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IRF WORLD ROAD MEETING 2017

/ 14-17 NOVEMBER / DELHI / INDIA /

Cost-effective provision of low-volume roads in South Africa

Matthew Townshend
Ph.D. Student
University of Cape Town
matthew@nigeltownshend.com

Joint work with: Don Ross
University College Cork
University of Cape Town
Georgia State University

CONTENT

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PROBLEM STATEMENT

- 75% (459 957 km) of SA's proclaimed roads are gravel
  - An additional 131 919 km of unproclaimed gravel roads
- Most of these gravel roads carry low traffic volumes
  - Class 3 & 4
  - 93% of gravel roads in the WC carry < 250 vehicles per day
- 67% of provincial gravel roads in poor/v.poor condition
- R36 billion to re-gravel roads in poor/v.poor condition
  - 132% of total 2017/18 consolidated road expenditure
- But, authorities cannot abandon all gravel roads as some fulfil important basic access functions
- Therefore, it is important to determine the most cost-effective surface options for low-volume gravel roads in South Africa

LIFE CYCLE COST ANALYSIS (LCCA)

- LCCA uses initial and discounted future costs to evaluate the overall economic efficiency of alternative investment options

- Explores the trade-offs between the investment, maintenance, rehabilitation and road user costs of:
  - Gravel roads
  - Sand seal
  - Slurry seal
  - Single chip seal
  - Cape seal
  - UTRCP

