Digital Infrastructure in the Netherlands
Driver for the Online Ecosystem

Content

Executive summary and key message: the Digital Infrastructure, our third mainport, is a driver of the rapidly expanding Online Services sector

In Europe, the Dutch are among the frontrunners in the area of Digital Infrastructure (Internet connectivity, colocation housing and hosting). In many ways this infrastructure fulfills a gateway function, similar to that of Schiphol Airport and the Rotterdam Harbor. While we all have an idea on how the latter impact our economy, much less is known about the impact of Digital Infrastructure on the Dutch economy. In this report we argue that the Digital Infrastructure, despite its modest size, is a driver of the much larger and rapidly expanding Internet economy, impacting the fortunes of future economic growth in the Netherlands.

Growth and developments in the sector
In 2013 we already concluded that the Dutch have a world class Digital Infrastructure. This year we see that the importance of this sector - inhabited by Internet exchange points, and many housing and hosting parties - is on the rise. Amsterdam based AMS-IX remains the largest Internet exchange point in the world and the colocation housing market, centered around Amsterdam, produces strong growth rates. The Dutch also rank among Europe's elite in hosting.

Significance for the Dutch economy
The high ranking of the Netherlands Digital Infrastructure is an interesting observation, but how do we benefit from it? Our research shows that the direct economic impact of the sector itself in terms of employment, and the indirect effects of the sector on e.g. suppliers, construction companies and workforce spending, is limited related to our total GDP.
The real value of the Digital Infrastructure sector, however, lies in its significant impact on the much larger Internet economy and broader digital society. The picture emerges that Digital Infrastructure cannot be separated from a successful digital society, placing the Dutch in a favorable position to profit from digital growth.
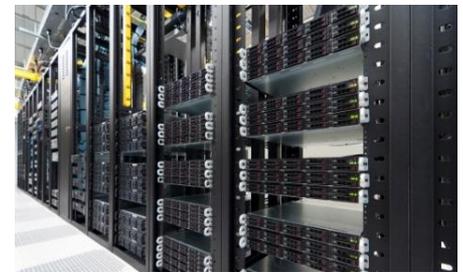
The Dutch Digital Infrastructure is part of a global backbone for delivering digital services to enterprises and consumers on a variety of devices
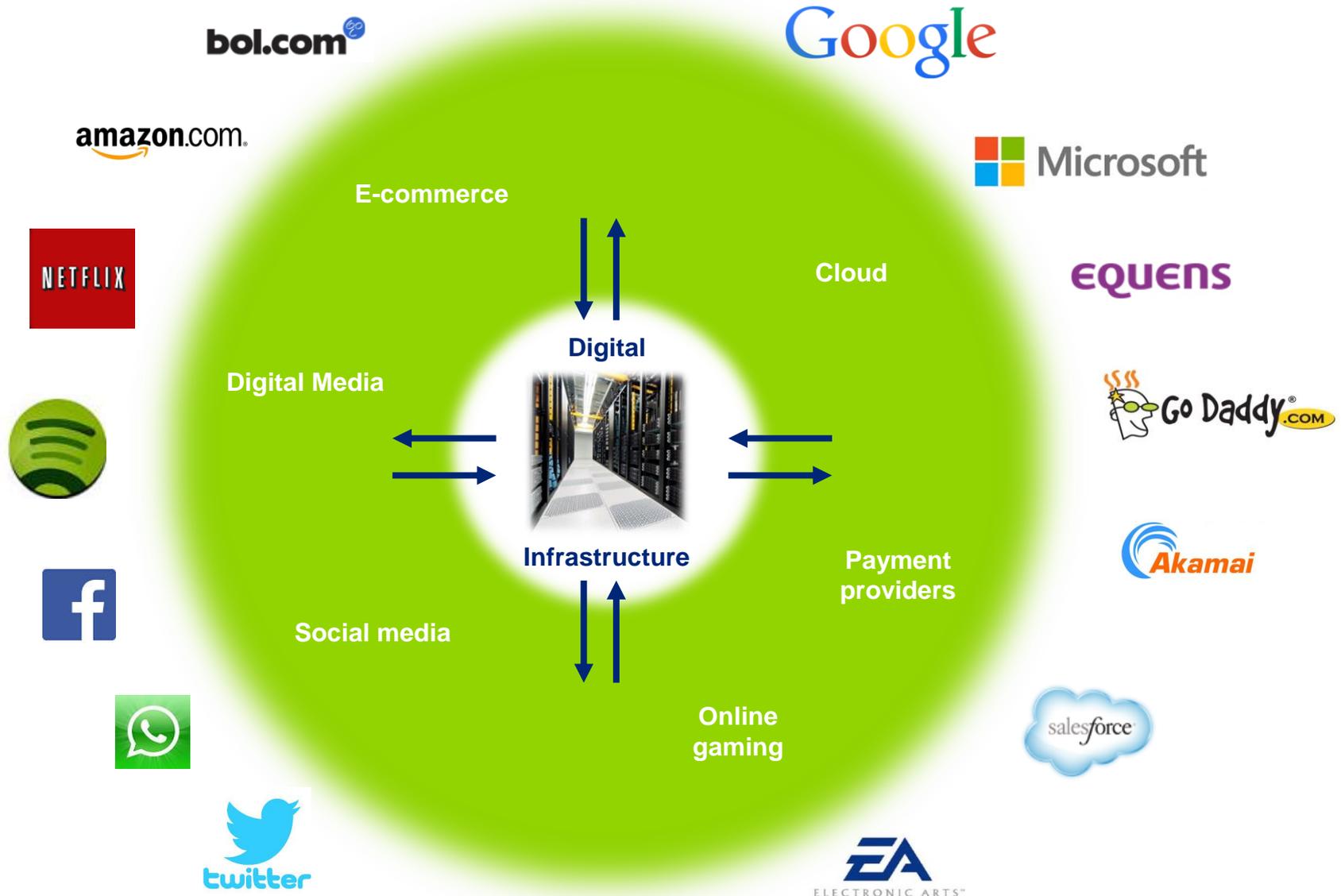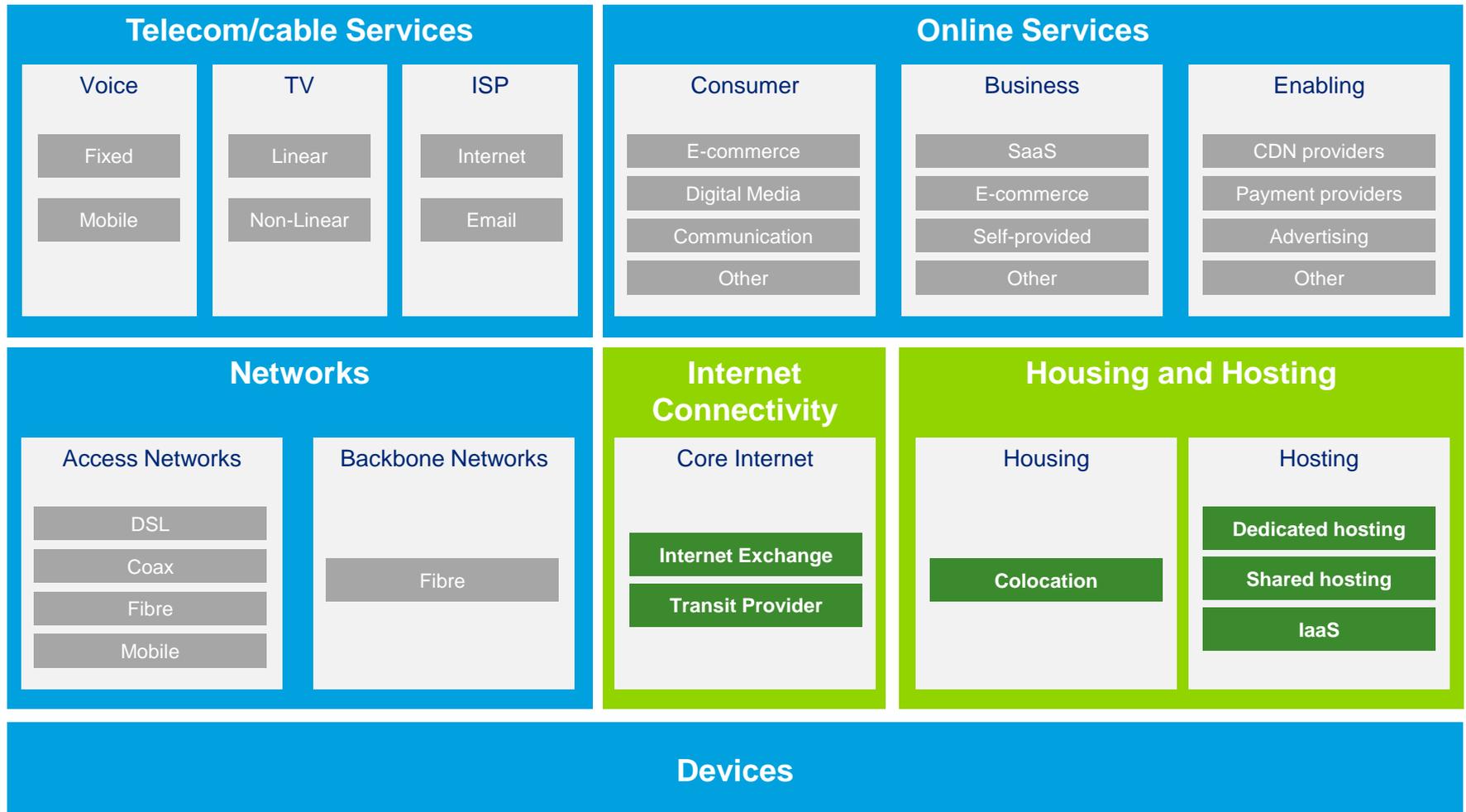
2. Digital Infrastructure sector overview
- Products and services
- Supplier ecosystem
- Size and growth
- International ranking
- Attractiveness and strengths

