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Catalyzing investment in skills for Africa's electric mobility ecosystem

CONCEPT NOTE

NOVEMBER 2023

Catalyzing investment in skills for Africa’s electric mobility ecosystem primer

This document aims to provide and introductory perspective of the skills gaps and challenges within Africa's electric vehicle (EV) sector, additionally, it serves to engage partners in identifying areas that require further investigation

- Building upon the momentum set during Africa Climate Week 2023, which highlighted the immense potential of Africa's e-mobility ecosystems, Dalberg is eager to explore strategies for accelerating the growth of Africa's EV industry
- As the demand for EVs continues to rise across the continent, new job opportunities within the EV value chains are emerging for Africans. To fully harness the jobs potential presented by the industry and ensure skills are not a barrier to its growth, investment in EV skilling will be critical
- Efforts to understand the scale of skills gaps and ways to effectively address them in the emerging EV sectors have received limited attention thus far. To ensure that the African skilling ecosystem is prepared to facilitate this transformation, a deeper understanding of both the challenges and potential solutions is required

Dalberg recognises this as an opportunity for meaningful impact and believes that by tackling skilling challenges, we can help ensure the full impact potential of the shift to clean mobility is unlocked

Executive summary (1/2)

Africa's e-mobility ecosystem is set to grow rapidly from a small, existing base, paving the way for sustainable local employment across the EV, charging and battery value chains

- Africa and the Middle East's **nascent but growing EV industry** is concentrated in a sub-set of countries with **favourable conditions for long term growth**; a mix of local and international companies are set to emerge across these value chains. **Initial growth** is expected in **eMaaS sectors, B2B charging infrastructure and after-market care**
- The **localisation of EV supply chains** will generate a small but important set of **technical and non-technical jobs**, that alongside other enablers to EV growth, can help unlock value from a greater share of the EV, charging and battery value chains
- To power the shift, **new jobs will initially emerge within sales, service and repairs roles**. In the longer-term, jobs will be required in assembly and manufacturing as larger domestic markets improve the economics of local production facilities, as well as jobs in end-of-life battery recycling
- EV-related jobs will generate **positive spillover effects into local communities** through **indirect job creation**, increasing mobility to marginalised groups, improving access to healthcare, education and labour markets

There are significant potential benefits of job new creation and the redeployment of former ICE workers. However, significant further work is required to understand the precise roles and skills required to facilitate the EV transition, as well as the number of new workers needed

Amongst other barriers, skills development is critical to meeting the potential of the growing EV industry and to enable proven business models to scale. However, existing education and training systems inadequately equip workers for jobs in EV

- **Green skills training are trailing other barriers to the sector**, such a financing and EV-friendly policies: very little training currently exists, with **most green skilling programs taking place in-house**. eMaaS providers commonly cite **lack of skills as a key operating barrier** and currently bear the cost of training workers in the absence of adequate alternative vocational or technical training

Executive summary (2/2)

- **Low access to quality training** programmes, **high student costs**, **weak awareness** and **poor mechanisms to match** programme graduates to firms compound the challenges around mass skilling
- To ensure a sufficient pipeline of skilled workers for future EV jobs, **Africa's education systems will be required to set up more points of entry to green jobs**. In-house training, integration of EV modules into existing TVET courses, short courses to upskill existing workers and specialization paths in university engineering degrees all offer promising training formats, however the **scale and phasing of these investments are unknown**
- For skills programs to succeed, **careful collaboration between education groups, employers, labour-matching bodies and funders are required** to ensure workers are equipped with the right skills, practical knowledge and opportunities to succeed in job markets

The need is clear, but the nature of the jobs and programmes needed to train young people needs to be refined and deepened

- **Further work is required to understand EV skilling**, including an initial landscape analysis to estimate the demand for EV jobs, their precise nature and the skills and qualifications required to fulfil them. In a second step, **work is required to approximate the jobs-skills mismatch in different geographies to identify and prioritise skills training,** which is currently under provisioned
- Upon identifying areas for specific skills development, **pilot programs are needed to required high-potential training formats** and ensure supply-side, demand-side and job matching functions work effectively to convert trainees into full time, quality employment
- Only then will countries have the **right tools, knowledge, and scale-up initiatives to create mass skilling opportunities** for jobs for the future

