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BIOGAS

LIQUIDBIOFUELS

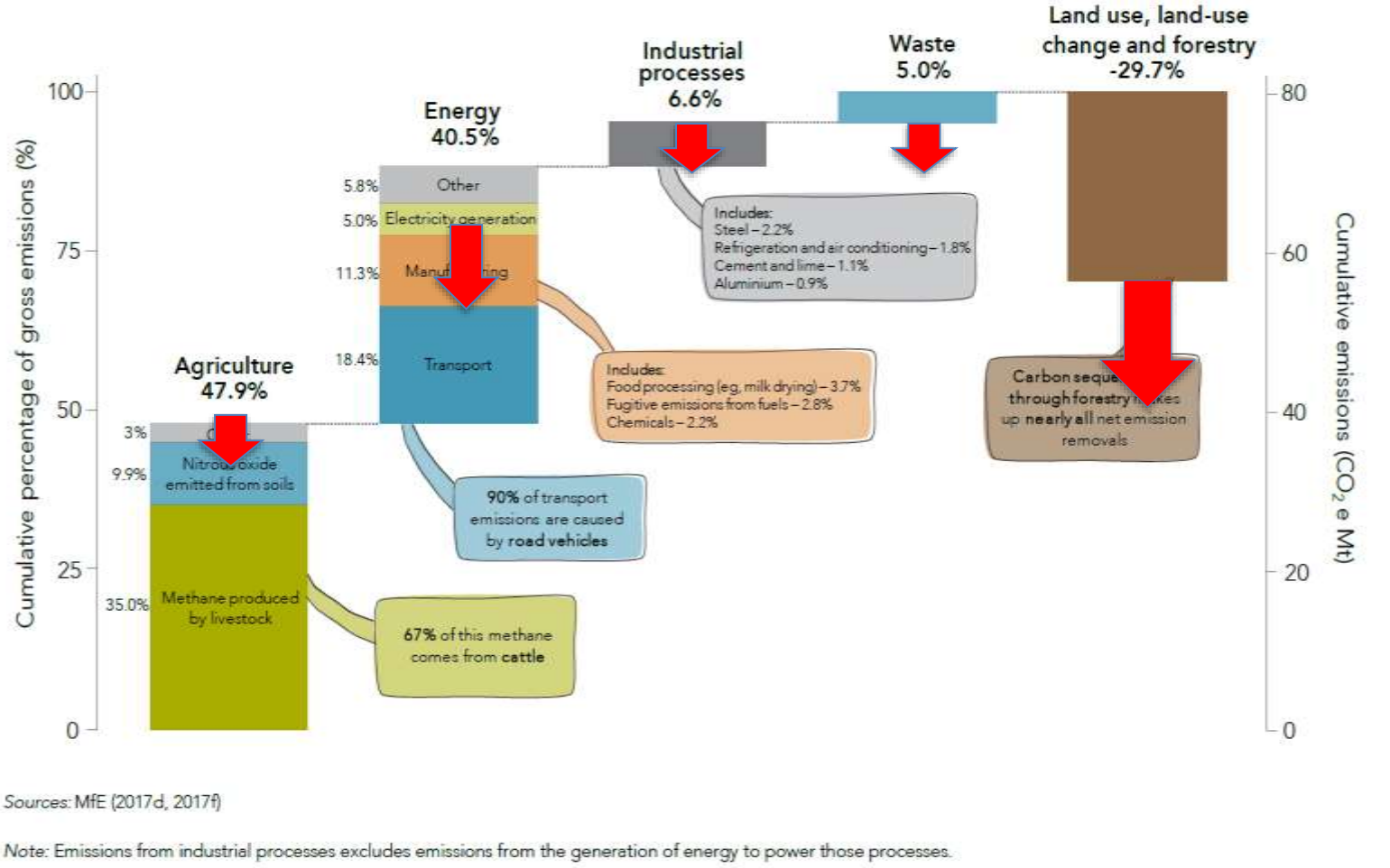
WOODENERGY

WHAT NEXT?

