APEC Workshop
"Doubling Renewable Energy in the APEC Region"
25-26 March, 2017
Jeju, Republic of Korea

The Role of Clean Energy in staying below the 2°C target – A Real Opportunity or An Impossible Dream?

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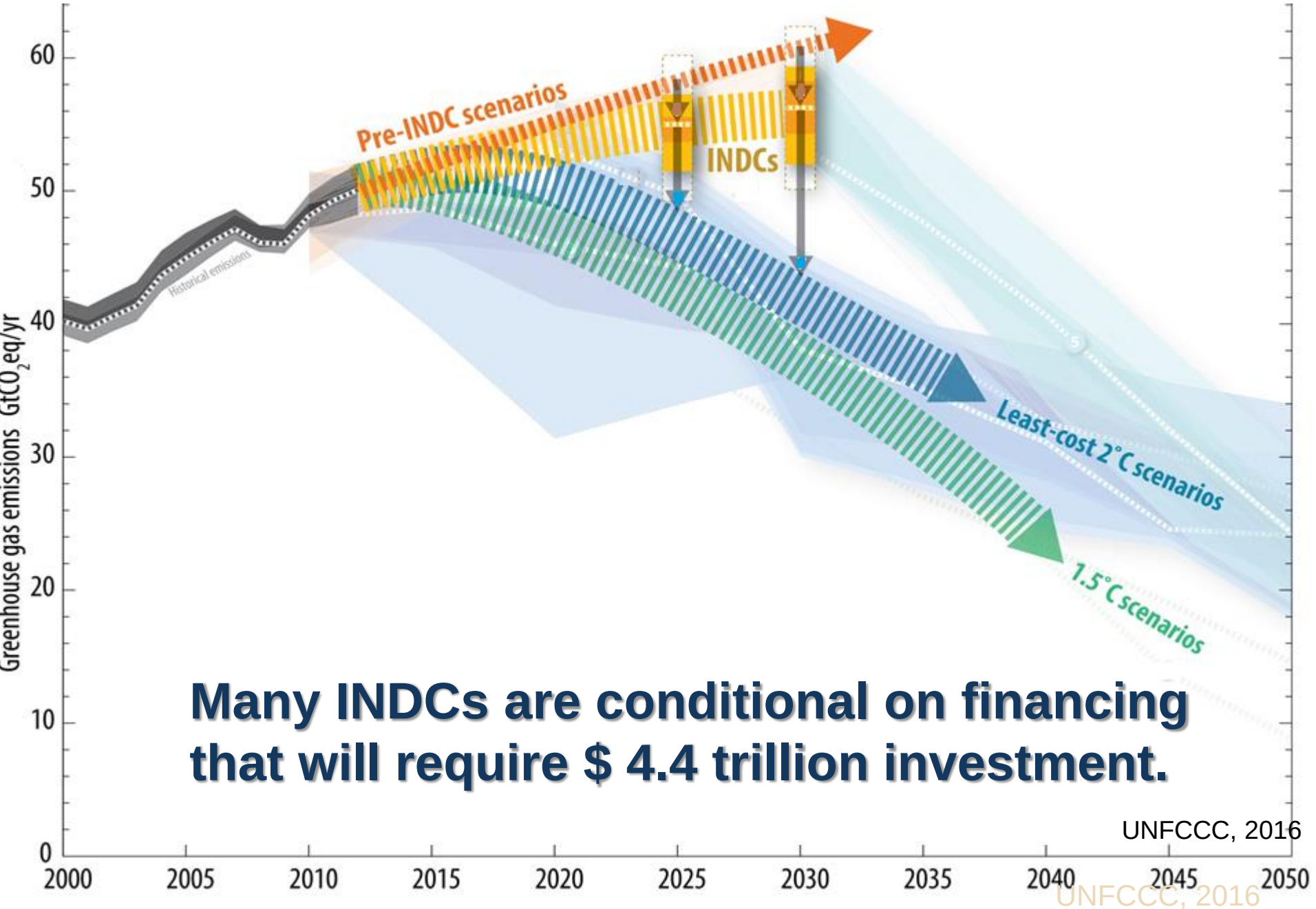
So what has happened in the past year?....

- World population increased by around 78 million.
- Around 1.3 million people per day moved into cities.
- US$ 286 billion was invested in renewable energy.
- Battery, wind turbine and solar PV prices reduced further.
- Electric vehicle sales grew 50% as did car-sharing schemes
- The 17 Sustainable Development Goals were endorsed.
- 2016 was warmest year ever recorded; (1909 the coldest).
- Extreme weather events around the world increased.
- Sea level rose 3.3 mm as confirmed by satellite and surface data. (200 million people live less than 1m above sea level).
- Thousands of refugees fled into Europe and elsewhere.
- The Paris Climate Agreement came into legal force.
- Trump became President of the USA and aims to support fossil fuels and renegotiate the Paris Agreement.
- We continued to move further into the *Anthropocene age* with the major Planetary Boundaries being exceeded as a result of the “Great Acceleration”.


Population
Real GDP
Foreign investment
Urban population
Primary energy
Fertiliser
Large dams
Water use
Paper
Automobiles
Atmospheric CO2
Surface temperature
We cannot continue along these exponential pathways so innovative solutions are urgently required to protect the "Global Commons".

The Agreement came into force in November 2016. Currently the rules are under negotiation (including in Marrakech at COP 22) and will be completed by 2018 - hopefully!

The current pledges are totally inadequate

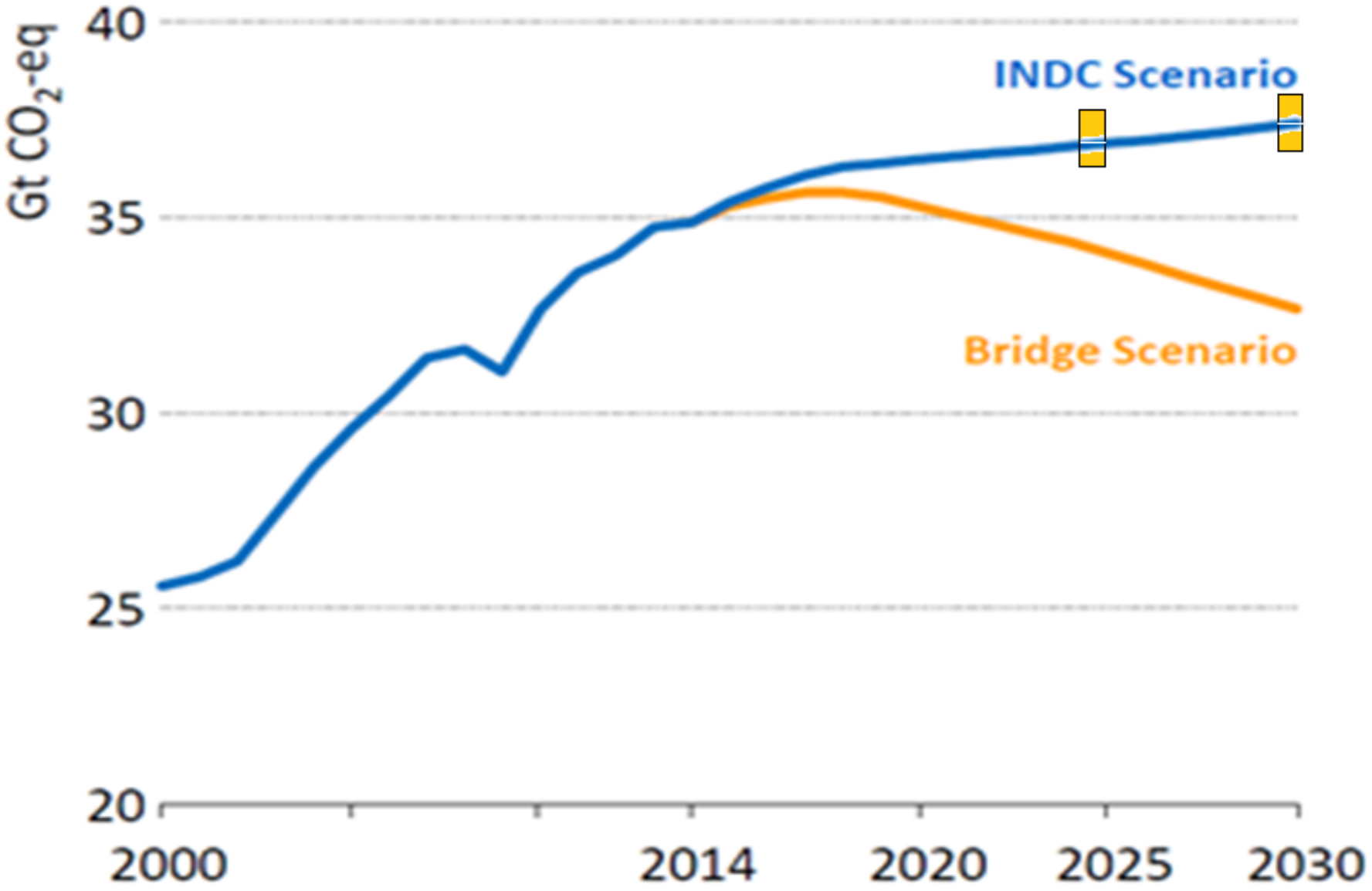


Many INDCs are conditional on financing that will require $ 4.4 trillion investment.

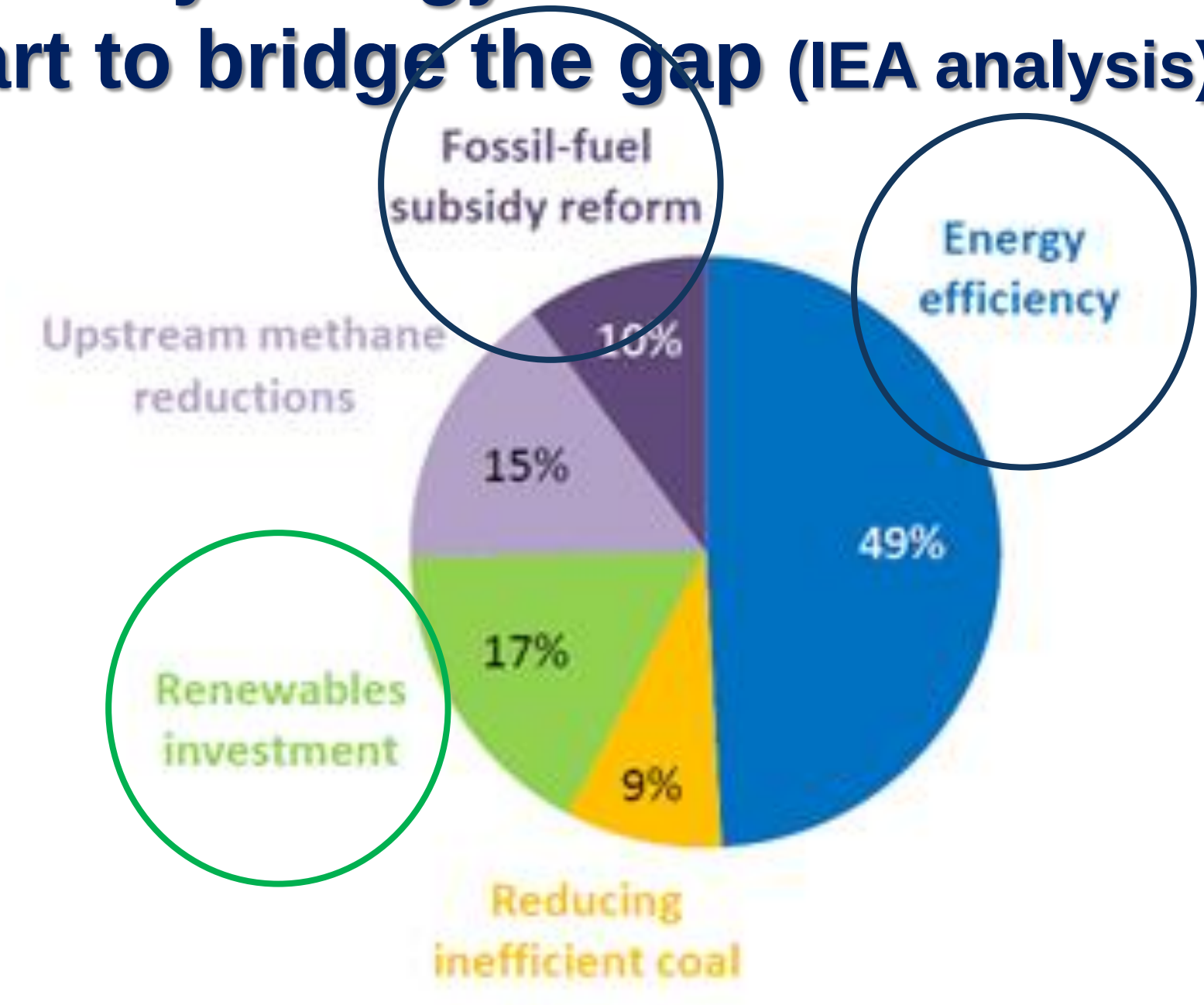
UNFCCC, 2016

UNFCCC, 2016

The gap between INDC pledges and what is needed to be on the 2ºC pathway can be bridged (IEA analysis)



Five key energy measures that can start to bridge the gap (IEA analysis)



Fossil Fuel Subsidy Reform

At the Paris COP 21:

