CABLETOCABLE 2026

Closing the Aluminium Loop

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Acknowledgement | Stedin acknowledges the contribution of Mensen Maken de Transitie in writing this report.

STEDIN GROEP

Management Summary

The goal: The central question of the Cable to Cable pilot was whether aluminium from selected leftover electricity-cable lengths can be reused in new cables with a 10% share of physically recycled aluminium in a controlled closed loop route. Within the specific production route and test conditions investigated, the result is positive: the use of 10% physically recycled aluminium proved technically feasible. The produced cable met the relevant quality requirements assessed in the pilot. The pilot did not yet establish repeatability, commercial scalability or application to other cable types, material streams or recycled-content percentages.

The pilot went beyond a technical test. It also examined logistics, traceability, legal and regulatory requirements, the environmental assessment and the current business case. The work was carried out through a learning-by-doing approach in which the partners produced an actual low-voltage cable together.

The Organisation

The inner ring - operational partners: Stedin, HKS The Metal Company, Myne, Raak Metals Group, Lamifil, TKF and Invest-NL. Invest-NL conducted the business case study.

The outer ring - validation and knowledge sharing: Enexis, Alliander, NKT, Hydro and Fedet.

Facilitators - Mensen Maken de Transitie (MMT) and Circulaire Energie Economie (CEE). A Joint Pilot Declaration and an NDA formalised the collaboration.

Answers to the seven KPIs

The pilot shows that scaling up is not solely a technical challenge. Further development is required around the availability of suitable aluminium streams, efficient and auditable traceability, completion of the LCA and business case, and the operational coordination needed to make a closed-loop value chain work at scale.

Any scaled approach must preserve clear responsibilities for quality, documentation, product performance, safety, conformity and reliable supply throughout the value chain.

Completed and answered: The analysis has been completed, the conclusions have been drawn and the question has been definitively answered.

In progress: The first steps or analyses have been completed, but further data collection and optimisation are still ongoing or need to be planned.

KPI 1 - Technical feasibility and quality

Tests confirmed that recycled aluminium retained the quality requirements of the pure 1000 series: different EN AW 1350 and 1370 cable streams can be blended; other aluminium alloys must not be mixed in.

KPI 2 - Continuity of supply

Grid operators' own supply covers only part of the aluminium demand. Further scaling therefore requires exploration of additional suitable aluminium streams.

KPI 3 - KPI 3: Environment and sustainability (Energy & CO_2)

Initial LCA results indicate promising potential for reducing CO_2 emissions through the use of recycled aluminium. Further analysis is needed to validate the findings and establish the extent of the reduction.

KPI 4: Mechanical & electrical properties

Measurements on wire rod and the final sector conductor complied with factory specifications and EN/IEC 60228. No deviations were identified.

KPI 5: Traceability

Controlled Blending enabled physical and administrative traceability. The approach worked in the pilot, but the administrative burden must be reduced for scale-up.

KPI 6: Compliance, regulation and value chain coordination

The required documentation was delivered. The pilot showed that physical material and compliance documentation must move through the chain in step to avoid delays.

KPI 7: The business case

Invest-NL mapped the as-is aluminium value chain. Further work is required to assess the circular value chain and the conditions for commercial scalability.

The way forward

The follow-up focuses on industrialising the process, testing repeatability and other processing methods for the wire rod, exploring additional suitable material streams, improving traceability for scale-up, and completing the environmental and economic assessments.

Chapter 1 Introduction

This public report summarises the Cable to Cable pilot with 10% recycled aluminium content. The pilot ran from the initial setup in 2025 through to production of the circular cable in the summer of 2026. It followed the operational process from source material to a new low-voltage cable and linked the findings to the seven KPIs.

Central Question

Is it possible to successfully reuse aluminium from old electricity cables, while achieving a 10% share of recycled aluminium in a closed loop?