$$NPV = C + \sum_{i} M_i (1 + r)^{-x_i} - S(1 + r)^{-z}$$

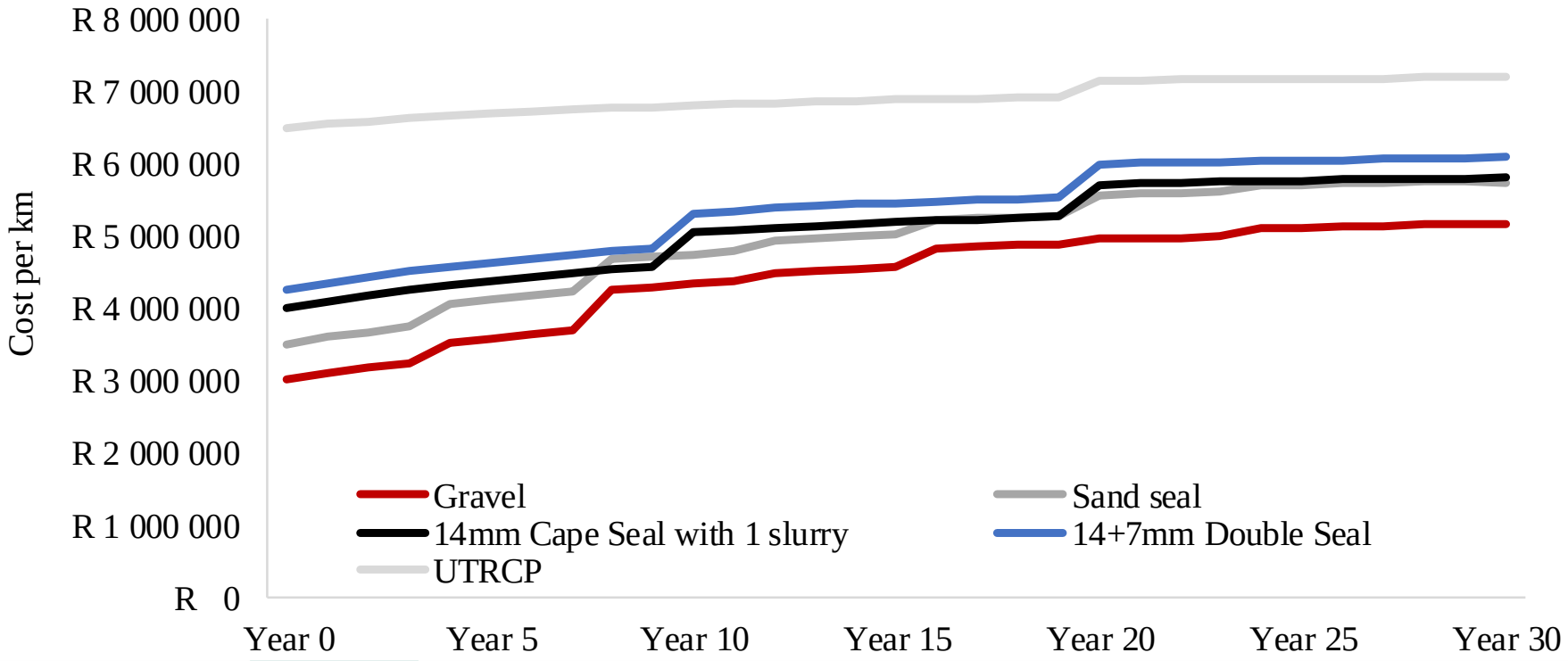
DETERMINISTIC APPROACH

- Fixed costs are applied for each road surface variable
  - Evidence
  - Professional judgement
- Sensitivity analyses are conducted on a selected set of assumptions made for major cost variables to account for uncertainty of the outcomes
  - Input prices
  - Labour intensity of road works
  - The cost of labour
  - Road user costs
  - Environmental factors
- The appropriate method in the context of data constraints

