optibus

MASTERING ELECTRIFICATION
IN BUS OPERATIONS:

A Comprehensive Guide to Planning and Scheduling Electric Vehicles

Included:
Easy-to-use checklists for smooth implementation and real-world examples showcasing best practices.

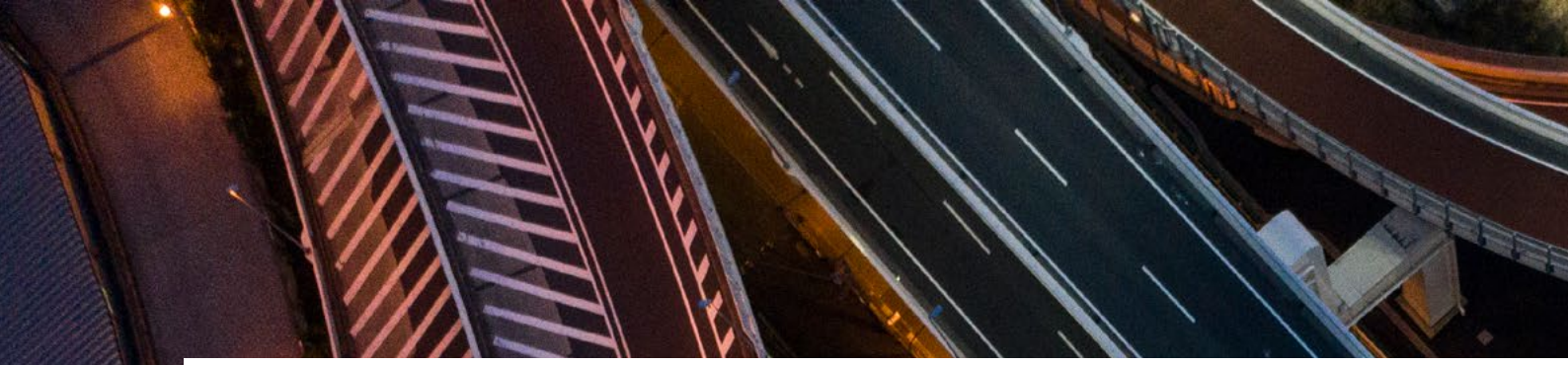
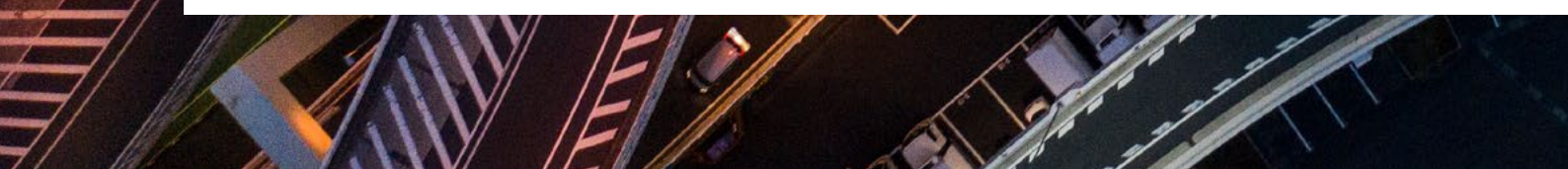


Table of Contents



Introduction

As cities worldwide face challenges related to pollution, congestion, and climate change, the adoption of electric vehicles (EVs) has emerged as a game-changer for the transportation sector.

Governments and regulatory bodies around the globe are increasingly mandating stricter emissions standards and environmental regulations for public transportation services. To remain compliant and avoid penalties, operators must meet regional deadlines to transition towards emission-free fleets.

Beyond personal electric vehicles, electric public transportation operations hold powerful implications for sustainability - both environmental and commercial. By transitioning entire fleets to electrified solutions, transportation operators can among others decrease vehicle maintenance demands, and create a quieter, smoother ride for passengers, all while fighting climate change by switching to renewable energy sources and protecting public health and the environment by reducing harmful vehicle emissions.

Electric vehicles are one crucial component in the move toward zero emissions fleets, yet they present a range of challenges that make the transition complex. Planning, scheduling, and operational processes must incorporate new parameters, such as charging times, charging locations, and battery range, just to name a few, in order to keep services moving smoothly.

Today, at least 45% of newly purchased vehicles for public service contracts must be low-emission or zero-emission according to the Directive of the European Union. From 2026, the proportion will rise to 65%.