THE OPPORTUNITIES FROM BIOENERGY

Presentation to Officials - 25 October 2018

GHG Reductions by Bioenergy

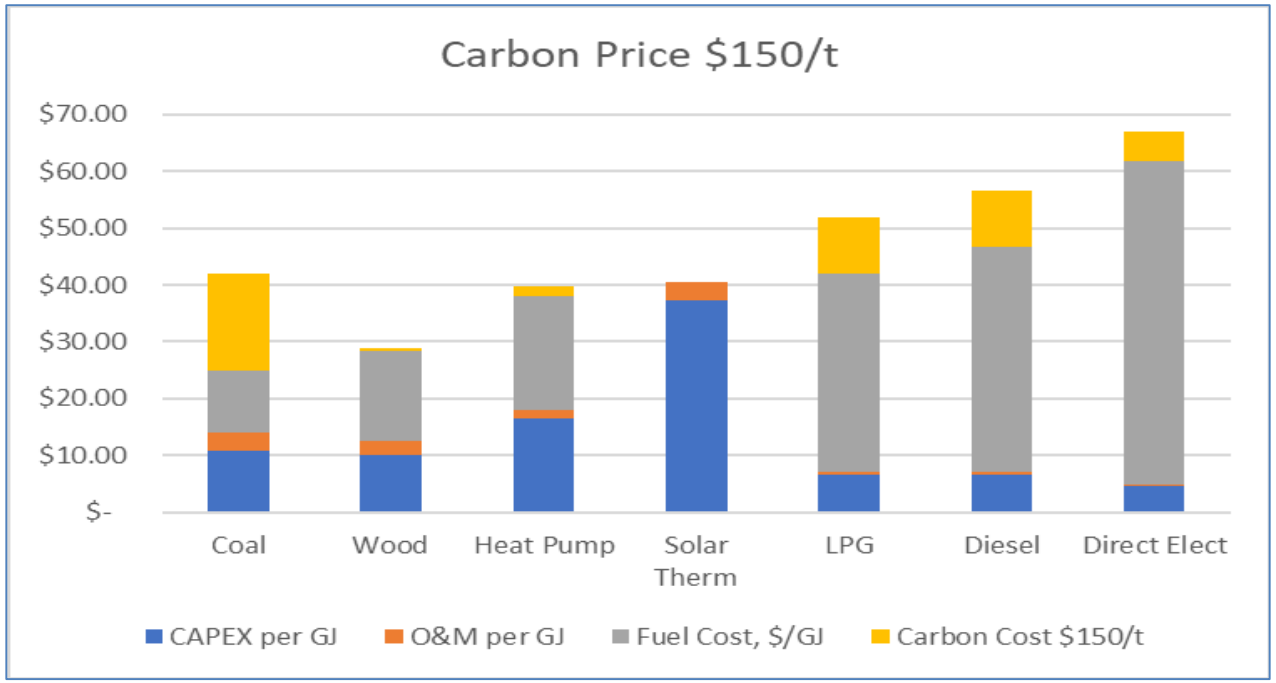


Sources: MfE (2017d, 2017f)

Note: Emissions from industrial processes excludes emissions from the generation of energy to power those processes.

Biomass offsets possible in every sector, each with land use leverage opportunities.
Resource potential is 90PJ and ~23% of Primary Energy energy demand.
Higher international carbon prices could double bioenergy resources by 2100.

Wood Heating will be the lowest cost



- Electrical heating is often preferred but has some serious constraints:
  - Direct heating is already twice as expensive as wood fuels.
  - Heat pumps are competitive but currently restricted to low processing temperatures.
  - All forms of electrical heating and EV's are very capital intensive economic pathways.