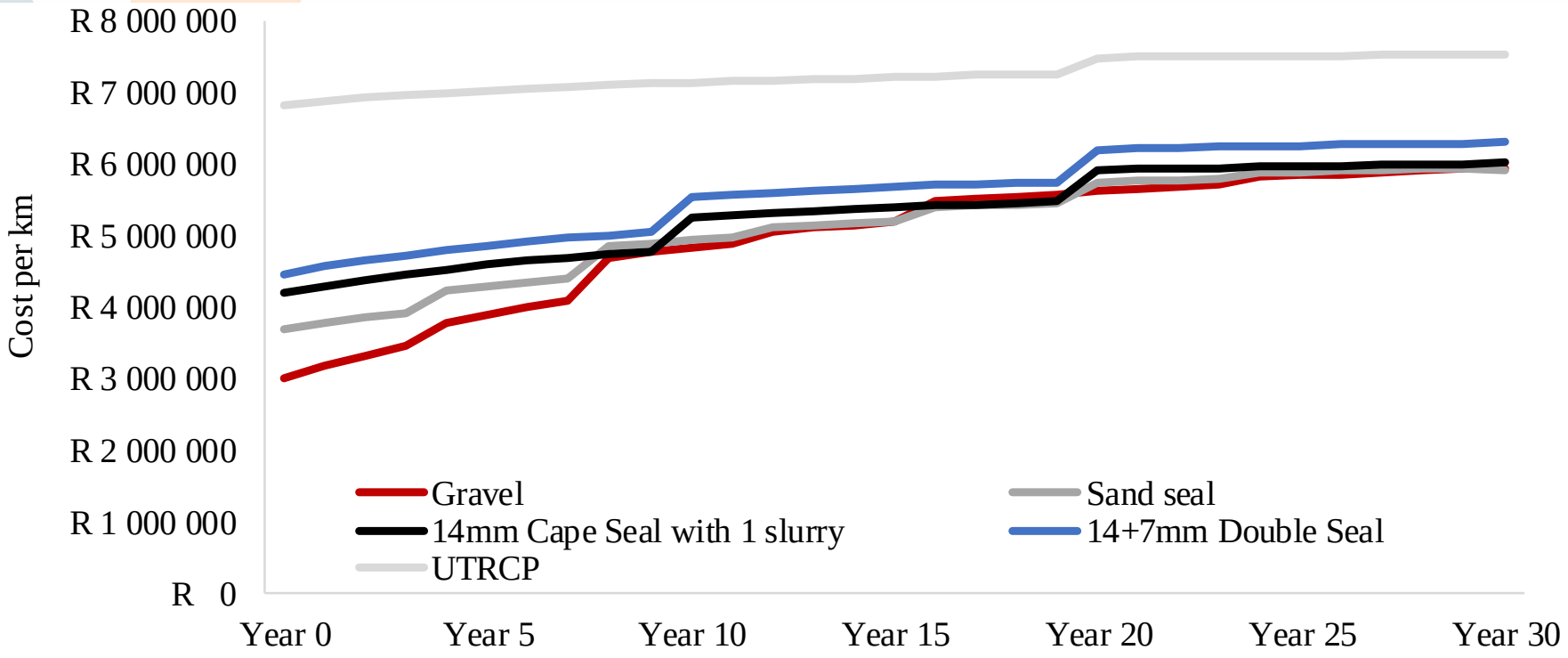
ROAD SPECIFICATIONS AND DATA

	Gravel	Sand seal	14 mm cape seal + 1 slurry	14 mm + 7 mm double seal	UTRCP
Serviceable life	8 years	20 years	20 years	20 years	30 years
Construction					
Total cost	R 3 000 000	R 3 500 000	R 4 000 000	R 4 250 000	R 6 500 000
Haulage	*R 150 000*	*R 374 500*	*R 376 000*	*R 374 000*	*R 344 500*
Unskilled labour	*R 180 000*	*R 280 000*	*R 360 000*	*R 340 000*	*R 780 000*
Bitumen	*NA*	*R 71 887*	*R 109 720*	*R 135 635*	*NA*
Routine maintenance: Minor repairs and clean-up operations, including grading and blading					
Frequency	4 per year	4 per year	4 per year	4 per year	4 per year
Total cost	R 100 000	R 100 000	R 100 000	R 100 000	R 50 000
Haulage	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Unskilled labour	*R 50 000*	*R 50 000*	*R 50 000*	*R 50 000*	*R 25 000*
Bitumen	*NA*	*R 5 000*	*R 5 000*	*R 5 000*	*NA*
Periodic maintenance: Reseal of light seals					
Frequency (years)	NA	4;12;20;28	NA	NA	NA
Total cost	NA	R 350 000	NA	NA	NA
Haulage	*NA*	*R 6 300*	*NA*	*NA*	*NA*
Unskilled labour	*NA*	*R 28 000*	*NA*	*NA*	*NA*
Bitumen	*NA*	*R 134 133*	*NA*	*NA*	*NA*
Minor rehabilitation: Strengthening of the surface layer through re-gravelling, repair, and reseal					
Frequency	4 years	8 years	10 years	10 years	20 years
Total cost	R 300 000	R 850 000	R 1 100 000	R 1 150 000	R 1 500 000
Haulage	*R 28 200*	*R 34 850*	*R 37 400*	*R 37 950*	*R 19 500*
Unskilled labour	*R 18 000*	*R 68 000*	*R 99 000*	*R 92 000*	*R 225 000*
Bitumen	*NA*	*R 134 028*	*R 98 410*	*R 168 577*	*NA*
Major rehabilitation: Intensive re-gravelling and resealing to extend serviceable life					
Frequency	8 years	20 years	20 years	20 years	30 years
Total cost	R 800 000	R 1 550 000	R 1 800 000	R 1 825 000	R 4 100 000
Haulage	*R 84 800*	*R 91 450*	*R 93 600*	*R 94 900*	*R 57 400*
Unskilled labour	*R 48 000*	*R 124 000*	*R 162 000*	*R 146 000*	*R 492 000*
Bitumen	*NA*	*R 31 000*	*R 40 290*	*R 34 675*	*NA*