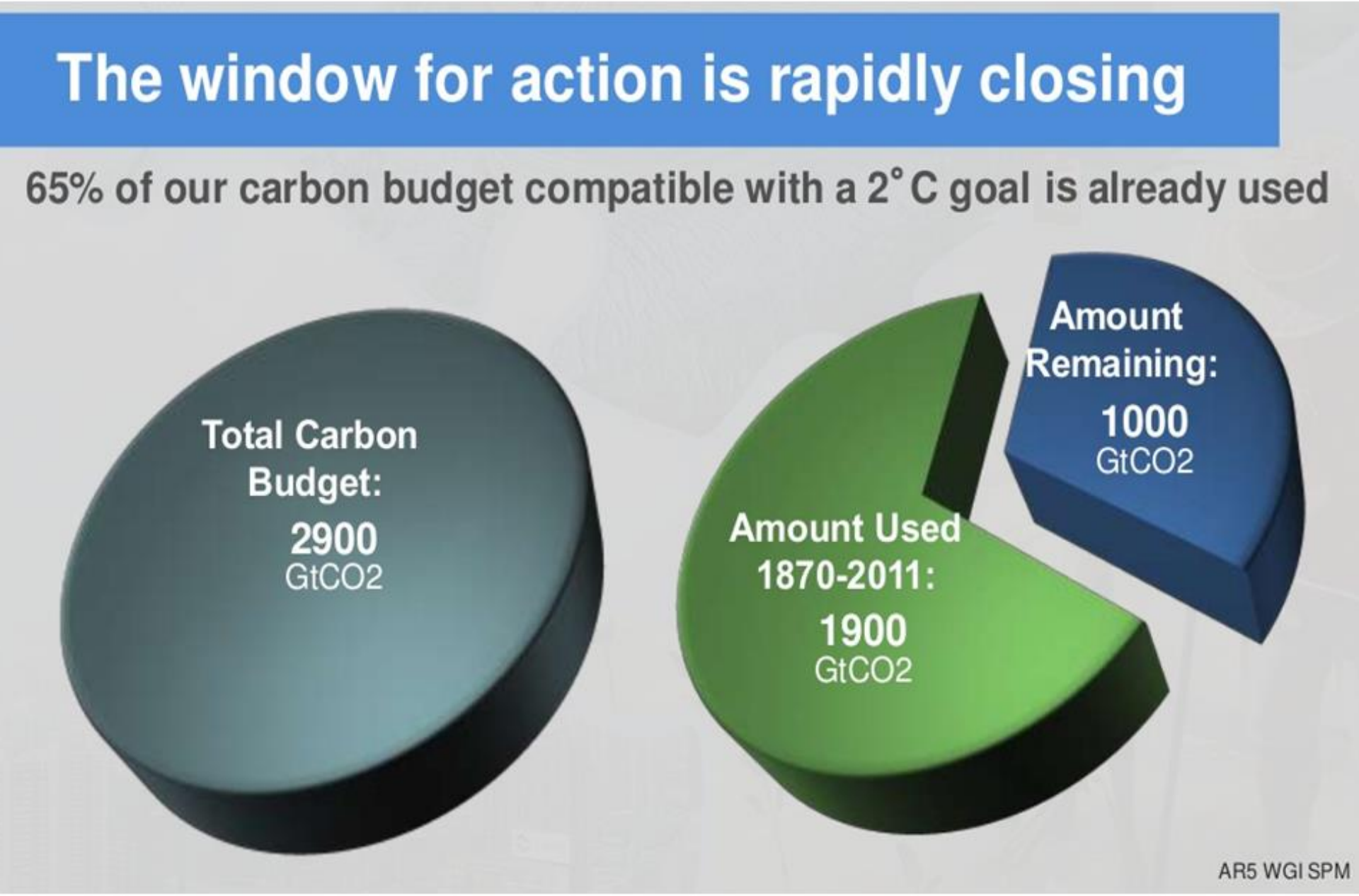
1) New Zealand's prime minister John Key presented the communiqué from the "Friends of Fossil Fuel Subsidy Reform" to the UNFCCC.

2) IEA Executive Director, Dr Fatih Birol, stated:

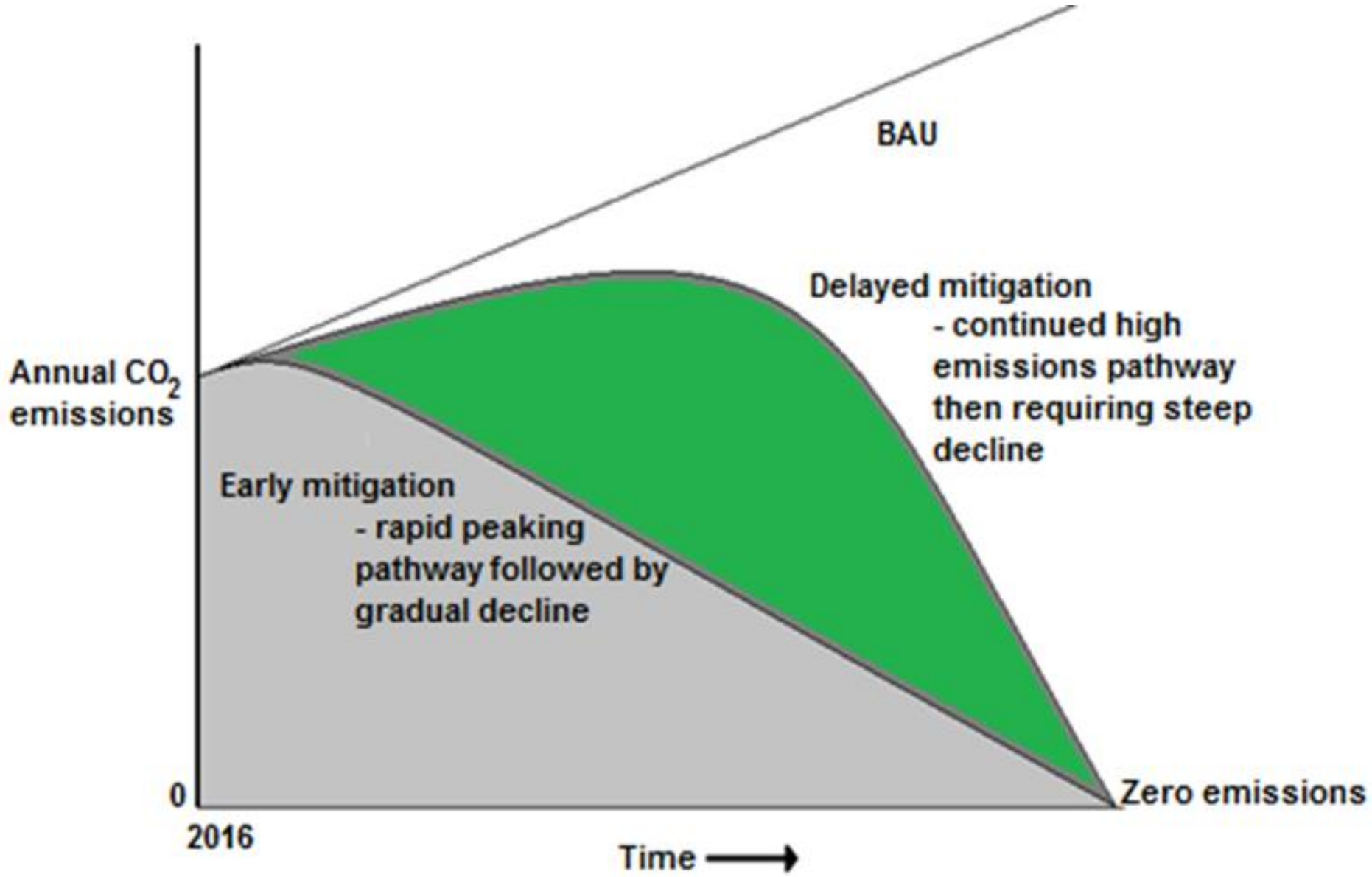
- **Fossil fuel subsidies presently provide support for fossil fuel combustion equating to around $110 / t CO_2 emissions.**
- **The typical current carbon price from emission trading schemes increases the cost of fossil fuel combustion by only around $10 /t CO_2 !**


So now the Paris Climate Agreement has come into force, all countries will need to do something to reduce carbon footprints – and gain the societal co-benefits.!

How much more Carbon can we release?



Delaying mitigation actions is not an option.

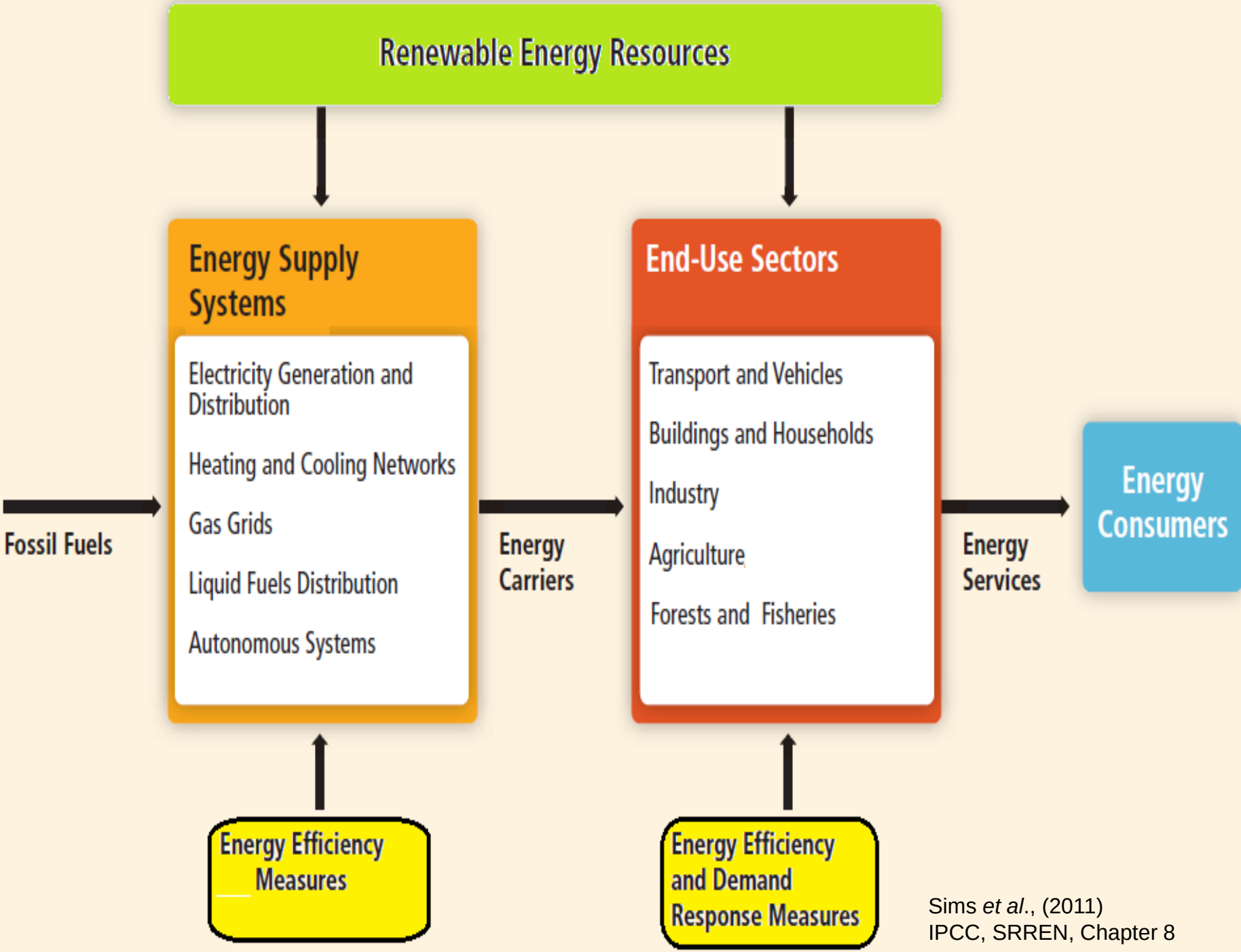


Renewable energy is key over the long-term

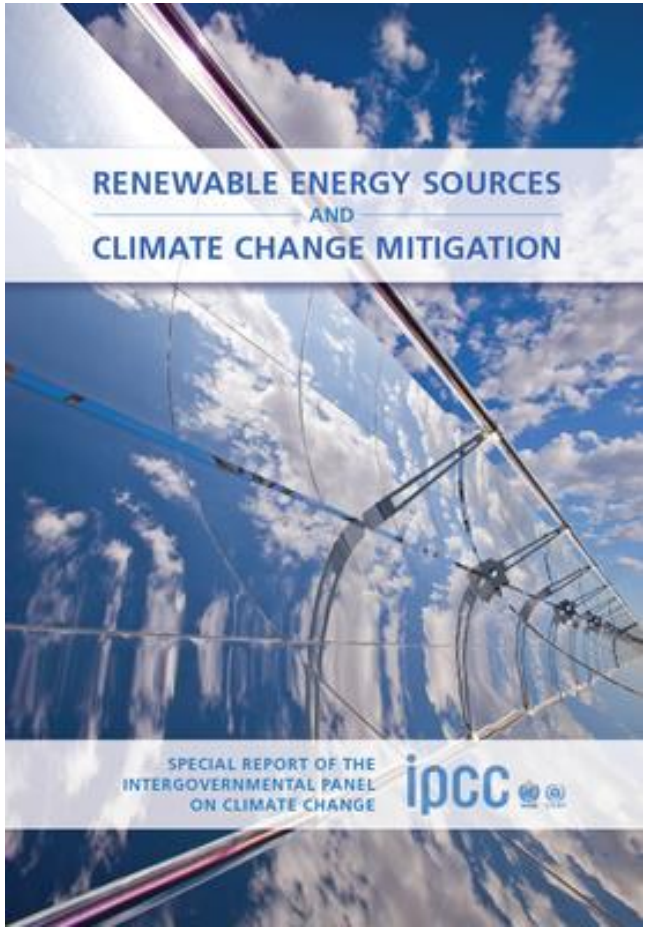
- Solar, wind and smart-grid systems are expanding as technologies evolve and costs decline.
- Geothermal and hydro have good potential but partly constrained by location and environmental impacts.
- Bioenergy from crop and forest residues, and from animal and other bio-wastes, has good potential throughout the APEC region and elsewhere:

"It can play a critical role for mitigation, but there are issues to consider, such as the sustainability of practices and the efficiency of bioenergy systems to provide heat, power, and biofuels for transport." **IPCC AR5 Mitigation (2014)**

- IPCC SRREN (2011) scenarios identified that renewables could mitigate around one third of global cumulative energy-related CO_2 emissions up to 2050.
- Energy efficiency also has a major role to play.