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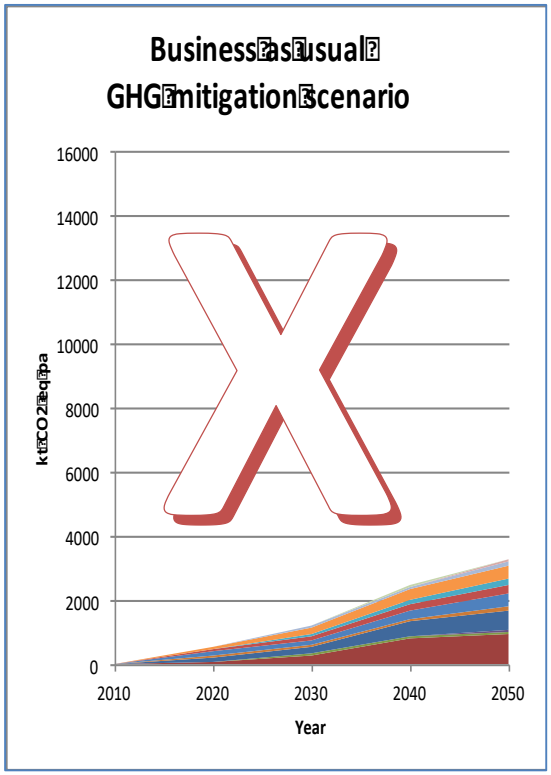
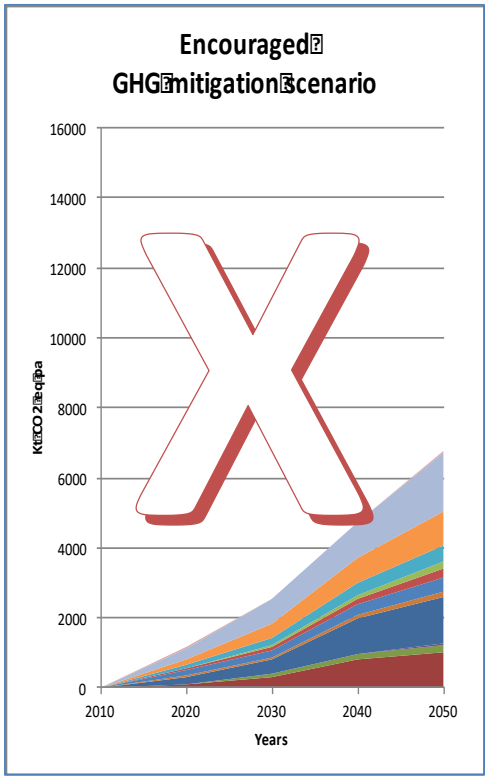
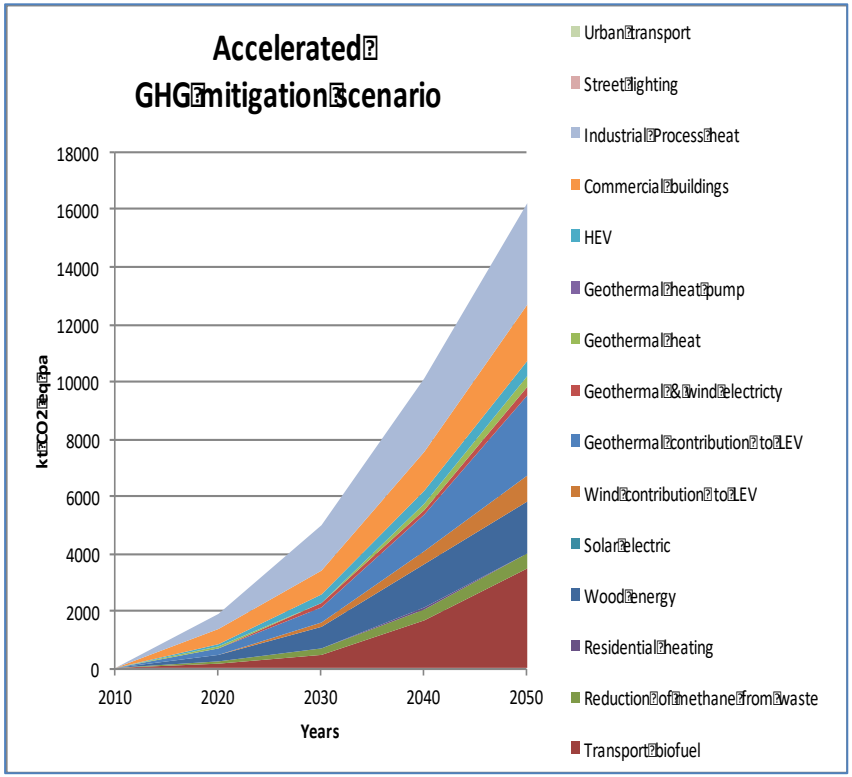
Progressing from "Yes we Can" - 2017

- "Accelerated Renewables" Scenario is now the required pathway to Net Zero Economy
- Biomass could achieve more than 23% of New Zealand primary energy share by 2050
- This is a $10bn investment opportunity– with a good payback for New Zealand Inc.







