

Programmes and Investment Committee



Date: 28 June 2017

Item: London Underground Infrastructure Renewals Programme Authority Submission

This paper will be considered in public

1 Summary

LU Infrastructure Renewals Programme				
Financial Authority	Estimated Final Cost (EFC)	Existing Programme and Project Authority	Additional Authority Requested	Total Programme and Project Authority
£982.72m	£982.32m	£615.54m	£130.58m	£746.12m

- 1.1 A paper is included on Part 2 of the agenda, which contains exempt supplementary information. The information is exempt by virtue of paragraph 3 of Schedule 12A of the Local Government Act 1972 in that it contains information relating to the business affairs of TfL.

2 Recommendation

- 2.1 **The Committee is asked to note the paper and the supplementary paper in Part 2 of the agenda; and:**
- (a) **approve additional Programme and Project Authority of £130.58m (outturn including risk) for the London Underground Infrastructure Renewals Programme to undertake lift and escalator renewals until 2024/25, and power and energy projects until 2018/19.**

3 Background

- 3.1 In 'A City for all Londoners' (October 2016), the Mayor stated his intent to improve the transport system to ensure a world-class experience. The London Underground (LU) Infrastructure Renewals Programme has been established to deliver:
- (a) renewal of lifts, escalators, power and ventilation assets to improve safety, accessibility, customer environment, reliability and customer journey times, whilst reducing maintenance costs; and
- (b) enhancements to existing TfL assets to increase the generation and use of low and zero carbon energy.
- 3.2 The LU Infrastructure Renewals Programme brings together projects that have similar strategic objectives and share common resource requirements for their delivery, including programme management.

- 3.3 The TfL Business Plan includes the latest estimated costs for the projects that will be delivered within the Programme.
- 3.4 Future investment in the infrastructure assets will continue to be required as they age, requirements evolve and new assets are added into the Programme. The annual business planning process will provide the Financial Authority to meet these requirements and new projects will be initiated within the Programme. Additional Programme and Project Authority and Procurement Authority will be sought as appropriate in accordance with TfL's Standing Orders.

4 Strategic Case

LU Infrastructure Renewals Programme Objectives

- 4.1 The individual projects in the programme contribute towards one or more of the programme's objectives. The table below presents the programme's objectives and the specific policy goal from the Mayor's Transport Strategy, currently subject of consultation, that they support.

Current MTS Policy Goals	Infrastructure Renewals Programme Objectives
Support economic development and population growth	<ol style="list-style-type: none"> 1. Reduced operating costs 2. Increased capacity 3. Improved reliability 4. Reduced journey times
Enhance the quality of life for all Londoners	<ol style="list-style-type: none"> 5. Improved customer satisfaction
Improve the safety and security of all Londoners	<ol style="list-style-type: none"> 6. Improved customer safety
Improve transport opportunities for all Londoners	<ol style="list-style-type: none"> 7. Maintain accessibility across the LU network
Reduce transport's contribution to climate change, and improve its resilience	<ol style="list-style-type: none"> 8. Improved energy efficiency 9. Generation of low and zero carbon energy

- 4.2 For each of the asset areas within the programme, there are detailed workbanks which indicate which assets should be renewed or replaced in a given year. These workbanks are determined by the London Underground Asset Management Strategy, asset criticality, asset risk profiles, and are planned to align with other projects, such as station enhancements and line upgrades. Most of the projects within the programme are repeatable scope items, with minor variations either due to site specific constraints, or opportunities to enhance the asset during an intervention. The proposals support the London Underground safety and reliability targets.

5 Equalities Impact Assessment

- 5.1 The Programme will be delivered in accordance with the Equality Act 2010. Equality Impact Assessments are considered on all strategies, policies, business

plans, change programmes or projects, with regard to our obligations under the public sector equality duty in section 149 throughout the delivery of the Programme.

- 5.2 As projects progress through feasibility and design, consideration will be given to the need for an Equality Impact Assessment for each one. Possible effects on people with protected characteristics under the Equality Act 2010 (such as age, race, sex, and, often of particular relevance, disability), and mitigations of and countervailing considerations in respect of any adverse effects, will be considered and recorded.