The Value Chain

Grid operators

Stedin

Enexis

Recyclers

HKS Metals

Raak Metals Group

Myne

Smelter

Lamifil

Cable manufacturer

TKF

New cable

4x150 mm^2 low-voltage

The pilot was deliberately designed as a learning-by-doing trajectory. Rather than assessing feasibility only on paper, the partners produced the cable and used the practical process to identify technical, logistical, administrative and organisational requirements.

Scope

The pilot focused on leftover cable lengths on reels because this material stream was immediately available and has a high degree of aluminium purity. Old cables recovered from the ground, copper and plastics were kept outside the scope of this pilot and remain relevant for subsequent stages.

Chapter 2 Pilot setup

The setup consists of the following elements: the objectives and scope, *learning by doing* method, and the seven KPIs.

2.1 Objectives and scope

The Cable to Cable pilot followed a value-chain dialogue hosted by Stedin in May 2025. The dialogue focused on increasing the share of recycled material and on retaining raw materials within national or European value chains. The pilot translated this ambition into a concrete test: producing a new low-voltage cable with 10% recycled aluminium content.

2.2 Learning by doing

The partners chose to learn by producing an actual cable. To keep the process workable, the collaboration used two rings:

The inner ring carried out the operational work: Stedin provided residual material streams and project coordination; HKS, Myne and Raak Metals Group processed the cable remnants, maintained batch separation and took responsibility for preventing contamination of the aluminium during their respective processing steps; Lamifil assessed, meldted and processed the aluminium into sector-shaped conductor; TKF manufactured and tested the new cable; Invest-NL studied the business case. Each operational partner retained responsibility for the quality, documentation and decisions within its own part of the value chain.

The outer ring consisted of Enexis, Alliander, NKT, Hydro and Fedet. These parties contributed expertise and validated the findings against their own knowledge and experience. Through Fedet, the perspective of electrical-product and cable manufacturers was included, with particular attention to product performance, safety, conformity, standardisation, traceability and the practical conditions for industrial scale-up.

MMT and CEE facilitated the value chain. The partners signed a Joint Pilot Declaration and/or an NDA to formalise collaboration and safeguard confidential data sharing. Not all participants signed these documents, only where this was relevant regarding their level of involvement and access to confidential information.

2.3 Definition of the seven KPIs

1. Technical feasibility and quality of recycling and processing: Ensuring that the recyclate aluminium (EN AW 1350/1370 from the 1000 series), after processing, meets exactly the same mechanical and electrical specifications as primary material.

2. Continuity of supply: Investigating the feasibility of a stable and predictable inflow of recycled content from leftover cable lengths in order to prevent production interruptions at the smelter and cable manufacturers, including mapping the total volume of leftover cable lengths for scale-up.

3. Environment and sustainability (energy & CO_2): Measuring and quantifying the direct reduction in energy consumption and CO_2 emissions achieved by using secondary aluminium instead of primary LME aluminium (using a Life Cycle Assessment calculation).

4. Mechanical & electrical properties of the cable: Validation in accordance with the international IEC 60228:2023 standard to demonstrate the technical feasibility of the selected recycling percentage and to inform procurement and quality specifications.

5. Traceability: Establishing a robust administrative and physical system to demonstrate the origin, purity and route of each batch of aluminium throughout the entire value chain.

6. Compliance, regulation and value chain coordination: Assessing the value chain collaboration against industry standards and the legal frameworks concerning the waste or raw material status of the material stream.

7. The business case: Providing insight into the economic feasibility for each value chain partner and calculating the total financial value creation within the value chain. The pilot maps out the 'as-is' business case of the aluminium value chain.

Chapter 3 Implementation of the pilot

Following the desk research and introductory phase, January 2026 marks the start of the phase in which the cable will be produced. All steps below were followed to create the new low voltage cable with recycled aluminium.

