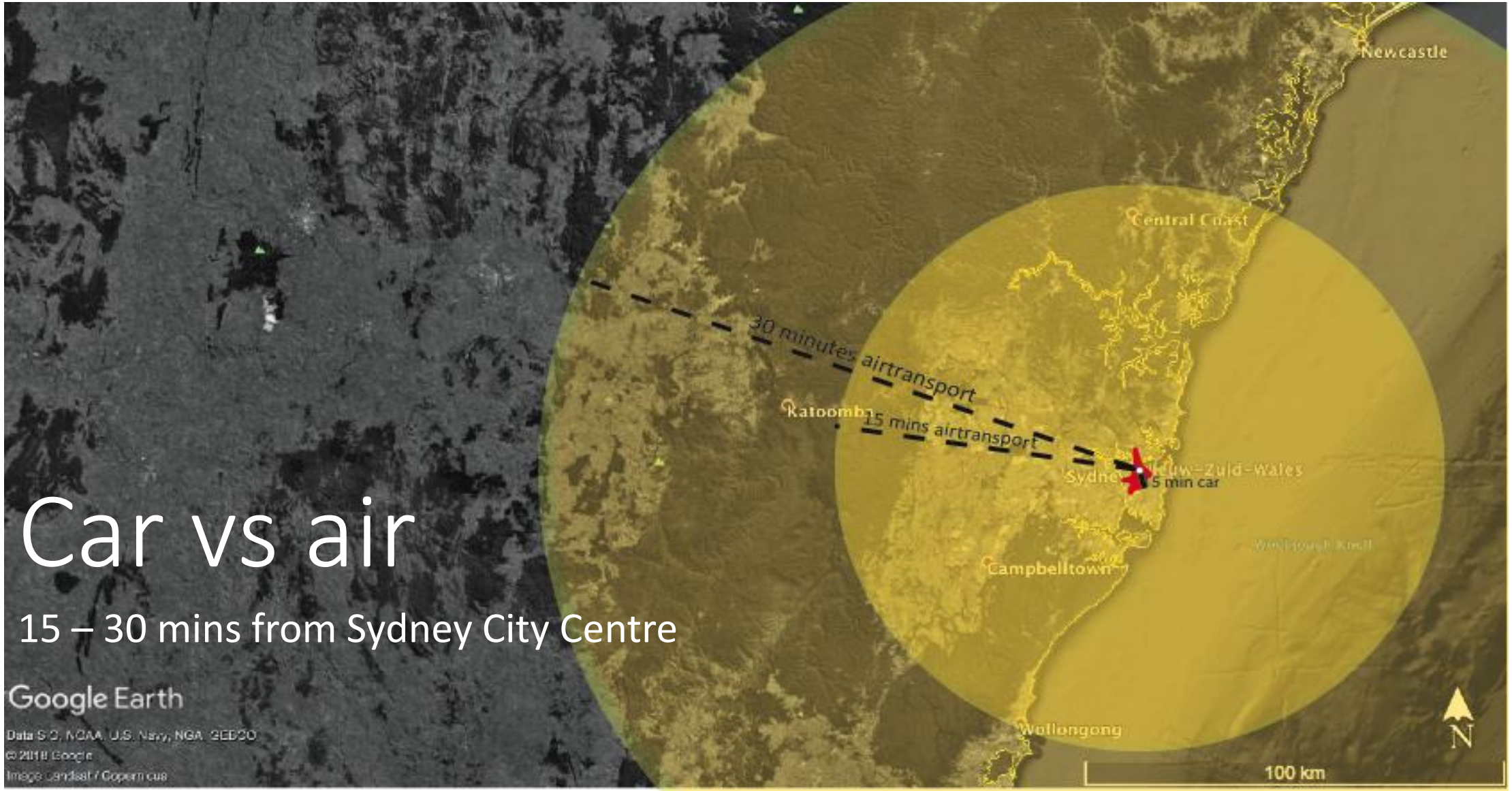
Amazon, Bell Air (Boeing), Lillium

Uber, Volocopter, Surefly

	UberX	VTOL
San Francisco-San Jose	56.9 miles 1.40 hrs	43.3 miles 15 mins
Sao Paulo	73.8 miles 2.10 hrs	51.3 miles 18 mins
Haryana-New Delhi	19.6 miles 1.40 hrs	12.3 miles 6 mins
Manhattan-JFK	26 km 55 mins	19 km 5 mins

