

Action #	Description		2016 Baseline Start of Modelling	2050 Business as Planned (BAP) 60% Intensification	2030 Assumptions, Inputs and Required Actions	2050 Assumptions, Inputs and Required Actions
Demographics						
1a	Population		969,318	Preliminary Growth Projections, based on Scenario 2f Sc Imm MOF ON provided by City of Ottawa Research and Forecasting with linear extrapolation after 2046 PPU assumptions by sub-area and dwelling type for new dwellings provided by Ottawa	1,219,860	1,500,664
1b	Background employment		630,181	Preliminary Growth Projections, based on Scenario 2f Sc Imm MOF ON provided by City of Ottawa Research and Forecasting with linear extrapolation after 2046	722,501	910,638
LAND-USE						
1c	Dwelling units		385,074	2046 new: 194,812 historic: 385,074	new: 104,674 existing: 385,074	new: 224,059 existing: 385,074
1d	Non-residential floor space (sqm)		23,697,909	2046 new: 8,307,487 existing: 23,600,327	new: 2,950,075 existing: 23,600,327	new: 9,881,102 existing: 23,600,327
2	Spatial distribution	Avoided thermal and electric energy and avoided transportation energy	Current geographic layout	60% of new dwellings allocated to intensification areas by 2046 (balance growth plan with some urban expansion); exact areas are to be determined Employment growth by zone provided by Ottawa, scenario "Sc2 - Incremental Expansion"	No further urban boundary growth beyond BAP	No further urban boundary growth beyond BAP

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BUILDINGS						
New buildings - buildings codes &						
3	Dwelling size	Increase use intensity of new dwellings	Single-detached: 223m2 Semi-detached: 159 m2 Row: 147 m2 Apartment: 104 m2	2016 dwelling sizes maintained	Maintain 2016 size of dwellings	Maintain 2016 size of dwellings
4	Building mix	Avoided thermal and electric energy	Single-detached: 45% Semi-detached: 7% Row: 21% Apartment: 27%	Allocation to dwelling types based on assumptions for 60% Intensification by 2046 provided by City of Ottawa Research and Forecasting with linear extrapolation after 2046 shares of new dwelling units by 2046 singles: 31% doubles: 4% rows: 37% apartments: 28%	Maintain BAP allocation	Maintain BAP allocation
5	Efficiency of new homes	Avoided thermal and electric energy	2012 Building Code	10% improvement every 5 years for new construction	NA - superseded by Action 6	NA - superseded by Action 6
6	Net zero homes	Avoided thermal and electric energy (Relates to solar PV installations)	N/a	2016 efficiencies held constant	Increase the percent of new construction which is net zero energy to 100% in 2030	100% of new construction is net zero energy after 2030
7	New commercial buildings	Avoided thermal and electric energy	2012 Building Code	10% improvement every 5 years for new construction	Apply Energy Evolution's High Performance Development Standard targets according to the same timeline as being used currently in Toronto up to 2030	Hold the target for 2030
Existing buildings - retrofitting						
8	Retrofit older homes (pre-1980)	Avoided thermal and electric energy	N/A, estimated 1% annual renovation rate	No additional retrofits	Scale up rate of retrofits to 27% of all dwellings by 2030; achieve thermal savings of 70%; electrical savings of 30%	Scale up rate of retrofits to 98% of all dwellings by 2040; achieve thermal savings of 70%; electrical savings of 30%
9	Retrofit newer homes (post-1980)	Avoided thermal and electric energy	N/A, estimated 1% annual renovation rate	No additional retrofits	Scale up rate of retrofits to 27% of all dwellings by 2030; achieve thermal savings of 70%; electrical savings of 30%	Scale up rate of retrofits to 98% of all dwellings by 2040; achieve thermal savings of 70%; electrical savings of 30%
10	Retrofits for small commercial and office buildings	Avoided thermal and electric energy	N/A, estimated 1% annual renovation rate	No additional retrofits	Scale up rate of retrofits to 27% of all buildings by 2030; achieve thermal savings of 60%; electrical savings of 30%	Scale up rate of retrofits to 98% of all buildings by 2040; achieve thermal savings of 60%; electrical savings of 30%