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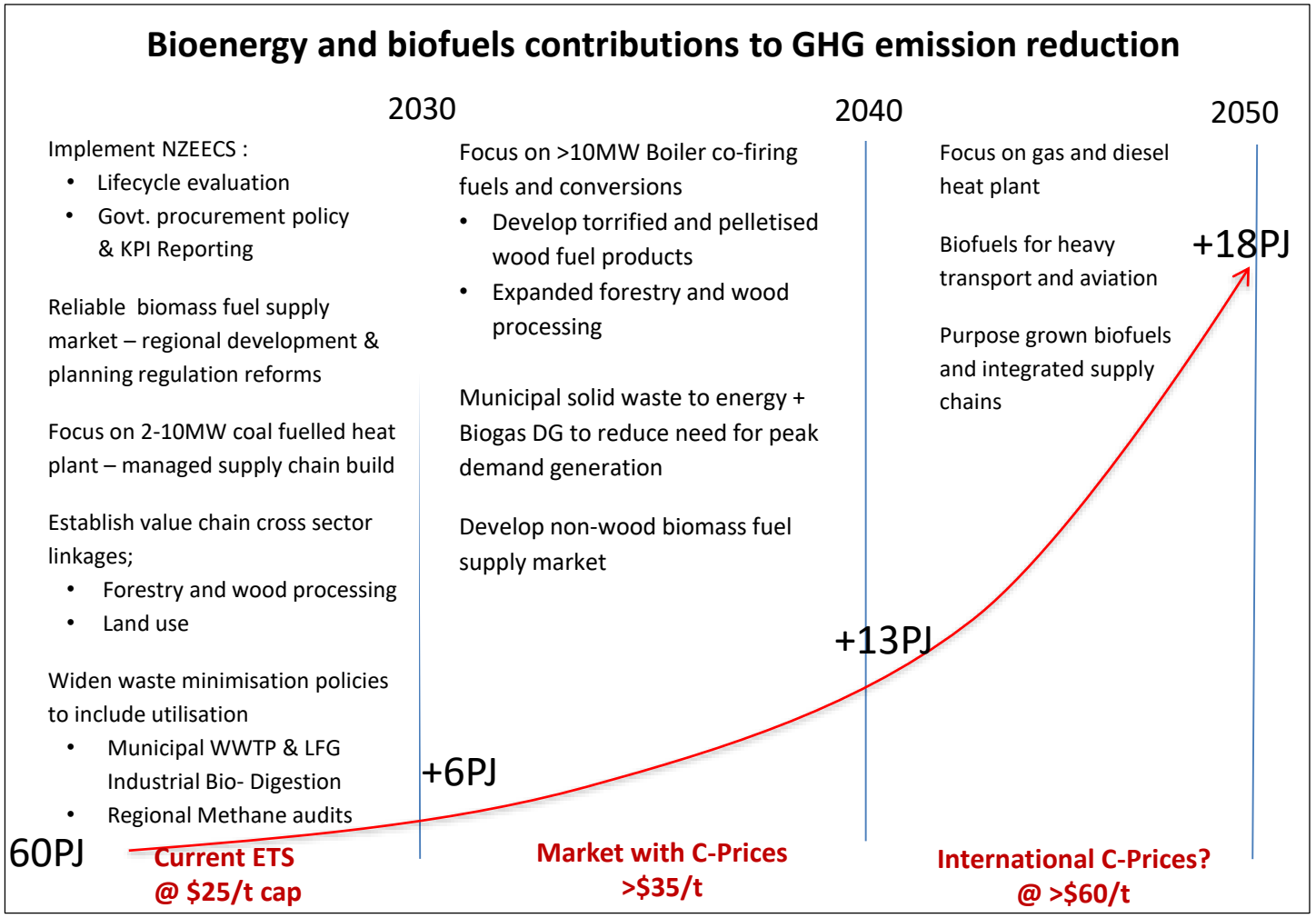
Alignment with NZEECS and Paris Obligations



