The Infrastructure Company Classification Standard (*TICCS*™)

EDHEC*infra*
building benchmarks
for infrastructure investors

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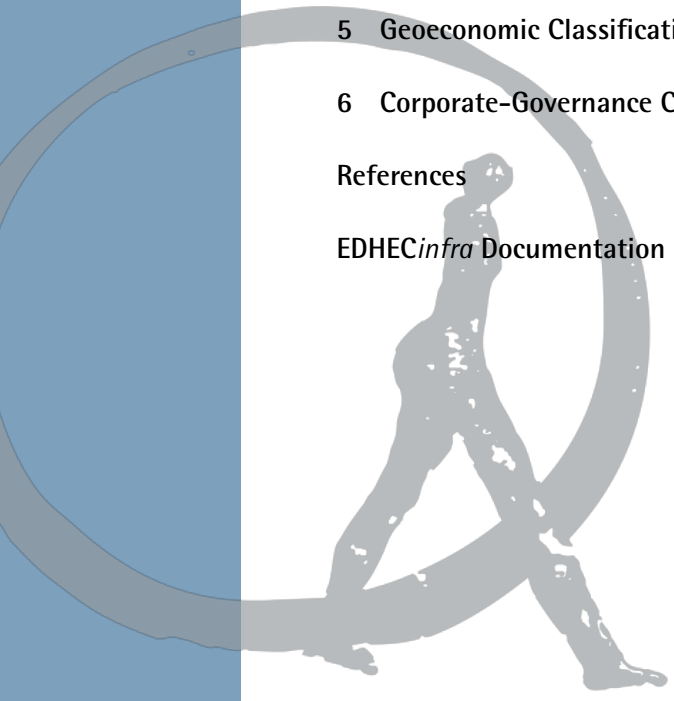
Contents



1. *TICCS*™ Overview

*Private infrastructure investment is developing rapidly as a global asset class. This evolution requires a clear and robust classification of the individual infrastructure companies that equity investors can acquire or debt investors can lend to. The textbfGlobal Infrastructure Company Classification Standard (TICCS™) was created by EDHEC*infra *to provide investors with a frame of reference to approach the infrastructure asset class. It offers an alternative to investment categories that were inherited from the private-equity and real-estate universe (e.g., "Core" vs. "Core+"), which may not be the most informative when trying to group infrastructure investments and design strategies or simply to document the structure of the sector. TICCS™ is designed to be compatible with other standard investment-classification schemes, but it also uses fundamental insights from the academic literature to create a classification that embodies some of the key aspects of infrastructure businesses' risk profiles.*

TICCS™, A Standard for the Industry

TICCS™ is a common classification standard that can be used by asset owners and managers, regulators, banks, and other investors across the various stages of the infrastructure-investment value chain, including consultants and researchers. It is designed to help investment and research professionals:

- take into account the evolution of the infrastructure-procurement landscape in space and time;
- compare sectoral- and business-risk exposures of investor portfolios with broad market benchmarks;
- document investable infrastructure markets;
- analyse the contribution of individual categories of companies to an infrastructure portfolio; and
- design consistent sector- and business-risk-driven investment strategies in infrastructure globally.

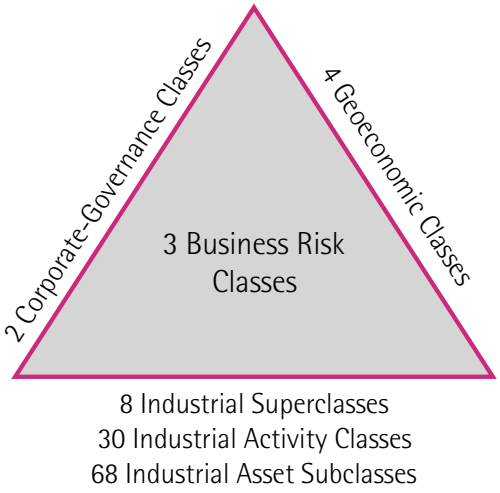
TICCS™ Structure and Methodology

TICCS™ is a four-pillar multi company-classification system designed to capture the characteristics of infrastructure investments. It consists of:

- 3 classes and 5 sub-classes of business risk;
- 8 industrial superclasses, corresponding to 30 industry classes of specific industrial activities and 68 industrial asset-level subclasses;
- 4 geoeconomic classifications; and
- 2 corporate-governance classes with 4 subclasses

Companies are classified on the basis of individual qualitative and quantitative criteria, including their contractual and regulatory structure and environment; their source of revenues; and their type of industrial activity, including the complexity and level of uniqueness of the relevant infrastructure both from a construction and an operational perspective. Their financial and corporate structure is also taken into account.

Figure 1: The 4 Dimensions of the TICCS™ framework



Key Features of *TICCS*™

- **Robust**: *TICCS*™ is built on the basis of academic research about the financial economics of infrastructure companies.
- **Global**: The range of categories available ensures that any private infrastructure company worldwide can be integrated into this framework, be it a regulated utility or a solar-project company.
- **Risk focused**: While *TICCS*™ aims to categorise companies on the basis of their prima facie characteristics, it focuses on groupings that are relevant to understanding risk and that play a role in asset pricing and portfolio construction.
- **Dynamic**: Infrastructure companies evolve over their lifecycles and with changes in national and sector regulation. The evolution of their characteristics plays an important role in infrastructure investment and can be reflected consistently and homogeneously over time.

The *TICCS*™ Comparative Advantage

TICCS™ is built in the context of the EDHEC*infra* database of private infrastructure investments, the largest of its kind, which tracks the financial performance of hundreds of infrastructure companies globally.

Each national market included in the EDHEC*infra* universe is analysed in detail, including all the relevant aspects of infrastructure-procurement history and regulation in order to match this classification.

