Verifiable Credentials in Smart Cities – EU SSI and EBSI

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1 Objective

This research provides insights into how Verifiable Credentials (VCs) have been successfully used in the smart-city context.

1.1 What is a Verifiable Credential and why should I care?

Imagine having a wallet on your phone that holds digital versions of important documents — like your driving license, diploma, or proof of residency. Each one is like a **smart card**: it's issued by someone you trust (your city, school, or workplace), and it's **digitally signed** so others can instantly see it's real — no calls or paperwork needed.

But here's the best part: just like showing your license to prove you're old enough — without revealing your home address — a *Verifiable Credential* lets you **prove only what's needed**, no more, no less. You stay in control. It's safe, private, and tamper-proof. Instead of passwords and copies, you carry **trusted digital proof** that just works — anywhere, anytime.

2 Use Case Categories for Verifiable Credentials in Smart Cities

To understand how Verifiable Credentials are being used, we categorise real-world examples by sector and use case. This shows the breadth of applications in smart cities, both within the EU (leveraging SSI/EBSI) and globally (using similar decentralized credential approaches). Below are the key sectors and representative use cases, along with why they are relevant:

2.1 Government and Civic Services

Digital Citizen IDs & e-Government: City governments are issuing digital identities that residents control, enabling access to public services and civic participation. In Switzerland, the city of **Zug's blockchain-based ID** allows citizens to log into city portals and even participate in **e-voting** [3][2]. Zug's mayor emphasized the need for a single digital ID "not centrally on the city's servers, but on the blockchain" to give citizens control [6][7]. In the EU, the EBSI infrastructure supports decentralized **electronic identity** to **unlock city and cross-border services** [8]. These government-issued credentials (residence IDs, national IDs, etc.) are foundational in smart cities for proving who you are in a secure, privacy-preserving way. We include this category because **civic digital identity** underpins access to myriad city services (from tax to voting), and SSI/VCs greatly enhance trust and interoperability in this domain.

Municipal Permits and Benefits: City administrations are also using VCs to replace paper permits and entitlement cards. For instance, Zug is **exploring VCs for permits** like market stall licenses[9], making it easier to issue and verify these through a mobile wallet. In the EU's early pilots, Catalan municipalities issued **"municipality credentials"** to visiting students, granting them local discounts once their student status was verified via EBSI [1]. This use case shows how **local benefits (e.g. public-transport discounts,**

museum passes) can be digitized and linked to one's credentials (student, senior, resident, etc.). We include municipal permits/benefits as a use case category because it directly impacts daily city life – simplifying how citizens prove eligibility for city programs, and illustrating cross-sector collaboration (e.g., a university-issued credential accepted by a city council).

2.2 Education and Skills

Vocational Education Credentials & ESCO Harmonisation (EU, Certifydoc): The CERT project, led by the Institut Tecnològic de Barcelona with Biyiud and **Certifydoc**, created a system to issue verifiable digital diplomas aligned with SSI, ESCO and the European Blockchain Services Infrastructure (EBSI), compliant with eIDAS2 and integrated with Spain's new VET law. It enables instant, cross-border verification while protecting personal data, reducing bureaucracy and improving employability through EU-wide skills recognition [24].

Academic Credentials: Education is a leading sector for VC adoption. Universities and colleges issue **verifiable diplomas, degrees, and certificates** that graduates can store in digital wallets. Under EBSI, **cross-border diploma verification** pilots were conducted with universities from 11 countries [10][11]. By using VCs, a graduate in one city can easily prove their degree to an employer or institution in another country, without lengthy manual checks. We include this because smart cities with universities benefit from **trusted digital diplomas** – attracting talent and simplifying hiring or admissions. It demonstrates how **SSI reduces fraud and speeds up verification** of qualifications.