11	Retrofits for commercial, office and industrial buildings	Avoided thermal and electric energy	N/A, estimated 1% annual renovation rate	No additional retrofits	27% of the existing building stock is retrofit by 2030 with average savings of 50%	95% of the existing building stock is retrofit by 2040 with average savings of 50%
12	Municipal buildings retrofits	Avoided thermal and electric energy	N/A	Current efficiencies held constant	27% of existing municipal buildings are retrofit to net zero emissions by 2030	99% of existing municipal buildings are retrofit to net zero emissions by 2040
13	Federal building retrofits	Avoided thermal and electric energy	N/A	15% savings for both heating and cooling for 50% of the buildings by 2030 and 15% for the remaining buildings by 2050.	NA - superseded by Action 11	NA - superseded by Action 11

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Building Equipment						
14A	Low-rise residential heat pumps in existing buildings	Fuel-shifting	0 Heat pumps, 15,281 TJ natural gas consumption for space heating	Fuel shared from 2016 maintained until 2050	117,209 heat pumps installed by 2030 (72%/28% air/ground)	255,808 heat pumps installed by 2050 (72%/28% air/ground)
14B	Low-rise residential heat pumps in new buildings	Fuel-shifting		Fuel shared from 2016 maintained until 2050	47,451 heat pumps installed by 2030 (77%/23% air/ground)	158,883 heat pumps installed by 2050 (77%/23% air/ground)
15A	Apartments heat pumps in existing buildings	Fuel-shifting	0 heat pumps, 1,949 TJ natural gas consumption for space heating	Fuel shared from 2016 maintained until 2050	44,322 heat pumps installed by 2030 (72%/28% air/ground)	82,728 heat pumps installed by 2050 (72%/28% air/ground)
15B	Apartments heat pumps in new buildings	Fuel-shifting		Fuel shared from 2016 maintained until 2050	19,663 heat pumps installed by 2030 (77%/23% air/ground)	62,931 heat pumps installed by 2050 (77%/23% air/ground)
16A	Commercial heat pumps in existing buildings	Fuel-shifting	0 heat pumps, 12,552 TJ of natural gas consumption for space heating	Fuel shared from 2016 maintained until 2050	38% of heat load served by heat pumps by 2030	73% of heat load served by heat pumps by 2050
16B	Commercial heat pumps in new buildings	Fuel-shifting		Fuel shared from 2016 maintained until 2050		
42	Electric water heaters in residential and commercial buildings	Fuel-shifting	8,628 TJ of natural gas consumption for water heating	Fuel shared from 2016 maintained until 2050	residential: 331,660 on-demand electric water heaters by 2030 non-residential: 41% of water heating load served by electric water heaters by 2030	residential: 516,913 on-demand electric water heaters by 2050 non-residential: 63% of water heating load served by electric water heaters by 2050
ENERGY GENERATION						
Solar energy						
17	Residential PV	Local energy generation	72 kW	Capacity provided by Hydro One and Hydro Ottawa; no additional capacity added	174 MW by 2030 capacity factor = 15%	320 MW by 2050 capacity factor = 15%
18	Commercial PV	Local energy generation	584 kW	Capacity provided by Hydro One and Hydro Ottawa; no additional capacity added	400 MW by 2030 capacity factor = 15%	740 MW by 2050 capacity factor = 15%
19	Utility-scale PV	Local energy generation	N/A	Capacity provided by Hydro One and Hydro Ottawa; no additional capacity added	70 MW by 2030 capacity factor = 15%	140 MW by 2050 capacity factor = 15%
Waterpower						
20	Hydropower	Local energy generation	6,780 TJ / 260 MW	No additional capacity added	18 MW by 2030 capacity factor = 70%	36 MW by 2050 capacity factor = 70%
Biogas						
21	Rural and Wastewater Biogas	Local energy generation	Current farm operations making electricity under provincial FIT contracts	No additional capacity added	6 MW 2030: 1/2 electricity generation and 1/2 RNG	6 MW 2030: 1/2 electricity generation and 1/2 RNG 2040: all RNG
Wind						
23	Wind		N/A	Existing 2016 capacity is held constant through to 2050	1609 MW by 2030 capacity factor = 30%	3218 MW by 2050 capacity factor = 30%
Energy storage						