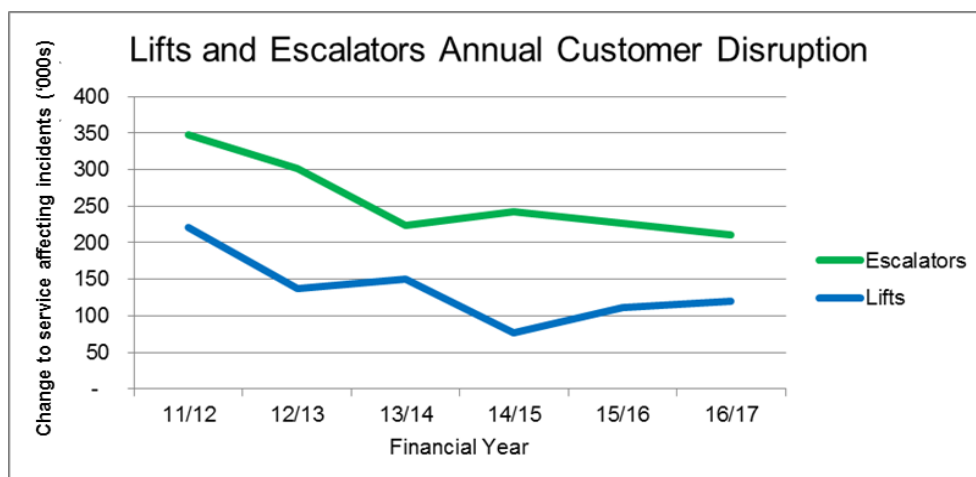
6 Lift and Escalators

- 6.1 Lifts and escalators play a vital role in the ability and speed of customers accessing the London Underground train service. The impact of unplanned downtime of a lift or escalator can have a significant effect on a customer's journey – the loss of a critical lift or escalator even for a short amount of time can result in crowd control, a station closure, or the loss of accessible routes.



Escalator project works

- 6.2 The usage of the lifts and escalators is high and customer use of the Underground is increasing. To mitigate the impact of unplanned failures and station closures, the asset management strategy for lift and escalators is a proactive approach, scaled according to the criticality and performance of the asset. The aim of the lift and escalator renewals projects is to achieve over 99 per cent availability.
- 6.3 Although the lift and escalator assets only contribute to 1.2 per cent of the overall London Underground customer disruption (measured by a Lost Customer Hours (LCH) metric), the number of incidents is relatively high with 12 per cent of all annual incidents in 2016/17 attributed to lifts and escalators. Over the past six years, the overall customer disruption from lifts and escalators has been successfully reduced due to the proactive programme of renewals and enhanced maintenance as shown in the following graph.



- 6.4 There are 427 escalators on London Underground stations and 196 lifts. The asset base is expected to grow by 30 per cent between now and 2026 due to new assets introduced by major station projects, the Elizabeth line stations and the Step Free Access Programme. The increase in asset base contributes to meeting London's demand for transport routes and is part of the Mayoral objective of increasing accessible routes for customers, particularly step free routes.
- 6.5 Escalators contribute to a high level of safety incidents. A significant number of all customer injuries in stations occur on escalators with nearly all attributed to customer behaviour. There are trials underway to increase awareness of escalator safety and the most effective of these trials will be rolled out across the network.
- 6.6 The management and volume of lift and escalators has grown organically. This has resulted in a diverse product base (29 different types of escalators and seven different types of lifts) with complex management arrangements and relatively high unit costs. Management of lifts and escalators has historically been based along the lines of the Public Private Partnership (PPP) asset divides: Bakerloo, Central and Victoria line station assets (BCV); Sub- Surface line station assets (SSL); and Jubilee, Northern and Piccadilly line station assets (JNP). The divides correlate with the different type of assets and whole life cost contracts which still exist.
- 6.7 In 2012, pan-TfL Lift and Escalator whole life contracts were put in place to simplify the asset base, improve standardisation, and reduce unit costs. For some assets, the asset groupings are still appropriate, for example, the Jubilee Line extension (JLE) stations (Westminster to Stratford) were built within a short timeframe, so the escalators are due for renewal at the same time and are the same type of machine.
- 6.8 The future strategy for lift and escalator works is to reduce the unit costs through value engineering initiatives, and to fully align with other station projects. This approach will reduce disruption to customers during works and provide coordinated station improvements.

7 Power and Energy

- 7.1 As the biggest consumer of electricity in London, LU has a responsibility to reduce the cost and impact of that consumption by ensuring:

- (a) the energy generated by LU is as clean as possible and cost efficient;
- (b) residual energy within the system can be stored, reused or utilised by others;
and
- (c) power assets are resilient, fit for purpose and operating efficiently.

Low Carbon Energy

- 7.2 Significant progress has been made to reduce power consumption and increase the use of low carbon energy. The Infrastructure Renewals programme includes a new project to develop some of these initiatives as well as widening the scope and impact of the low carbon projects to meet the objectives above.
- 7.3 The Mayor is Vice Chair of the C40 Cities Climate Leadership Group and has pledged to make London a Zero Carbon City by 2050. For TfL, the pledge includes:
- (a) London solar energy strategy;
 - (b) making the most of heat generated by London Underground;
 - (c) establishing energy for Londoners;
 - (d) buying only clean electric or hydrogen buses from 2020; and
 - (e) putting spare TfL land to better use.
- 7.4 The Low Carbon Energy project will contribute to the achievement of the pledges by:
- (a) installing solar panels;
 - (b) installing energy efficiency schemes on the TfL estate;
 - (c) using TfL land for energy generation and energy storage schemes; and
 - (d) utilising heat from tunnels for local and district heating schemes.
- 7.5 The solar panel workstream is already underway, and development of the other workstreams is at the early initiation and planning stage. Feasibility studies will be completed over the next 12 months to define the deliverables within the Business Plan period and an update will be provided in the next annual submission.
- 7.6 A flagship waste heat scheme is currently being built at Bunhill, near Old Street Station in partnership with Islington Borough Council. This scheme is a proof of concept to inform the viability of other similar schemes. It will provide heat to around 500 homes as well as cooling the Northern line tunnels during the summer.