Sims *et al*., (2011)
IPCC, SRREN, Chapter 8



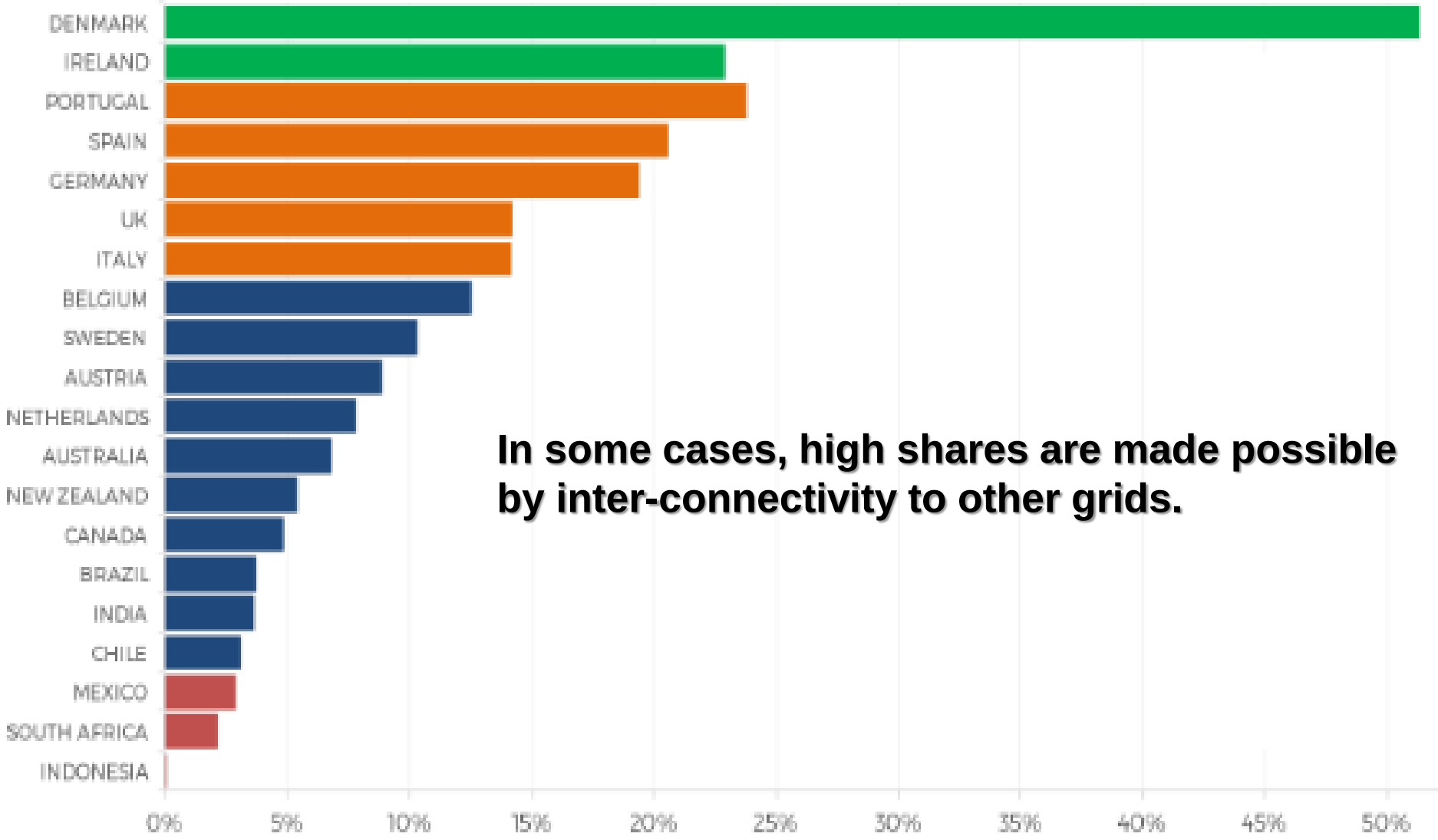
Sims *et al*., 2011. Integration of Renewable Energy into Present and Future Energy Systems. Chapter 8, IPCC SRREN. http://www.ipcc.ch/report/srren/

To achieve higher renewable energy shares than the low levels typically found in present energy supply systems, will require additional integration efforts.

These include:

- **improved understanding of the resource characteristics and availability,**
- **investments in enabling infrastructure and RD&D,**
- **modifications to institutional and governance frameworks,**
- **innovative thinking,**
- **attention to social aspects, markets and planning, and**
- **capacity building in anticipation of further renewable energy growth.**

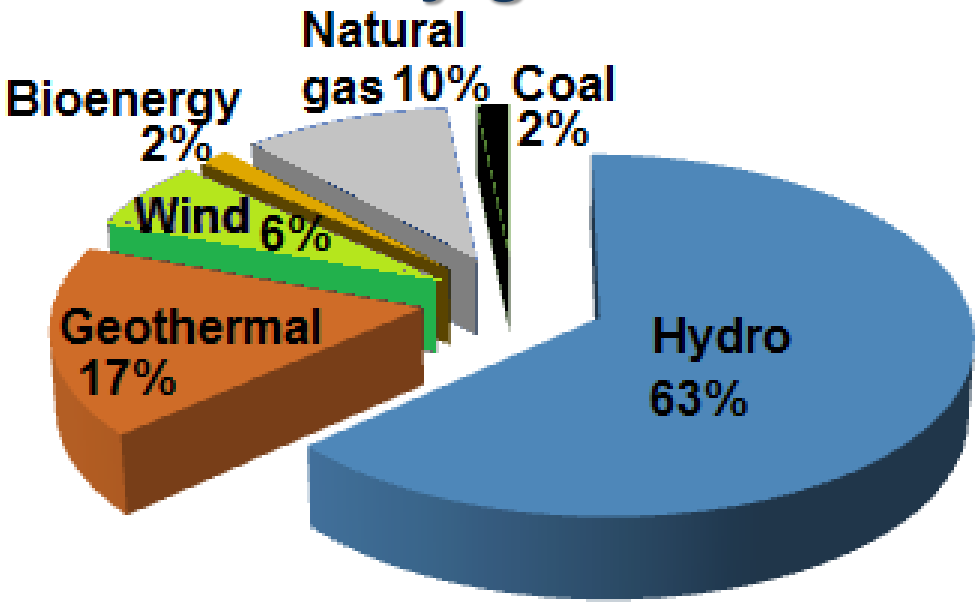
Shares of variable renewable energy generation in the electricity mix



In some cases, high shares are made possible by inter-connectivity to other grids.

IEA, 2017. *Getting wind and solar on to the grid.*
http://www.iea.org/publications/insights/insightpublications/getting-wind-and-solar-onto-the-grid.html

New Zealand has reached 88% renewable electricity generation – without any government intervention.



Solar PV is only 0.2% but growing fast.

We will reach our 90% target by 2025, and could fully decarbonise the electricity sector by mid-century.
Unless a breakthrough is made in energy storage, natural gas may have to be used for stand-by back-up in dry hydro years.
Forests, soil or CCS can offset this to get net zero emissions.

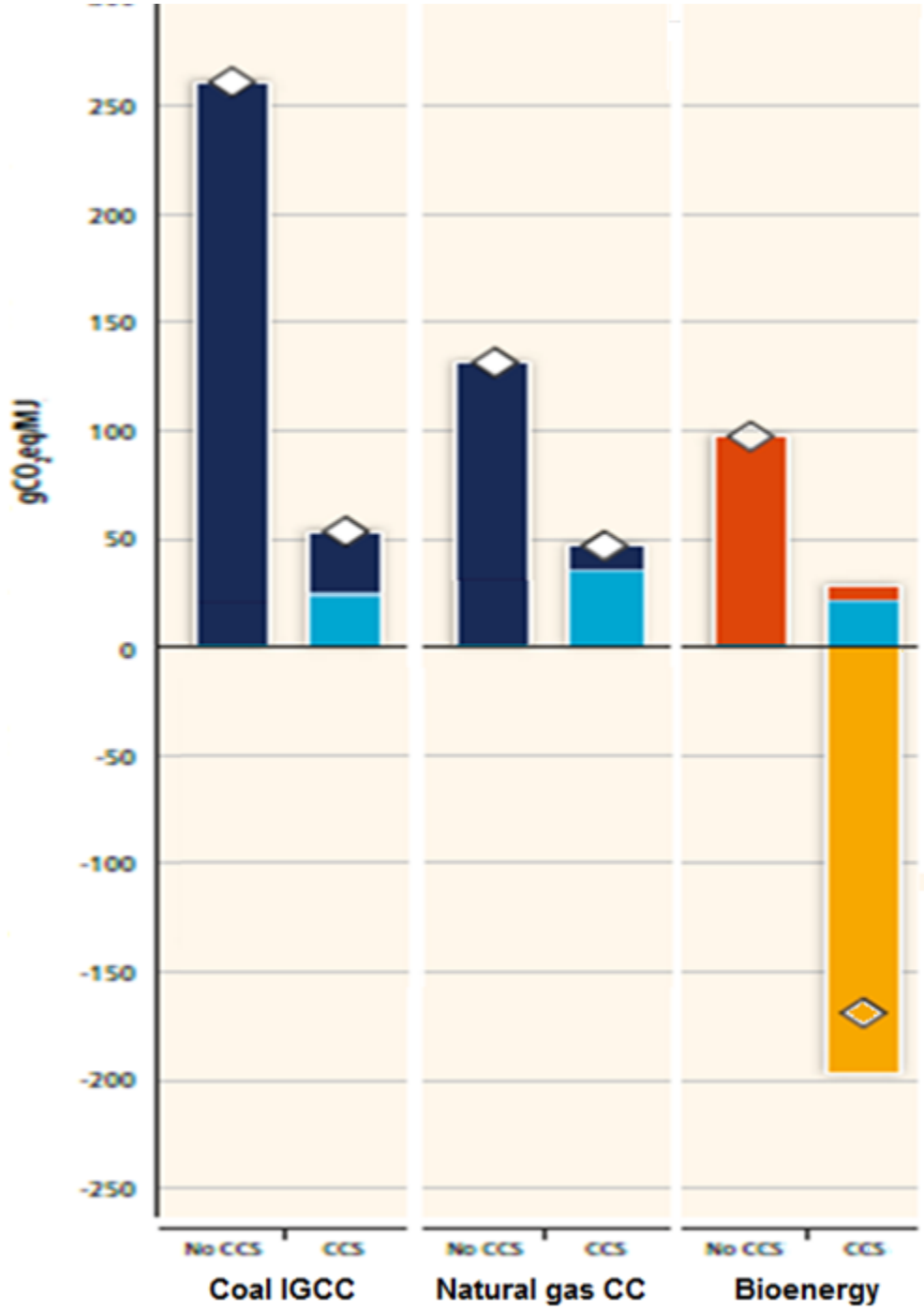
Overall however, New Zealand is only 40% *renewable energy* due to the dependence of heat and transport on fossil fuels.

Carbon dioxide capture and storage.

In IPCC AR5 scenarios, negative emissions are needed after mid-century to achieve stabilisation below 2°C.