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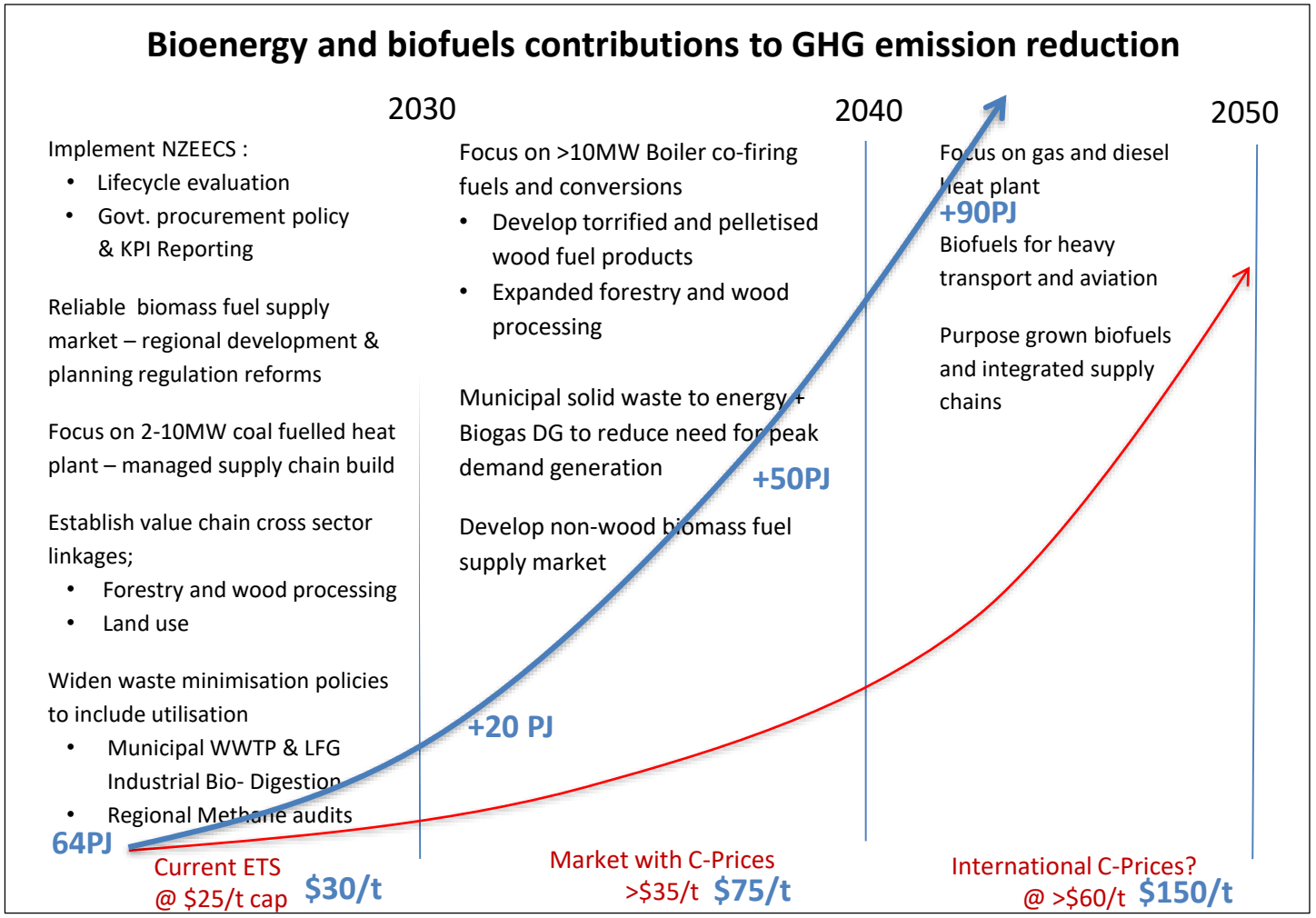
Alignment with NZETS and 2020 Paris Demands



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Our "What Next" Scenarios

1. Recovering Wasted Energy;
   - WTE is still the low hanging fruit with "double dividends"
   - Co-products are valuable and reduce other emissions e.g. synthetic fertilizers
   - Complimentary to electrical heat pumps and small wood boilers in the lower temperature (<100 deg C) demand segments.