24	Increase electricity storage		Installed capacity is <1MW	No additional storage	310 MW storage by 2030 sufficient storage to reduce curtailment of renewable generation from 90% to 85% included in set up of actions 17-20, 23	612 MW storage by 2050 sufficient storage to reduce curtailment of renewable generation from 90% to 85% included in set up of actions 17-20, 23

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District energy						
22	District energy systems (other than federal)		University of Ottawa only	Existing 2016 DE capacity is held constant through to 2050	no homes served by expanded DE by 2030 3,027,513 sqm non-residential floorspace served by expanded DE by 2030	80% of existing commercial buildings; 80% of apartments; 15% of residential buildings; 100% of the system low carbon (geothermal) 23,394 homes served by expanded DE by 2050 4,765,441 sqm non-residential floorspace served by expanded DE by 2050
22B	Federal district energy systems		1,673 TJ energy supplied	1,673 TJ energy supplied	Federal DE systems switched to geothermal by 2040 1,311,766 sqm floorspace served by federal DE by 2030	Federal DE systems switched to geothermal by 2040 3,325,612 sqm floorspace served by federal DE by 2050
Power to gas						
39	Power to gas	Not currently happening in Ottawa	None	None	2030: 865 TJ hydrogen produced at 70% efficiency, half of waste heat is used. Produced hydrogen is injected into natural gas pipelines. Hydrogen can displace up to 15% of natural gas by volume. Hydrogen production is limited to the amount of natural gas in use in this scenario	2040 and onwards: 95 TJ hydrogen produced at 80% efficiency, half of waste heat is used. At 2030, although its not modelled, power to methane will be considered as a way to maintain gas production.
TRANSPORT						
Transit						
25	Expand transit	Avoided transportation energy	12% internal trips, 11% outbound trips, 25% inbound trips	Completion of the Confederation & Trillium Line-Phase 1 and 2	The frequency of LRT is increased to every 1.5 min BRT speeds increase by 20% in dedicated bus lanes (currently every 5 minutes at peak times), and every 7.5 minutes for off-peak frequency (currently every 15 minutes for off-peak). Expanded transit to reflect "Concept Transit Network" rather than "affordable transit network"	The frequency of LRT is increased to every 1.5 min BRT speeds increase by 20% in dedicated bus lanes (currently every 5 minutes at peak times), and every 7.5 minutes for off-peak frequency (currently every 15 minutes for off-peak). Expanded transit to reflect "Concept Transit Network" rather than "affordable transit network"
26	Electrify transit	Fuel-shifting	N/A	100% electric by 2050	All rail and road passenger vehicles electricified/zero emission by 2030. Support vehicles: 60% zero emission by 2030	All rail and road passenger vehicles remain electricified/zero emission from 2030 onwards. Support vehicles become electricified/zero emission in 2040 and remain so onwards
Active						
27	Increase/improve cycling & walking infrastructure	Avoided transportation energy	12% internal trips, 11% outbound trips, 25% inbound trips 24-hr mode shares auto: 73.80% transit: 12.20% walk: 10.10% bike: 3.80%	Active mode shares by O-D zones in 2011 and 2031 model data 24-hr mode shares by 2050 auto: 68.10% transit: 16.50% walk: 11.70% bike: 3.70%	Mode shift to 50% of the walking and cycling potential away from vehicles and driving. Use 2km for walking and 5km for cycling. 24-hr mode shares by 2030 auto: 58% transit: 20% walk: 14% bike: 8%	Mode shift to 50% of the walking and cycling potential away from vehicles and driving. Use 2km for walking and 5km for cycling. 24-hr mode shares by 2050 auto: 55% transit: 19% walk: 15% bike: 11%
28	Car free zone	Avoided transportation energy	N/A	None	Byward market and downtown Ottawa are car free; wellington-rideau, sparks, bank, ottawa-U campus by 2030	Byward market and downtown Ottawa are car free; wellington-rideau, sparks, bank, ottawa-U campus
29	Congestion charge	Avoided transportation energy	N/A	None	Congestion charge of \$20 applied to the downtown core between 6:00 am and 10:00 am on weekdays.	Congestion charge of \$20 applied to the downtown core between 6:00 am and 10:00 am on weekdays.