- **"Combining bioenergy with CCS (BECCS) offers the prospect of energy supply with large-scale net negative emissions.**
- **It plays an important role in many long-run stabilization scenarios.**
- **However, it entails challenges and risks associated with the upstream large-scale provision of the biomass as well as those risks associated with the CCS technology itself."**

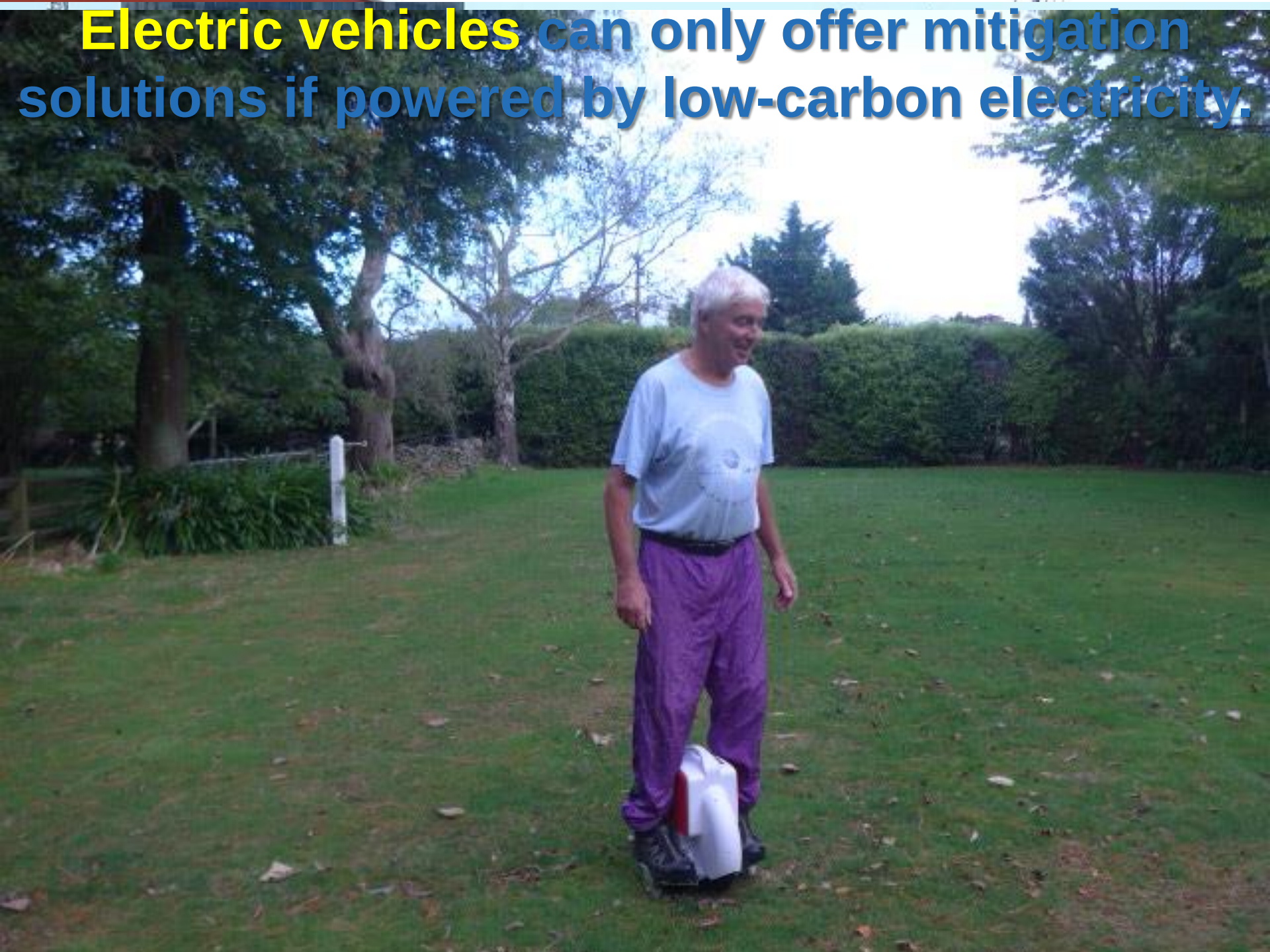
IPCC AR5 Mitigation (2014) Chapters 6, 7 and 11



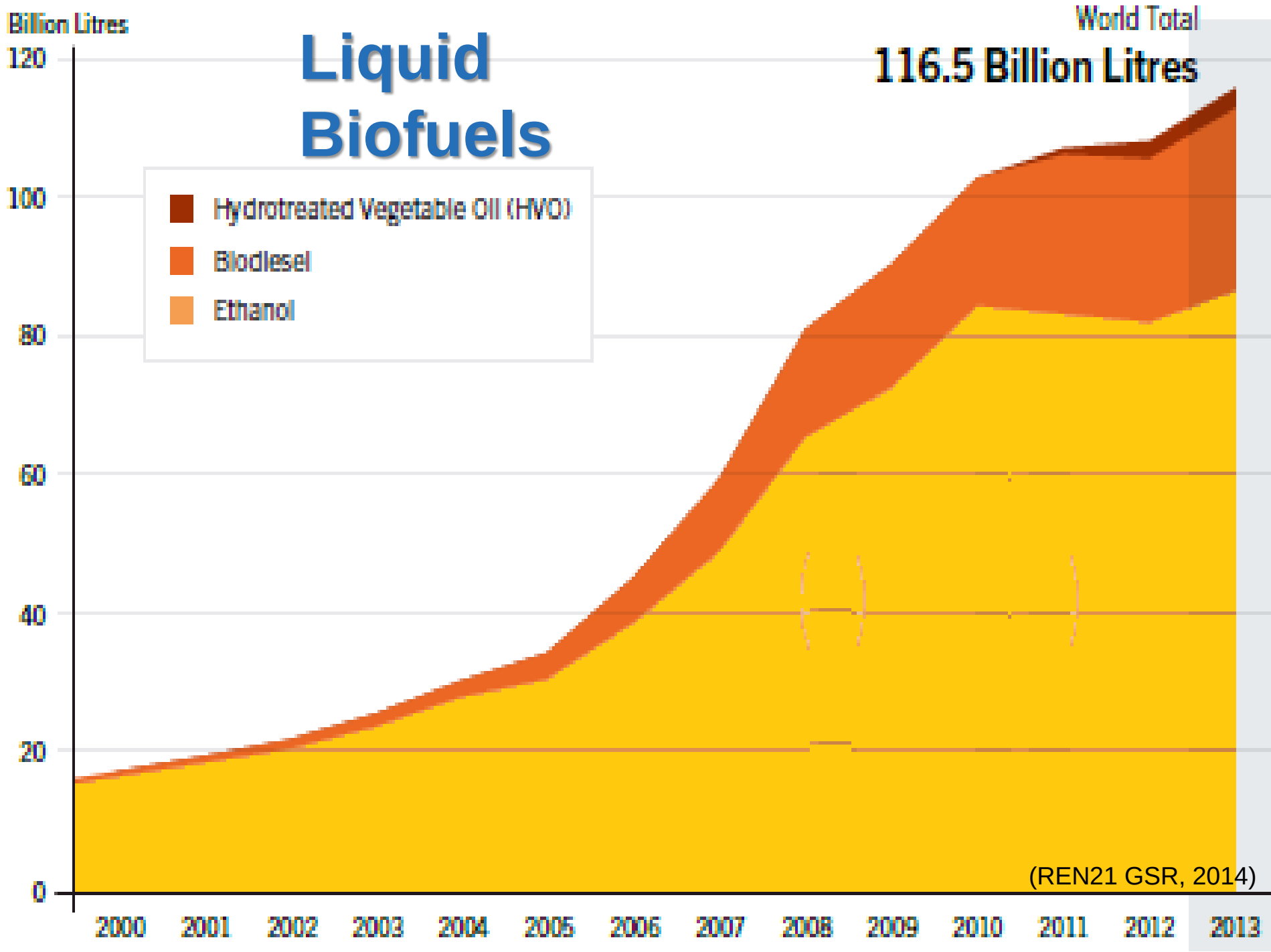
GHG emissions from coal, gas and bioenergy electricity generation systems with and without CCS.

A BECCS demonstration plant should be the next step.

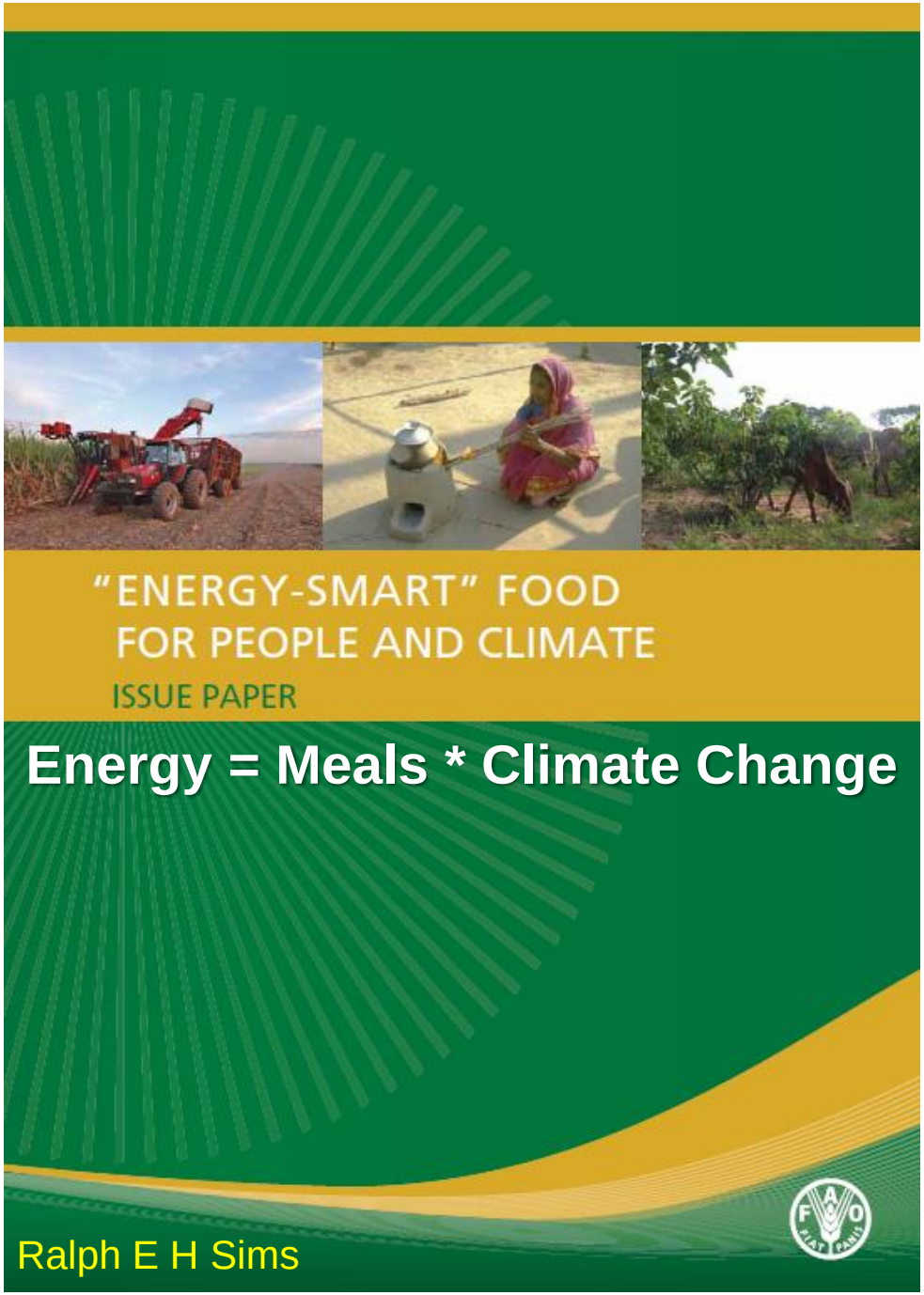
IPCC AR5 Mitigation (2014)
Chapter 7


Electric vehicles can only offer mitigation solutions if powered by low-carbon electricity.

Liquid Biofuels



(REN21 GSR, 2014)



http://www.fao.org/docrep/014/i2454e/i2454e00.pdf

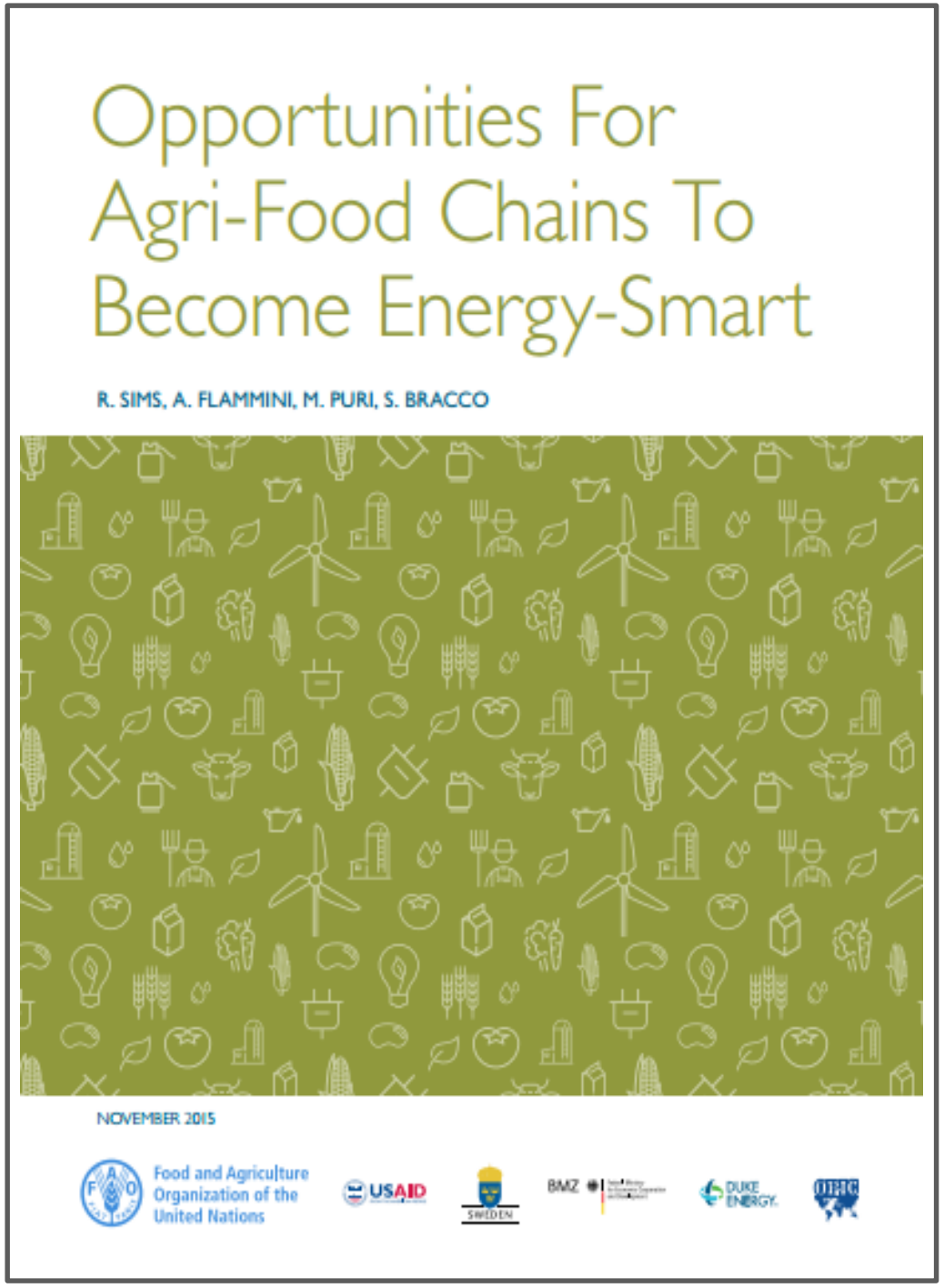
Key messages:

The food/energy/water nexus is critical to maintain productivity.