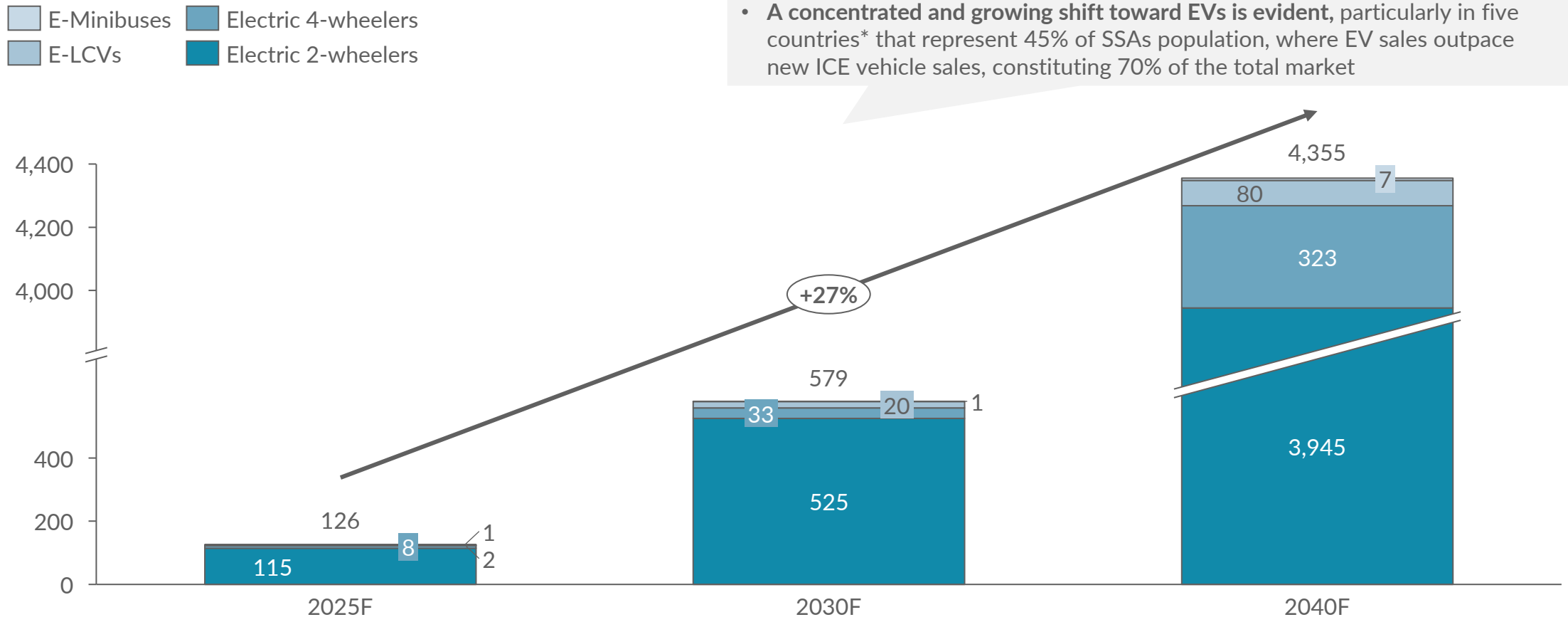
With this in mind, Dalberg is seeking partnerships to jointly navigate the evolving landscape, identifying opportunities to test, refine, and scale training initiatives that enable employment and facilitate the growth of EV sectors

Consumer demand for electric vehicles (EVs) is projected to grow 20x in the next 15 years across major African markets

Annual expected sales of electric vehicles by segment in 5 countries[1]

Thousands of units

- **Dominance of two- and three-wheelers especially in commercial use cases** such as delivery services and taxis
- **Gradual rise of 4-Wheel EVs over a longer time horizon** due to factors like evolving preferences, supportive policies, lower prices, and the need for widespread charging infrastructure
- **A concentrated and growing shift toward EVs is evident,** particularly in five countries* that represent 45% of SSAs population, where EV sales outpace new ICE vehicle sales, constituting 70% of the total market



*Note: The five countries represented include Ethiopia, Kenya, Nigeria, Rwanda, Uganda, and make up 60% of all Sub-Saharan African vehicle sales

1. Shell Foundation, Financing the transition to electric vehicles in sub-Saharan Africa, 2022; 2.McKinsey & Company, Power to move: Accelerating the electric transport transition in sub-Saharan Africa, 2022; 3. Dalberg expert interviews, 2023

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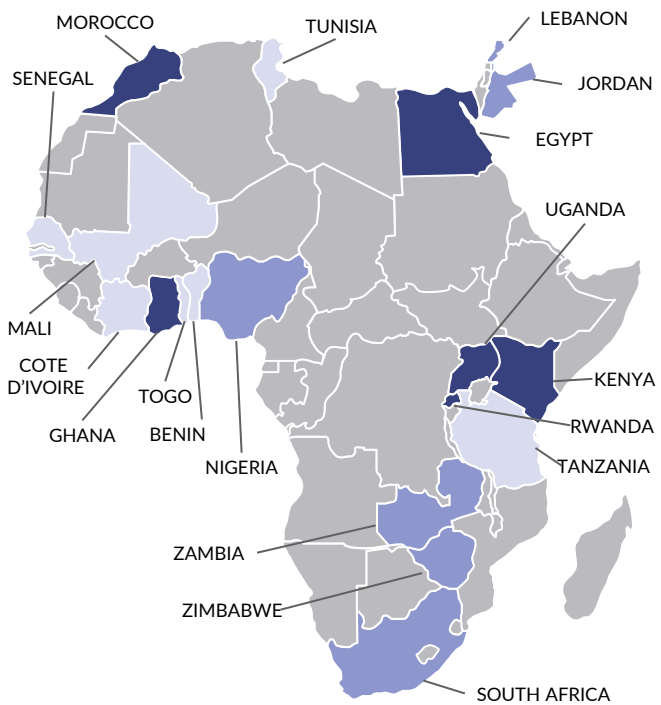
EV growth will be concentrated within a handful of African and Middle Eastern countries with favourable conditions for growth

While the majority of Africa and the Middle East have little to no electric vehicle infrastructure or investable opportunities…



Tier 1

Countries that are likely to **already have several viable e-mobility investment opportunities and currently display most conditions for long-term growth**

Tier 2

Countries that may already have **some viable e-mobility investment opportunities**, but are only likely to display most of the **conditions for long-term growth within the next 2-5 years**

Tier 3

Countries that are likely to have **few viable e-mobility investment opportunities** within the next 5 years as they **lack conditions for long-term growth**

Tier 4

Countries with **viable e-mobility investment opportunities** nor conditions for growth