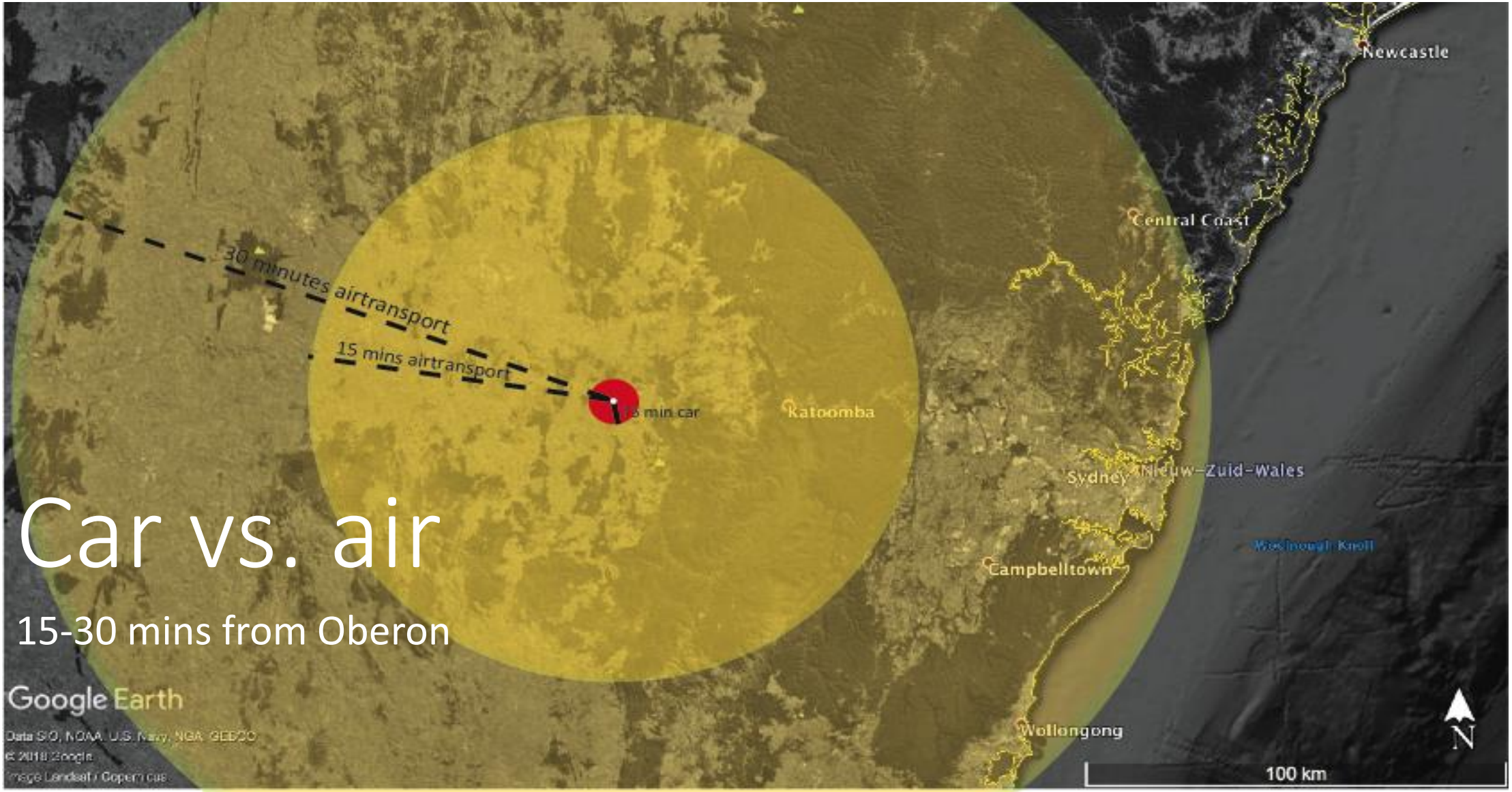
Car vs air

15 mins from Sydney City Centre



Car vs air

15 – 30 mins from Sydney City Centre



Car vs. air

15-30 mins from Oberon

Barriers

Culture and habits

Education

Political will

Vested interests

Barriers

Culture and habits

Education

Political will

Vested interests

Barriers

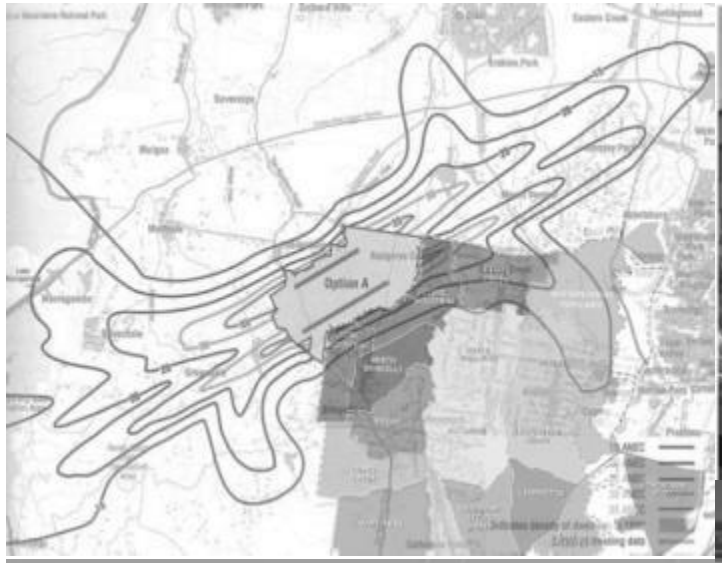
Culture and habits

Education

Political will

Vested interests

Barriers



Culture and habits

Education

Political will

Vested interests


BE FAST! ACT NOW!
Don’t wait for more certainty,
more facts, more research
It’ll never be enough

Thank you!

rob@cittaideale.eu