**Appendix A** Variables and equations of the economic benefit model of construction waste recycling enterprises

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| S/N | Variables | Equation |
|  | GDP | INTEG (GDP growth,270232) |
|  | GDP growth | GDP growth rate×GDP×GDP growth trend |
|  | GDP growth rate | =WITHLOOKUP(Time,([(2007,0)-(2030,1)],(2007,0.182373),(2008,0.0925335),(2009,0.183192),(2010,0.18466),(2011,0.104367),(2012,0.101555),(2013,0.0818649),(2014,0.0699999),(2015,0.0799288),(2015.93,0.0701754),(2017.06,0.0701754),(2018.04,0.0657895),(2019.17,0.0789474),(2020.22,0.0614035),(2021.14,0.0833333),(2021.91,0.0745614),(2022.97,0.0701754),(2023.95,0.0833333),(2024.8,0.0614035),(2026.06,0.0789474),(2027.4,0.0745614),(2028.24,0.0789474),(2030,0.07295) )) |
|  | GDP growth trend | 1 |
|  | Net present value | Total income - Total cost |
|  | Wastes sorting | Total amount of waste sorted on site×Ratio of waste sorting |
|  | Unit cost of sorting waste | 15 CNY/t |
|  | Total cost of sorting waste | Wastes sorting×Unit cost of sorting waste |
|  | Cost of office decoration | 3×PULSE (2007, 1) |
|  | Value of unit waste recycling | 200 CNY/t |
|  | Publicity expenses | 4×PULSE (2007, 1) |
|  | Factory rent | =28.8+STEP (282672, 2011) |
|  | Cost of raw material | Cost of cement+Cost of wate+ Cost of fuel + Cost of productive labor |
|  | Unit price of recycled waste | WITH LOOKUP (Production technology, ([(0,0)-(10,20)],(0,5),(1,10),(2,15),(3,20) )) |
|  | Cost of recycling waste | Unit price of recycled waste×Amount of construction waste recycling |
|  | Fixed assets investment cost | 2680×PULSE (2007, 1)+30×PULSE(2009, 1)+243×PULSE(2012, 1)+30×PULSE(2013, 1)+145×PULSE(2016, 1) |
|  | Cost of landfill waste | Wastes for direct landfill×Unit cost of direct landfill of waste |
|  | VAT | Tax rate×Sales revenue |
|  | Ratio of waste sorting | 0.88 |
|  | Total cost of waste disposal | Cost of landfill waste+ Cost of construction waste to be landfilled +Total cost of sorting waste |
|  | Unit cost of direct landfill of waste | 60 CNY/t |
|  | Construction waste to be landfilled | Proportion of construction waste to be landfilled×Total amount of waste sorted on site |
|  | Increment of construction waste | Ratio of construction waste collection×Total annual output of construction waste |
|  | Cost of construction waste to be landfilled | Construction waste to be landfilled×Unit cost for landfill×0 |
|  | Proportion of construction waste to be landfilled | 0.45 |
|  | Total construction waste collection | INTEG (Increment of construction waste- Wastes sorting - Wastes for direct landfill) |
|  | Ratio of construction waste collection | 0.86 |
|  | Ratio of construction waste recycling | 0.36 |
|  | Amount of construction waste recycling | Ratio of construction waste recycling×Government-provided recycling projects×Government incentives×Total amount of waste sorted on site |
|  | Annual output of demolition wastes | Unit output of demolition wastes×Area for demolition of buildings |
|  | Building demolition area factor | 0.1 |
|  | Total annual output of construction waste | Annual output of demolition wastes + Annual output of construction wastes for new construction Units: 10kt |
|  | Unit output of demolition wastes | 1.3 |
|  | Area for demolition of buildings | Construction area of new buildings×Building demolition area factor |