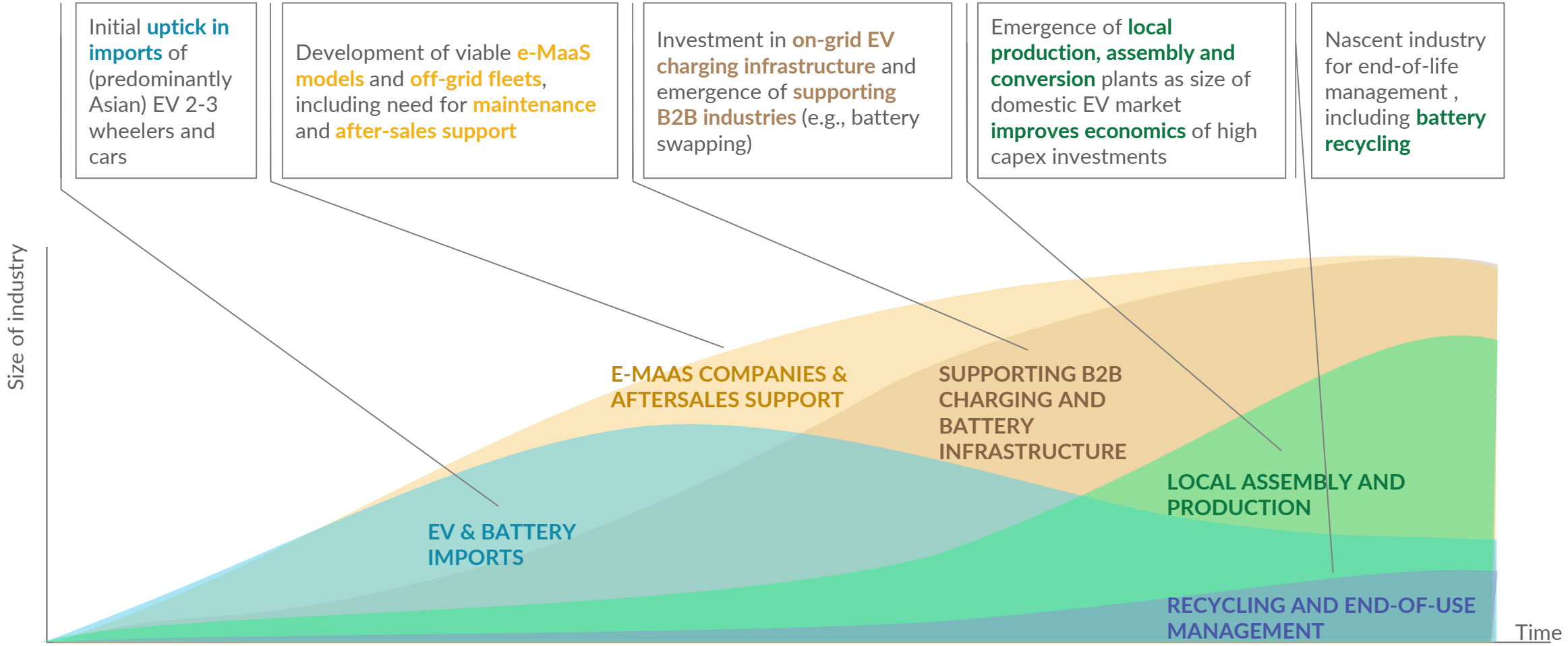
…a sub-set of countries demonstrate favourable conditions for long-term growth and investment

	Enabling condition	*Supporting facts*
Demand growth	A sizeable consumer base	**There is strong EV awareness** and benefits recognition among Nigerian and Kenyan vehicle owners, and despite 85% used vehicle sales in SSA, **overall vehicle demand is set to multiply ~2x by 2040**[1]
Demand growth	Reliable energy infrastructure	**African EV leaders have surplus power**, with Kenya generating 50% more electricity than needed[2], and electricity prices in Africa averaging 0.13-0.15 USD per kWh, below the global average of 0.18 USD per kWh[3]
Ecosystem growth	Sufficient capital flows from key stakeholders	Kenya and Nigeria have **collectively raised over $80 million for electric vehicle (EV) start-ups**[4], representing approximately 7% of global venture capital investments in EV start-ups in 2022[5]
Ecosystem growth	A conducive policy and business environment	Rwanda grants **tax breaks for EV buyers**, Morocco plans a **new EV battery factory after tariff cuts** on lithium-ion cells in 2021, and Ghana targets **32% EV sales by 2050**, reflecting **regional efforts** in electric mobility[5]
Ecosystem growth	Abundance of inputs	Africa boasts **crucial battery minerals** (70% of global cobalt and abundant manganese, lithium, platinum, and copper[6]), **with production, especially of batteries, on the rise**[7]

1. FMO - Dalberg Report - E-mobility in Sub-Saharan Africa and MENA, 2022; 2. GIZ, Electric Mobility in Kenya, 2019; 3. World Bank Group, The Economics of Electric Vehicles for Passenger Transportation, 2023; 4. The Exchange, Decarbonizing transport: Exploring e-mobility in Africa, 2023; 5. IEA, Global EV Outlook, 2023; 6. AfDB, Strengthening Africa's Role in the Battery and Electric Vehicle Value Chain; 7. Siemens Stiftung, E-Mobility Solutions for Rural Sub-Saharan Africa, 2020; 8. McKinsey & Company, Power to move: Accelerating the electric transport transition in sub-Saharan Africa, 2022; 9. UNEP, In the face of rising air pollution Rwanda turns to electric vehicles