Renewable energy and energy efficiency can be integrated throughout the agri-food supply chain.

Need to transition away from animal proteins to vegetable proteins.

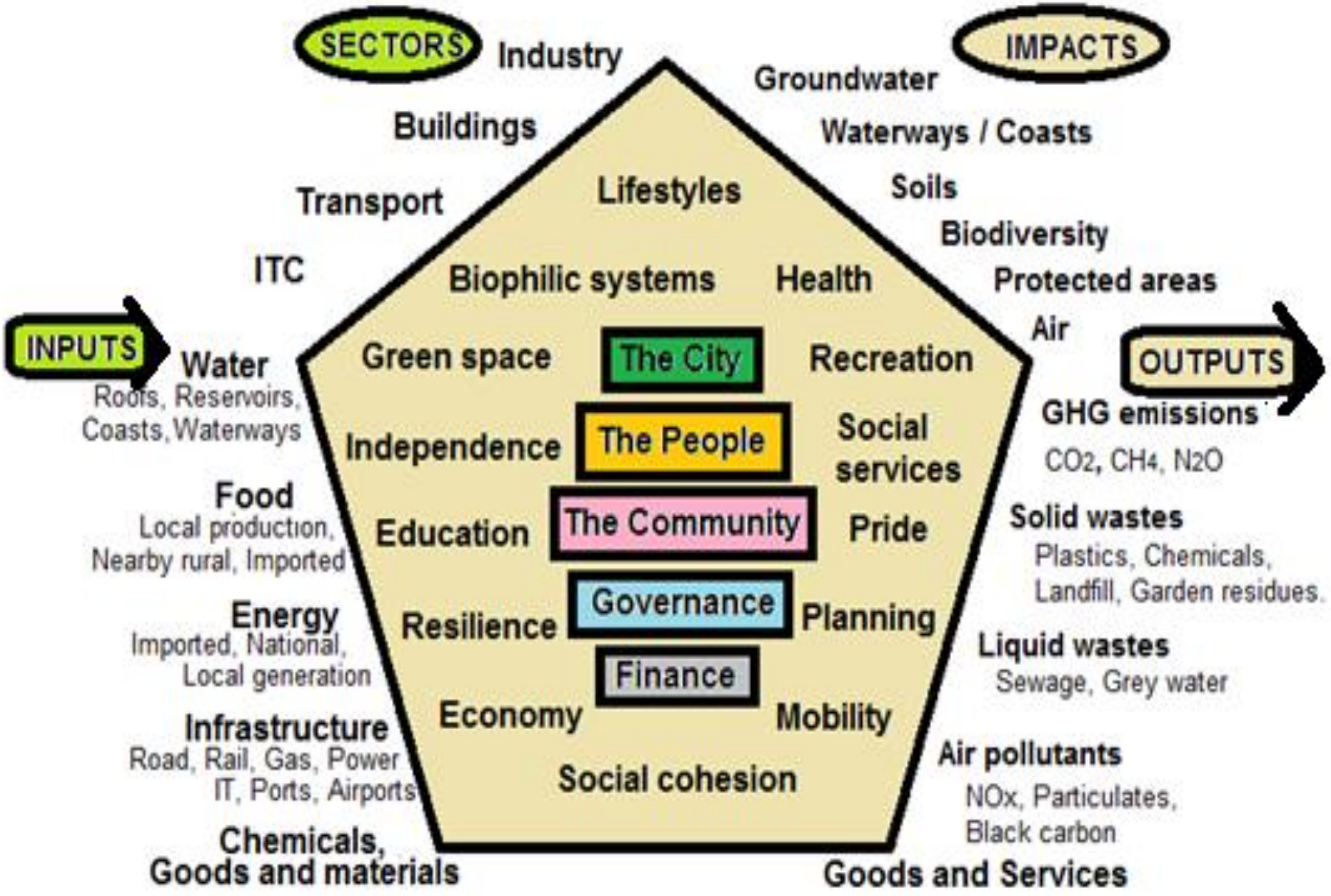
We fail to consume one third of all the food we produce!



This report used milk, rice and vegetable agri-food supply chains as examples. Another report soon to be released analyses the costs of clean energy systems. Renewable energy and energy efficiency opportunities exist at all scales.

http://www.fao.org/3/a-i5125e.pdf

Cities can move faster than nations and states.



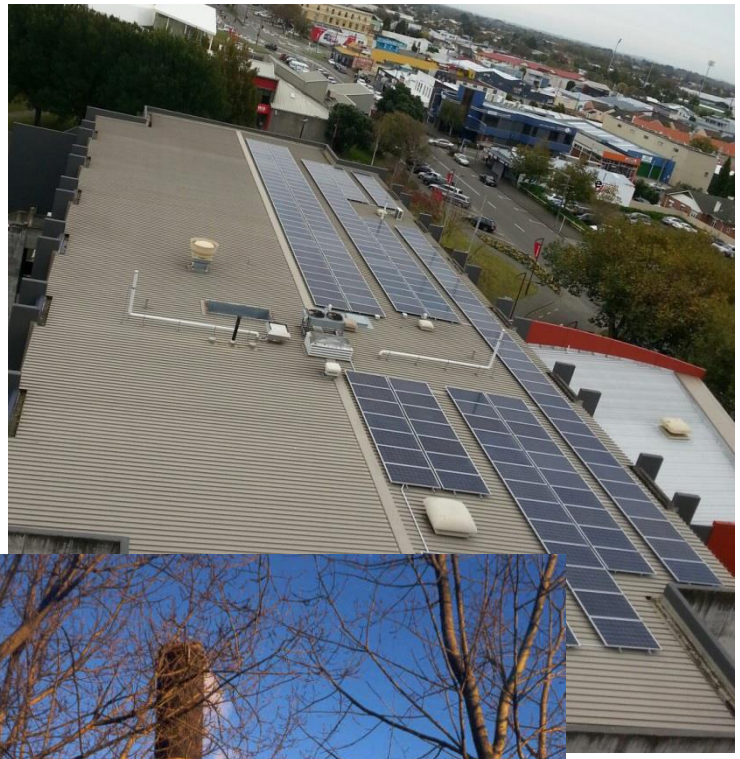
City councils can

Regulate for:

- land use
- infrastructure
- public transport
- water supply

City councils own

- public buildings
- land and green space
- vehicle fleets
- waste treatment facilities



City councils have good proximity to

- citizens
- local businesses
- national governments

City or town	Policy classification																		
	Target		Stick			Carrot						Guidance		Voluntary -municipal operation			Voluntary -role model	
	Overall target	Sector specific target	Urban planning	Building codes regulations/	Taxes	Standards and mandates	Capital grants and rebate	Operating grants	Investment	Soft loans and guarantees	Tax credits	Tax reduction/exemption	Information/promotion	Training	Procurement / purchase	Investment	Utility	Demonstration / land use	Voluntary agreements
1) Tokyo	X	X		X		X							X		X	X			
2) Capetown, S. Africa	X	X	X				X						X	X	X				
3) Nagpur, India	X	X		X							X	X	X	X		X		X	X
4) Adelaide, Australia	X	X					X						X		X	X		X	
5) Merton, London, UK	X	X	X	X		X							X						
6) Freiburg, Germany	X	X	X	X		X	X			X			X	X	X	X	X	X	X
7) Växjo, Sweden	X	X		X			X						X		X		X	X	X
8) Palmerston North,NZ	X	X														X	X	X	X
9) Masdar City, UAE		X											X		X	X	X	X	
10) El Hierro, Spain		X					X			X			X	X		X	X	X	X
11) Samsø, Denmark		X					X			X			X	X		X		X	
12) Güssing, Austria		X				X							X	X	X	X	X	X	
13) Greensburg, USA		X	X	X					X			X	X				X	X	

So is achieving net zero emissions in the second half of this century feasible - or an impossible dream?

"It is hard to have a more ambitious NDC mitigation goal……"

Country A – without $s from the Green Climate Fund.
Country B – without buying international C credit offsets.
Country C – without accounting for forest sinks and LUC.
Country D – because our higher priority is to increase GDP growth and provide energy access for all.
Country E – because we cannot gain long-term support across all political parties.
Country F – since much of our export revenue comes from trading in oil, gas and coal.
Country G – because our emphasis has to be on adaptation and investing in resilience to climate impacts.

So what is the solution to obtaining more ambitious NDCs?

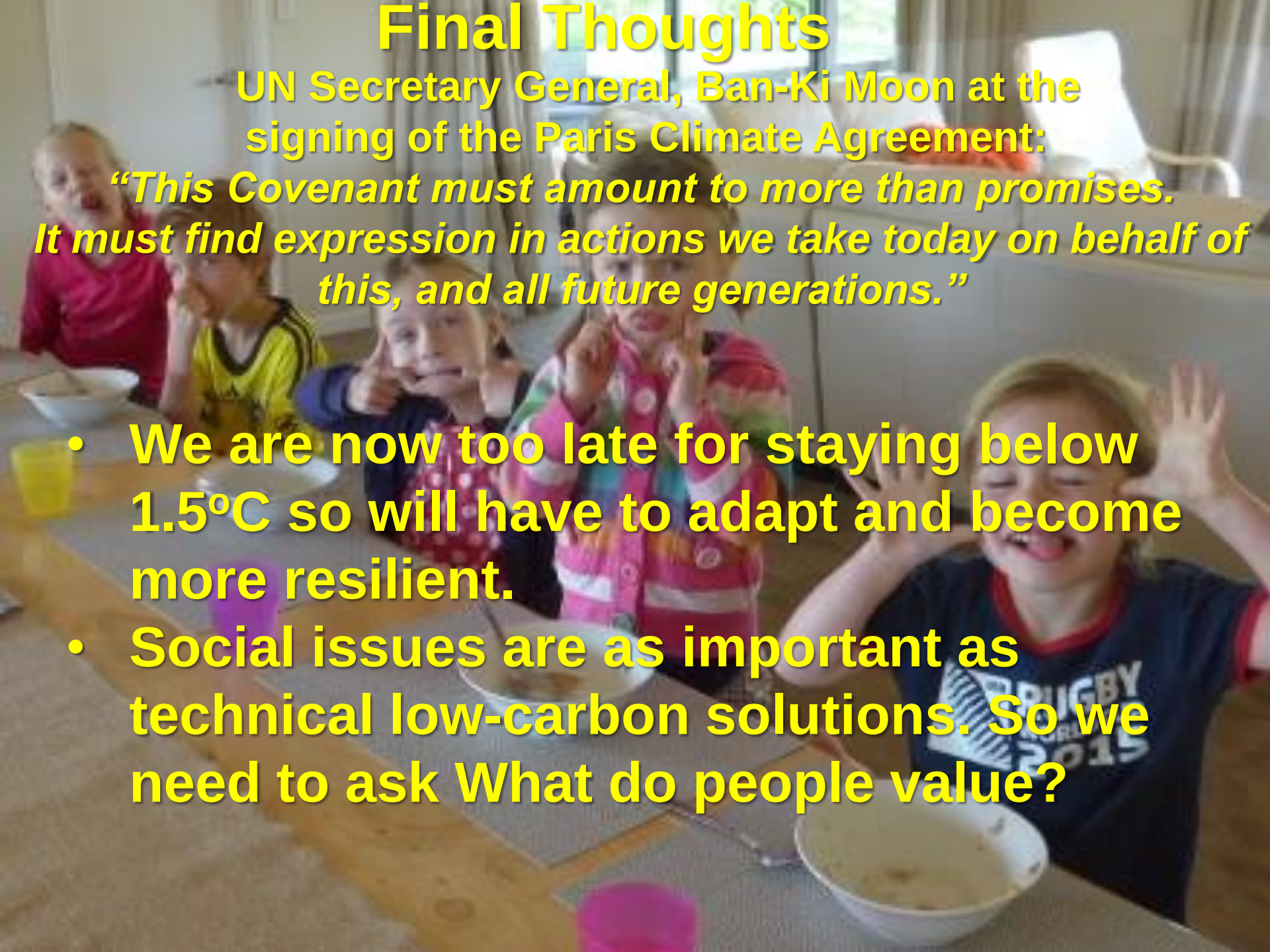
Governments need to:

- encourage the more rapid deployment of renewable energy systems, especially where local resources are good;
- support local governments in their endeavours to encourage clean energy;
- remove fossil fuel subsidies;
- invest more to support innovative research and development in climate technologies;
- better understand the value of the co-benefits from mitigation actions; and
- create a greater awareness of climate change issues and solutions by the public.