Cooling Assets

- 7.7 There is a network of cooling assets which help prevent the temperatures getting too high during the summer. The efficiency and whole life cost of these assets is currently under review and a new form of cooling asset is being developed and trialled to support the Deep Tube Upgrade Programme. This will ensure that heat mitigation equipment, if it is necessary, has the lowest whole life cost and can be easily maintained. This project finishes in 2019 at which point any new cooling assets will be funded by the major programmes.

- 7.8 In addition to air cooling, there is a network of ventilation fans which allow the air in the tunnels to circulate and help reduce temperatures. There is a fan renewals programme that will have renewed or reinstated 24 ventilation fans by 2021. Upon completion, the new ventilation asset management strategy will be a risk based approach and will form part of the new Stations and Building Asset Resilience Portfolio within the Stations Programme. Therefore no additional authority is being sought as part of the Infrastructure programme.

Power Assets

- 7.9 The asset management strategy for power assets is to undertake effective maintenance and renewals projects to safeguard availability, provide redundancy, and comply with legislation. This strategy is based on the prevention of significant asset failures given the high impact on customers and safety risk when a major single point failure occurs. Depending on the asset and the type of failure, incidents can result in trains stalled in tunnels, a partial closure of multiple lines, a station closure or a significant reduction in train service. The renewals projects target poor performing and aging assets to maintain the current high asset availability.
- 7.10 The asset base includes a control and monitoring system which is obsolete and requires replacement from 2020, and an emergency power station at Greenwich, which provides power in case of a failure within the National Grid. There is a project in the planning stage to install new lower carbon generation at Greenwich to generate power on a daily basis for the Underground and deliver significant energy cost savings.
- 7.11 Sustainability and low carbon energy initiatives are also included in the power asset strategy. In an average year, 77 per cent of power operating expenditure is spent on electricity. Demand for power will continue to grow as ridership increases, and electricity costs are forecast to increase year on year. The current energy forecast for the next ten years to 2026/27 is £1.8bn. An example of an energy efficiency initiative is the installation of an inverter at Cloudesley Road substation as part of the Victoria line Upgrade. The inverter recovers regenerated energy from braking, and is part of the solution that allowed the Victoria line Upgrade to increase capacity from 33 trains per hour to 36 trains per hour in peak periods without increasing energy usage.
- 7.12 The majority of the authorised spend on power and cooling assets going forward is related to the upcoming line upgrades and service increases on the Piccadilly, Northern, Jubilee, Central and Bakerloo lines, the costs of which are included in the respective major programmes. The power asset renewals are aligned with the line upgrades to reduce abortive works and to maximise benefits.

8 Proposal

8.1 The LU Infrastructure Renewals Programme comprises the following projects (all figures £m including risk and inflation):

Specific Appendix	Project Description	Financial Authority	Estimated Final Cost (EFC)	Existing Programme and Project Authority	Current Business Plan Authority*	This Authority Request	Future Requests
Appendix 1: Escalators	Escalator Replacements (all lines)	318.51	318.51	304.23	301.13	5.28	12.10
	BCV/SSL Escalator Renewals	72.84	72.84	35.15	32.53	0.00	40.31
	JNP Escalator Renewals	183.95	183.95	117.10	111.32	72.63	0.00
Appendix 2: Lifts	BCV/SSL Lifts Renewals and Replacements	96.53	96.53	68.64	64.10	2.05	30.38
	JNP Lifts Renewals and Replacements.	100.81	100.81	56.12	54.94	45.87	0.00
Appendix 3: Power and Energy	Development of low carbon energy utilisation.	24.00	23.60	0.25	0.25	3.95	19.40
	Development of heat mitigation methods and renewals of ventilation assets. No additional authority requested.	10.75	10.75	10.75	10.75	0.00	0.00
	Three year renewal of life expired power assets.	102.36	102.36	22.81	19.98	0.50	81.88
	Replacement of obsolete power asset control system.	38.88	38.88	0.00	0.00	0.00	38.88
	Enhancement of Greenwich Power station.	34.09	34.09	0.48	0.48	0.30	33.31
	Total	982.72	982.32	615.54	595.49	130.58	256.25

*The table includes all currently approved projects and unapproved projects until the end of 2024/25. Following the 2016/17 business planning prioritisation process, the EFC of some projects have been reduced below their authorised Programme and Project Authority. As a result, the total Financial Authority and EFC for the Programme are less than the sum of the existing Programme and Project Authority, this authority request and future requests. Following approval of this paper, the Programme and Project Authorities will be aligned with the new EFCs of the project, which is reflected in the TfL Business Plan and shown in the 'proposed revised existing authority' column.

