COST BENEFIT ANALYSIS STUDY OF ELECTRIC MOTORS (0.75-375kW)

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Presentation of draft final report to CLASP and SA Government

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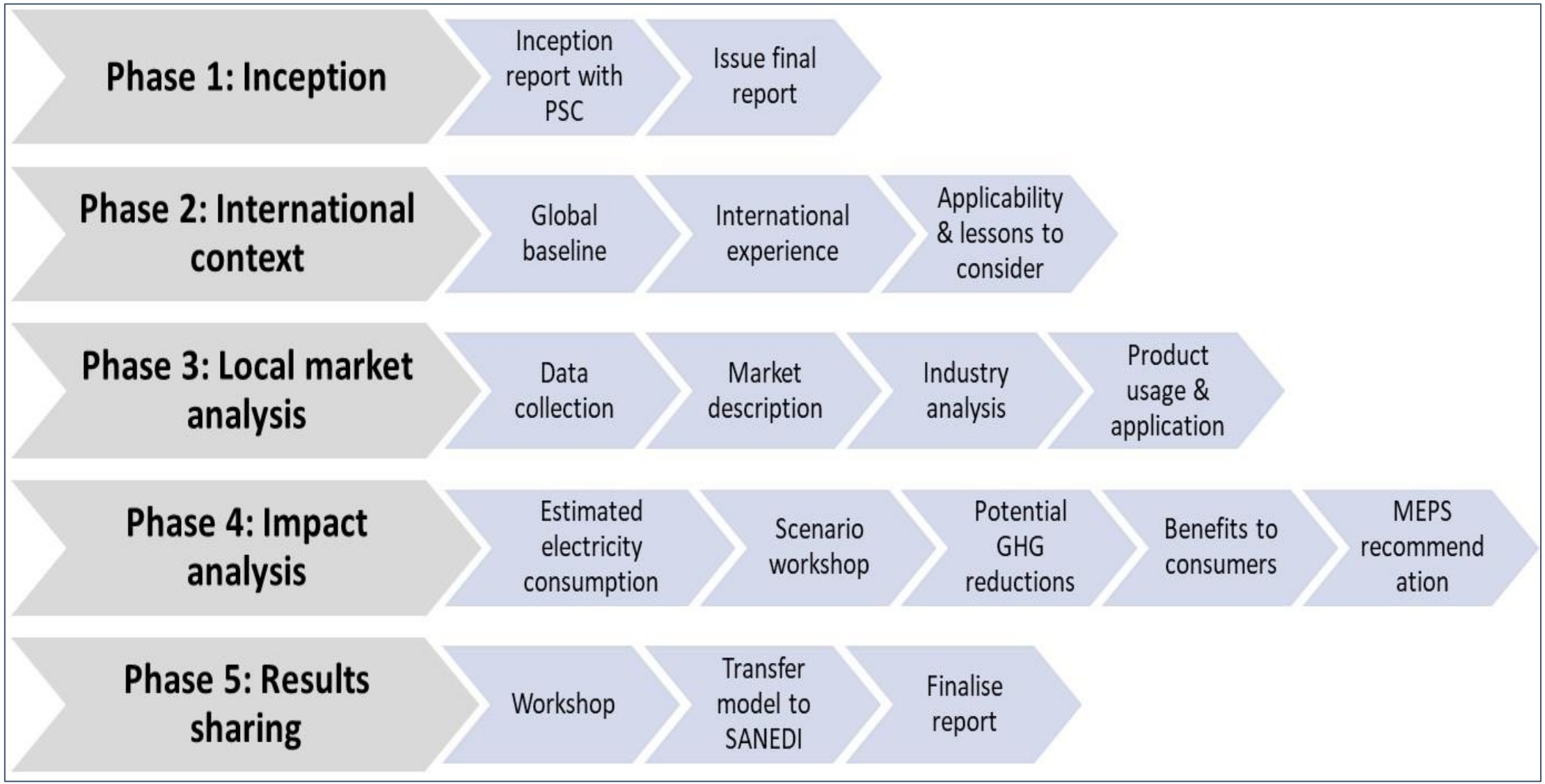
Techno-economic Study - Project phases



Summary of previous presentations

Inception meeting

- SA's S&L has been effective – in line with international experience
- Study Objectives – driven by DMRE and DFFE climate change policy
- 2018 DMRE study identified EM as a priority product for MEPS
- This CBA commissioned to confirm the energy savings potential & appropriate MEPS level