These enabling conditions will give rise to waves of local and international enterprise activity across the EV value chain

Stylised view of the estimated evolution of local EV, battery and charging value chains*



*Note: Precise job figures in Africa's sectors are uncertain; this graph does not include the input supply (raw material) segment of the EV value chain

1. Expert interviews, 2023; 2. Identifying African countries' potential in the African automotive industry – A continental supply chain mapping approach, UNCTAD, 2023; World Economic Forum, How many jobs could the clean energy transition create?, 2022

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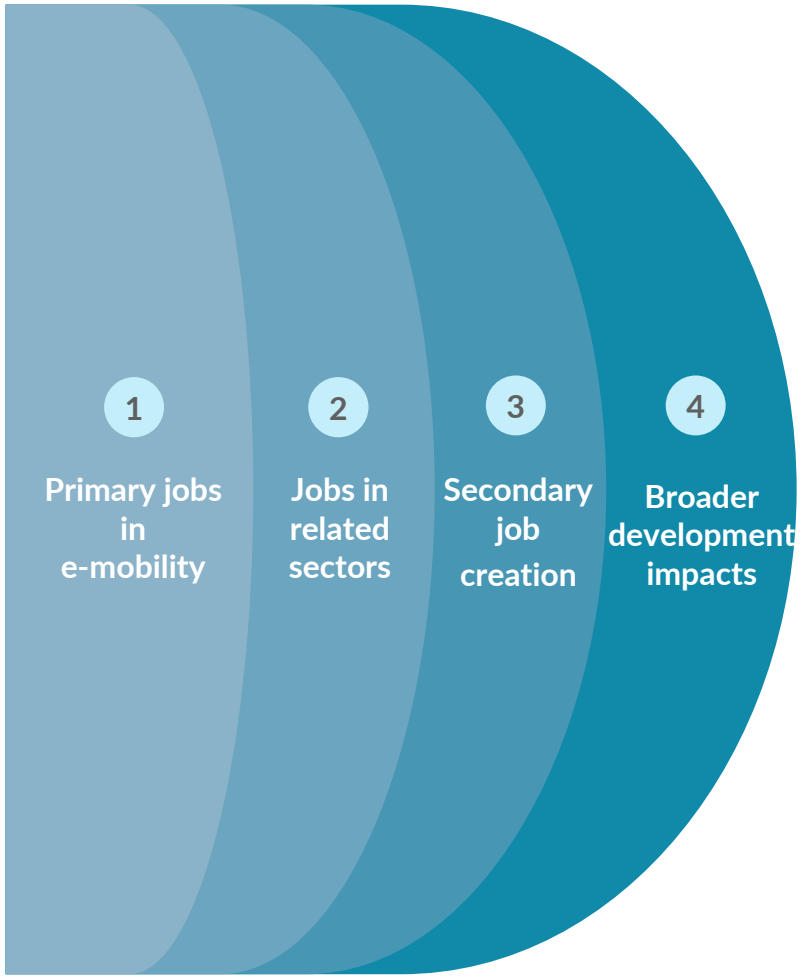
Direct job creation in e-mobility will unlock indirect employment opportunities and produce spillover benefits for the wider economy

Job creation and linkages due the growth of the e-mobility sector



1
- Strong potential multiplier effects with **BEV (Battery Electric Vehicle) manufacturing and charging infrastructure shown to have employment multipliers* of ~3.7-7.7 and ~7.3-21.2[2]**, respectively

2
- An estimated **18% of e-mobility jobs created are in electricity generation, grid connection/reinforcement, or civil and road work[3]**, many of which will be geographically dispersed due to off-grid/mini-grid needs of peri-urban and rural communities

3
- Mobility for Africa, a Zimbabwean social enterprise, has shown that e-transport can **empower rural women** by helping them save time, **sell their goods at markets**, collect water, transport their children to school or clinics, and **improve economic opportunities** within local communities[5]

4
- **Reduction in urban air pollution** and related infant mortality and respiratory illnesses[6], responsible for 1.1 million deaths across Africa annually[7]
- **Lower carbon emissions** that advance NDC goals and create positive externality benefits worth 5,000 USD over an EV's lifetime[8]
- **Distributed power and improved last mile logistics** for isolated communities[9]

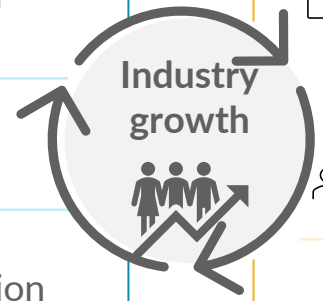
*An employment multiplier refers to the number of jobs created per million USD of capital investment or expenditure on certain goods.

1.Dalberg, Stakeholder interview, 2023; 2. IEA, Sustainable Recovery, 2020; 3. AIE, Powering a new value chain in the automotive sector, 2019; 4. Siemens Stiftung, E-Mobility Solutions for Rural Sub-Saharan Africa, 2020; 5. Mobility for Africa, About Us, 2023; 6. Electrek, New study: Every electric car brings $10,000 in life-saving benefits, 2020; 7. Fisher et al., Air pollution and development in Africa: impacts on health, the economy, and human capital, 2021; 8. World Bank Group, The Economics of Electric Vehicles for Passenger Transportation, 2023; 9. IRENA, Global Renewables Outlook: Energy Transformation 2050, 2020

However, supply and demand side barriers are hindering domestic activity within e-mobility industries….