|  | Construction cost | Cost of office decoration +Fixed assets investment cost+ Factory rent +Publicity expenses+Website construction cost |
|  | Unit cost for landfill | Units: 90 CNY / t |
|  | Total cost | INTEG (Construction cost+Operating cost) |
|  | Total revenue | INTEG (Government funding+Sales revenue+Additional income) |
|  | ROI | IF THEN ELSE(Total cost =0 ,0 , IF THEN ELSE(Total income - Total cost <0 , 0 ,( Total income - Total cost)/ Total cost ) ) |
|  | Government-provided recycling projects | 0.6 |
|  | Government incentives | 0.8 |
|  | Tax incentives | =1 |
|  | Government funding | 0 |
|  | Government financial subsidies | Units: 5 CNY /t |
|  | Construction area of new buildings | 898801×LN(GDP)-1.08504e+007 Units: 10km2 |
|  | Annual output of construction wastes for new construction | Construction area of new buildings×Unit output of construction wastes for new construction |
|  | Unit output of construction wastes from demolition | 0.055m3/m2 |
|  | Cost of cement | WITH LOOKUP (Time,([(2007,0)(2030,600)],(2007,95.31),(2008,143),(2009,190.6),(2010,158.8),(2011,158.8),(2012,158.8),(2013,238.3),(2014,278),(2015,278),(2016,317.7),(2017,317.7),(2018,317.7),(2019.45,315.789),(2020.01,363.158),(2021.14,371.053),(2022.83,368.421),(2023.81,413.158),(2024.58,413.158),(2026.55,415.789),(2027.47,460.526),(2029.23,465.789),(2030,465.789) )) |
|  | Cost of water | WITH LOOKUP (Time,([(2007,0)-(2030,100)],(2007,11.56),(2008,11.56),(2009,11.56),(2010,15.42),(2011,7.709),(2012,15.42),(2013,11.56),(2014,13.49),(2015,13.49),(2016,15.42),(2017,15.42),(2018,15.42),(2030,15.42) )) |
|  | Cost of fuel | WITHLOOKUP ( Time,([(2007,0)(2030,400)],(2007,55.51),(2008,23.8),(2009,52.85),(2010,77.64),(2011,77.64),(2012,77.64),(2013,132),(2014,143.6),(2015,143.6),(2016,186.3),(2017,186.3),(2018,186.3),(2019.38,208.772),(2020.72,215.789),(2022.26,214.035),(2022.9,235.088),(2024.16,236.842),(2025.15,238.596),(2025.85,270.175),(2026.91,275.439),(2030,282.456) )) |
|  | Total amount of waste sorted on site | INTEG (Wastes sorting - Construction waste to be landfilled -Amount of construction waste recycling,0) |
|  | Cost of productive labor | 971861+RAMP(1,2 , 12 ) |
|  | Production technology | 1 |
|  | Wastes for direct landfill | Total construction waste collection×Proportion of direct landfill |
|  | Proportion of direct landfill | 0.15 |
|  | Maintenance and operation cost | WITH LOOKUP (Time,([(2007,0)-(2030,2e+006)],(2007,27.6),(2008,18.96),(2009,15.6),(2010,17.76),(2011,20.16),(2012,22.32),(2013,43.68),(2014,52.8),(2015,57.6),(2016,68.16),(2017,72.96),(2018,77.28),(2019.17,82.46),(2020.5,85.96),(2022.4,90.35),(2023.95,93.86),(2025.78,99.12),(2027.19,100),(2028.73,104.4),(2030,108.8) )) |
|  | Website construction cost | 50- STEP (49, 2008) |
|  | Operating cost | Cost of raw material+ Cost of recycled waste +Depreciation fee of fixed assets+VAT+Administration expense+Maintenance and operation cost+Total cost of waste disposal |
|  | Sales revenue | (Government financial subsidies+Value of unit waste recycling)×Amount of construction waste recycling |
|  | Administration expense | 1.03927e+006+RAMP (1, 2, 12) |
|  | Tax rate | 0.105×Tax incentives |
|  | Income tax  | IF THEN ELSE(Sales revenue >Operating cost, (Sales revenue-Operating cost)×Income tax rate×Favorable income tax , 0 ) |
|  | Income tax rate | 0.25 |