In the beginning, it's imperative to provide training for planners and schedulers regarding the specifics of electric vehicles which should then be extended to encompass drivers and maintenance personnel. Well-trained staff play an important role in taking care of electric cars. They make sure everything runs smoothly, keep things safe, and help encourage the use of electric transportation.

This white paper delves into the critical aspects of planning and scheduling for fleet electrification that operators should consider during this historical time of change. It offers valuable checklists to address key questions that arise in the process, explores new digital technologies that are making it easier to plan and manage electric fleets, and presents real-world use cases of successful implementations.

Electrifying bus operations:

Navigating challenges and optimizing results through efficient Planning and Scheduling

The transition to electric vehicles poses several challenges for operators. Key hurdles include a lack of widespread knowledge about and experience with electric buses, high initial investment costs, limited battery range, restrictions on operational flexibility, the need to develop extensive charging infrastructure, as well as the need to adapt work processes and how the industry approaches planning and scheduling as a whole.

So, what does a successful transition to electric buses look like? This is an important question because the transition is not guaranteed to be smooth, nor does it promise to leave services or commercial operations undisrupted. One way of measuring success is from an operational standpoint. How efficiently are resources distributed, mainly the balance of electric vehicles to chargers? Is energy usage efficient and affordable? Are buses running out of charge mid-route or does the battery range enable reliable services?
There are also the environmental and social benchmarks: fewer greenhouse gas emissions, improved air quality, the accessibility of services, and increased demand in ridership.

Planning and scheduling are vital components in the successful deployment of electric buses and management of charging infrastructure. A well designed schedule can smoothly integrate charging times into daily operations with zero or minimal service disruptions by optimizing routes to accommodate charger locations and accounting for vehicle downtime during charging. But this, of course, is a complicated feat that can only be accomplished if planners and schedulers have access to the proper tools and can answer this key question: how many electric buses does your operation need and what charging infrastructure is needed to support those buses.

In the following sections, we provide checklists, based on potential scenarios, with specific steps to answer these key questions and be on your way to a successful e-bus roll-out.

Checklist

Determining the right number of buses

USE CASE: A public transport operator needs to electrify two routes.
QUESTION: How many buses are needed in order to operate the two electrified routes?

Route and Ridership Analysis

- [ ] Analyze ridership data and passenger demand patterns to determine required bus capacity and service frequency
- [ ] Determine the distance of each route and the hours of operation to estimate the number of buses needed for efficient coverage
- [ ] Differentiate between peak and off-peak hours to determine the optimal number of buses required to meet varying levels of passenger demand throughout the day

Electric Bus Specifications

- [ ] Research and choose the appropriate electric bus model(s) that align with the operational needs, taking into account factors like range, charging times, and passenger capacity
- [ ] Analyze battery performance to ensure that electric buses can comfortably cover the required distance for the routes without compromising operational efficiency
- [ ] Assess whether the selected electric buses can be used interchangeably on both of the two routes, optimizing fleet utilization and maintenance logistics

Charging Infrastructure and Range Considerations

- [ ] Calculate the average charging time required for electric buses to complete a full route and ensure that it aligns with operational schedules
- [ ] Evaluate the availability and capacity of charging infrastructure along the routes and at the depots to support the charging needs of the electric buses

Fleet Optimization

- [ ] Based on route demand, charging time, and operational schedules, calculate the minimum number of electric buses needed to ensure timely and efficient service
- [ ] Factor in the need for replacement buses to cover maintenance downtime or unforeseen operational issues, ensuring uninterrupted service delivery

Financial Considerations

- [ ] Compare the initial investment and operational costs of electric buses with conventional buses to assess the overall financial impact of electrification
- [ ] Explore available incentives or grants for electric bus adoption, which can help offset the initial investment and promote sustainable practices
- [ ] Analyze potential long-term savings from reduced fuel and maintenance costs associated with electric buses to determine the economic viability of the transition

Checklist

Determining the right charging infrastructure

USE CASE: A public transport operator needs to electrify one of its depots.
QUESTION: What(charging) infrastructure does the electrified depot require?