9 Authorities sought

9.1 This paper is seeking Programme and Project Authority as set out below:

Project	Programme and Project Authority request (£m)
Escalator Replacements (new initiative trial)	£5.28
Jubilee Line escalator renewals	£72.63
BCV/SSL lifts replacement	£2.05
JNP lift renewals	£45.87
Low Carbon Energy projects	£3.95
Greenwich Power Station	£0.30
Power asset renewals projects	£0.50
Total	£130.58

Escalator Replacements (Appendix 1)

9.2 The requested £5.28m Programme and Project Authority is to undertake the trial of a new innovative approach to escalator replacements on three escalators. This approach replaces the components of the escalators whilst retaining the original escalator structure and will significantly reduce unit costs.

Jubilee Line Escalators (Appendix 1)

9.3 The requested £72.63m of additional Programme and Project Authority will continue the renewal of the escalators on the Jubilee line stations.

9.4 The remaining authority (£63.58m) will fund the renewal of 65 escalators over six years and will extend the life of these escalators by 20 years. The phasing of the escalator renewals has been based on targeting the least reliable escalators at the beginning of the project and aligned with other works taking place on the stations.

Bakerloo, Central, Victoria and Sub Surface line (BCV/SSL) Lifts (Appendix 2)

9.5 The requested £2.05m of additional Programme and Project Authority will fund the replacement of two lifts at Hillingdon station and will extend the life of the lifts by 20 years.

9.6 The delivery of the lifts will be completed utilising the existing Pan TfL Lift contract, which was set up to undertake lift renewals, as well as install new lifts in the Elizabeth line stations and third party funded station enhancements.

Jubilee, Northern and Piccadilly line (JNP) Lifts (Appendix 2)

9.7 The request of £45.87m additional Programme and Project Authority is to continue the renewal of the lifts on the JNP stations. The authority will fund the renewal of 40 lifts and will extend the life of the lifts by 20 years.

Power and Energy (Appendix 3)

- 9.8 £3.95m Programme and Project Authority is requested for the low carbon energy utilisation project to further develop waste heat, solar and energy centre and energy storage projects.
- 9.9 The requested £0.50m Programme and Project Authority for power assets will initiate the next three year plan of power asset renewals, based on a whole life cost model. The remaining authority for the implementation of the asset renewals will be requested in the next annual submission.
- 9.10 The requested £0.30m Programme and Project Authority for Greenwich Power Station will deliver the procurement stage of the current proposal or develop a new proposal. The current proposal is to install new equipment to independently generate lower carbon power for the London Underground network and reduce operating costs. The remaining authority will be requested in the next annual submission.

Programme Financial implications

- 9.11 Summary of the Programme costs and funding:

Costs and Funding (£m)	Prior years	17/18	18/19	19/20	20/21	21/22 to 24/25	Future years	Total
Estimated Final Cost	211.25	57.18	74.02	85.65	94.11	409.69	50.81	982.72
Forecast Budget/Plan	210.85	57.18	74.02	85.65	94.11	409.69	50.81	982.32
Plan Surplus/ (Shortfall)	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.40
Existing Authority	210.85	55.16	34.00	24.73	14.14	205.03	50.81	594.72
This Authority Request	0.00	2.02	20.78	18.95	23.31	65.51	0.00	130.58
Future Requests	0.00	0.00	19.23	41.97	56.66	139.15	0.00	257.01

- 9.12 The Programme costs and funding includes the delivery of the efficiencies which are embedded in the current business plan. Further initiatives to reduce unit costs will be progressed and an update will be given at the next annual submission.

10 Assurance

- 10.1 A TfL Project Assurance (PA) and Independent Investment Programme Advisory Group (IIPAG) Assurance Review of the Programme has been completed and confirmed that there are no critical issues. Actions and management responses have been prepared for all recommendations.

List of appendices to this paper:

Appendix 1 - Escalators
Appendix 2 - Lifts
Appendix 3 - Power and Energy

List of background papers:

IIPAG and Project Assurance Reports.
Management response to IIPAG and Project Assurance Reports.

Contact Officer: David Hughes, Director of Strategy, Sponsorship & Change
Number: 020 3054 8221
Email: davidhughes03@tfl.gov.uk

Appendix 1 – Escalators

1 Background

- 1.1 There are 427 operating escalators across the entire LU network, consisting of 423 escalators and four passenger conveyors. It is anticipated by 2024 LU's escalator asset base will grow to approximately 561 escalators through the inclusion of both the Elizabeth Line and third party developments across LU. The escalator fleet is diverse, with varying age, design and usage coupled with 29 different escalator product types. Given the diversity of the escalator fleet, the Asset Management Strategy prioritises replacement of obsolete designs and renewal of critical escalators.