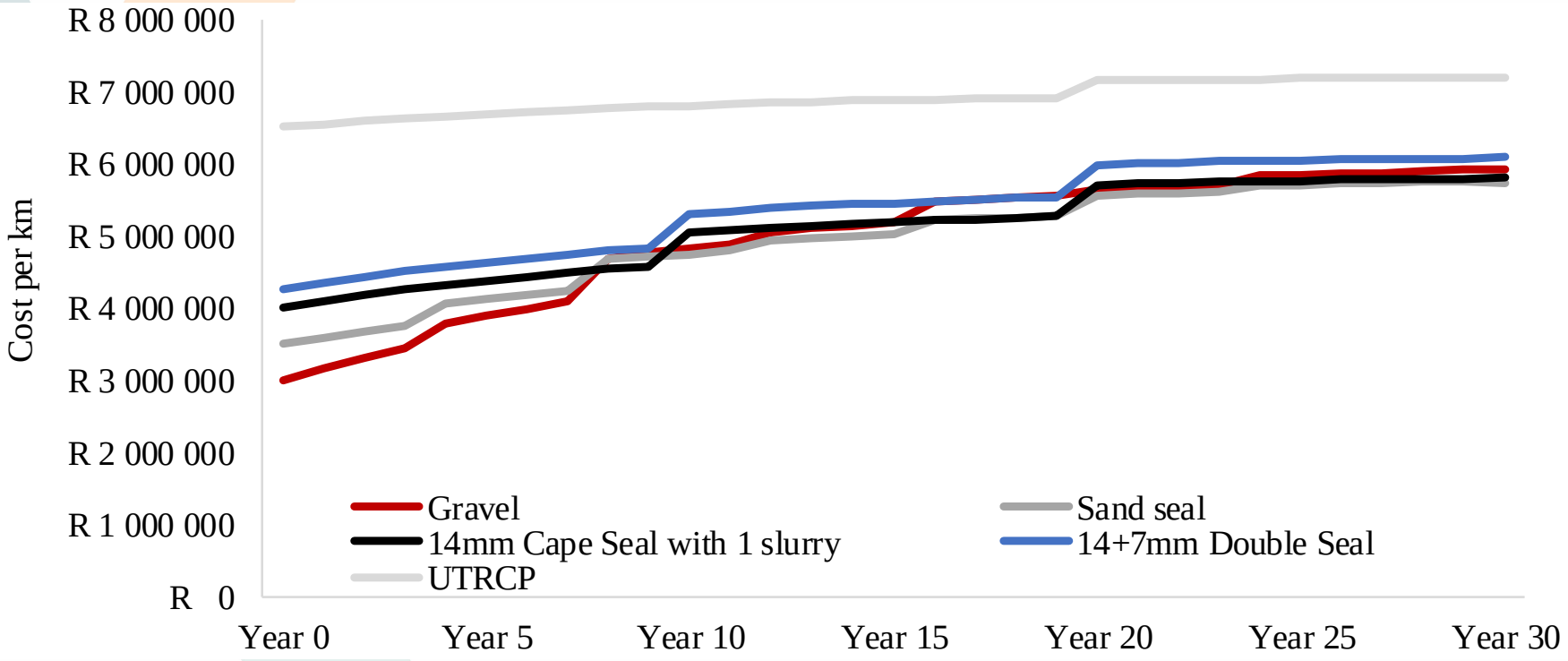
BASELINE


R 8 000 000
R 7 000 000
R 6 000 000
R 5 000 000
R 4 000 000
R 3 000 000
R 2 000 000
R 1 000 000
R 0
Cost per km
Year 0
Year 5
Year 10
Year 15
Year 20
Year 25
Year 30
Gravel
Sand seal
14mm Cape Seal with 1 slurry
14+7mm Double Seal
UTRCP