Student IDs and Youth Services: Beyond diplomas, student status itself becomes a credential. The **Municipality Credentials** pilot (Catalonia & Belgium) is a prime example: a student from Belgium obtained a **European student ID credential**, which was honored in a Spanish city for discounts [1]. This use case highlights **interoperability across cities** – a student's VC works as a student card anywhere, even abroad, thanks to common standards. We chose to highlight student credentials because they show immediate real-world value (student discounts, transit passes, library access) and engage the youth demographic in SSI. They also showcase a positive story of EU-wide integration via EBSI: empowering students with portable identities.

Workforce Skills Passports: In the realm of skills and vocational training, VCs allow individuals to carry proofs of competencies earned. For example, the **New South Wales Digital Skills Passport** in Australia lets workers share verified micro-credentials and qualifications with employers [12][13] (a non-EU example of the same concept). While not an EU project, we include it to show a global trend: cities and regions helping citizens **capture lifelong learning achievements** in verifiable form. This category is motivated by the need for **economic development** – a smart city can better match people to jobs if skills are easily verifiable. It's an extension of educational credentials into workforce development.

2.3 Healthcare and Social Services

Health Certificates: The COVID-19 pandemic accelerated the use of verifiable health credentials. The **EU Digital COVID Certificate** (issued over 2.3 billion times [14]) is essentially a **verifiable vaccination/test certificate**, with a QR code and digital signature

that any EU country's system can verify [4]. We mention this as it's a high-impact, pan-European example of VCs in action, used by cities for safe entry to venues and travel. It proved the concept that citizens could carry a trusted health credential on their phone to show at airports or events, without revealing extra personal data. We include health credentials because they highlight **public safety and convenience** in smart cities (e.g., for pandemic response or perhaps future use like immunization records for school admission). It shows how **privacy-preserving verification** (only proving vaccine status, nothing else) can be done via standard credentials.

Social Services & Vulnerable Populations: Verifiable Credentials are being tested to assist those who often lack traditional ID or paperwork. A notable case is **Austin, Texas**, where a blockchain-based digital identity was piloted for people experiencing homelessness [15][16]. The goal was to let individuals securely store personal records (ID, medical histories, social service records) and share them with service providers as needed. We include this use case to illustrate the **social impact** potential of SSI: a smart city can ensure **no one is left behind** by giving marginalized groups control over their documents, improving their access to shelters, healthcare, or job programs. Even though this Austin example is outside the EU, it's relevant as many European cities could use similar **self-sovereign IDs for refugees or the homeless**, aligning with EU values of inclusion. It motivates our choices by underlining that Verifiable Credentials aren't just high-tech convenience – they can improve lives in very tangible ways.

2.4 Transportation and Mobility

Digital Driver's Licenses & IDs for Mobility: Transport departments are exploring VCs to represent driving licenses, vehicle registrations, and transport passes. Under the upcoming EUDI Wallet pilots, EU states will test **mobile driving-license credentials and vehicle registration certificates** for use Europe-wide [17]. In practice, this means a citizen could prove they have a valid license or car registration via a digital credential in their wallet, which any traffic officer or rental agency can verify instantly. We include this because mobility credentials are a natural fit for smart cities aiming to modernize transit and car-related services – reducing fraud and paperwork in things like car rentals, parking permits, or cross-border driving.

Smart City Mobility Services: Verifiable IDs can integrate with local mobility offerings. A pioneering example was again **Zug's eID linked to a bike-sharing pilot** – residents with the blockchain ID could unlock e-bikes in a "Crypto-Bike-Sharing" program [18]. This use case shows how a city-issued credential can be used beyond official business, fostering a **trusted smart city ecosystem** (in this case, a private bike rental service verifying the user's city ID). We include it to demonstrate innovative uses: as cities invest in smart mobility (rideshares, scooter rentals, EV charging), **Verifiable Credentials can authenticate users or vehicles safely without creating new siloed accounts**. The motivation here is to emphasize convenience and security in daily urban mobility – a crucial aspect of city living.