Final Thoughts

UN Secretary General, Ban-Ki Moon at the signing of the Paris Climate Agreement:

"This Covenant must amount to more than promises. It must find expression in actions we take today on behalf of this, and all future generations."

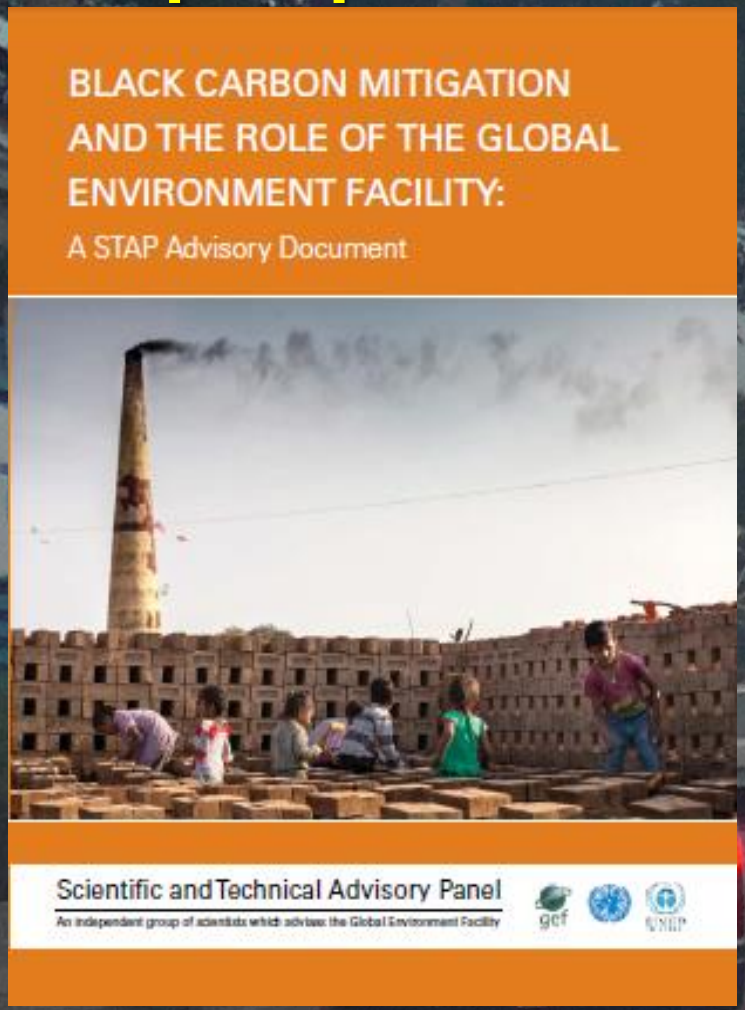


- **We are now too late for staying below 1.5ºC so will have to adapt and become more resilient.**
- **Social issues are as important as technical low-carbon solutions. So we need to ask What do people value?**

Capacity Building Initiative for Transparency

- **The Paris Agreement includes a provision for enhanced transparency of action and support.**
- **The aim is to build mutual trust and confidence in the country-led approach.**
- **Many countries lack the capacity to effectively monitor, report and track any progress made in the implementation of their NDCs.**
- **The Paris Agreement requested the Global Environment Facility (GEF) to establish a new financial initiative to help developing countries meet their enhanced transparency requirements.**
- **A new CBIT Trust fund has over $50 M pledged from donor countries.**

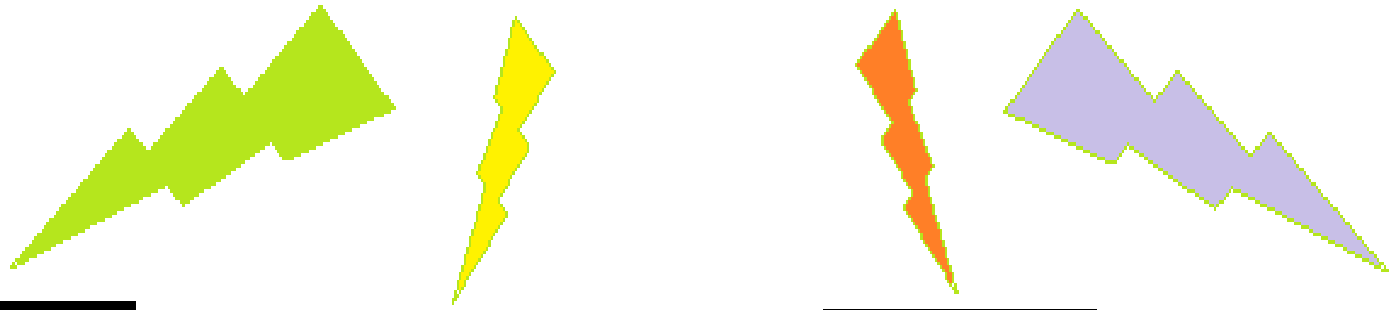
Reducing emissions of black carbon (a short-lived climate forcer) can slow the rate of warming and help improve local air pollution and health.



http://www.stapgef.org/black-carbon-mitigation-and-the-role-of-the-global-environment-facility/

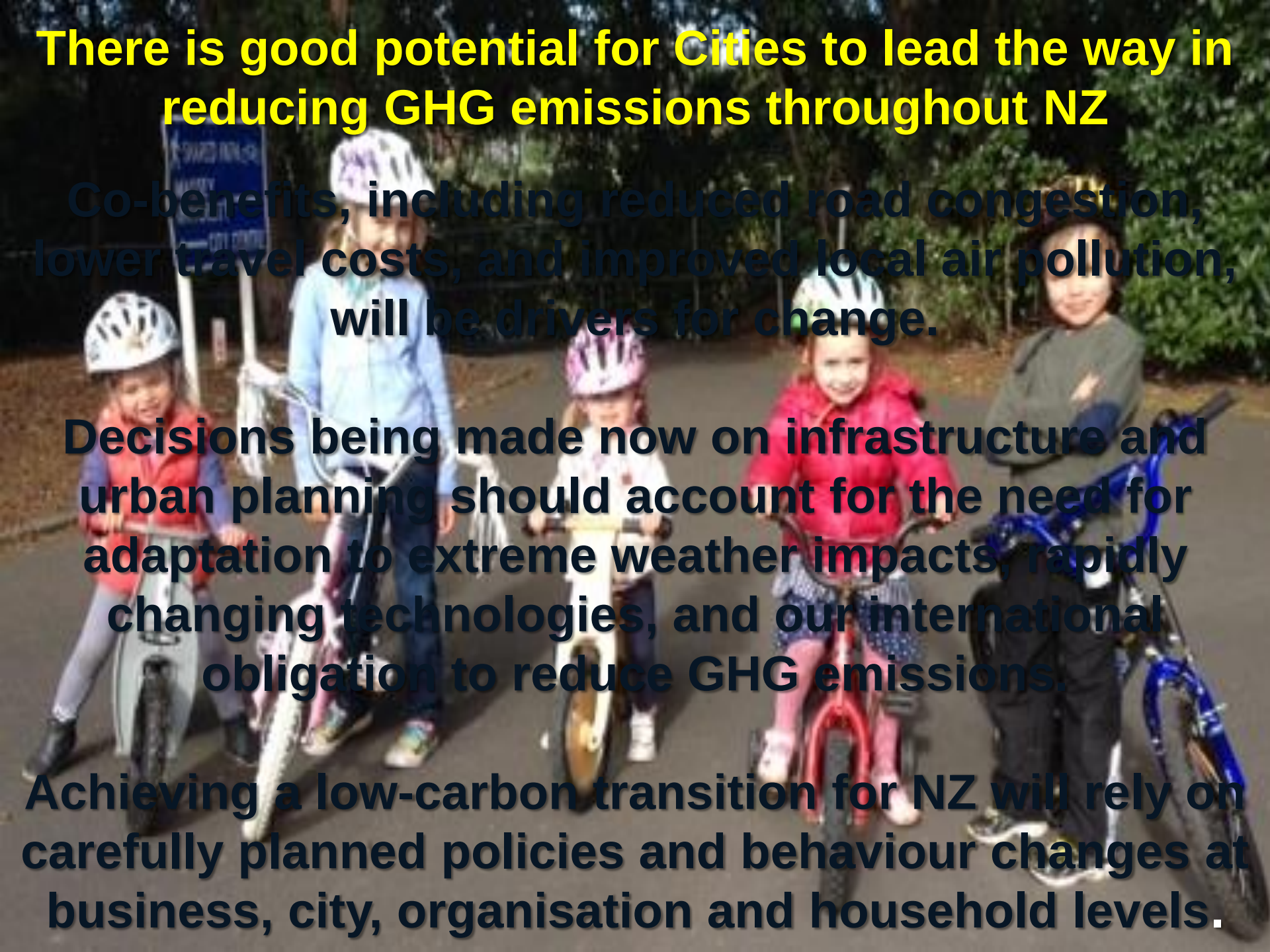
Transport mitigation is not easy!

TOTAL GHG emissions



Fuel carbon intensity ($gCO_{2\text{-}eq}/MJ$)	Energy intensity (MJ / km) (MJ / t km)	Journey (km / yr) (t km / yr)	System - infrastructure modal choice
Diesel	LDV / HDV / Bikes	Distance to travel	Urban planning
Gasoline	Rail	Combine trip objectives	Roading / airports / railways / ports
Biofuels	Marine	Avoidance	Choice between speed / comfort / cost / convenience
Electricity	Aviation	Internet shopping	
Hydrogen	Mass transit		
	Cycling / walking		

Low-carbon transport solutions



There is good potential for Cities to lead the way in reducing GHG emissions throughout NZ

Co-benefits, including reduced road congestion, lower travel costs, and improved local air pollution, will be drivers for change.

Decisions being made now on infrastructure and urban planning should account for the need for adaptation to extreme weather impacts, rapidly changing technologies, and our international obligation to reduce GHG emissions.

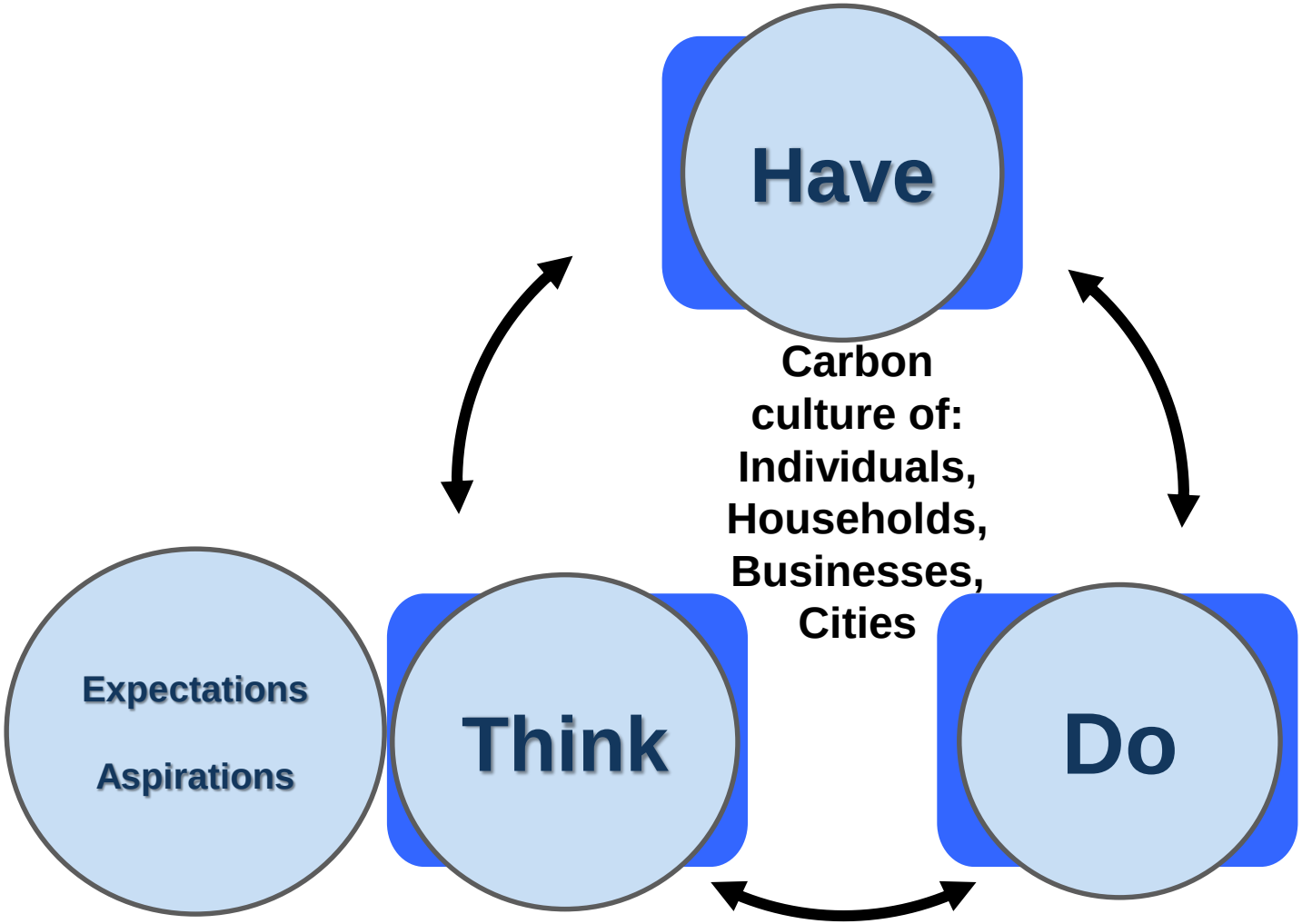
Achieving a low-carbon transition for NZ will rely on carefully planned policies and behaviour changes at business, city, organisation and household levels.