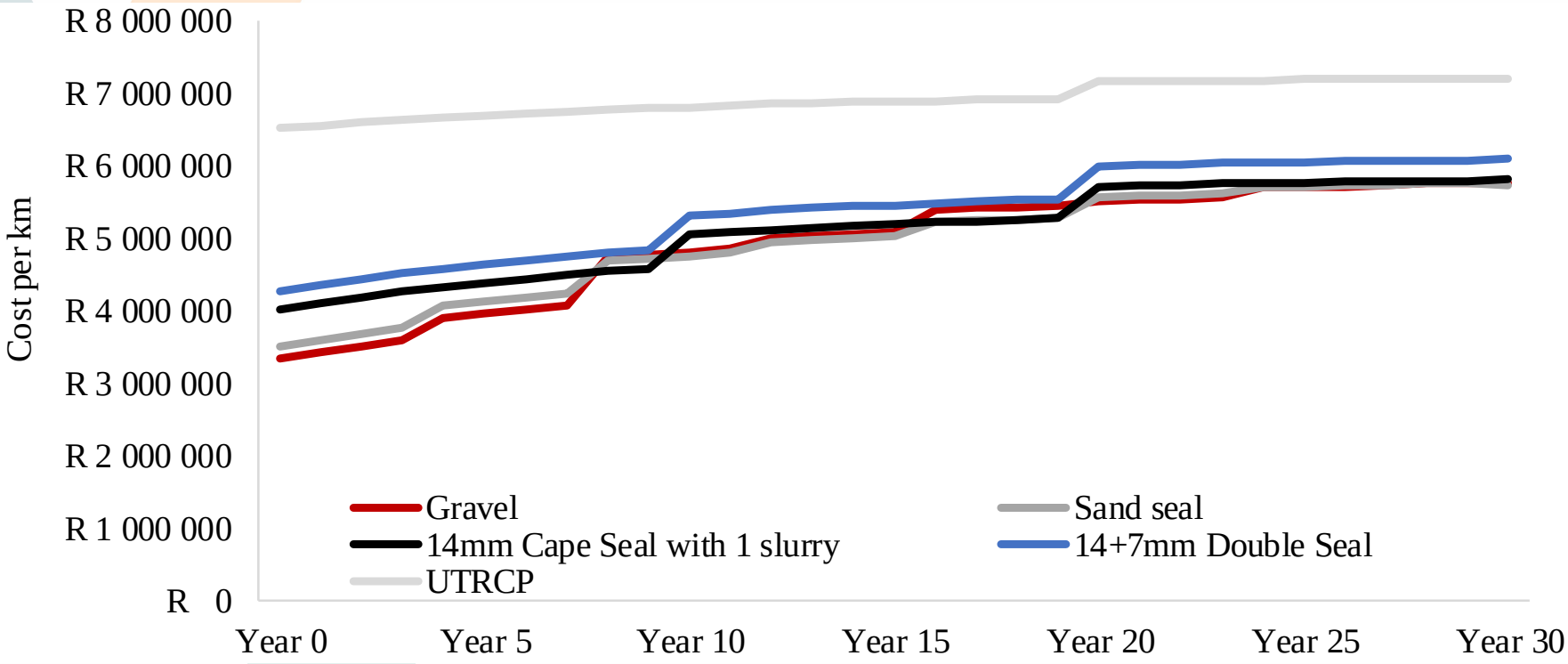
STRESS TEST 1: HIGH MOISTURE



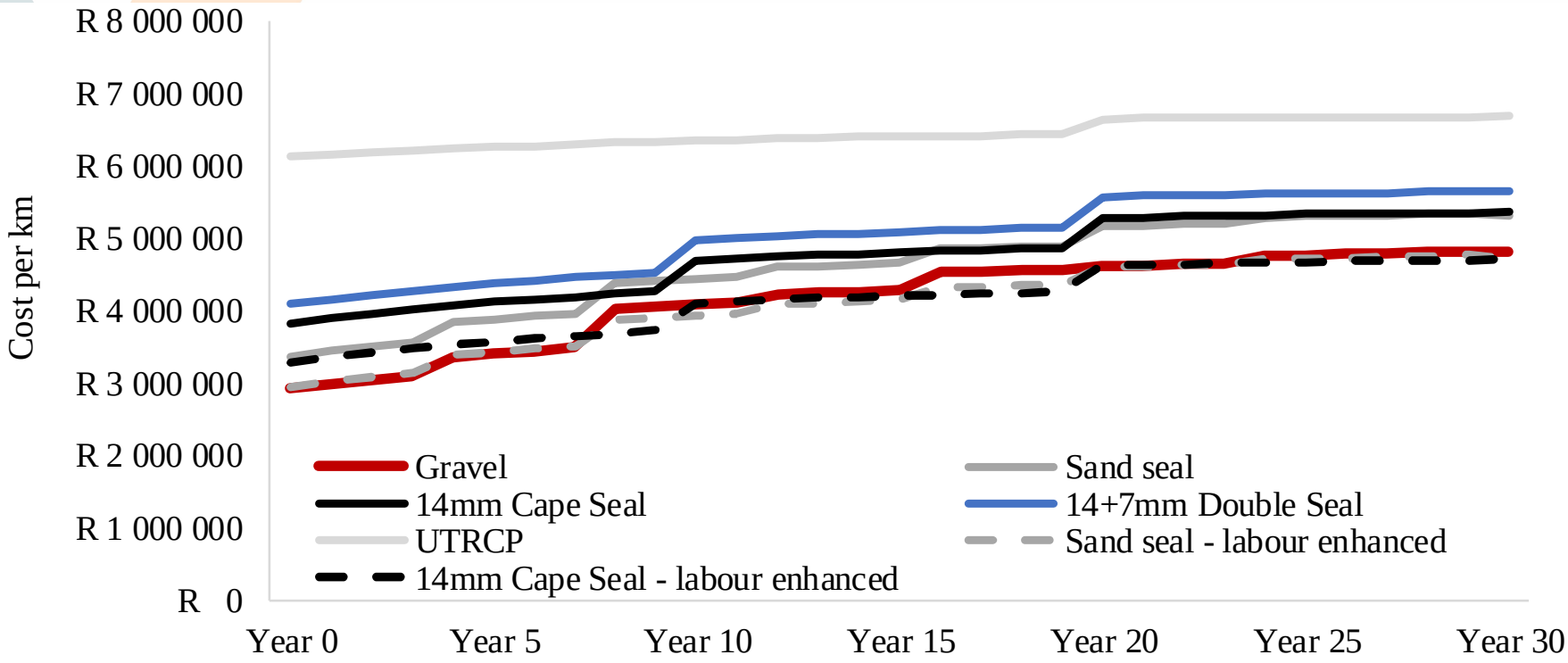
STRESS TEST 2: STEEP GRADIENT



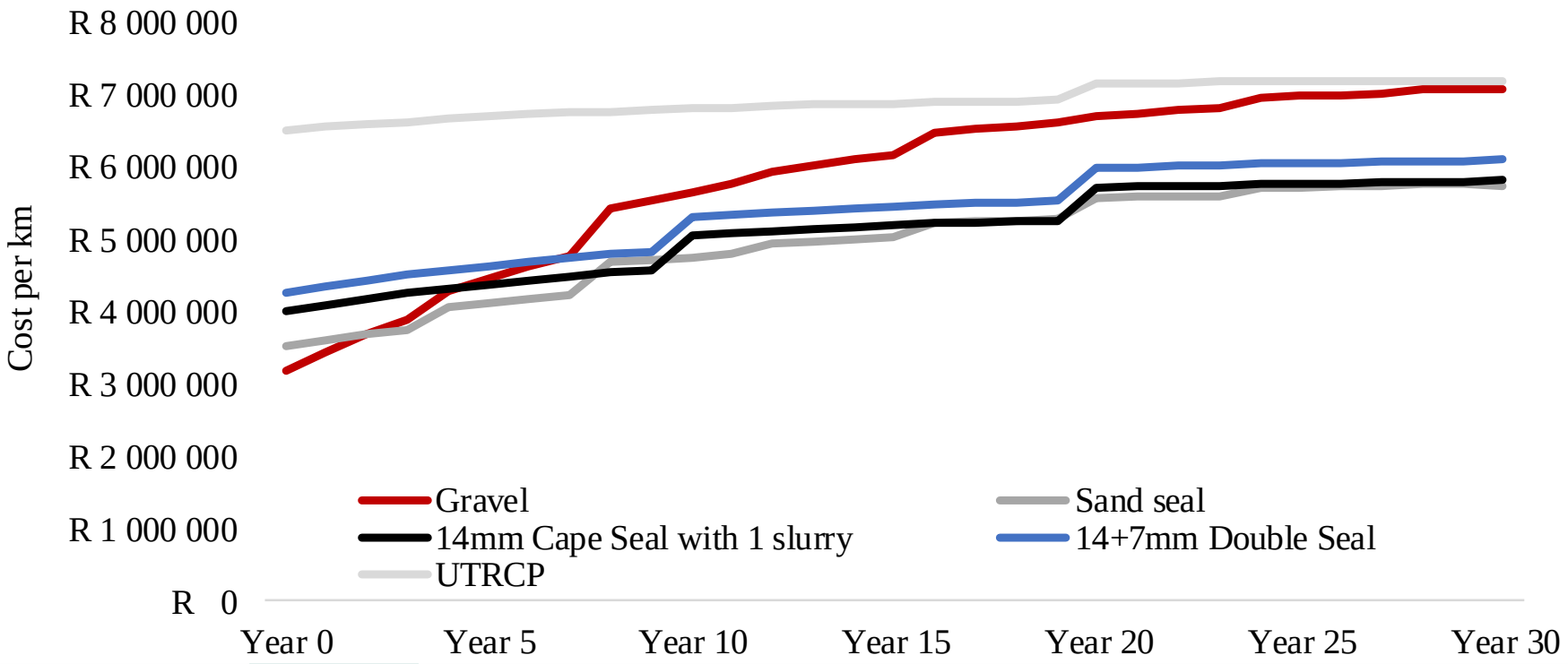
STRESS TEST 3: BORROW PIT DISTANCE



STRESS TEST 4: LABOUR PRICE



STRESS TEST 5: ROAD USER COSTS



POLICY IMPLICATIONS

- All factors examined here individually eliminate the cost advantage to gravel in the ideally simple world
- Sealing gravel roads:
  - generates more employment opportunities
  - Is able to be decentralized to small scale contractors
  - Is consistent with internal capacity constraints
- There are additional benefits of sealing gravel roads:
  - Faster vehicle speeds
  - Increased price of neighbouring properties
  - Reduced dust emissions
  - Reduction in cases of eye and respiratory issues
  - Better vegetation and crop growth
- Need to relax Provincial Roads Maintenance Grant conditions

QUESTIONS

Thank you