Infrastructure Assessment

- [ ] Determine the capacity of existing electrical infrastructure and assess whether it can support the additional load from electric bus charging stations
- [ ] Perform a comprehensive site survey to identify suitable locations for charging stations, considering factors like space availability, accessibility, and safety requirements
- [ ] Ensure that the depot's electrical system and grid are compatible with the chosen charging technology (e.g. fast vs. slow chargers) and that necessary updates or modifications are made if required

Charging Technology Selection

- [ ] Explore different charging technologies available in the market (e.g. pantograph charging, plug-in charging) and evaluate their pros and cons in the context of the depot's operational needs
- [ ] Determine the required charging speed and capacity based on the electric buses' energy consumption, daily mileage, and charging times to ensure efficient and timely operations
- [ ] Anticipate future fleet expansion and charging demands to select a scalable charging infrastructure that can accommodate potential growths

Operational Considerations

- [ ] Develop a charging schedule that optimizes electricity consumption and minimizes peak demands, considering the depot's electricity pricing structure and grid constraints
- [ ] Analyze the number of electric buses and their charging needs to determine the optimal bus-to-charger ratio, ensuring that enough charging points are available for efficient operations
- [ ] Evaluate the need for backup power systems (e.g. battery storage or generators) to ensure uninterrupted charging during power outages or emergencies

Financial and Regulatory Factors

- [ ] Conduct a detailed cost-benefit analysis, considering the initial investment, ongoing maintenance expenses, and potential energy savings associated with different charging technologies
- [ ] Research available incentives or grants for electrification projects, which can help offset the initial investment and encourage the adoption of sustainable practices
- [ ] Ensure that the chosen charging infrastructure meets all relevant safety, environmental, and regulatory standards

Stakeholder Engagement and Training

- [ ] Collaborate with bus drivers, maintenance staff, and other relevant personnel to gather input on charging infrastructure requirements and address potential concerns

Balanced decision-making: Matching bus fleet size and charging infrastructure

The number of electric buses required depends on service demand, route profiles, and passenger volume. In turn, the number of electric buses will determine charging infrastructure needs, as each bus must have access to a suitable charger. If you've planned your charging infrastructure efficiently and aligned charger speed and locations with fleet demands, you will be better positioned to minimize vehicle downtime and ensure smooth, reliable operations. Looking at bus and charger needs side-by-side during the decision-making process will enable a more seamless transition to electric public transportation.

To achieve this, the following factors need to be considered:

- Before starting electrification, assess transport demand, including passenger volume, peak hours, and travel patterns, to determine the needed number of buses. Analyze route profiles, including distances and terrains, to identify charging requirements for electric buses.
- Choose electric buses based on battery range and charging speed. Longer routes with high passenger demand need larger battery capacities for single-charge coverage. Shorter routes can use smaller batteries for cost-effectiveness without compromising efficiency.
- Charging speed matters with regards to bus downtime and availability. Fast-charging suits shorter routes, minimizing off-road time. Strategic slow-charging during layovers suits long routes.
- Factor in how charger speed will impact your budget. Fast chargers are more costly than slow chargers, which are also simpler to install.
- Align the number of electric buses with the availability of charging infrastructure, based on operational needs and budget. When the number of buses exceeds the capacity of the charging infrastructure, charging will be ineffective and buses may become underutilized. Too few buses with too little charge disrupts operations and compromises service reliability.
- Analyze historical data and growth projections to determine the optimal fleet size and charging infrastructure. Use advanced software to optimize fleet allocation and charging infrastructure placement.
- Plan for scalability and future technological advancements. Be ready for improvements in battery technology and charging infrastructure. Scalable charging solutions and adaptable fleet strategies ensure long-term sustainability and cost-effectiveness.

Advanced Planning and Scheduling software: Strategies for optimizing fleet and charging infrastructure

Advanced software solutions can make the complexity of fleet electrification more manageable by supporting strategic decision making and data analysis. Innovations in data visualization, artificial intelligence, and optimization algorithms are creating new opportunities for transportation professionals to assess demand, route profiles, and other critical factors that help determine the optimal fleet size. Through simulations and scenario analyses, planners can even experiment with and visualize the impact of various fleet configurations on operational performance and costs.