CBA IS TO IDENTIFY HOW AND NOT IF TO PROCEED

- International case studies found that SA is lagging its trading partners by as many as four revisions (MEPS updates)

Summary of previous presentations (2)

Progress update

- No regulation means the benefits of EE are not being exploited
- Payback periods of <1 year, based on Urban Econ Study
- Motor efficiency versus system efficiency – barrier and opportunity
- Rewinding of motors
- Methodological approach – number of stakeholders, primary data sources, modelling approach
- Market characteristics – agricultural, mining and commercial sectors
- Preliminary economic modelling results

Benefits of a CBA

- MEPS require careful consideration & analysis. Important factors must be balanced.
- Efficiency programmes seek to reduce usage/slow its growth - security; costs; GHG etc
- EE implementation comes with costs - to improve product efficiency and to manufacturers. If not managed this can negatively impact local industry and consumers.
- A complete analysis of proposed MEPS must consider: *Energy Demand Reduction; Peak Load Reduction; Environmental Impacts; Consumer Impacts; Manufacturer and Employment Impacts; Trade Impacts*
- MEPS must not impose a net financial penalty, which will also be resisted by industry
- However, if MEPS deliver substantial financial benefits- a strong justification for MEPS.

Therefore, cost-effectiveness analyses ideally provide the primary determinant of MEPS targets.

Modelling Assumptions

Triangulated against SARS data, desktop research, reports and industry stakeholders.

- Total annual sales were retained at 200 000 units. Market share by motor size was revised.
- The annual sales growth rate (2%), market share by size (kW), and EM categories were maintained
- Average annual usage hours assumed loaded, and market share by IE classification, were revised.
- Market share by poles were revised, where 2 pole =24%; 4 pole =70%; 6 pole =5%; and 8 pole + others =<1%:
- The calculations used by the original model for IE0 motors were maintained, but now represents rewound motors and is all but eliminated
- A carbon factor of 0.94kg CO2e/kWh was applied
- A non-residential electricity tariff of R3.50/kWh was applied, compared to R3/kWh used in the prior study

Assumed attributes

Electric motor size (kW)	Assumed market share	Assumed Usage (Hrs/yr)	Assumed Loading	Assumed current IEC energy efficiency rating shares			
				IE0	IE1	IE2	IE3
0.75	19%	2500	75%	50%	30%	5%	15%
1.5	15%	2500	75%	50%	30%	5%	15%
3	13%	2500	75%	50%	30%	5%	15%
5.5	12%	3000	75%	50%	30%	5%	15%
11	10%	3500	75%	40%	36%	6%	18%
18.5	9%	4000	75%	40%	36%	6%	18%
45	8%	4500	75%	40%	36%	6%	18%
90	6%	5000	75%	40%	36%	6%	18%
160	5%	5500	75%	40%	36%	6%	18%
300	3%	6000	75%	40%	36%	6%	18%

EM size: (kW)	Assumed market share	Assumed Usage (Hrs/pa)	Assumed Loading	IE0 (Rewound Motors)	IE1	IE2	IE3
0,75	10%	5 500	72%	5%	75%	5%	15%
1,5	15%	5 500	72%	5%	75%	5%	15%
3	18%	5 500	72%	5%	75%	5%	15%
5,5	18%	5 500	72%	5%	75%	5%	15%
11	15%	5 500	72%	5%	75%	5%	15%
18,5	7%	5 500	72%	5%	75%	5%	15%
45	10%	5 500	72%	10%	70%	5%	15%
90	4%	5 500	72%	10%	70%	5%	15%
160	2%	6 500	72%	10%	65%	5%	20%
300	1%	6 500	72%	10%	65%	5%	20%

Linton – modelling results IE1 to IE2 (2023)

Motor size (kW)	IE1 Motors		IE2 Motors		Impact:IE1 to IE2			
	Energy Consumption (kWh/yr)	Energy cost (based on R3,5/kWh tariff)	Energy Consumption (kWh/yr)	Energy cost (based on R3,5/kWh tariff)	Energy Savings (MEPS savings)	Energy Savings Value	Motor sales	Savings GW/h per year)
0,75	4 789	16 758	4 371	15 295	418	1 463	41 956	18
1,5	8 707	30 469	8 159	28 549	549	1 920	33 122	18
3	16 214	56 737	15 498	54 232	716	2 506	28 706	21
5,5	27 949	97 798	27 046	94 638	903	3 160	26 498	24
11	53 273	186 412	52 020	182 029	1 253	4 384	22 081	28
18,5	87 776	307 146	86 020	301 001	1 756	6 145	19 874	35
45	204 045	713 995	201 092	703 662	2 953	10 334	17 665	52
90	397 812	139 2023	392 866	1 374 716	4 946	17 306	13 250	66
160	833 236	291 5661	823 833	2 882 755	9 404	32 906	11 040	104
300	155 8994	545 5232	154 1436	5 393 794	17 558	61 438	6 624	116
							TOTAL	481