TICCS™ is also reviewed regularly as new markets and companies are added to the EDHEC*infra* universe. The design of this universe is described in the **Index Methodology Standards** document available on the EDHEC*infra* website.

2. Defining Infrastructure

There are several ways to define what constitutes or is considered "infrastructure." The OECD proposes a broad definition as the " system of public works in a country, state or region, including roads, utility lines and public buildings." However, this can be hard to operationalise.

The World Bank proposes a limited list of "essential" services (see appendix) that can seem restrictive for the purpose of classifying all potential infrastructure investments globally.

The OECD and World Bank approaches are rooted in public-policy considerations and focus on what infrastructure "does," that is, service delivery.

For the purposes of classifying **investments** in infrastructure, a second approach focuses on what infrastructure "is like." This is the approach taken by financial regulators in their effort to define **qualifying infrastructure assets** under various prudential frameworks.

Criteria-based definitions of qualifying infrastructure companies exist under the Basel-II Accord, the Solvency-II Directive, and the CRR-2 Regulation of European banks (See appendix for details.)

These definitions focus on the financial economics of infrastructure companies and aim to identify criteria differentiating them from other types of corporate equity or debt investments, especially with respect to known or expected differences in their risk profiles.

The definition put forward by the European Insurance and Occupational Pension Authority (EIOPA) for Solvency-II stipulates that "the infrastructure assets and infrastructure project entity are governed by a contractual framework that provides debt providers and equity investors with a high degree of protection."

EIOPA argues that "the cash flows generated for debt providers and equity investors shall be considered predictable" and in particular that the revenues qualifying infrastructure investment should be either 1) / "availability-based" or 2/ "subject to a rate-of-return regulation" or 3/ "subject to a take-or-pay contract" (see appendix).

Such prudential definitions aim to isolate what is expected to be a *lower* level of business and financial risk found in infrastructure companies.

TICCS™ takes these multiple perspectives into account and uses a four-pillar multicriteria approach that uses a number of academic insights about the industrial dimension as well as financial economics of infrastructure companies:

1. A **business-risk classification** takes into account the financial economics of infrastructure companies, in particular the role of contracts and regulation.
2. An **industrial classification** uses a very granular taxonomy of industrial activities, technologies, and asset-level characteristics that capture the potential diversity of infrastructure companies' services and products.
3. A **geoeconomic classification** captures the degree of common economic exposure of different infrastructure companies;
4. A **corporate-governance classification** reflects the expected difference of behaviour between single-project and multiproject infrastructure ventures.

The rest of this document presents each pillar of the *TICCS*™ classification in more detail.

3. Business-Risk Classifications

The first *TICCS*™ pillar is the business-risk classification of infrastructure companies. Broad families of business-risk or business-model profiles can be identified on the basis of how stand-alone, investable infrastructure is created using different forms of long-term contracts. In turn, these families of infrastructure-business risk are fundamental drivers of the financial structure and total risk profile of infrastructure companies.

TICCS™ business-risk profiles are found across various industrial classifications (the second *TICCS*™ pillar) described in the next section.

Academic Insights

While infrastructure assets are usually understood to be tangible assets–physical structures of steel and concrete–from the point of view of financial economics, infrastructure investment is better defined as a high-sunk-cost, long-term investment in immobile, relationship-specific assets. It is contracts, not concrete, that matter.

In other words, the physical characteristics of tangible infrastructure only determine the need for long-term contracts, which in turn determine the investment profile of infrastructure investments. Outside of contractual and regulatory relationships, tangible infrastructure assets have no or little value. This is what fundamentally differentiates infrastructure from other so-called real assets: infrastructure is never a store of value. It needs to be used to have value. And its usability is entirely determined by a combination of long-term contractual commitments.

The contracts that allow infrastructure investment to take place are characterised by risk-sharing mechanisms embodied by their revenue model. While numerous risk-sharing agreements can be envisaged, in practice, three types of contractual arrangements are used:

The first type are *contracted* or availability-payment schemes, by which a public- or private-sector client commits to paying a fixed income over a pre-agreed period, typically in excess of two decades. In exchange, the investor accepts more or less unlimited responsibility for the investment, operating, debt, and equity cash flows incurred to invest in the delivery of an infrastructure service, according to an agreed output specification. Terminal value can be set to zero and control of the physical assets is returned to public-sector clients at the end of the contract. This model is typically used to deliver social infrastructure projects like schools, hospitals, or government buildings. It is also common in the energy sector, including in renewable-energy projects, but it can also be found in a range of other sectors including transportation projects such as roads or port terminals.

The scond type of arrangements are *merchant* or commercial schemes, by which the public- or private-sector client enters into a similar long-term contract with an investor but in exchange for a risky income stream. This is typically the case with tolled transportation projects, for which an investor is granted the right to collect tolls/tariffs from users. Likewise, terminal value is often zero in most jurisdictions. This model is typically used for transport projects with real tolls but also energy projects connected to a competitive power or gas market, as well as privatised airports or certain rail projects. Merchant telecom companies are also common.

Regulated schemes are typically associated with large network industries that benefit from a natural monopoly, such as water or gas utilities