SUPPLY-SIDE BARRIERS

- **Access to financing:** EV investments across Africa are still nascent and concentrated in select geographies, limiting infrastructure and operational capacity
- **Access to electricity:** Some electricity networks remain unreliable and hindered by fossil fuel subsidies
- **Access to affordable inputs:** Limited access to manufactured inputs (e.g., batteries)
- **Lack of supply chain integration:** Large distances between downstream EV production stages, along with lack of economies of scale in production involving EV components and machinery
- **Skills gap:** Lack of local training provisions for green skills and/or practical training elements for jobs in local EV/battery industries



DEMAND SIDE BARRIERS

- **Consumer affordability:** EVs are prohibitively expensive for purchase compared to used ICE vehicles, especially in absence of subsidies
- **Availability of charging infrastructure / range anxiety:** Charging infrastructure development is still in early stages, triggering range anxiety over inability to charge batteries
- **Consumer awareness:** Continued widespread reliance on used ICE vehicles
- **Policies and used-vehicle legislation:** Lack of harmonised policies/norms that incentivise EV usage and regulate vehicle emissions standards outside of select markets

Deep-dive on following slides

Dalberg expert interviews, 2023; FMO, Catalyzing Investment in Electric Mobility, 2022; Siemens Stiftung, E-Mobility Solutions for Rural Sub-Saharan Africa: Leveraging Economic, Social and Environmental Change, 2020

…and a current lack of relevant skills provision will inhibit e-mobility sector growth as other key barriers are addressed

Current efforts to develop skills for jobs in e-mobility sectors are limited to a few select geographies

High-focus countries

Countries that **have already launched numerous skills training programs** targeted towards jobs in e-mobility

Medium-focus countries

Countries with **some evidence of skills training programs** for the climate and e-mobility transition

Limited-focus countries

Countries with **little to no presence of green skills training programs**

Existing programs are focused on technical skills and coaching, but lack scale to drive industry-wide change

TVET and other technical skills training for electric vehicle mechanics
WeTu (Kenya): social enterprise that offers technical e-mobility training for mechanics, including vocational training for workers in the informal sector

Mentorship and network-building with focus on soft skill development
Siemens Stiftung (Uganda): nonprofit that launched an e-mobility human-centered design training and mentorship program, with networking opportunities with industry leaders

Product development workshops for SMSEs
Charge 2022 Design Sprint (Ghana): design sprint workshop to develop e-mobility charging facility prototypes, with winners joining Impact Hub Accra for 12 months

Job matching programs for workers in green industries
E4D (multi-country): initiative to link jobseekers with employers in the green job sector through internships, job fairs, and capacity-building of training institutions

Scaled and coordinated curriculum development and delivery is needed to meet the emerging job-skills gap

Siemens Stiftung, 2023; Impact Hub Accra and Siemens Stiftung, 2023; Impact Hub Accra and Siemens Stiftung, 2022; WeTu, 2023 ; GIZ and Siemens Stiftung, 2023; GIZ, 2022; TTI, Wangari Mathai Foundation, and WRI, 2023; Grup Eina, 2023

To unlock a wider set of EV skills and drive industry-wide change, an array of scalable interventions will need to be pursued

Potential training intervention	Relevance	Advantages	Disadvantages
Apprenticeships with an existing company	On- the-job training for specific tasks (e.g., battery repair for specific model)	✓ Real-world work experience and mentorship ✓ Direct application of job tasks ✓ Skill development in a professional work setting	× Potential low-transferability of skills × Limited availability of positions × Dependence on the host company's resources
Add-on modules to courses in local vocational training colleges	Green skills provision for trainees in vocational jobs (e.g., battery mechanics, EV installation mechanics)	✓ Access targeted skills within existing programmes ✓ Align with industry demand for a particular type of credit/skill ✓ Potential for recognised accreditation	× Quality of the modules may vary × No direct link to EV-related jobs upon course completion × Potential cost barriers
Standalone courses to upskill existing technical workers	Focused skill enhancement to target specific skills or knowledge areas relevant to the job or industry (e.g., EV policy and regulation advancements)	✓ Save time and costs compared to full degrees ✓ Workers acquire transferable skills to transition to green industries ✓ Flexible format delivery ✓ Potential for recognised accreditation	× May lack the depth of full degree programs × Limited networking opportunities × Potential cost barrier (unless paid by existing employer)
Specific modules within higher education degrees	Add-on modules to existing university-level degrees to provide specialist EV knowledge (e.g., EV design courses, battery engineering course)	✓ Transferable skills with wide application ✓ Enhance competitiveness in the job market	× Quality of the modules may vary × No direct link to EV-related jobs upon course completion × Potential cost barriers

Further work is required to understand the relative demand for skills types and how investment be prioritized and phased across these interventions