2. Transitioning Med/High Temperature Process Fuels;
   - Biomass is a lower capital intensive process heating option across all segments
   - Substitution of coal through co-firing with "dry biofuels" - avoiding large boiler asset stranding.
   - Competing with natural gas until C-prices are above $100/t_c.

3. Net Zero Biofuels Transformation;
   - Heavy transport and industrial drop-in fuel blends.
   - Moving away from the current bio-commodities of unprocessed export logs.
   - Enormous regional investments and jobs growth potential.
   - Keep logs off wharfs – use the current 50% of the log "given away"

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Ability of bioenergy and biofuels to reduce GHG emissions in NZ

Brian Cox Executive Officer, 24 October 2018

The opportunities

- Biomass energy for process heat
  - Wood harvest residues
  - Wood processing residues
  - Agricultural residues
- Use of waste to reduce methane
  - Create value from municipal and food waste
  - A resource we produce every day
- Use of biofuels for heavy transport
  - Marine, heavy road vehicles, rail, aviation

Is this a problem or an opportunity

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Key messages

- Bioenergy and biofuels provide opportunities and are not fixing a problem
- We have large quantities of biomass and waste which can be used in the transformation to a low-emissions economy
- Based on proven technologies
- Under developed markets
- Complex biomass supply chain is manageable.

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What can be achieved

- *Currently 11% of consumer energy is supplied from biomass.*
- *Including only process heat and use of waste this could increase to 15% by 2050 and reduce net greenhouse gas emissions by 3-4%. ,*

but

- *with biofuels use by heavy transport this could increase to 26% energy with 13% reduced greenhouse gas emissions.*

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Energy increase above 2017 levels

	Reduction of use of fossil fuels in process heat[1, 5] (PJ)			Methane reduction from waste to energy[2] (PJ)			Emissions reduction from use of biofuels in transport (PJ)		
Year	BAU	Transition[3]	Transformation[4]	BAU	Transition[3]	Transformation[4]	BAU	Transition[3]	Transformation[4]
2030	2	4	8	0	1.1	1.8	3	3	20
2040	5	11	17	0.05	1.5	2.5	6	6	48
2050	7	15	20	0.1	1.8	3.3	12	12	68

There are opportunities to triple bioenergy contribution to NZ Economy with both large and smaller scale investments across all regions.

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Greenhouse gas emission reduction below 2017 levels

	Reduction of use of fossil fuels in process heat[1, 5] (kt CO2-e pa)			Methane reduction from waste to energy[2] (kt CO2-e pa)			Emissions reduction from use of biofuels in transport (kt CO2-e pa)		
Year	BAU	Transition[3]	Transformation[4]	BAU	Transition[3]	Transformation[4]	BAU	Transition[3]	Transformation[4]
2030	200	400	700	0	180	320	200	200	1500
2040	500	1000	1500	+20	210	410	400	400	3500
2050	700	1300	1800	+40	320	515	800	800	5000

The waste and wood fuels are low cost reductions and the liquid biofuels are important for heavy transport.

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BAU or transformation

1. BAU
   - Left alone a slow growth to 19PJ energy switching
   - Occurs as coal plant requires replacement
   - Infrequent investment decisions
2. Transition
   - Implement NZEECS
   - Increases to only 29PJ
   - A useful step to provide a platform for transformation
3. Transformation
   - Can go to 91PJ and reduce 13% of GHG emissions
   - Available if we want to grab the opportunity

Productivity Commission- Barriers
Utilising existing serviceable equipment?

- Use the coal existing plant
  - Cofiring biomass with coal
    - blending wood pellets
    - Torrifaction to make green coal
    - Process low grade biomass into industrial fuel
- Gradually upgrade existing WWTP
  - Anaerobic treatment
  - Accept trade waste
- Use existing transport fleet and infrastructure
  - Transition to drop in biofuels

Productivity Commission – Barriers Biomass supply chain reliability?