Escalator project works

- 1.2 During the life cycle of the escalators there are two types of major interventions to extend the life of the assets and minimise unplanned maintenance: replacement projects, which replace the entire escalator and supporting equipment and infrastructure, and renewals projects, which replace certain components of the escalator which have a shorter asset life than the escalator as a whole. There are four escalator projects within the Infrastructure Renewals programme.

Escalator Replacements

- 1.3 In 2012, £304.23m Programme and Project Authority was approved by the Board to replace 46 escalators. A whole life contract was awarded to Otis to be used for this project, Elizabeth line stations and station upgrade projects. The project standardises escalator components, reduces escalator types, creates economies of scale and ensure escalators are maintainable and reliable. 12 escalator replacements have been completed under the contract. The project has achieved an average availability of 99.9 per cent following replacement. The Pan TfL contract provides a coordinated approach to grouping works together to take advantage of closures and minimise both costs and customer disruption.

- 1.4 Initiatives are being developed to further reduce the unit cost of escalators, such as comparing industry standards to LU specifications and developing innovative ways of completing escalator replacements, such as replacing the components of an escalator, rather than the whole escalator structure.
- 1.5 The whole life cost contract runs until 2042 with the final full replacement completed in the financial year 2023/24. Otis will continue to maintain these assets for the remainder of their design life.

Bakerloo, Central, Victoria and Sub-Surface line (BCV/SSL) Renewals

- 1.6 In 2012, £29m Project Authority was approved to deliver the first tranche of BCV/SSL renewals carried out by in-house capital delivery teams. During delivery, the project team have been able to reduce BCV/SSL renewals costs by £3.25m through delivery efficiencies. As a result, the project has delivered three additional escalator renewals compared to the original baseline of 19, bringing the total delivery to 22. The estimated final cost of the first tranche is £27m. By mid 2017 the first tranche will be financially closed out and an Integrated Assurance Review will be undertaken.
- 1.7 Following the success of the first tranche, in 2016, £35m was approved by the Commissioner to deliver a second tranche of renewals. This project will refurbish 20 escalators and two passenger conveyors by 2020. The project has completed two escalator renewals to date.

JNP Renewals

- 1.8 In 2012, additional Project Authority was approved to continue the delivery of 118 JNP escalators renewals. Similarly to the BCV/SSL, JNP renewals are completed by an in-house capital delivery team. 115 renewals have been completed to date, maintaining an average availability of 99 per cent. The existing Programme and Project Authority for JNP renewals and Jubilee line renewals is combined and totals £117.10m.
- 1.9 At the end of the current authority, the remaining interventions will be transferred to maintenance. From this point forward the remaining interventions will be undertaken by the existing in-house maintenance teams. No additional Programme and Project Authority for this project is required.

Jubilee Line Renewals

- 1.10 In 2006, a separate whole life contract was awarded to Kone to deliver the renewal of 111 escalators and two passenger conveyors for the Jubilee line stations between Westminster and Stratford. These escalators were installed as part of the Jubilee line extension project and have been separated from the other escalators at JNP stations since they are a similar type of escalator and are all due for renewal in a similar time period.
- 1.11 The contract includes both major renewals and continued maintenance of the escalators. To date, 63 assets have been renewed and maintained an average availability of 99.6 per cent.

1.12 The existing escalator contract ends in December 2018. A further £8.6m of Programme and Project Authority is required to complete the renewals under the contract.

2 Proposal

Escalator Replacements

2.1 The authority submission requests £5.28m Programme and Project Authority to undertake the trial of a new approach to escalator replacements on three escalators. This approach replaces the components of the escalators whilst retaining the original escalator structure and will significantly reduce unit costs.

JLE Escalator Renewals

2.2 The authority submission requests £72.63m of additional Programme and Project Authority for the continued renewal of the escalators on the JLE stations. Part of the additional Programme and Project Authority request (£8.6m) will be used to complete the existing contract. The remaining authority (£63.58m) will fund the renewal and continued maintenance of 65 escalators over a six year period, extending the life of these escalators by 20 years.

Benefits

2.3 The main benefits that the escalator projects will deliver are summarised in the table below:

Title	Description	Expected benefits
Improved reliability	Reduced unplanned faults will result in a reduction in customer disruption.	<p>Reduced customer disruption (Lost customer hours)</p> <p>Reduced failures</p> <p>Improved availability and Mean Time Between Failures</p>
Reduction in unit cost	Through smoothing annual escalator works and grouping projects by asset type and/or location, and value engineering, the unit cost of escalator interventions will be reduced.	Reduction in capital costs