Table 1: TICCS™ Business-Risk Classification

Business-Risk Classes *Code and Defintition*	Business-Risk Subclasses *Code and Defintition*	 *Synonyms*
BR1 – Contracted: Contracted infrastructure firms enter into long-term contracts to pre-sell all or most of their output at a pre-agreed price. All or the majority of market risk (price and/or demand) is transferred to a third party. The contract is for a significant period of the investment's life, typically one or several decades.	**BR10 – Fully contracted income**: Fully contracted infrastructure firms enter into a long-term contract by which they will provide a service or product corresponding to the entirety of their activity. Hence they do not engage in any other activity during the life of the contract.	- Availability-based infrastructure or project - Take-or-pay off-take agreement - Feed-in tariff - Capacity agreements - Renewable obligation certificates - Large-scale generation certificates (LGCs) and small-scale technology certificates (STCs)
	BR11 – Partially contracted income: Partially contracted infrastructure firms commit to deliver a certain level of service or output below their full capacity level.	- Shadow tolling arrangements - Partial capacity agreements - Partial power purchase agreements - Tolling agreements
BR2 – Merchant: Merchant infrastructure firms are mostly or fully exposed to market risk (price and demand risk).	**BR20 – Variable income**: Merchant infrastructure firms collect fees and tariffs from end users as a function of the effective demand for service.	- Real toll roads - Merchant power plants
BR3 – Regulated: The regulator can set allowable limits on tariffs, rate of returns, or revenues. Also referred to as ⊠discretionary regulation."	**BR30 – Rate-of-return regulation**: The regulator is expected to set tariffs high enough to cover the costs of an efficient firm, including operating-expense depreciation and a reasonable return on invested capital.	- Cost-of-service regulation - Commission regulation (US)
	BR31 – Price-cap regulation: The regulator sets a multiyear price cap typically defined in terms of the rate of inflation minus an expected rate of productivity improvement. Firms can increase their profits by cutting costs between regulatory reviews, thus creating incentives for efficiency gains.	- Incentive regulation

or power distribution networks. They require regulation in order to ensure efficient operations at a reasonable cost to end users, who are typically captive and receiving "essential services" from the companies in question. Terminal value may not always be set to zero, for example, privatised utilities own tangible assets outright and in perpetuity. Regulators set tariffs to achieve multiple economic and financial objectives and often aim to mimic competitive market forces through so-called yardstick competition. Such schemes exist because of the universal tendency of monopolies to overcharge and underinvest (irrespective of public or private ownership). They also create up- and downside limits on business risk, which sets them apart from contracted and merchant infrastructure companies. For a detailed discussion of these three types of arrangements and of the related academic literature, see Blanc-Brude (2013). For a discussion of the role of contracts in infrastructure finance see Brealey et al. (1996). An empirical analysis of the difference of cost of capital and credit risk between contracted and merchant infrastructure business models is provided by Blanc-Brude and Strange (2007) and Blanc-Brude et al. (2018). For a detailed discussion of regulated infrastructure, see Gomez-Ibanez (2003).

The *TICCS*™ Business-Risk Classification

Using the insights above, *TICCS*™ includes three business-risk classes. Each business-risk class can be further divided into subclasses.

- BR1: Contracted infrastructure companies
  - BR10: fully contracted infrastructure companies
  - BR11: partially contracted infrastructure companies
- BR2: Merchant infrastructure companies
  - BR20: variable-income infrastructure companies
- BR3: Regulated infrastructure companies
  - BR30: Rate-of-return regulated infrastructure companies
  - BR31: Price-cap regulated infrastructure companies

Table 1 describes the *TICCS*™ business-risk classification.

4. Industrial Classification

The second *TICCS*™ pillar categorises infrastructure companies by groups of industrial activities. Industrial-sector group classifications (or superclasses) represent broad areas of industrial activity but also transaction or project-development expertise. Industrial sector and subsector classifications (or classes and subclasses) represent specific industrial activities and types of physical assets and technologies. Moreover, a series of cross-sector *key industrial characteristics* (KICs) that can be determined for any infrastructure company aims to capture essential aspects of the industrial-risk profile of infrastructure companies.

Academic Insights

Standard industrial classification can be ill-suited to represent different types of infrastructure companies. They focus on broad industrial activities only but do not take into account other aspects of the delivery of infrastructure projects and services. For instance, an airport operator and an airline-catering company are typically bundled together.[1] Likewise, many road-operating companies are categorised as construction firms, while some project-financing vehicles are often found under "financials." Instead, the activities of infrastructure companies can be seen as broad families of technical and financial skill sets that are relevant not only to creating and operating but also to investing in infrastructure companies.

The first *TICCS*™ pillar highlights the role of different business models and types of regulation in the segmentation of the infrastructure sector. Likewise, infrastructure investments require highly specialised knowledge of various industrial processes, such as power generation or the construction and maintenance of major structures but also project management and financial structuring.

Transportation projects have common technical and industrial features, as do renewable-energy or social infrastructure projects, which correspond to broad groups of professionals that have the relevant know-how to understand and execute individual transactions.

For instance, stand-alone power generation facilities may use different fuel types and water-treatment companies may serve residential (potable water) or industrial clients (ultra-pure water). Wind power generation may be on-shore or off-shore. Such industrial activities can be sufficiently differentiated to warrant individual classifications. For example, different types of power-generation fuel (coal vs. gas vs. nuclear) have an impact on the level of regulatory risk taken by investors.

The *TICCS*™ Industrial Classification

TICCS™ uses a multicriteria classification system focusing specifically on infrastructure-related industrial activities, as well as varying degrees of complexity, size, and scale. Using the insights above, *TICCS*™ includes the following industrial classes and subclasses:

- 8 industrial-group classifications (or superclasses)
- 30 industrial classes
- 68 industrial subclasses or asset-level categories

Table 2 describes the *TICCS*™ industrial classification. Table 3 provides the corresponding definitions.

1 - Under MSCI's Global Industrial Classification Standard, "operators of airports and companies providing related services" are classified together.