- Develop non traditional biomass fuels
  - Pelletising waste
  - Revise consenting rules to remove fuel limitations
  - Torrefaction to make green coal

- Maximise value from existing biomass sources
  - Strengthen domestic use of wood
    - Strong forestry and wood processing strategy
  - 1 billion trees
    - not just trees in the ground. A great opportunity for biomass supply

- Farms produce food plus fuel
  - Use of agricultural wastes
  - Offset biological emissions
  - Shelter belts, riparian planting, woodlots

Productivity Commission – Barriers Marginal Economics

- BAU is positive – shows economics not an absolute barrier
- Use govt facilities to demonstrate economics
  - 52% of heat plant are owned by government
  - Government investment based on life cycle
- Focus on life cycle and not least capital cost
- Support local government investments
  - Potholes not efficiency are the priority for capital expenditure
- Perception of supply chain affects risk analysis

Action Plans

- Waste to Energy
- Wood Energy
- Liquid Biofuels

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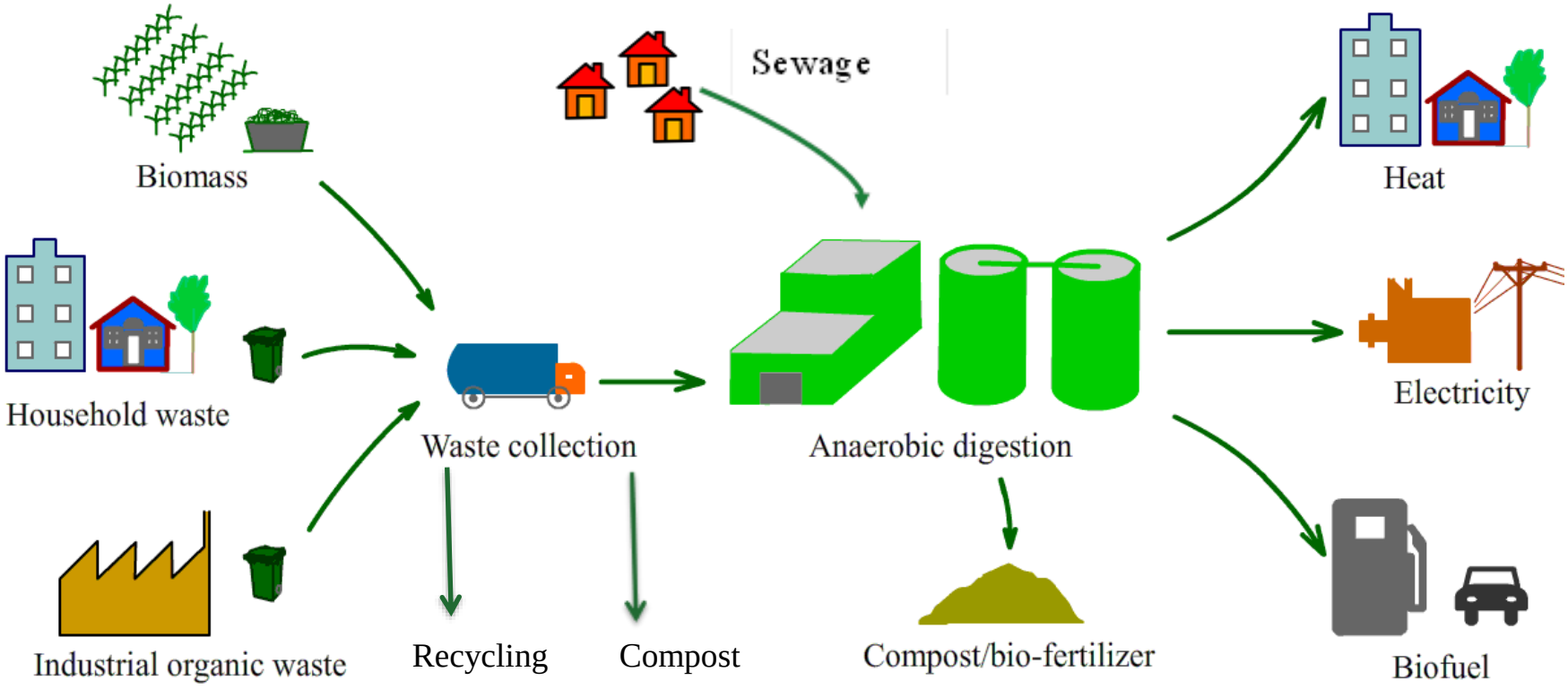
Residues to energy value stream