Vehicles						

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30	Electrify municipal fleets Fuel-shifting	N/A	None	Municipal fleet is 60% zero emission by 2030 (starting in 2025)	Municipal fleet is 100% zero emission by 2040 and later

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31	Electrify personal vehicles	Fuel-shifting	150 Electric Vehicles	Vehicle fuel consumption rates reflect the implementation of the U.S. Corporate Average Fuel Economy (CAFE) Fuel Standard for Light-Duty Vehicles. 24,530 EVs (3.5%) in personal use vehicle stock by 2035, 44,549 EVs (5.5%) in personal use vehicle stock by 2050. 4.2% of new PUVs are EVs by 2035	EVs compose 90% of new vehicle sales by 2030	EVs compose 100% of new vehicle sales after 2040
32	Car sharing/car cooperatives	Avoided transportation energy	Approximately 170 Carshares available in Ottawa through Vrtucar and Zipcar	Same as 2016	Same as 2016	Same as 2016
34	Parking management	Avoided transportation energy	\$1.5 - 3 / Hour	No change	No off-street parking within 500m of LRT: 50% reduction in Centretown; double on-street parking fares during peak hours by 2050; VKT reduction of 15% in relevant zones.	No off-street parking within 500m of LRT: 50% reduction in Centretown; double on-street parking fares during peak hours by 2050; VKT reduction of 15% in relevant zones.