Table 2: TICCS™ Industrial Classification

Industrial Superclass		Industrial Class		Industrial Asset Subclass	
Code	Name	Code	Name	Code	Name
IC10	Power Generation x-Renewables	IC1010	Independent Power Producers	IC101010	Nuclear Power Generation
				IC101020	Gas-Fired Power Generation
				IC101030	Coal-Fired Power Generation
				IC101040	Combined Heat and Power Generation
				IC101050	Other Fossil-Fuel-Fired Power Generation
		IC1020	Independent Water and Power Producers	IC102010	Power and Water Production
IC20	Environmental Services	IC2010	Solid Waste Treatment	IC201010	Non-Hazardous Waste Treatment
				IC201020	Hazardous Waste Treatment
				IC201030	Waste-to-Power Generation
		IC2020	Water Treatment	IC202010	Potable Water Treatment
				IC202020	Industrial Water Treatment
				IC202030	Sea Water Desalination
				IC202030	Water Supply Dams
		IC2030	Wastewater Treatment	IC203010	Residential Wastewater Treatment and Reuse
				IC203020	Industrial Wastewater Treatment and Reuse
		IC2040	Environmental Management	IC204010	Flood Control
				IC204020	Coastal and Riverine Locks
				IC204030	Energy Efficiency
IC30	Social Infrastructure	IC3010	Defence Services	IC301010	Strategic Transport and Refuelling
				IC301020	Training Facilities
				IC301030	Barracks and Accommodation
		IC3020	Education Services	IC302010	Schools (Classes and Sports Facilities)
				IC302020	Universities (Classes, Labs, Administration Buildings)
				IC302030	Student Accommodation
		IC3030	Government Services	IC303010	Police Stations and Facilities
				IC303020	Courts of Justice
				IC303030	Prisons
				IC303040	Street Lighting
				IC303050	Social Accommodation
				IC303060	Government Buildings and Office Accommodation
		IC3040	Health and Social Care Services	IC304010	Hospitals
				IC304020	Clinics
				IC304030	Residential and Assisted Living
		IC3050	Recreational Facilities	IC305010	Stadiums and Sports Centres
				IC305020	Public Parks and Gardens
				IC305030	Convention and Exhibition Centres
				IC305040	Arts, Libraries, and Museums
				IC305050	Amusement Parks
IC40	Energy and Water Resources	IC4010	Pipeline Companies	IC401010	Gas Pipeline
				IC401020	Oil Pipeline
				IC401030	Water Pipeline
				IC401040	Wastewater Pipeline
		IC4020	Energy Resource Processing Companies	IC402010	Liquefied Natural Gas - Liquefaction
				IC402020	Liquefied Natural Gas - Regasification
				IC402030	Crude Oil Refinery
		IC4040	Energy Resource Storage Companies	IC404010	Gas Storage
				IC404020	Liquid Storage
				IC404030	Other Storage
IC50	Data Infrastructure	IC5010	Data Transmission	IC501010	Telecom Towers
				IC501020	Long-Distance Cables
				IC501030	Communication Satellites
		IC5020	Data Storage	IC502010	Data Centres
IC60	Transport	IC6010	Airport Companies	IC601010	Airport
		IC6020	Car Park Companies	IC602010	Car Park
		IC6030	Port Companies	IC603010	Tool Port
				IC603020	Bulk Goods Port
				IC603030	Container Port
				IC603040	Other Port
		IC6040	Rail Companies	IC604010	Heavy Rail Lines
		IC6050	Road Companies	IC605010	Motorways
				IC605020	Motorway Network
				IC605030	Dual-Carriage way roads
				IC605040	Stand-Alone Tunnels
				IC605050	Stand-Alone Bridges
		IC6060	Urban Commuter Companies	IC606010	Urban Light-Rail
				IC606020	Underground Mass Transit
				IC606030	Overground Mass Transit
				IC606040	Bus Transportation
IC70	Renewable Power	IC7010	Wind Power Generation	IC701010	On-Shore Wind Power Generation
				IC701020	Off-Shore Wind Power Generation
		IC7020	Solar Power Generation	IC702010	Photovoltaic Power Generation
				IC702020	Thermal Solar Power
		IC7030	Hydroelectric Power Generation	IC703010	Hydroelectric Dam Power Generation
				IC703020	Hydroelectric Run-of-River Power
				IC703030	Pumped Hydroelectric storage
		IC7040	Other Renewable Power Generation	IC704010	Biomass Power Generation
				IC704020	Geothermal Power Generation
				IC704030	Wave Power Generation
		IC7050	Other Renewable Technologies	IC705010	Battery storage
				IC705020	Off-Shore Transmission (OFTO)
IC80	Network Utilities	IC8010	Electricity Distribution Companies	IC801010	Electricity Distribution Network
		IC8020	Electricity Transmission Companies	IC802010	Electricity Transmission Network
		IC8030	District Cooling/Heating Companies	IC803010	District Cooling/Heating Network
		IC8040	Water and Sewerage Companies	IC804010	Water and Sewerage Network
		IC8050	Gas Distribution Companies	IC805010	Gas Distribution Network