All citizens and councillors need to:

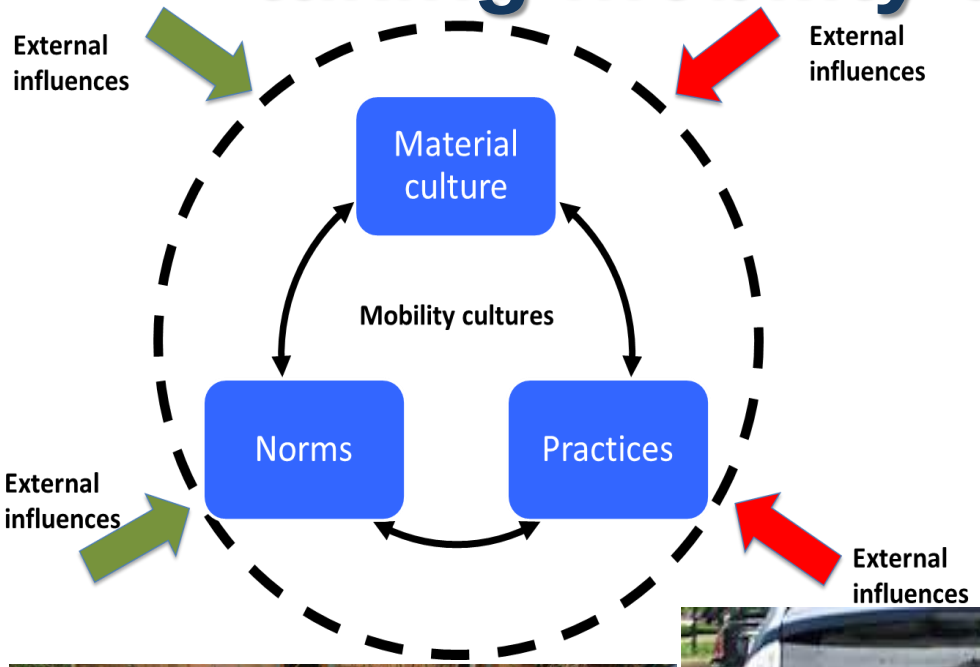
- understand the risks and uncertainties of climate change;
- accept that we need to change the way we act and modify our aspirations;
- realise that trade-offs will need to be made;
- become personally involved in making the necessary transition to a low-carbon economy; and
- deploy low-risk mitigation actions now whilst planning for more ambitious GHG emission reduction options and system changes in the future.

“Carbon culture”

Dr Janet Stephenson, Otago University

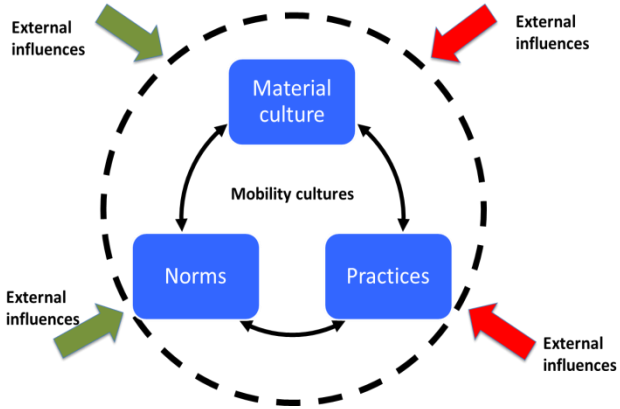


Change is driven by external influences – taking mobility as an example:



1. New technologies, smarter systems…

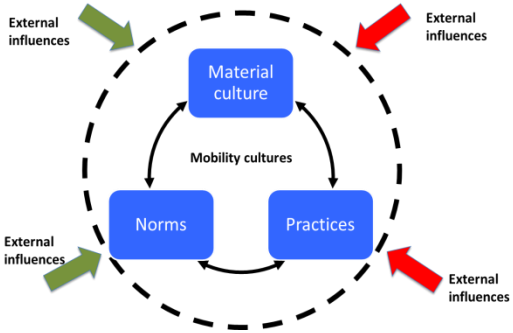
2. New business models…



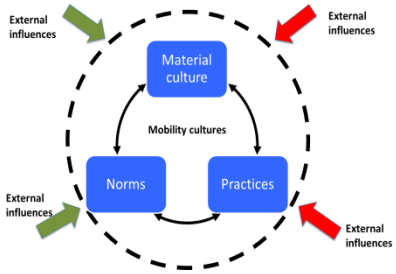
enterprise CarShare

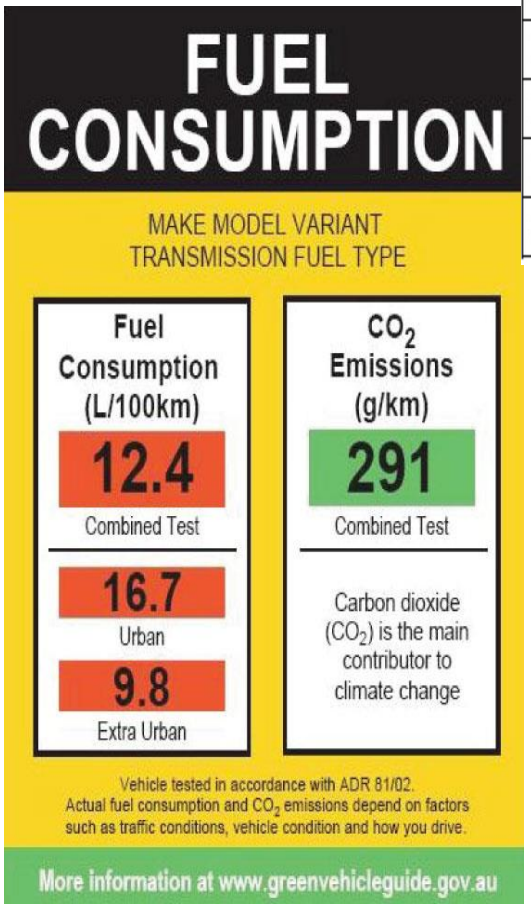
Cité lib
l'autopartage pour tous

3. New infrastructure, urban form



4. Changes in policies and regulations…

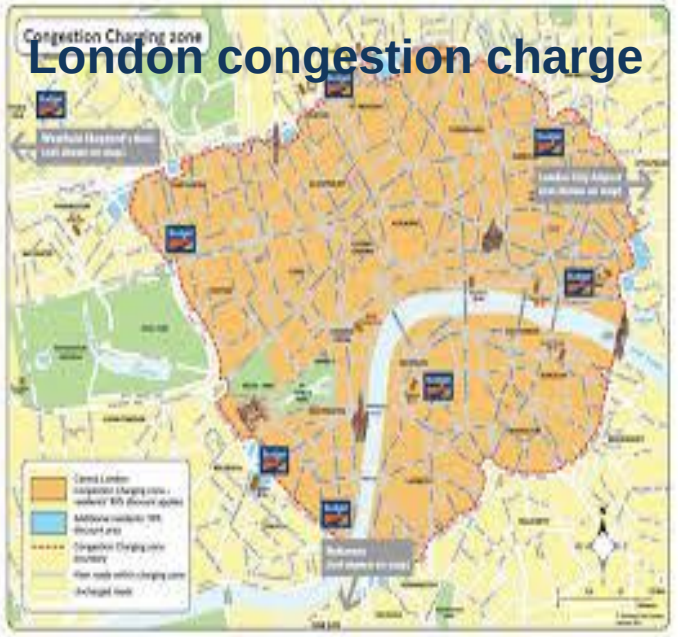




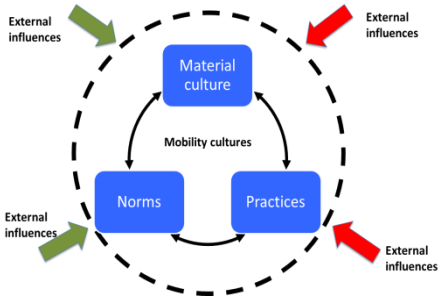
Feebate scheme

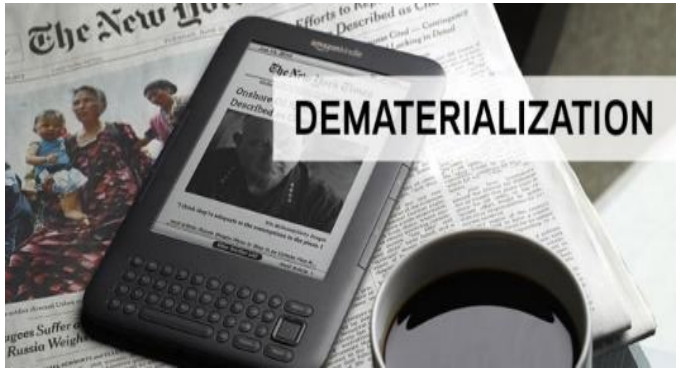
Emission rate of CO_2/km	Amount of the penalty in 2012
Between 141 and 150 grams of CO_2/km	€ 200
Between 151 and 155 grams of CO_2/km	€ 500
Between 156 and 180 grams of CO_2 /km	€ 750
Between 181 and 190 grams of CO_2/km	€ 1,300
Between 191 and 230 grams of CO_2/km	€ 2,300
Beyond 230 grams of CO_2/km	€ 3,600

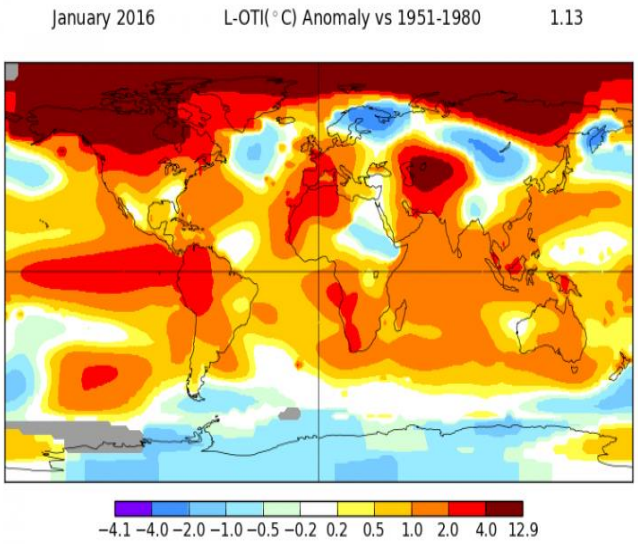
London congestion charge



5. Changing social norms…





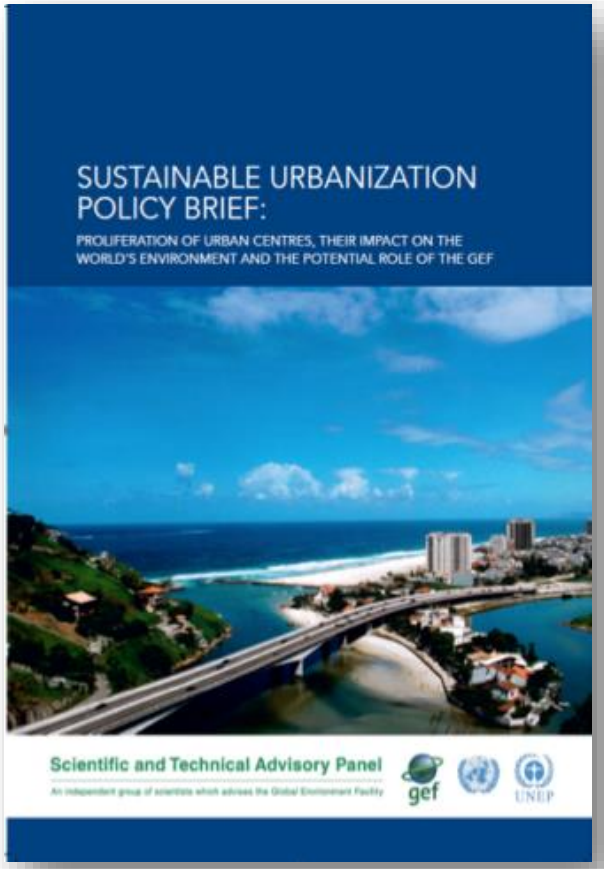


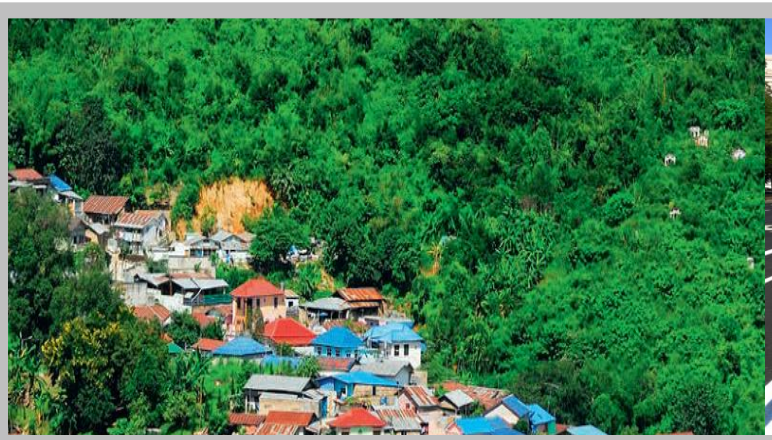
UNFCCC

Convention/MEA goal or objective: To stabilize greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system." It states that "such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner."