2.5 Business and Workforce Credentials

Employee and Contractor IDs: Cities and local businesses are issuing work-related credentials to streamline verification of roles and permissions. In Zug, over 500 school

teachers received **digital employee certificates** via an eZug app [19]. This verifiable credential replaced physical ID cards and allows teachers to prove their status (for example, to get discounts at educational stores[5]). We highlight this as a use case because it directly shows operational efficiency – no more manually checking a paper ID for a teacher discount; a quick scan of a VC can do it. It also underscores privacy: the store just learns you are a certified teacher, nothing more. Similarly, a city could issue **digital staff ID cards** for its employees or **contractor permits** for service providers, which can be verified on-site (say, a maintenance worker proving their credentials to access a restricted area).

Business Licenses and Vendor Permits: In the commercial sector, **business registries** can provide verified digital licenses. A start-up or food truck owner in a city could carry a VC that proves their business is licensed and up to date. The **Procivis platform** used in Zug is being considered to issue and verify such permits (like market stall permits mentioned earlier)[9]. We include business credentials because smart cities thrive on small business activity, and making compliance easy benefits the economy. A verifiable license means quick trust – e.g., a festival organizer can instantly verify all stall vendors have the required permits. The motivation is that by **reducing bureaucratic friction** through VCs, cities become more business-friendly and efficient.

3 Findings for our research

We incorporated a **diverse set of use cases** drawn from our research. The aim was to convey the **breadth of verifiable credential applications in smart cities.**

3.1 Why these use cases?

We selected use cases across different sectors (government, education, health, mobility, etc.) because smart cities are multi-faceted. Each category demonstrates how VCs solve specific problems: from simplifying access to public services to protecting personal data in health or enabling new digital services (like bike-sharing). For example, the student ID scenario was included as a clear, relatable case of cross-border interoperability yielding real benefits [1]. The Zug digital ID and voting use case was chosen to show a concrete success in government services with SSI [2][3]. We cited the Austin homeless ID pilot to illustrate social impact, underscoring *why* SSI matters for inclusivity [15]. By covering high-impact areas (civic identity, education, health, etc.), we convey that **this technology isn't theoretical – it's already improving urban life in various ways**.

3.2 EU focus with global context:

Our research emphasises European initiatives (like EBSI pilots, EU COVID certificates, EUDI wallet plans) to show alignment with EU policy and leadership. However, we also included a few global examples (marked as outside EU) to **show that cities worldwide are embracing VCs**. If Buenos Aires or Austin are solving problems with VCs, European smart cities can too – often with even more robust frameworks (thanks to EBSI).

3.3 Categorisation rationale:

We organized use cases by sector to make it logical and scannable. A city

policymaker can quickly find the sector they care about (e.g. transportation or healthcare) and see how VCs apply. This categorisation was motivated by clarity-providing structure rather than a random list of projects. Under each sector, we explained *why* that use case matters (e.g., business licenses for economic vitality, or student credentials for youth mobility).

4 Conclusions

Our research concludes with a compelling narrative: **Verifiable Credentials can touch every aspect of smart city life**, and the EU's SSI/EBSI initiative provides the unified approach to make it happen, increasing efficiency, enhancing privacy, fostering inclusion, and enabling innovation, thereby confirming its rightful place in the Smart-Cities ecosystem.

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- RSA Security Blog – **EU Digital COVID Certificate** as a verifiable credential[4]
- TechCrunch (2018) – Austin's blockchain **homeless ID** pilot improving access to services[15][16]
- City of Buenos Aires – **QuarkID digital identity** with ZK proofs giving residents control (global example)[21][22]
- European Commission EBSI – *Success Stories* (2021 pilots in education & municipal services)[10][23]
- Certifydoc – Press Release – CERT connects Vocational Education with Europe: verifiable credentials, digital identity and ESCO harmonisation [24]

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