3 Financial implications

3.1 Summary of escalator finances:

Costs and Funding (£m)	Prior years	17/18	18/19	19/20	20/21	21/22 to 24/25	Future years	Total
Escalator Replacements	40.29	4.37	16.01	17.98	16.56	187.04	36.25	318.51
BCV/SSL Renewals	5.86	9.29	10.52	8.16	8.35	30.66	0.00	72.84
JNP Renewals and Jubilee Line Escalators	96.46	13.45	9.51	9.84	9.76	44.92	0.00	183.95
Total	142.62	27.10	36.04	35.99	34.67	262.63	36.25	575.30
Forecast Budget /Plan	142.62	27.10	36.04	35.99	34.67	262.63	36.25	575.30
Plan Surplus/ (Shortfall)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Existing Authority	142.62	26.63	22.20	20.97	13.11	182.75	36.25	444.52
This Authority Request	0.00	0.47	11.39	11.84	9.76	44.44	0.00	77.91
Future Requests	0.00	0.00	2.45	3.18	11.80	35.44	0.00	52.88

Appendix 2 - Lifts

1 Background

- 1.1 There are 196 lifts operating on the London Underground network, which are either the main mode of transport from street to platform, known as Primary Means of Vertical Transport (PMVT) lifts; or lifts which supplement stairs or escalators and are used principally to provide step free access, known as Secondary Means of Vertical Transport (SMVT) lifts. The type of lift determines the specification and major renewals interventions. The SMVT asset base is expected to grow over the next seven years with approximately 125 additional lifts being introduced as part of new station schemes, the Step Free Access programme and Elizabeth line stations.
- 1.2 There are two types of major investment interventions required to maintain the required lift performance and reliability levels: renewals and replacements. There are two lift projects within the Infrastructure Renewals programme to undertake the major interventions.

Bakerloo, Central, Victoria, and Sub-Surface line (BCV/SSL) Lift Renewals

- 1.3 In 2013, £68.64m Project Authority was approved to undertake renewals of 28 lifts. The whole life contract, which included Elizabeth line lifts and third party funded lifts, was awarded to Kone. The intention of the contract is to standardise lift components, leverage cost efficiencies through economies of scale, and provide incentives to the supply chain to value engineer the lift solutions and ensure that lifts are maintainable and reliable. The project has successfully completed ten lift replacements and four lift renewals. The new lifts are achieving 99.3 per cent reliability on average. Additional Programme and Project Authority is requested for replacement of two additional lifts renewals at Hillingdon Station which will complete the planned works on this lift type.
- 1.4 There are initiatives in the planning stages to further reduce the unit cost of the lifts, such as a comparison of LU specifications with industry standards, a review of LU standards, reduced specifications for above-ground SMVT lifts, rationalisation of lift interventions, and simplification of the procurement and delivery routes.

Jubilee Northern and Piccadilly (JNP) Lift Renewals

- 1.5 In 2012, £56.12m Project Authority was approved to undertake major renewal of 61 lifts on the JNP network as part of a combined renewals and maintenance contract. The renewals extend the life of the asset, address compliance with standards, remove existing non-conformities, standardise component type and reduce faults and unplanned maintenance.
- 1.6 During delivery, the project team have increased the intervention scope compared to the original anticipated scope due to poor asset condition, obsolescence and capacity enhancement opportunities. This has resulted in an increase in intervention costs but an increase in asset residual life and additional station capacity benefits. As a result, the project scope will deliver 58 lifts on the

JNP network, the remaining three lifts form part of the new authority request. The contract will expire in December 2018.

2 Proposal

BCV/SSL Lift Renewals

- 2.1 The authority submission requests an additional Programme and Project Authority of £2.05m to replace two lifts by December 2019. The replacement of the lifts is essential to maintaining an acceptable level of lift availability and reliability, maintaining step free access at the stations and reducing delays to customer journeys.

Jubilee Northern and Piccadilly (JNP) Lift Renewals

- 2.2 The authority submission requests an additional £45.87m to renew 40 lifts on the JNP network and to support the analysis of the future delivery strategy. The continued major renewal of the lifts is essential to maintaining an acceptable level of lift availability and reliability, maintaining step free access at the stations and reducing delays to customer journeys.
- 2.3 The release of the requested Programme and Project Authority will be subject to the endorsement of an investment submission to the Managing Director, London Underground, planned for late 2017.

Benefits

- 2.4 The main benefits that the renewal of the lifts will deliver are summarised in the table below:

Title	Description	Expected benefits
Improved escalator reliability	Reduced unplanned faults will result in a reduction in customer disruption.	Reduced customer disruption (Lost customer hours) Reduced failures Improved availability and Mean Time Between Failures
Reduction in unit cost	Through smoothing annual escalator works and grouping projects by asset type and/or location, and value engineering, the unit cost of escalator interventions will be reduced.	Reduction in capital costs

3 Financial implications

3.1 Summary of lift finances:

Costs and Funding (£m)	Prior years	17/18	18/19	19/20	20/21	21/22 to 24/25	Future years	Total
BCV/SSL	16.91	6.65	4.49	7.38	1.78	44.75	14.56	96.53
JNP	34.45	11.24	11.47	8.62	13.55	21.48	0.00	100.81
Total	51.36	17.90	15.96	16.00	15.33	66.23	14.56	197.34
Forecast Budget /Plan	51.36	17.90	15.96	16.00	15.33	66.23	14.56	197.34
Plan Surplus/ (Shortfall)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Existing Authority	51.36	17.82	9.85	2.37	0.69	21.98	14.56	118.62
This Authority Request	0.00	0.08	6.11	7.12	13.55	21.07	0.00	47.92
Future Requests	0.00	0.00	0.00	6.52	1.09	23.19	0.00	30.79