The GEF is supporting 25 "Sustainable Cities" in 11 countries as a pilot scheme, and wishes to expand this in the next funding cycle.

A compilation of 180 indicators has been produced by World Bank and GEF that cities can use to measure sustainability.





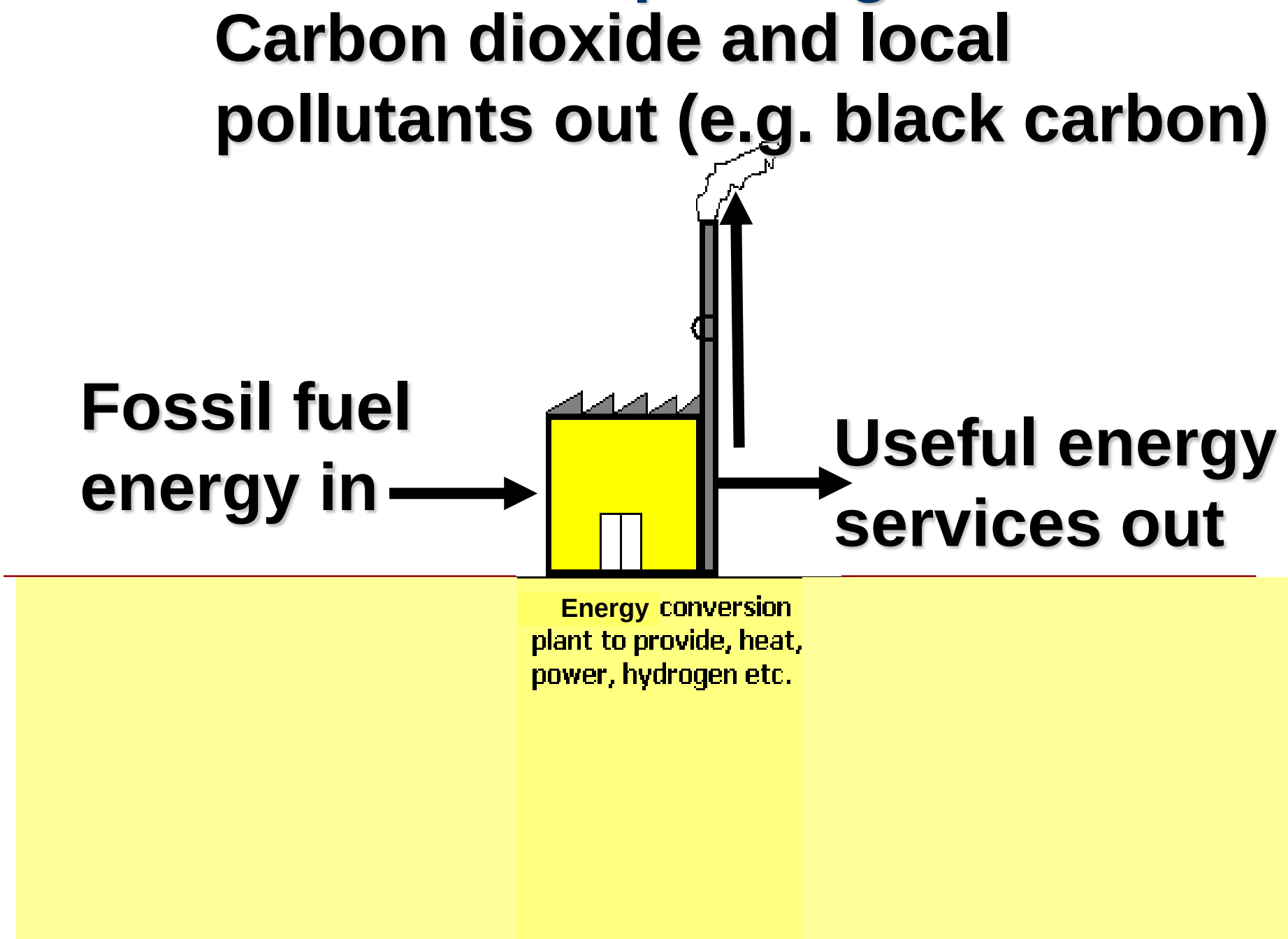
IPCC Special Reports in progress

a) **"1.5ºC warming and pathways for this goal".**
(This work will start immediately in response to the request in the Paris Agreement with the scoping meeting held in August).

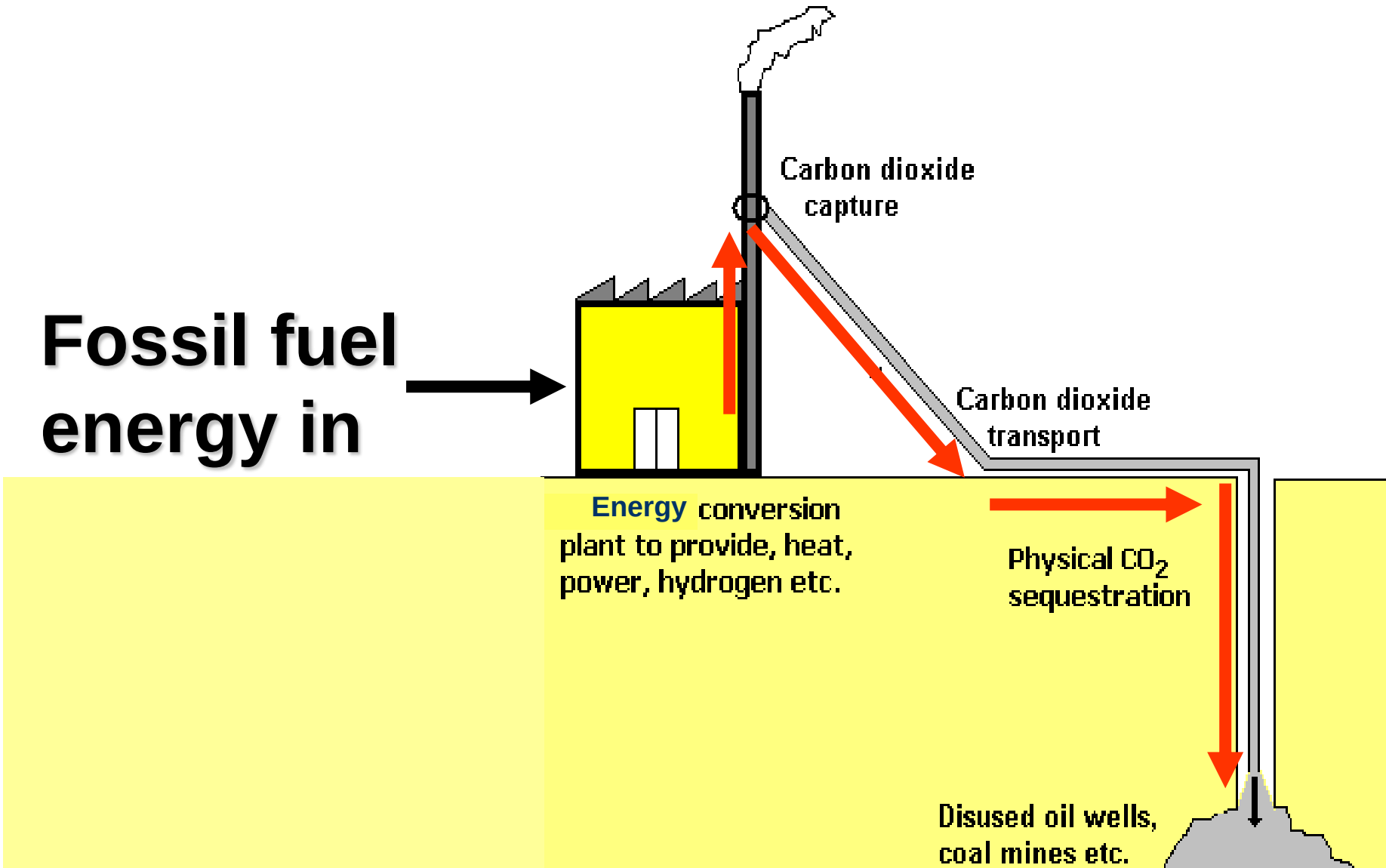
b) **"Oceans and the cryosphere"**

c) **"Climate change, desertification, land degradation, sustainable land management, food security and GHG fluxes in terrestrial ecosystems".**

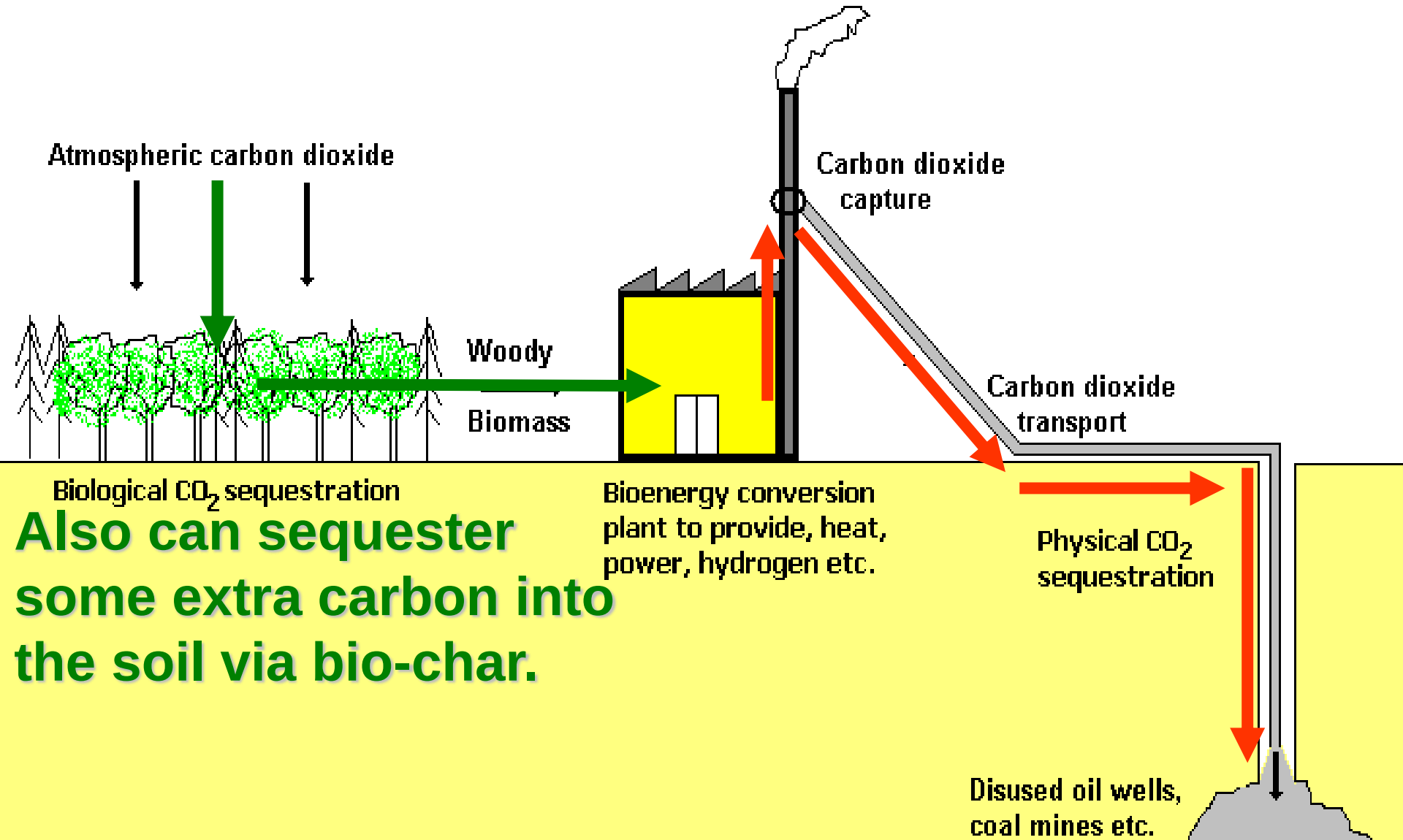
Thermal heat and power generation.



Carbon dioxide capture and storage.



Carbon dioxide capture and storage linked with bioenergy "BECCS".



Also can sequester some extra carbon into the soil via bio-char.