3.1 January 2026: Mapping the quantity of raw material

A leftover cable length arises when cable remains on a reel after a grid project. The reel is returned to the grid operator and the remaining cable is stored until collection by a recycler. Mapping this stream showed that grid operators' own supply is not sufficient on its own for long-term scale-up. Additional suitable aluminium streams will therefore need to be explored alongside grid-operator supply.

3.2 February 2026: Laboratory tests

The spectrometric tests indicated that the selected aluminium batches remained within the composition criteria used for the 1000-series input material in this pilot (EN AW 1350 or 1370). The tested batches could be combined without compromising the metallurgical characteristics assessed during the pilot. Note: this does not demonstrate that all 1000-series cable streams are interchangeable. Streams with a different alloy, contamination, an uncertain origin or insufficient documentation require separate assessment and must not enter the batch unless their suitability has been established.

The recyclers must provide the smelter with the required documentation and chemical-composition certificates for acceptance of the relevant batch. Based on the positive quality tests, Lamifil concluded that the electrical-conductivity requirements could be met with 10% recycled aluminium content.

3.3 March 2026: Transport and traceability from the source

The first shipments left Stedin and Enexis locations for Raak Metals Group, Myne and HKS. The pilot selected the Controlled Blending method to make the recycled content physically and administratively traceable throughout the value chain.

To guarantee a robust, high-quality closed loop using Controlled Blending, strict registration directly at the source is essential. The traceability process in the pilot is organised as follows:

1. Point of initial allocation: Unique batch numbers are assigned to the material stream by the recycler from the very first weighing and processing stage. This constitutes the formal starting point of the traceability chain.

2. Reel linkage: To ensure complete traceability of origin, these batch numbers are directly linked to the grid operators' unique reel numbers. Stedin provided the initial source data used to establish traceability throughout the supply chain. Operational registration is managed through a shared Excel protocol in which all value chain partners record changes and movements.

3. Clear agreements: These are essential for this method, clear agreements on deliveries and the simultaneous provision of the required documentation are necessary because batches must be stored and processed separately.

3.4 April 2026: Mechanical processing and quality assessment

HKS processed the cable remnants from Enexis, while Myne and Raak Metals Group processed material from Stedin. The pilot used a semi-manual stripping method to separate the aluminium while limiting contamination. This dedicated batch approach was selected for the pilot and is not the standard processing method for all recyclers.

3.5 May 2026: Raw material acceptance and preparation for melting

The stripped aluminium from the three recyclers arrived at Lamifil. The supplied batches were kept physically separated and given unique identification numbers for traceability and contamination control.

For each relevant consignment, the recycler acting as the producer of the end-of-waste aluminium scrap was required to provide a statement of conformity in accordance with Article 5 and Annex III of Council Regulation (EU) No 333/2011. This statement confirms that the consignment meets the applicable end-of-waste criteria for aluminium scrap. Raak Metals Group, Myne and HKS provided the documentation required for acceptance by Lamifil. The pilot showed that the statement of conformity and the supporting quality and composition documentation must accompany the physical consignment to avoid delays. Lamifil also carried out chemical analyses as part of its incoming-material acceptance and quality assurance.

3.6 June 2026: Melting phase and certification

The dismantled cable remnants were melted and combined with primary aluminium, resulting in an actual recycled content of approximately 10%. The recycled input was deliberately blended from different recyclers to reflect a realistic value-chain setup.

The chemical composition and the mechanical and electrical measurements on the resulting wire rod met the specified requirements. The wire rod was successfully processed into sector conductor, with no deviations identified compared with standard wire rod processing. Spectrometric measurements, resistance measurements, dimensional checks and tensile-strength tests all complied with the specified factory requirements and quality standards.

3.7 July 2026: Cable production

TKF received the sector conductor and processed it into a 4x150 mm² low-voltage cable. The production process combined the aluminium conductors with the other cable components and concluded with final dimensional and electrical inspection. In total, 21 kilometres of cable were produced.