[page left intentionally blank]

Appendix 3 - Power and Energy

1 Background

Low Carbon Energy

- 1.1 The approach to low and zero carbon energy generation from London Underground assets has evolved to co-exist with both power and cooling schemes. The objectives of the Low Carbon Energy project are to:
 - (a) deliver schemes to provide low and zero carbon energy to LU;
 - (b) utilise waste heat to provide potential cooling to LU and low carbon energy to third parties.
- 1.2 A waste heat scheme is currently being built in partnership with Islington borough council. A total of four similar schemes are planned, this scheme is the proof of concept to secure the funding for the other schemes. The scheme is part of a District Heating network project funded by a local borough at Bunhill, near Old Street Station and will provide heat to around 500 homes (see diagram in section 4) as well as delivering cooling to the Northern line tunnels during the summer. It is a prime example of a mutually beneficial scheme and will directly contribute to the Mayor's carbon targets.
- 1.3 Several other low carbon and energy efficiency options will also be investigated especially where there is synergy with power and cooling schemes as part of the Deep Tube Upgrades. For example, the stations and ventilation fan cooling schemes create opportunities to utilise the waste heat currently exhausted to atmosphere.
- 1.4 In addition to waste heat utilisation, solar generation and energy storage schemes will increase the proportion of low or zero carbon energy used by LU. In 2016, £0.25m Project Authority was approved to undertake a feasibility study to install solar generation at up to 30 buildings in conjunction with energy efficient technology.
- 1.5 The Business Plan includes £34.09m to install five new gas powered engines at Greenwich Power Station. This project would enable LU to produce electricity for its own use, significantly reducing the equivalent cost of electricity sourced via the National Grid. The project is currently reviewing the proposed option to ensure alignment with the Mayoral policies on air quality.

Power Assets

- 1.6 The London Underground Power assets are fed from the National Grid and supply assets with power, including rolling stock, stations and signalling systems using 1.3 Terawatt Hours of electricity annually, equivalent to the annual electricity of a medium-sized town.
- 1.7 The assets distribute the power around the network and are located at strategic points to provide resilience in case of an unplanned outage. The assets are significant and comprise of:

- (a) 1,500 Kilometres of High Voltage cable;
- (b) 10,000 Low Voltage Assets;
- (c) 230 Substations and Transformer Rooms;
- (d) eight bulk supply points;
- (e) Greenwich Power station to provide emergency power in event of a major outage; and
- (f) power control system.

1.8 The asset management strategy for LU power assets is to undertake risk-based renewals of assets based on a prioritised workbank, which includes the entirety of the power network assets. The workbank is derived and prioritised using information from the Asset Risk Register which feeds into the Asset Condition Reporting (ACR) process. Items are then assessed against the risk of Lost Customer Hours (LCH) performance, operational risk, safety and compliance to legislation.



High voltage cable failure

- 1.9 The Power Supervisory Control and Data Acquisition (SCADA) system monitors and controls LU's power assets. The current system is obsolete, but work has taken place to prolong the system up to 2020, when replacement would be required.
- 1.10 The key deliverables of the power renewals project include replacing obsolete and poor performing assets with modern equivalents, and installing new assets to comply with statutory legislation and standards.

2 Proposal

2.1 This authority submission requests £4.75m Programme and Project Authority for Power and Energy with the following breakdown:

- (a) £0.5m to initiate the next three years of power renewals;

- (b) £0.3m funding for Greenwich project to either complete the current proposal or to develop a new proposal, dependant upon the outcome of a review on air quality impacts;
- (c) £1.45m to undertake concept design and delivery activities for solar generation and energy efficiency;
- (d) £1.0m to complete feasibility studies into new waste heat utilisation schemes; and
- (e) £1.5m to undertake feasibility studies into potential low carbon energy generation and energy storage schemes on the TfL estate.

2.2 The scope of these projects excludes activities on the network which will be addressed by Line Upgrade Programmes.

2.3 Additional authority will be requested at the next annual submission to the Committee in June 2018.

Delivery

2.4 Key milestones for the Power and Energy projects are:

Milestone	Target Date
Agree Greenwich strategy	September 2017
Initiate the next three years of power renewals	April 2018
Solar panel detailed design complete	December 2018
Low Carbon Energy feasibility study complete	February 2018