Range of technology options

Tank systems

Covered pond systems

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Actions - Reducing methane emissions from waste

- Establish a National Policy Statement setting a policy of Zero organic waste to landfill by 2040
- Provide guidance, demonstration and assistance to territorial authorities for upgrading and optimising WWTP
  - beneficial treatment of trade wastes providing reduction of emissions and operating costs.
- Provide guidance, demonstration and assistance for use of food waste
  - multi-stream treatment of food and organic waste to produce energy.
- R&D into the high value uses of biogas digestate/biosolids
  - Use of biomethane as a vehicle fuel
  - Biogas as a feedstock for the manufacture of bio-based materials.
  - Validation of the use of anaerobic digestion digestate as a fertiliser
  - Use of WWTP biosolids as a combustion fuel.

Heat Segment Conversion Challenge

	Low Temp and under up to 300 kW_{th}	Med Temp and up to 5 MW_{th}	High Temp and Over 5 MW_{th}	Process Commodity
Addressable Conversion market PJ	10	40	40	20
Estimated # Existing Boilers	700	1000	600	100
Conversion Rate to 2030 estimated at 30 PJ	250 sites and 5PJ	150 sites 10PJ	100 sites and 10PJ	20 sites and 5PJ
Biomass	12%	30%	50%	30%
Heat Pumps	65%	4%	30%	10%
Electrode	25%	20%	15%	65%
Solar Thermal	3%	5%	5%	2%
Solar CHP	0%	3%	3%	3%

We estimate around 150 Boilers need to convert to Biomass fuels by 2030, with an investment cost of ~$1bn. (or ~10 x current boiler conversions)

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Actions – process heat

- Focus on improving the efficacy of the supply of biomass fuel
  - from plantation forestry, wood processing, and farm forestry
  - use the One billion trees programme to produce future biomass fuel.
- Assist farmers to offset biological emissions by use of bioenergy based activities
  - farm forestry to produce woody biomass fuel,
  - treatment of waste to reduce nutrient runoff to waterways.
- R & D into the treatment and use of non traditional biomass fuels
  - Agricultural biomass eg stover, and their use
  - co-firing with coal as a transition for existing coal plant.
  - Investigate torrifaction of biomass to make green coal.
- Improve regulations and best practice for consenting heat plant
- Guidance on the comparative benefits of alternative process heat technologies.

Liquid biofuels

Biodiesel from tallow

Bioethanol and biodiesel produced from:

- Dairy processing residues (whey)
- Used cooking oil
- Canola
- Tallow

Biogas from:

- Landfill gas,
- Waste water treatment plant

Future advanced liquid biofuel production from:

- Lignocellulosic material
- Municipal waste

Landfill gas collection

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Actions-Use of biofuels by heavy transport

- Provide guidance on the use of biomethane as a vehicle fuel.
- Use imported biofuels as a transition pathway to provide an incentive for domestic manufacture
- Establish specific programmes for marine, heavy road vehicles, rail and aviation so that R&D is demand driven.
- Include production of biofuels within a wider transition to the manufacture of bio-based products within a low emissions economy based on wise use of renewable natural resources.

High value bio-based products

Xylose

$1.5 Billion Market

- Food Additives
- Xylitol
- Personal Care Products
- Pharmaceuticals

Lignin

$64 Billion Market

- PVC Additive
- Adhesive & Epoxy Resins
- Polyurethane
- Carbon Fiber

Cellulose/Ethanol

$35 Billion Market

- Transportation Fuels
- Fuel Additives
- Solvents
- More Economical Feedstock for Pulp & Paper plants

What is required

- A desire to do more than BAU
- Focus on the opportunities
- Have transformational policies and programmes
- Use current programmes as transition pathways
- Act collectively