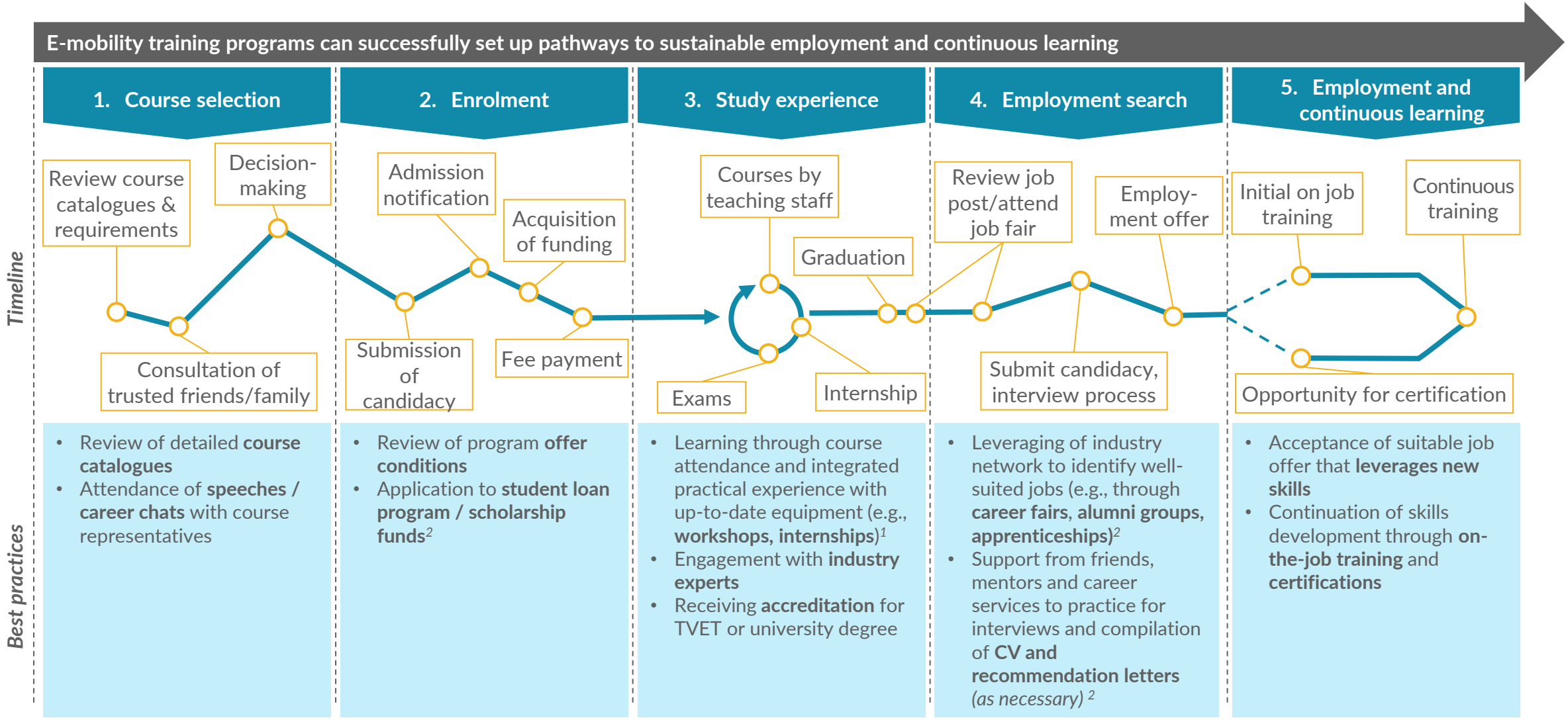
Dalberg analysis, expert interviews, 2023

Interventions will require careful design to overcome skilling barriers that prevents successful scaling and roll out today…

	Key barriers	Specific challenges
Demand	Limited course offerings	• Very **few e-mobility training courses** available, with existing programs limited to **few markets and small class sizes**[1] • Training **often occurs in-house**, limiting employers' hiring capacity and industry-wide knowledge sharing[1]
Demand	Lack of practical training and curriculum	• Many programs do not involve employers in course development, resulting in a **skills mismatch**[3] • Training **programs and universities lack modern equipment/technology** deployed by industry players[1] • **70% of TVET trainers in Africa have no recent experience in companies related to their sector**[2]
Demand	Limited equity in opportunities	• Courses almost exclusively offered **in large urban centers** • **Lack of gender equity** in program admission, course enrollment, and job placement[1]
Matching	Weak conversion of education to employment	• Very **limited placement schemes and job-finding support** for students in university courses and apprenticeship programs[1] • **Lack of standardized trainee accreditation** that helps de-risk hiring for employers[1]
Supply	Lack of course affordability and financing	• Courses are **prohibitively expensive** if not accompanied by funding support (from employers, governmental agencies, or scholarships)[1] • Only **4% of public expenditure on education in Africa is devoted to vocational training**[2]
Supply	Lack of awareness about e-mobility courses	• **Limited awareness** of relatively new e-mobility sector and training opportunities by students[1] • **Limited prioritization of e-mobility skill development** by public interest groups including key decision-makers within **automotive industry**[1]

1. Dalberg expert interview, 2023; 2. IIEP-UNESCO, Eight key issues for TVET in Africa between now and 2030, 2023; 3. African Development Bank Group, Creating decent jobs: Strategies, policies, and instruments, 2019

…helping to ensure students have access to best-practice learning experiences that consistently result in meaningful employment



1. African Development Bank Group, Creating decent jobs: Strategies, policies, and instruments, 2019; 2. UNECA, Best Practises in Job Creation, 2021

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Trialling select solutions could help alleviate access, affordability and skills mismatch barriers within the e-mobility ecosystem