Table 3: TICCS™ Industry-Classification Definitions

Industrial Superclass		Industrial Class	
Code	Definition	Code	Definition
IC10	Stand-alone power generation using a range of technologies except wind, solar, and other renewable sources.	IC1010	Independent power producers (IPP) provide electricity to power distribution and transmission companies or directly to industrial or commercial clients.
		IC1020	Independent water and power producers (IWPP) are power producers with a colocated water-desalination or filtration facility. Industrial, potable, or ultra-pure water is typically a by-product of the power generation process.
IC20	Companies involved in the treatment of water, wastewater, and solid waste for sanitation and reuse purposes.	IC2010	Waste treatment services include the collection and disposal of solid refuse from residential, commercial, or industrial sources.
		IC2020	Stand-alone water treatment companies produce water for various uses, including residential, commercial, and industrial end users.
		IC2030	Stand-alone wastewater treatment companies treat wastewater from residential, commercial, and industrial sources to a certain discharge or reuse standard.
		IC2040	Environmental management companies invest in projects that conserve natural resources, protect habitats, and control hazards.
IC30	Companies involved in the delivery of support and accommodation services for public or other services.	IC3010	Defence infrastructure companies provide noncombatant support services to public-sector military organisations, including strategic transport, training facilities, and telecommunications.
		IC3020	Infrastructure companies providing education services through the development and maintenance of school and university buildings and related facilities for the use of public or private institutions.
		IC3030	Infrastructure companies providing support and accommodation services to government departments and other public-sector organisations and agencies.
		IC3040	Healthcare infrastructure companies provide support service and facilities to public- or private-sector medical treatment units.
		IC3050	Convention, entertainment, and recreational facilities infrastructure companies deliver and maintain various large-scale leisure facilities typically requiring a bespoke structural-engineering component.
IC40	Companies involved in the treatment and delivery of natural resources.	IC4010	Pipeline companies develop and operate high-pressure transmission pipelines.
		IC4020	Energy natural resource processing companies transform crude oil, natural gas, and other commodities into various derivative or transformed products.
		IC4040	Energy natural resource storage companies provide storage services to private and public clients by exploiting large natural caverns or buildings and maintaining over- or underground tanks.
IC50	Companies involved in the provision of telecommunication and data infrastructure.	IC5010	Data transmission companies involved in the construction, operation, and maintenance of data transmission assets including telecommunications towers, land or sea based long-distance communication cables, and communication satellites.
		IC5020	Data storage companies involved in the development, operation, and maintenance of physical data storage infrastructure. This does not include companies that offer data storage in addition to other products.
IC60	Companies involved in the provision of transportation infrastructure services.	IC6010	Airport companies build, maintain, and operate airport terminals, runways, and associated support and logistical services. Large airports also lease property for commercial and retail purposes.
		IC6020	Car park service companies provide individual and commercial end users with vehicle-parking facilities. They are relatively small-scale structures built over- and underground mostly within large urban areas.
		IC6030	Port infrastructure companies build, maintain, and operate port jetties, passenger terminals, and freight transit and storage facilities.
		IC6040	Rail companies provide long-distance, intercity passenger and freight services.
		IC6050	Road companies build, maintain, and operate roads and motorways including bridges and tunnels.
		IC6060	Urban commuter companies build, maintain, and operate urban rail routes from light (tramway) to mass-transit rail tracks, including over- and underground rail lines.
IC70	Stand-alone power generation and transmission companies using wind, solar, hydro and other renewable energy sources. Also energy storage companies.	IC7010	Wind power companies produce electricity using wind power to operate various types of electromagnetic turbines.
		IC7020	Solar power companies produce electricity by capturing solar radiation using a range of solar-cell technologies.
		IC7030	Hydroelectric power generating companies use water to produce electricity. This can either be from a dam or from a river.
		IC7040	Other renewable power generation companies using various physical phenomena or alternative renewable fuels (other than the wind, sun, or hydro) to generate electricity.
		IC7050	Other renewables technology companies use a variety of different methods to provide, store and transmit renewable energy.
IC80	Companies operating an infrastructure network with natural monopoly characteristics (barriers to entry, increasing returns to scale).	IC8010	Electricity distribution companies distribute medium-voltage electricity to final consumers.
		IC8020	Electricity transmission companies transmit relatively high-voltage electricity from the point of generation source to a distribution network.
		IC8030	Heating or cooling companies provide service in urban areas using combined heat and power to recycle or reuse waste heat.
		IC8040	Water and sewerage companies provide potable water treatment and distribution services as well as the collection, treatment, and disposal of wastewater and sewerage.
		IC8050	Gas distribution companies operate low-pressure pipeline networks delivering natural gas to end residential, commercial, and industrial consumers.

5. Geoeconomic Classification

The third *TICCS*™ pillar classifies infrastructure companies into four levels of geoeconomic exposure that are relevant to understanding potential correlations between investments. Business-risk families defined in the first *TICCS*™ pillar capture the resemblance between infrastructure firms' business models, including how they may or may not covary as contracted or merchant companies. But an additional dimension is the exposure of each company to different geographic levels of the economy which they serve.

Academic Insights

Infrastructure companies operate large immobile structures. Their position in space is a lifelong constant. However, the type of economic activity they are involved in can correspond to different economic factors, creating a multitude of possible interactions between infrastructure companies.

A first intuition is that two merchant toll roads can be expected to be less correlated if they are farther away from each other in space. This assumes that traffic variability is mostly determined by local economic conditions. However, the roads in question could be part of a regional transport corridor spanning hundreds or thousands of kilometres and thus exhibit a high level of revenue-risk dependency.

Likewise, two contracted infrastructure companies can be expected to be relatively unrelated unless they have a similar or the same counterparty, which could be a local government.

Certain infrastructure companies are part of and exposed to the global economy. This includes large transportation hubs such as major airports and ports, which are not only exposed to the business cycle but, as a result of that, tend to be correlated with each other (see for example Choi et al., 2006; Lee, 2009).

Conversely, global and regional or national infrastructure companies can be less correlated with each other even though they may be relatively close in space and have similar business models. This is the case in the port sector, which can be divided into several categories of global container-shipping hubs; regional ports, which act partly as distribution networks of global port traffic; and national or subnational ports which cater to the local economy.

Certain infrastructure companies are also exposed to global commodity prices: gas pipelines or coal terminals, even when they have a contracted business model, face a highly correlated counterparty risk because commodity price movements can make their off-take contracts uneconomic or bankrupt their sole client (Bonetti et al., 2010).

The *TICCS*™ Geoeconomic Classification

The EDHEC*infra* data-collection process includes recording the GIS data of infrastructure assets in order to understand their exact positions in space. To qualify this information, and using the insights above, the third *TICCS*™ pillar uses four classes of geoeconomic exposure to classify infrastructure companies:

- Subnational infrastructure companies
- National infrastructure companies
- Regional infrastructure companies
- Global infrastructure companies

Table 4 describes the *TICCS*™ geoeconomic classification.