Stedin had defined the cable quality requirements in advance. The conductor had to comply with EN 60228, to which the Dutch cable standard HD 620 refers. TKF checked electrical resistance, dimensions and metallurgical composition, and the final cable underwent a representative sample test. Traceability was supported by a dedicated article number, an updated materials passport, physical marking and separate registration in Stedin's GIS..

3.8 Sustainability impact and business case

A customised Life Cycle Assessment model was developed during the pilot. To calculate the actual environmental impact, primary data from the supply-chain partners still needs to be completed and validated. Only then can the model be converted into a definitive company-specific LCA.

3.9 July 2026: Business case

Invest-NL analysed the as-is situation in the current aluminium market. In the existing market structure, high-grade cable-remnant aluminium can leave the national value chain through export or be recycled for other applications, in which case the purity of the 1000-series material is lost. The questions below are still being researched.

Does the financial and environmental added value of keeping the Cable to Cable value chain pure and closed outweigh the additional logistical and administrative costs?

What financial or policy incentives are required to operate this closed-loop value chain on a commercially viable and scalable basis?

Chapter 4 Reflections on value chain collaboration

High-value recycling of secondary aluminium is not business as usual. The pilot required organisations that normally work in separate client-contractor relationships or departments to coordinate closely across the value chain. The partners identified the following success factors and lessons learned.

1. The strength of the 'short sprint' - Tightly facilitated 45-minute calls focused on the KPIs helped the partners understand one another's working methods and resolve issues quickly.

2. Operational disruption - A pilot interrupts normal operations because dedicated batches and new working methods require extra coordination. Standardisation can reduce this friction during scale-up.

3. 'Learning by Doing' - Producing an actual cable exposed operational details that would have remained invisible in a theoretical assessment, especially the need to keep material flows and documentation aligned.

4. Administrative bottlenecks - Waiting for documentation proved to be a bottleneck. The pilot showed that the speed of the chain depends on its slowest administrative and logistical step.

5. Trust as a basis for collaboration - Because several participating organisations may be actual or potential competitors, the collaboration was organised under a Joint Pilot Declaration and an NDA. These instruments supported confidentiality but did not replace compliance with competition law. Information sharing was therefore to be limited to what was objectively necessary for the pilot, with appropriate safeguards for competitively sensitive information.

6. Independent value chain coordination - The partners valued facilitation by MMT and CEE as neutral parties that could maintain momentum and help resolve issues across organisational boundaries.

Chapter 5 Insights by value chain partner

Closing the aluminium value chain is a joint achievement. The pilot generated distinct operational and strategic lessons for each link in the chain.

5.1 Grid operators (Stedin)

Source registration is the starting point for physical traceability. Grid-operator supply alone is not sufficient for long-term scale-up, so additional suitable aluminium streams are needed. Unique article numbers and GIS registration support traceability of the final cable.

5.2 Recyclers (HKS, Myne & Raak Metals Group)

Recyclers act as quality gatekeepers. Spectrometric measurements and the accompanying documentation are important for acceptance by the smelter. The pilot showed that suitable 1000-series streams from different grid operators can be blended while maintaining quality.

5.3 Smelter (Lamifil)

Early coordination on documentation helps prevent production stops. Physical material and compliance documents must move through the process in step. The pilot confirmed the technical feasibility of the selected route; follow-up work can test repeatability, other wire-rod processing methods and different percentages of secondary material.

5.4 Cable manufacturer (TKF)

At a 10% blend, the produced cable met the relevant mechanical and electrical requirements. The Controlled Blending approach worked operationally but is administratively intensive for structural scale-up. Further validation is needed for other cable types or voltage levels.

5.5 Value chain coordination (MMT, CEE, Invest-NL & experts)

Trust, independent coordination and short lines of communication were important alongside the technology. A closed-loop value chain depends on shared knowledge, clear agreements and continued attention to traceability, quality, market development and the business case.

Chapter 6 Acknowledgements

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