Solution areas	*Example interventions*	*Example Benefits*
Investment in curriculum development to better prepare individuals for the e-mobility industry	• Collaborative curriculum development • Open-source digital learning resources	✓ Higher job-match chances with relevant curriculum ✓ Enhanced accessibility and flexibility of learning
Innovative financing mechanisms to secure and ensure impact of funds to support skills development	• Income sharing agreements • Social/development impact bonds	✓ Increased affordability for students ✓ Addressed upfront capital constraints to investment
Improved program design and delivery formats to optimise learning outcomes	• Customized industry-focused skills programs co-created with employers • Accreditation upon course completion	✓ Provide hands-on experience and reduce skills mismatches ✓ Improved signalling quality that reduces hiring risk to employers
Firm-labor matching mechanism to connect job seekers with appropriate employment opportunities	• Funding of career and mentorship support • End of programme apprenticeship schemes	✓ Reduced labour market frictions through improved signalling and matching ✓ Positive employment outcomes likely to encourage others to high-quality courses
Just and inclusive skilling provisions that ensures access to all individuals, including women, rural and other underrepresented groups	• Course information sessions in rural areas • Provision of gender and disability support services	✓ Boosted awareness in rural communities ✓ Improved equity in opportunities and workforce diversity

However, scaling training interventions and ensuring their quality requires collaboration across the education to employment ecosystem

	EXAMPLE ACTORS (*Illustrative*)	EXAMPLE ACTIVITIES *Illustrative*)
Cross-cutting actors	The Rockefeller Foundation; giz; SIEMENS Stiftung	**Foundations and Foundations** responsible for: • Financing of **individual course places** and **curriculum development** • Funding of **outreach and job matching initiatives**
Supply-side actors	TOOLKIT;	**TVET and other training providers** responsible for: • **Curriculum development** (in partnership with businesses) • Technical **skills development** aligned to industry
Matching actors	FUZU; harambee YOUTH EMPLOYMENT ACCELERATOR	**Accreditation groups, industry bodies, governments, job finding platforms** responsible for: • Employee-job matching via job advertisements, careers fairs, job placements, etc. • Certification provision to signal skills to potential employers and ensure industry quality
Demand-side actors	ROAM; MOBILITY for AFRICA	**Employers** across value chain responsible for: • **Provision of jobs, internships and apprenticeship** schemes • **On-the-job continuous training,** as well as financing for classroom skills development • Support to supply-side actors to ensure **relevance of curriculum development**

Developing and testing these ideas further require partnership with leading e-mobility and education actors

	Stage 1 – LANDSCAPE ANALYSIS	Stage 2 – PILOT DESIGN	Stage 3 – SCALE-UP
DESCRIPTION	*Comprehensive landscape analysis to understand size of skills-job mismatch and effectiveness of potential intervention areas*	*Early pioneers make first moves to establish proof of concept in e-mobility solutions in select countries/sub-sectors based on landscape analysis*	*Successful pilot studies are refined and scaled-up to other geographies and sub-sectors*
KEY QUESTIONS	• Where will job growth be most pronounced in the e-mobility value chain? • What are the most in-demand skills in the next 5-10 years? • Which job categories will face skill imbalances, and what obstacles do jobseekers, educators, and employers encounter in addressing these imbalances?	• What roles do stakeholders play in intervention design and implementation? • What capacity constraints do educational groups face? • Which interventions effectively address (re)-skilling barriers and engage underrepresented communities?	• What were the key challenges in the pilot model, and how can it be improved for future success? • How can the pilot program be efficiently scaled to meet demand in specific geographies and sectors? • What context-specific factors should be considered during the pilot's expansion?
OUTCOME	• Understanding of **biggest job growth sectors** in SSA • Understanding of **specific skills required** for e-mobility sectors • Shortlist of **high-potential interventions** to unlock jobs in e-mobility	• Identification of **potential partners** for pilot implementation • Outline of **key support model** to effectively address e-mobility skills mismatch	• **Evaluation of pilot performance** based on MEL framework • Understanding of main challenges faced in pilot to inform **potential changes** to model • Investigation of **potential for scale-up** in specific geographies and sectors

Dalberg's expertise lies in identifying and supporting promising initiatives, with a strong track record in building scalable pilots and enabling effective scale-up of programmatic work

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ANNEX

1. **DEEP DIVE:** EV VALUE CHAIN AND PLAYERS
2. **DEEP DIVE:** SKILLS GROWTH ACROSS THE EV VALUE CHAIN

Deep Dive: Enabling conditions have given rise to local players across the EV value chain, along with increased regional interest by global firms

Value chain insights

- **Majority of local firms are concentrated in sales/ installation and service provision**, with gaps between input extraction and later stages[1]
- **Companies in nascent markets often perform various roles** due to lack of alternative offerings
- Africa **relies heavily on imported vehicles** (>90% of vehicles in Nigeria and Rwanda are imported secondhand[2]), although there has been some **increase in (foreign owned) production and assembly plants across the continent**
  - 64% of Kenyan players have invested in local assembly[3]
  - Egypt began EV production in 2022 and plans to build 3,000 charging stations nationwide in partnership with a Chinese manufacturer[3]
  - Morocco's EV manufacturing efforts are growing, with a government-led launch of a new local battery plant[4]

Value chain overview (illustrative and non-exhaustive)

The majority of local firms are concentrated in these activities

EV mobility activities	Input supply	Production	Assembly	Sales and/or installation	Service provision	Aftermarket	Recycling
	Raw material extraction Raw material processing	Component and cell production Programming, stamping, welding Cabling, casing, programming	Battery pack assembly Body and chassis assembly Unit construction	Sales, marketing, financing Installation of charging stations/points	B2B services to EV producers or battery swap businesses B2B/B2C services to drivers, e-MaaS providers, or public sector	Technical support Servicing, repairs, replacement	Deconstruction, cleaning, extraction, reuse Dismantling, separation, shredding, reuse