Table 4: TICCS™ Geoeconomic Classification

Geoeconomic Classes		
Code and Name	*Definition*	*Examples*
GE1 - Global infrastructure companies	The relevant infrastructure is exposed to global economic factors, e.g., international airports, oil and gas pipelines, some ports, etc.	Major transportation hubs, projects exposed to global commodity prices.
GE2 - Regional infrastructure companies	The relevant infrastructure is exposed to a group of national economies, e.g., energy transmission between two or more countries, airports serving regional routes. A regional regulator or legal framework may also exist such as the European Union.	Medium-size container ports, transborder projects like transmission lines or certain road corridors.
GE3 - National infrastructure companies	The relevant infrastructure is exposed to the national economy, e.g., domestic airports and national electricity transmission assets, and is relevant to the national government or a national regulator.	Large-scale road or telecommunicaton networks, companies regulated by a national-level entity.
GE4 - Subnational infrastructure companies	The relevant infrastructure serves the local economy, e.g., schools and hospitals, and has subsovereign public clients or counterparts.	Municipal or other subsovereign-entity social infrastructure projects.

6. Corporate-Governance Classifications

The fourth *TICCS*™ pillar classifies the corporate-governance structure of infrastructure companies into two classes and two subclasses. The behaviour of a firm and its managers differs depending on if it was created to develop a single project or multiple projects. Furthermore, the level of external debt financing impacts the behaviour of a firm as well. External debt financing creates a demand for monitoring on the part of creditors, especially with single-project firms. External monitoring impacts the predictability of behaviour of the firm and its managers.

Academic Insights

Infrastructure companies typically take one of two corporate forms: "projects" or "corporates." Infrastructure project companies are single-project firms or project-financed. Infrastructure corporates are multiproject companies more akin to corporate-governance structures found in other industrial sectors. These two types of firms can be expected to have fundamentally different behaviours.

Infrastructure project companies are created in the context of a long-term contract between an investor (the owner of the project company) and a public- or private-sector client. Project companies are created for the sole purpose of delivering a new tangible infrastructure asset and operating it for the length of the contractual period. Infrastructure project companies are also referred to as special-purpose vehicles (SPVs) or special-purpose entities (SPEs). They typically serve as the focal point of a nexus of contracts between investors, builders, operators, a client, and providers of long-term finance, usually in the form of long-term senior debt. The formal definition of project financing put forward in the Basel-II Accord is reproduced in the appendix.

Debt plays a significant role in project finance because it tends to be the main source of capital. The theoretical literature on project finance and corporate governance (see for example Shah and Thakor, 1987) highlights the role of leverage as one of the most counterintuitive dimensions of project financing. Project financing reduces the net financing costs associated with large capital projects (Esty, 2004) because external debt plays an important disciplinary role by preventing managers from wasting or misallocating free cash flows and deterring related parties, including the public sector, from trying to appropriate them (Jensen and Meckling, 1976; Hart, 1995).

Because leverage mitigates these costly incentive conflicts among capital providers, managers, and investors, it increases expected cash flows available to capital providers, thereby establishing a link between financing structure and asset values. In this context, the presence of significant loan financing is a signal of creditworthiness (Fama and French, 1997).

Indeed, infrastructure assets have few growth options, which hinders overinvesting in negative-NPV projects and makes investment decisions more easily monitored by external claim holders. When raising financing, infrastructure project companies typically commit to a given capital program and are not able to seek other sources of financing without the explicit involvement of their original creditors. In the event of various credit events, senior creditors have control rights akin to those of majority shareholders and can require a financial restructuring or even take over the company from its original owners.

The empirical literature on infrastructure project finance (Brealey et al., 1996; Esty, 2002; Blanc-Brude and Strange, 2007; Blanc-Brude et al.,

Table 5: TICCS™ Corporate-Governance Classification

Corporate-Governance Classes	Corporate-Governance Subclasses	
Code and Defintition	*Code and Defintition*	*Synonyms*
CG1 – Infrastructure project companies: Companies according to the Basel-II defintion of project finance created for the sole purpose of building and operating a well-defined tangible infrastructure asset limited in time and space.	**CG10 – Monitored project companies**: Infrastructure project companies with more than 50% of their outstanding financing provided by external senior creditors.	- Special-purpose vehicle - Special-purpose entity - Single-project company
	CG11 – Unmonitored project companies: Infrastructure project companies with less than 50% of their outstanding financing provided by external senior creditors.	
CG2 – Infrastructure corporates:	**CG20 – Monitored infrastructure corporates**: Infrastructure companies with more than 50% of their outstanding financing provided by external senior creditors.	- Multiproject company
	CG21 – Unmonitored infrastructure corporates: Infrastructure companies with less than 50% of their outstanding financing provided by external senior creditors.	

2018), shows that project financing typically relies on high levels of nonrecourse external debt financing (typically between 60 and 90%) and concludes repeatedly that project finance loans have different characteristics from corporate debt. In corporate finance, debt can be used to increase returns on equity, creating incentives to take risks. In project finance, because the financial viability of a single project has to be demonstrable ex ante with a high probability, debt is used to minimise the cost of capital and creates incentives to minimise risk.

In contrast, infrastructure "corporates" or multiproject companies have all the usual characteristics of the firm: managers have more freedom to make various investment decisions and can change course both strategically and financially over time. They can take on new projects, including those in sectors that are not directly related to infrastructure (e.g., utilities investing in media companies) or invest internationally in other infrastructure firms (e.g., European utilities invested in Asian utilities in the mid-1990s), thereby changing their business-risk profile.

Likewise, infrastructure corporates are free to change their financial structures and can use multiple sources of private and public financing. Creditors play a much more limited monitoring role and do not have different control rights in the event of default than with other corporate borrowers. Nor do they play a leading role in the financial structuring of the firm either before or after credit events.

As a result, high or increasing levels of indebtedness in infrastructure corporates is typically interpreted as signalling higher credit and equity risk. UK water utilities are a case in point (see Helm, 2009).