35	Electrify commercial vehicles	Fuel-shifting	N/A	Phase 1 and Phase 2 of EPA HDV Fuel Standards for Medium- and Heavy-Duty Vehicles.	40% of heavy trucks are zero emissions by 2030	100% of heavy trucks are zero emissions by 2040
40	EV only zones	NA	None	None	EVs only inside the area bounded by Bronson Avenue, Catherine Street, and Queen Elizabeth Drive (Rideau Canal) by 2028. (This is the area to which the congestion charge is applied.)	EVs only inside the area bounded by Bronson Avenue, Catherine Street, and Queen Elizabeth Drive (Rideau Canal) by 2028. (This is the area to which the congestion charge is applied.)
WATER AND WASTE						
Waste						
36	Leaf and yard waste		Not modelled as an energy or emissions source	Not modelled as an energy or emissions source	all leaf and yard waste gasified after 2030, displaces fossil gas included with Action 38	all leaf and yard waste gasified after 2030, displaces fossil gas included with Action 38
38	Waste diversion	Avoided methane emissions	2016 residential waste diversion: Paper: 78% Organics and yard: 58% Plastic/metal/glass: 65%	Existing diversion rate unchanged	98% organics diverted by 2024 Achieve residential Ottawa waste diversion targets by 2030, increase paper diversion to 98% Non-res targets: - paper: 98% - plastic/metal/glass: 50% Route all of organic waste to anaerobic digester All yard and leaf waste goes to compost AD gas and LFG are used as RNG and displace natural gas use	Maintain 2030 targets
Industry						
37	Industry process improvements	Avoided electric energy	4,877 TJ	Hold process efficiency constant	Hold process efficiency constant	Hold process efficiency constant
41	Waste heat	Avoided electric and fossil energy	NA	NA	2030: 700 TJ of waste heat displaces fossil gas	2050: 1600 TJ of waste heat displaces fossil gas

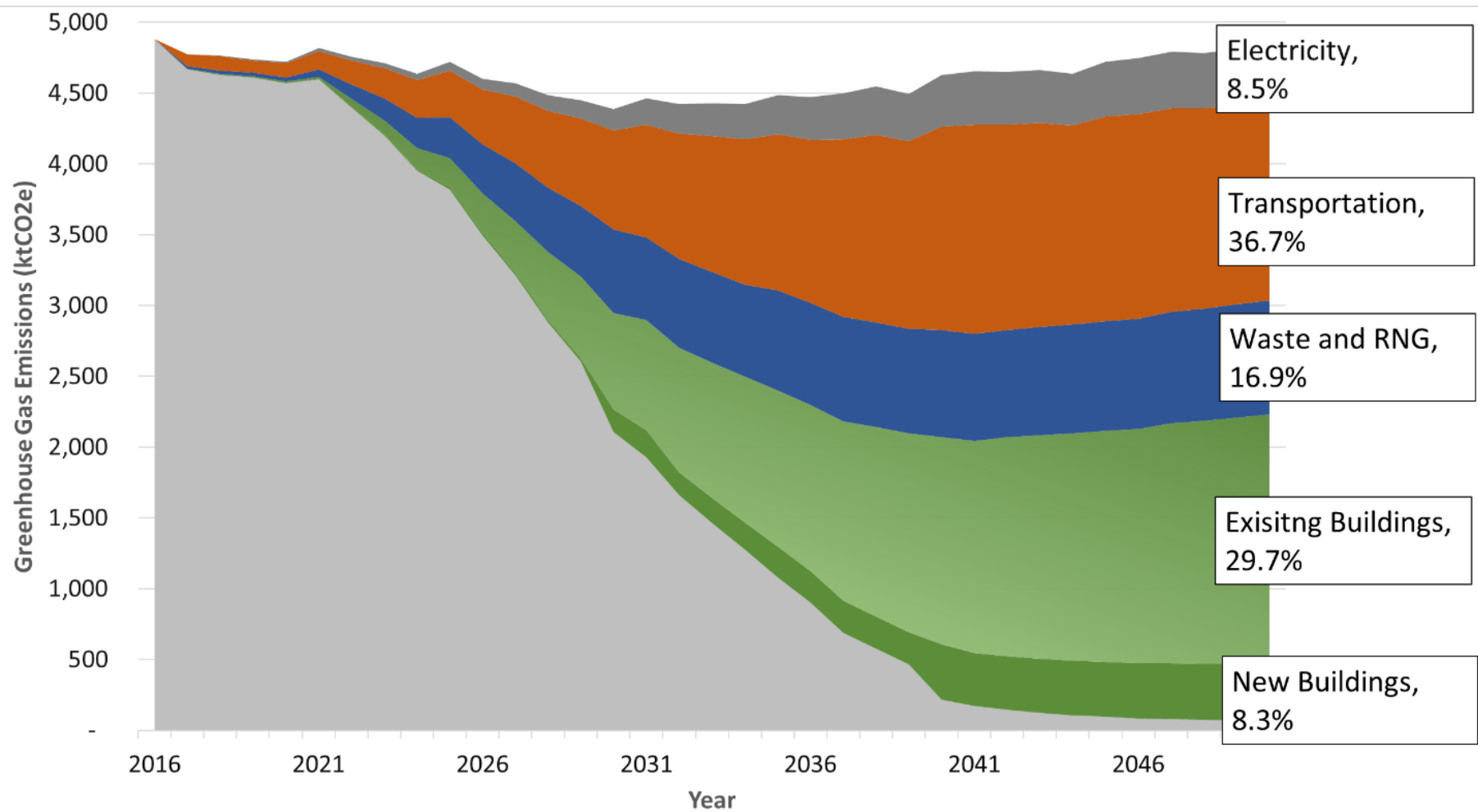


Figure 1: Total projected community-wide GHG emission reductions required by sector to achieve 100% scenario incremental to BAP scenario, 2016-2050. (percentages shown at 2050 are non-cumulative)

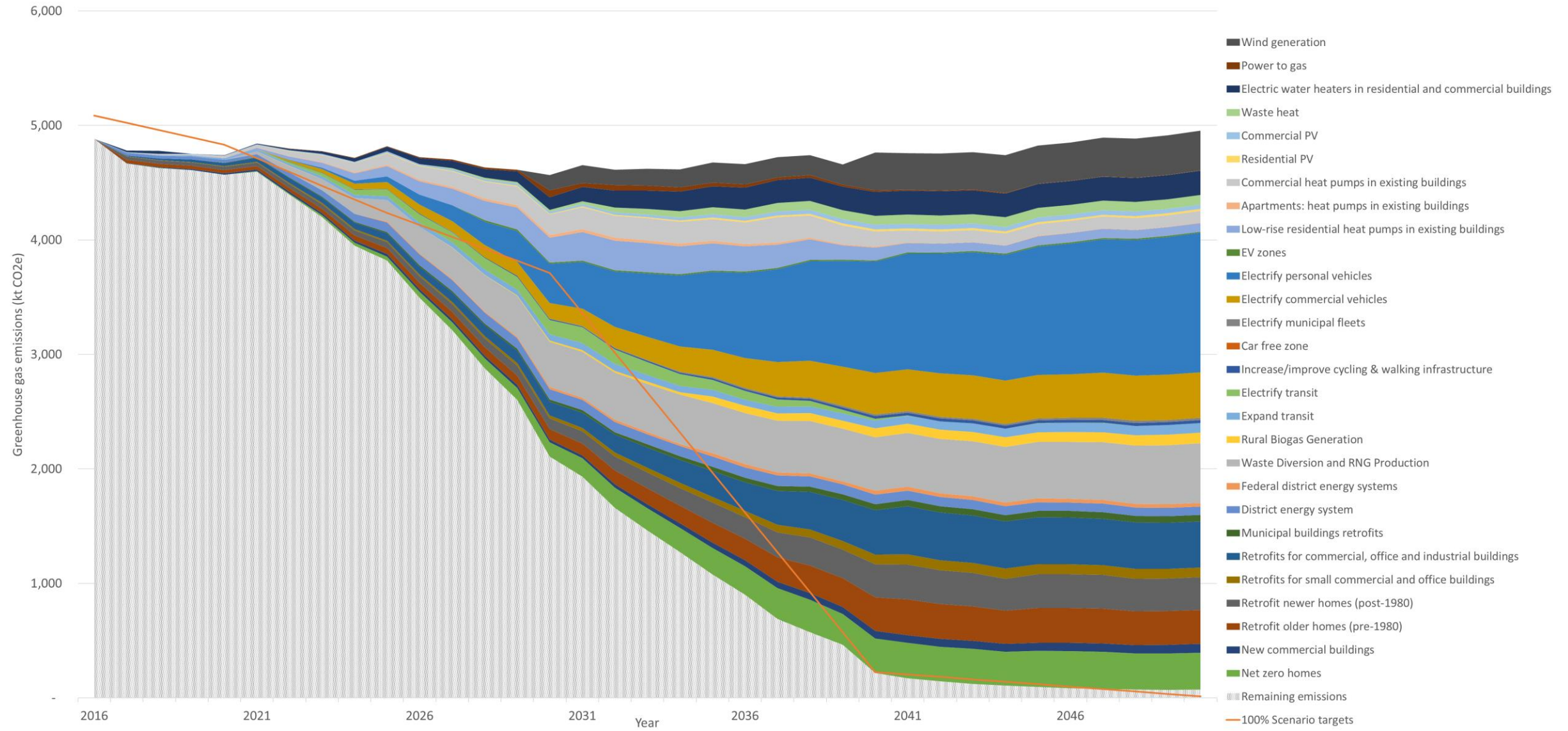


Figure 2: Total projected community-wide GHG emission reductions by action, 2016-2050