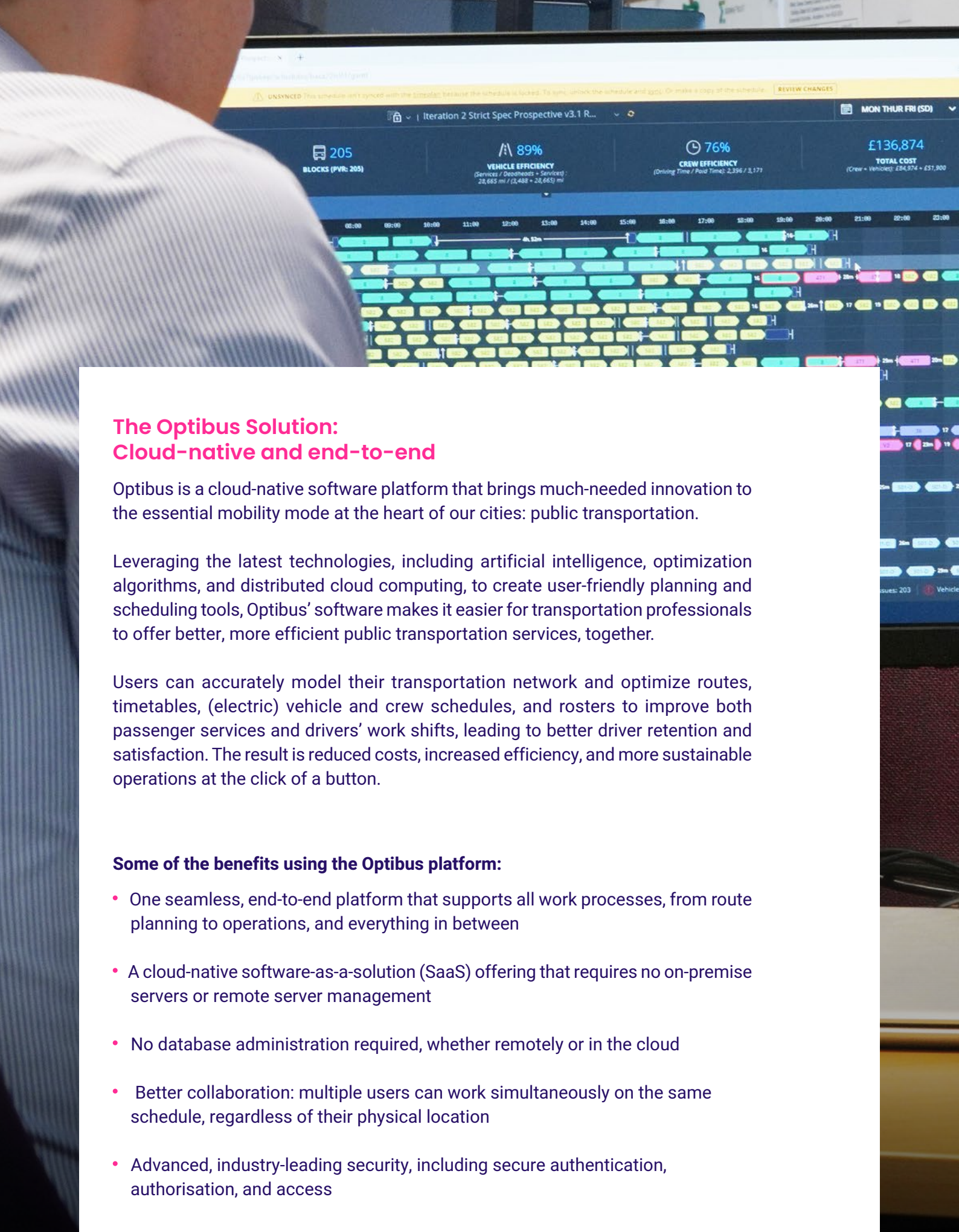
When it comes to electric fleets, that means that operators can better understand and evaluate how factors like battery range, charging speed and location, route distance, and passenger demand will impact operations. In addition to that increased visibility, the more advanced the software, the easier it is for planners and schedulers to make smart, cost-effective decisions about aligning electric bus specs with route profiles. This level of strategic decision making will enable fleet operators to electrify their routes with minimal disruption to existing schedules and services, which passengers and drivers will certainly appreciate!

How software simplifies the complexity of electric vehicle planning

Vehicle scheduling already has its challenges. Now, electric vehicles have made it even more complex, even when just a few e-buses are added to the fleet. There is also the transitionary challenge of scheduling mixed fleets that consist of both diesel-powered and electric buses.

When it comes to EV fleet operations, operators face many unknowns. How much will it cost to operate an EV fleet? Where should chargers be located? How much electricity is needed to support the infrastructure? How many buses and chargers should be purchased?

Optibus' specialized EV Scheduling solution uses EV-specific metrics to help operators create optimized operational and charging plans that account for all these complex considerations— not just in terms of operations, but also in terms of strategic planning.



The Optibus Solution: Cloud-native and end-to-end

Optibus is a cloud-native software platform that brings much-needed innovation to the essential mobility mode at the heart of our cities: public transportation.