The *TICCS*™ Corporate-Governance Classification

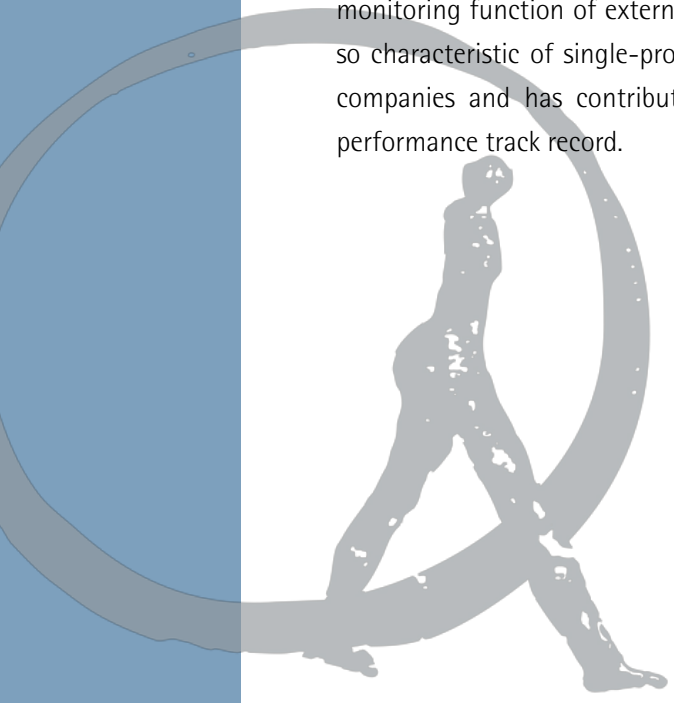
Single-project infrastructure companies can be found in any of the industrial classifications identified in the *TICCS*™ second pillar, in particular social infrastructure, road, and conventional or renewable power generation projects. Infrastructure corporates or multiproject companies tend to be found in the utilities sector and in some transportation sectors (ports and airports), where they have often existed for several decades. Regulated infrastructure companies defined in the first *TICCS*™ pillar also tend to be infrastructure corporates. In principle however, the *TICCS*™ corporate-governance classifications are not exclusive of any of the other classes defined in the other three pillars.

As noted above, external debt financing creates monitoring mechanisms that can be expected to have a significant impact on the behaviour of

managers and and the predictability of the firm's activities and risk profile.

As asset owners and managers become the new owners of infrastructure project companies, they sometimes reimburse senior creditors early (prepayment) and replace external senior debt instruments with shareholder-provided debt or refinance project debt at the portfolio or group level (e.g., holdco).

Such decisions can lower the cost of external financing, but they also remove the project-level monitoring function of external creditors that is so characteristic of single-project infrastructure companies and has contributed to its historic performance track record.



Using these insights, the *TICCS*™ fourth pillar includes two classes of corporate governance and four subclasses. We differentiate between subclasses of "monitored" and "unmonitored" companies as shown.

- CG1: Infrastructure projects
  - CG10: Monitored infrastructure project companies with substantial external senior debt
  - CG11: Unmonitored infrastructure project companies without substantial external debt
- CG2: Infrastructure corporates
  - CG20: Monitored infrastructure corporates with substantial external senior debt
  - CG21: Unmonitored infrastructure corporates without substantial external debt

Table 5 describes the *TICCS*™ corporate-governance classification.

Appendix: Accepted Definitions of Infrastructure

OECD Definition of Infrastructure

Infrastructure: "The system of public works in a country, state or region, including roads, utility lines and public buildings."

Source: https://stats.oecd.org/glossary/detail.asp?ID=4511

World Bank Definition of Infrastructure

- "Electricity - generation, transmission, and distribution
- Natural gas - transmission and distribution
- ICT ICT backbone like hard infrastructure cable assets (such as fiber optic networks and other types of broadband networks) where the government is involved either through being a contracting authority (i.e. a party to a concession agreement), the owner of the assets, or some other form of government support.
- Airports - runway and terminal
- Ports - channel dredging and terminal
- Railways - fixed assets, freight, local passenger/light rail, and regional passenger
- Roads - bridge, highway, and tunnel
- Treatment plant potable and sewerage treatment plants
- Utilities water utilities with and without sewerage service, sewerage collection and treatment"

Source: https://ppi.worldbank.org/methodology/glossary

Basel-II Definition of Project Finance

"Project finance is a method of funding in which investors look primarily to the revenues generated by a single project, both as the source of repayment and as security for the exposure. In such transactions, investors are usually paid solely or almost exclusively out of the money generated by the contracts for the facility s output, such as the electricity sold by a power plant. The borrower is usually a Special Purpose Entity (SPE) that is not permitted to perform any function other than developing, owning, and operating the installation. The consequence is that repayment depends primarily on the project s cash flow and on the collateral value of the project s assets." (BIS 2005)

Solvency-II Defintion of Qualifying Infrastructure

1. For the purposes of this Regulation, qualifying infrastructure investment shall include investment in an infrastructure project entity that meets the following criteria:
   (a) the infrastructure project entity can meet its financial obligations under sustained stresses that are relevant for the risk of the project;
   (b) the cash flows that the infrastructure project entity generates for debt providers and equity investors are predictable;

(c) the infrastructure assets and infrastructure project entity are governed by a contractual framework that provides debt providers and equity investors with a high degree of protection including the following:

(a) where the revenues of the infrastructure project entity are not funded by payments from a large number of users, the contractual framework shall include provisions that effectively protect debt providers and equity investors against losses resulting from the termination of the project by the party which agrees to purchase the goods or services provided by the infrastructure project entity;

(b) the infrastructure project entity has sufficient reserve funds or other financial arrangements to cover the contingency funding and working capital requirements of the project;