Linton – modelling results IE1 to IE3 (2023)

Motor size (kW)	IE1 Motors		IE2 Motors		Impact:IE1 to IE2			
	Energy Consumption (kWh/yr)	Energy cost (based on R3,5/kWh tariff)	Energy Consumption (kWh/yr)	Energy cost (based on R3,5/kWh tariff)	Energy Savings (MEPS savings)	Energy Savings Value	Motor sales	Savings GW/h per year)
0,75	**4 789**	**16 758**	**4 211**	**14 734**	**578**	**2 024**	**41 956**	**24**
1,5	8 707	30 469	7 908	27 672	799	2 797	33 122	26
3	16 214	56 737	15 095	52 819	1 120	3 918	28 706	32
5,5	27 949	97 798	26 448	92 545	1 501	5 253	26 498	40
11	53 273	186 412	51 081	178 742	2 192	7 670	22 081	48
18,5	87 776	307 146	84 700	296 383	3 076	10 762	19 874	61
45	204 045	713 995	198 753	695 476	5 292	18 519	17 665	93
90	397 812	1 392 023	388 857	1 360 690	8 954	31 333	13 250	119
160	833 236	2 915 661	816 340	2 856 538	16 896	59 123	11 040	187
300	1 558 994	5 455 232	1 527 447	5 344 844	31 547	110 389	6 624	209
							TOTAL	**840**

Linton – modelling results lcc modelling outputs

Motor size	Payback		2023-2033	
Kw	Duration (years)	Year of completion	Energy cost savings (GWh/year)	GHG reductions ($MtCO_2$)
0.75	0,28	2023	295	257
1.5	0,27	2023	322	281
3	0,27	2023	391	341
5.5	0,29	2023	484	422
11	0,38	2023	589	513
18.5	0,42	2023	744	648
45	0,58	2023	1 138	991
90	0,61	2023	1 444	1 258
160	0,51	2023	2 270	1 978
300	0,87	2023	2 543	2 216
		Totals	10 219	8 906

National standards, testing & regulatory approach

- Three standards. Two IEC (60034-1 outdated and 60034-2) and one national (SANS 1804). Besides ensuring that the standards are up to date no issued are envisaged
- SABS certification – major revenue stream for SABS. Requires dtic policy consideration before introducing a VC. This however should not delay the process
- SABS testing capacity is limited. Can test up 80kW with internal application for equipment upgrade
- Regulatory approach – is fast becoming the Achilles heel of the S&L programme
  - 3rd party approach should be maintained. SDoC not recommended
  - Product registration has improved, but still lengthy due to H&S
  - Market surveillance activities are insufficient and creating strong market resistance

Recommendations

Impacts	Research Finding
Energy Demand Reduction	Significant. 481 and 840 GWh for Scenario 1 and 2 respectively in year 1, 2023. This equates to 0.2 and 0.37% of total electricity generated in 2016 (47)
Peak Load Reduction	Limited impact due to the nature of application i.e. continuous use
Environmental Impacts	Significant, due to South Africa's high coal usage, with an emission factor of 0.9488, as well as high particulates of NOx and SOx emission. And 1.1 billion litres of water saved per year (Scenario 2)
Cost Savings (Rands) pa	Payback of less than one year for all motor sizes and R2.94 billion per annum for Scenario 1
Consumer Impacts	As above
Manufacturer and Employment Impacts	Limited impact, as all EM are imported
Trade Impacts	Minimal, but must be managed through awareness and communication
Education Campaign and S&L	A well designed and adequately funded communication and awareness campaign will be a key driver of maximising savings
Government Incentive Scheme	Subject to available funds, an incentive scheme could yield immediate energy savings

Based on the research findings, it is recommended that the DMRE move forward and implement MEPS at the IE3 level for EM in the 0.75 to 375 kW range for 2, 4, 6 and 8 pole motors, in line with international standards.
VSD and VFD, which are used in specialist applications, should not be regulated at this time.
Industry must be allowed a reasonable period to sell existing stock - no longer than 18 months - while clearly communicating from the outset that the determined start date is non-negotiable.