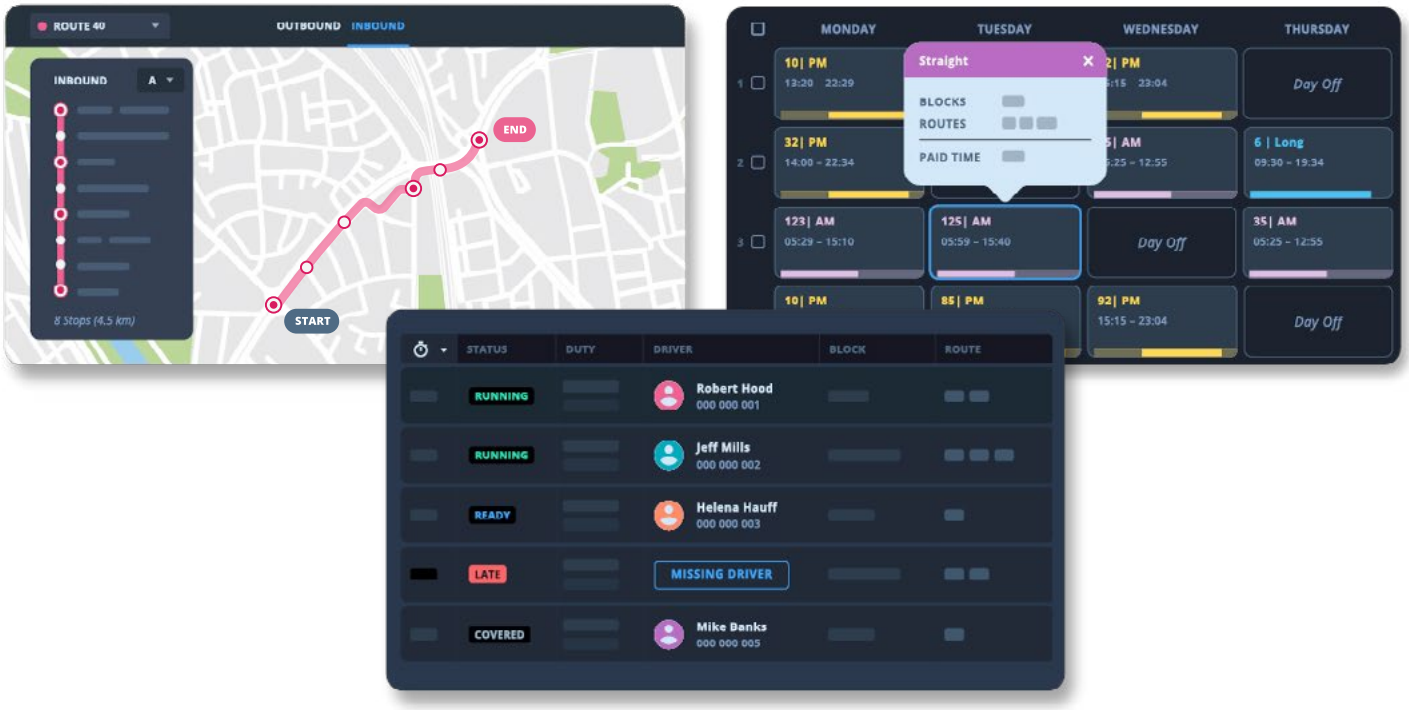
Leveraging the latest technologies, including artificial intelligence, optimization algorithms, and distributed cloud computing, to create user-friendly planning and scheduling tools, Optibus' software makes it easier for transportation professionals to offer better, more efficient public transportation services, together.

Users can accurately model their transportation network and optimize routes, timetables, (electric) vehicle and crew schedules, and rosters to improve both passenger services and drivers' work shifts, leading to better driver retention and satisfaction. The result is reduced costs, increased efficiency, and more sustainable operations at the click of a button.