- Where investments are in bonds or loans, this contractual framework shall also include the following:

(i) debt providers have security to the extent permitted by applicable law in all assets and contracts necessary to operate the project;

(ii) equity is pledged to debt providers such that they are able to take control of the infrastructure project entity prior to default;

(iii) the use of net operating cash flows after mandatory payments from the project for purposes other than servicing debt obligations is restricted;

(iv) contractual restrictions on the ability of the infrastructure project entity to perform activities that may be detrimental to debt providers, including that new debt cannot be issued without the consent of existing debt providers;

(d) where investments are in bonds or loans, the insurance or reinsurance undertaking can demonstrate to the supervisor that it is able to hold the investment to maturity;

(e) where investments are in bonds for which a credit assessment by a nominated ECAI is not available, the investment instrument is senior to all other claims other than statutory claims and claims from derivatives counterparties;

(f) where investments are in equities, or bonds or loans for which a credit assessment by a nominated ECAI is not available, the following criteria are met:

(i) the infrastructure assets and infrastructure project entity are located in the EEA or in the OECD;

(ii) where the infrastructure project entity is in the construction phase the following criteria shall be fulfilled by the equity investor, or where there is more than one equity investor, the following criteria shall be fulfilled by a group of equity investors as a whole:

- the equity investors have a history of successfully overseeing infrastructure projects and the relevant expertise;
- the equity investors have a low risk of default, or there is a low risk of material losses for the infrastructure project entity as a result of the their default;
- the equity investors are incentivised to protect the interests of investors;

(iii) the infrastructure project entity has established safeguards to ensure completion of the project according to the agreed specification, budget or completion date;

(iv) where operating risks are material, they are properly managed;

(v) the infrastructure project entity uses tested technology and design;

(vi) the capital structure of the infrastructure project entity allows it to service its debt;

(vii) the refinancing risk for the infrastructure project entity is low;

(viii) the infrastructure project entity uses derivatives only for risk-mitigation purposes.

2. For the purposes of paragraph 1(b), the cash flows generated for debt providers and equity investors shall not be considered predictable unless all except an immaterial part of the revenues satisfies the following conditions:

(a) one of the following criteria is met:

(i) the revenues are availability-based;

(ii) the revenues are subject to a rate-of-return regulation;

(iii) the revenues are subject to a take-or-pay contract;

(iv) the level of output or the usage and the price shall independently meet one of the following criteria:

- ✓ it is regulated;
- ✓ it is contractually fixed;
- ✓ it is sufficiently predictable as a result of low demand risk;

(b) where the revenues of the infrastructure project entity are not funded by payments from a large number of users, the party which agrees to purchase the goods or services provided by the infrastructure project entity shall be one of the following:

(i) an entity listed in Article 180(2) of this Regulation;

(ii) a regional government or local authority listed in the Regulation adopted pursuant to Article 109a(2)(a) of Directive 2009/138/EC;

(iii) an entity with an ECAI rating with a credit quality step of at least 3;

(iv) an entity that is replaceable without a significant change in the level and timing of revenues."

Source:https://ec.europa.eu/transparency/regdoc/rep/3/2015/EN/3-2015-6588-EN-F1-1.PDF

EU Capital Requirement Regulation Use of the EIOPA Definition

"A preferential treatment to specialised lending exposures aiming at funding safe and sound infrastructure projects. These are defined through a set of criteria able to reduce the risk profile of the exposure and enhance the capacity of institutions to manage that risk. The criteria are consistent with those identifying qualifying infrastructure projects that receive a preferential treatment in the Solvency II framework."

Source: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52016PC0850

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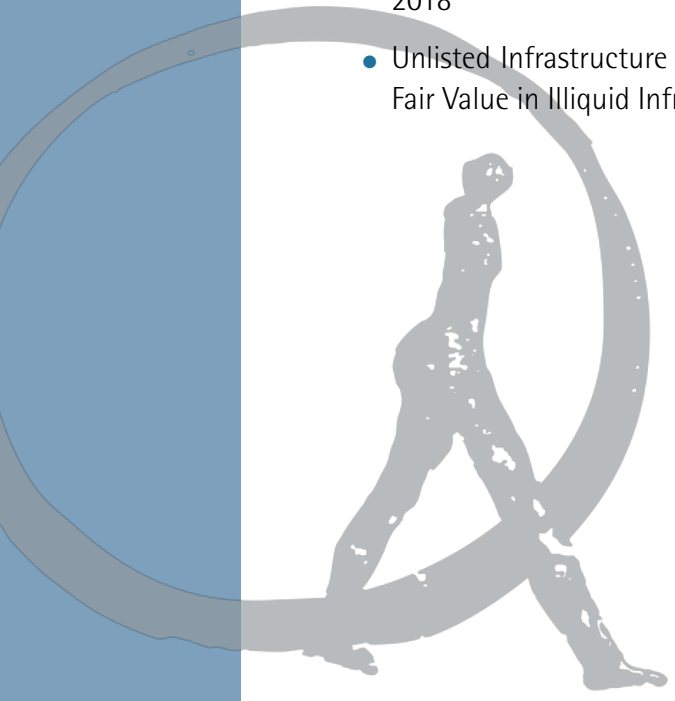
EDHEC*infra* Documentation (2018)

EDHEC*infra* Index Data & Analytics Documentation

- Infrastructure Indices Methodology Standard (Unlisted Equity & Private Infrastructure Debt) - October 2018
- The Infrastructure Company Classification Standard (*TICCS*™) - October 2018
- Global Infrastructure Investment Data Standard for Asset Pricing and Benchmarking - October 2018
- Data Contributor Code of Conduct for Infrastructure Investment Benchmarks - October 2018
- Unlisted Infrastructure Asset Pricing Methodology (A Modern Approach to Measuring Fair Value in Illiquid Infrastructure Investments) - October 2018



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