3

4 Financial Implications

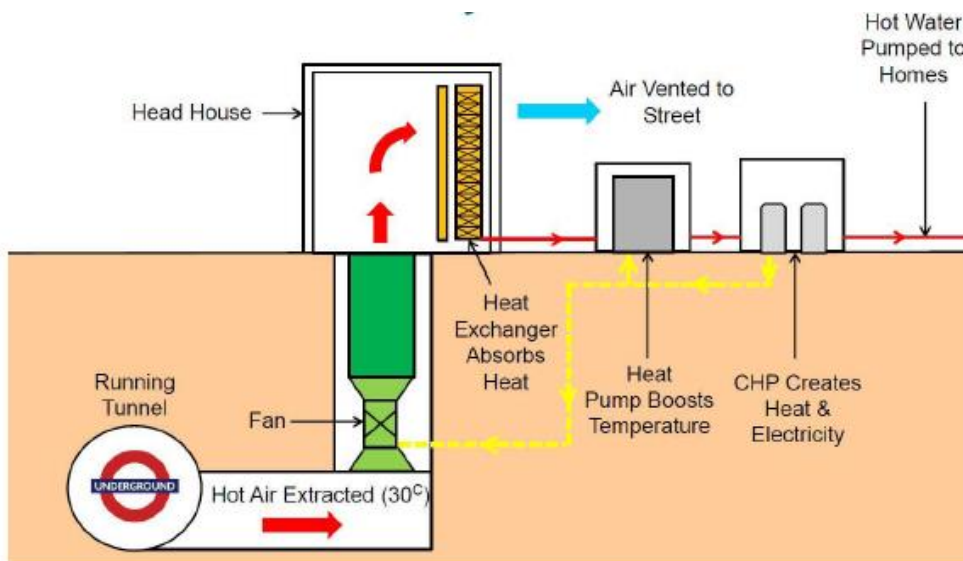
4.1 Summary of Power and Energy finances:

Costs and Funding (£m)	Prior years	17/18	18/19	19/20	20/21	21/22 to 24/25	Total
Waste heat utilisation	0.00	0.50	0.40	1.30	0.80	2.20	5.20
Energy Centre Devt	0.00	0.60	0.40	0.70	1.80	4.00	7.50
Energy Storage Devt	0.00	0.25	0.20	0.90	1.50	3.00	5.85
Solar Generation	0.00	0.25	1.60	1.50	1.70	0.00	5.05
Heat mitigation	5.23	1.64	1.84	1.39	0.35	0.31	10.75
Power Renewals	11.34	8.65	10.87	17.29	11.86	42.36	102.36
Power Control System	0.00	0.00	0.00	2.07	7.84	28.96	38.88
Greenwich engines	0.30	0.30	6.71	8.51	18.27	0.00	34.09
Total	16.87	12.19	22.02	33.66	44.11	80.83	209.67

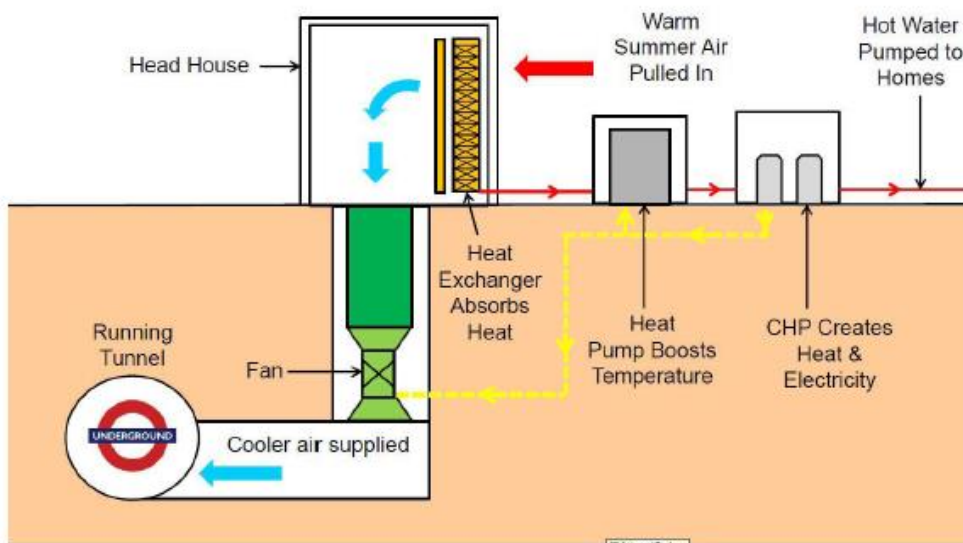
Costs and Funding (£m)	Prior years	17/18	18/19	19/20	20/21	21/22 to 24/25	Total
Forecast Budget /Plan	17.27	12.18	22.02	33.66	44.11	80.83	210.07
Plan Surplus/ (Shortfall)	0.40	0.00	0.00	0.00	0.00	0.00	0.40
Existing Authority	16.87	10.71	1.96	1.39	0.35	0.31	31.58
This Authority Request	0.00	1.47	3.28	0.00	0.00	0.00	4.75
Future Requests	0.00	0.00	16.78	32.27	43.77	80.52	173.34

5 Heat Extraction

5.1 The diagrams below give a summary of how heat can be extracted from the London Underground network in winter and summer.



Heat system in winter



Heat system in summer