Some of the benefits using the Optibus platform:

- One seamless, end-to-end platform that supports all work processes, from route planning to operations, and everything in between
- A cloud-native software-as-a-solution (SaaS) offering that requires no on-premise servers or remote server management
- No database administration required, whether remotely or in the cloud
- Better collaboration: multiple users can work simultaneously on the same schedule, regardless of their physical location
- Advanced, industry-leading security, including secure authentication, authorisation, and access

- Users can log in from anywhere — all they need is an internet browser
- Access to powerful tools backed by today's most advanced technologies, including artificial intelligence (AI) and optimization algorithms
- The software is automatically and continuously upgraded and updated via the cloud, meaning users get access to the latest technologies and tools with no migration or IT processes required and no need to re-enter preferences or rules or any other data following the upgrade
- User-friendly interface that is easy to learn and adopt for professionals of all experience levels and technical backgrounds
- Access to the Optibus Academy, a library of educational materials, that enables users to learn remotely and independently and quickly master the software
- 24/7 online support available through the Optibus Help Center and access to the Customer Support Team during business hours
- Integration with vendors via protocols like GTFS, BODS, VDV, EBSR, TXC, Ticketer, and more - the Optibus team is continuously adding new capabilities to support additional integrations
- Create custom reports for key stakeholders across the organization



Real-life use cases

This chapter delves into two use cases where Optibus' software played a pivotal role in optimizing electrification efforts for public transportation agencies and operators. These real-world examples demonstrate the powerful impact of technology in streamlining EV planning and charging, making the public transportation sector more sustainable and efficient.

EV procurement optimization: How Optibus helped a transport agency save $2.5M

In response to a tender initiated by a public transport agency, Optibus collaborated with an OEM seeking to optimize their fleet size. The integration of electric vehicles and charging infrastructure, though common industry practices, was a crucial aspect. Notably, our intervention led to improved outcomes compared to initial efforts, and with the introduction of Timetable Optimization (TTO), even greater reductions in infrastructure requirements could be achieved.

Background

Need to electrify 2 routes

OEM bus company proposed indication of 25 PVR (1 depot charger + 2 pantographs)

Solution

Optibus ran 3 scenarios:

- 23 depot chargers + 23 PVR
- 22 depot chargers + 2 pantographs: 22 PVR
- 20 depot chargers + 1 pantograph + Timetable Optimization: 20 PVR

Impact

- $2.5 m total savings
- 5 saved EVs
- 5 saved depot chargers
- 1 saved pantograph

Smart moves, big savings: Optibus API and smart charging deliver big wins

Initially skeptical about planning EVs due to operational complexities, an operator purchased smart charging software but didn't optimize its use, resulting in charging issues. With little value found in smart charging for fixed routes, the situation changed during winter when battery performance suffered. This led the operator to seek a more effective solution, including cost reduction and integration with Optibus for seamless charging plans without manual intervention.

Background

Issues with the old system

- Buses weren't being charged enough
- Schedules not well communicated to stakeholders

Solution

Optibus API integrated with a smart charging provider

Impact

- $63k total savings per depot per year
- 340% return on investment
- 4.6% less diesel miles - EV buses run longer routes

Conclusion

As the push for sustainable transportation gains momentum, operators face the challenge of transitioning to electric buses while ensuring they maximize the return on their investments.

Optibus' EV solution helps to experience seamless end-to-end work process support, enabling collaborative route planning, operations, and advanced security, backed by cutting-edge AI and optimization. The platform supports operators at the beginning of the electrification process with scheduling mixed fleets of diesel and electric vehicles, and growing with them over time, as they add more electric vehicles to the fleet.

Operators can use Optibus to gain greater visibility into their operation and ensure that their EV investments are commercially viable. This financial transparency is also key to securing funding for electric buses and chargers, and winning more EV business through tenders.

Optibus is here to support you as you transition to zero emission fleets. Contact us to learn more about how our software solution can help your operations and to have a consultation with our team.

Request a Consultation →

About Optibus

A cloud-native SaaS company founded in 2014, Optibus is an end-to-end software solution for public transportation planning, scheduling, rostering, operations and passenger information. Public agencies, private operators, cities, and consultancies in more than 4,000 cities across 35 countries use our software platform to plan and manage complex public transportation networks, leveraging our robust combination of artificial intelligence, advanced optimization algorithms and distributed cloud computing to improve service quality, promote transportation equity and access, reduce emissions and costs, and modernize operations.

Optibus powers 3 billion passenger trips annually for public and private sector clients including TransDev, RATP, Arriva, Abellio UK, Stagecoach, and AVTA, the US's largest electric bus fleet. In 2022, Optibus was valued at $1.3 billion, making us the first unicorn start-up dedicated to the public transportation industry. Optibus was selected by the World Economic Forum as a 2020 Technology Pioneer and has more than 350 employees across the globe throughout Europe, the Middle East, and Africa, Latin America, North America, and Asia Pacific.

Learn More →