Relevant local players

Battery

- Ghanian producer, importer, and distributer of EVs. Host of lithium-ion battery lab — SolarTaxi
- Kenyan company facilitating electric conversions of 2- and 4-wheelers, including public buses — ROAM
- Swap and Ride! (ARC RIDE) — Kenyan-based leading battery-as-a-service provider
- M-KOPA — Kenyan-headquartered payment plan provider for accessing 2-wheeler EVs and battery swaps

EV

- Global battery and EV producer and innovator expanded in South Africa — BYD
- Zimbabwean producer of e-tricycles built for a rural environment — Mobility for Africa
- STIMA — French-Kenyan company powering electric boda-bodas with integrated battery swap network
- AMPERSAND — East African based producer and seller of e-motorcycles and battery charging solutions

Charging

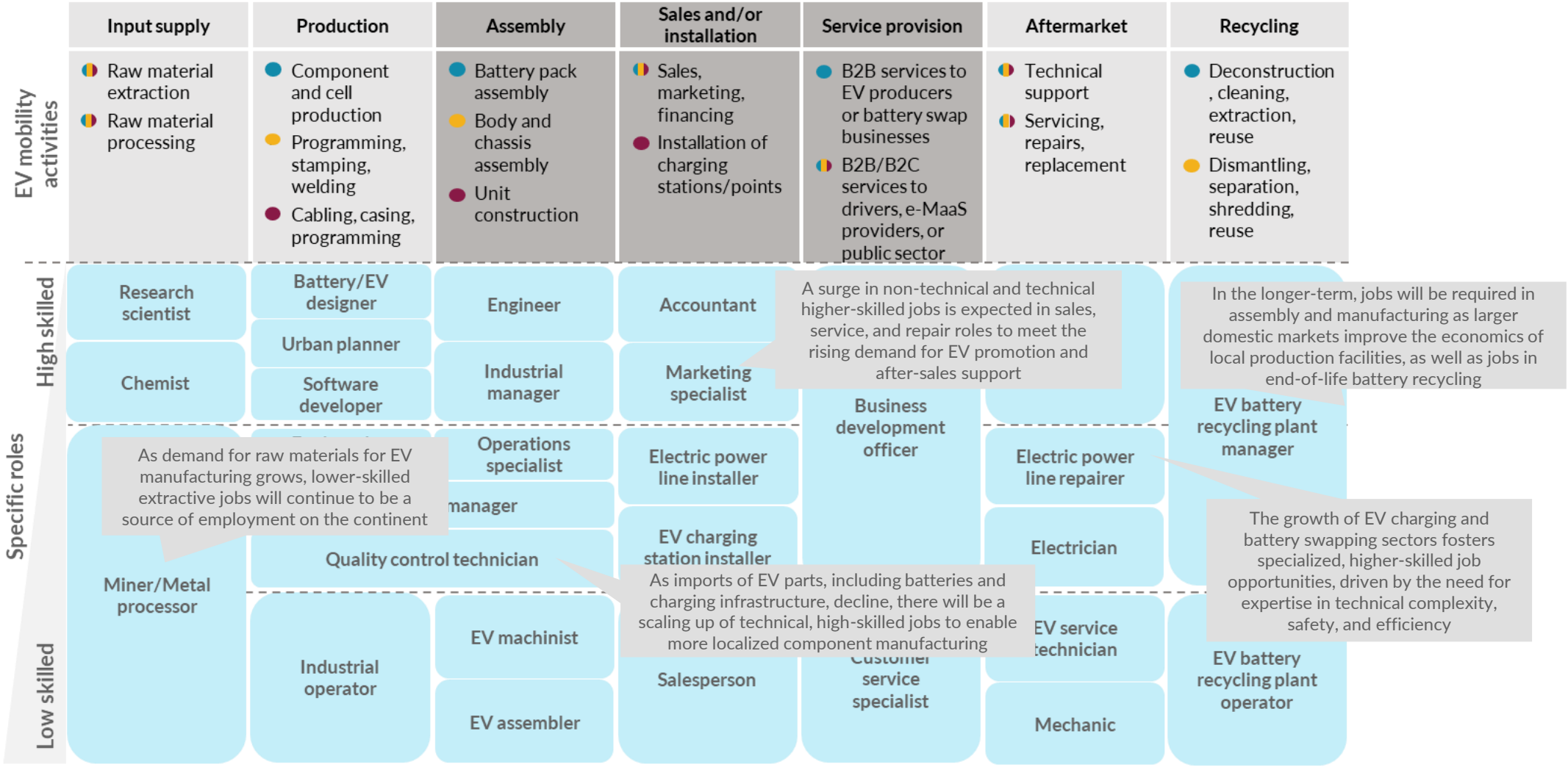
- Kenyan provider of EV charging solutions — EVChaja

Activities key: All three value chains = ◐ ; Battery VC = ● ; EV VC = ● ; Charging VC = ●

1. AfDB, Strengthening Africa's Role in the Battery and Electric Vehicle Value Chain; 2. World Bank Group, The Economics of Electric Vehicles for Passenger Transportation, 2023; 3. African Business, Opportunities for Africa in electric vehicle market, 2021; 4. Morocco World News, Study: Morocco is Becoming an 'Electric Vehicle Manufacturing Hub', 2022

Deep Dive: Across global EV supply chain, there is a mix of technical and non-technical jobs, some will emerge across the continent

Illustrative overview of the EV value chain



Activities key: All three value chains = ; Battery VC = ; EV VC = ; Charging VC =

1.World Bank Group, The Economics of Electric Vehicles for Passenger Transportation, 2023; 2. U.S. BLS, Careers in Electric Vehicles, 2023