Digital Infrastructure products, services and supplier ecosystem

Together with Networks, the Digital Infrastructure consists of Internet connectivity and housing & hosting and is part of the larger online ecosystem

Telecom/cable Services

Voice
- Fixed
- Mobile

TV
- Linear
- Non-Linear

ISP
- Internet
- Email

Online Services

Consumer
- E-commerce
- Digital Media
- Communication
- Other

Business
- SaaS
- E-commerce
- Self-provided
- Other

Enabling
- CDN providers
- Payment providers
- Advertising
- Other

Networks

Access Networks
- DSL
- Coax
- Fibre
- Mobile

Backbone Networks
- Fibre

Internet Connectivity

Core Internet
- Internet Exchange
- Transit Provider

Housing and Hosting

Housing
- Colocation

Hosting
- Dedicated hosting
- Shared hosting
- IaaS

Devices

Sources: Dutch Ministry of Economic Affairs Report; A.T. Kearney Report; Deloitte analysis

Services encompass core Internet on one hand and colocation, hosting and IaaS on the other hand

Internet Connectivity

Core Internet

Internet Exchange
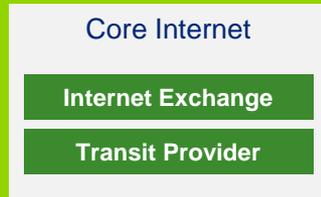
Transit Provider

- **Internet Exchange:** Parties that facilitate networks to interconnect with each other to exchange Internet traffic mutually (peering). This is typically done without charging for the traffic

- **Transit Provider:** Parties that provide network traffic in the 'core' Internet and connect smaller Internet service providers (ISPs) to the larger Internet

Housing and Hosting

Housing

Colocation

Hosting

Dedicated hosting

Shared hosting

IaaS

- **Colocation:** Delivering facilities (floor space, power, cooling, network connectivity) to enterprises and service providers for housing servers, storage and other computer equipment as an alternative for an in-company data centre

- **Dedicated hosting:** Delivering computing power and storage via equipment dedicated to a specific client but managed by the hosting provider

- **Shared hosting:** Delivering computing power and storage by sharing the resources of physical equipment among multiple customers

- **IaaS:** Infrastructure-as-a-Service, delivering computing resources (e.g. servers, storage) according to a model that meets the essential characteristics of Cloud computing: on-demand self-service by the customer, measured service (pay-per-use), rapid elasticity (any quantity at any time), resource pooling (multi-tenant model) and broad network access (infrastructure is available over the network via standardised mechanisms)[1]

1: The NIST Definition of Cloud computing

The colocation market is a mix of global and local colocation providers

Global Players			Local Player Colocation
Wholesale Colocation	**Retail Colocation**	**Carrier Biased Colocation**	
• Long term lease of large scale data centre space at commodity rates • Typically limited to floor space, power and cooling, the client is responsible for everything else • Clients are large scale users such as banks, government departments, multinationals and IT service providers • Wholesale capacity can be repackaged as retail colocation	• Contracts for provisioning of floor space and all facilities (power, cooling, network connectivity) • Network neutral offer access to multiple network carriers • Varies from multiple racks (caged) to slots in racks • Beneficial for companies that do not want to make the capital investment in in-house data centres	• Colocation services provided by network service providers as an extension to their networking service • Limited connectivity options as providers will push their on connectivity solutions	• Colocation services limited to one country or geographical area • Often operates multiple data centres spread over the country to offer local presence (close to the customers) • Suited for companies who do not need global presence in data centres at the major hot spots in the world (East coast, West coast, Europe, Asia)
DIGITAL REALTY Data Center Solutions	EQUINIX evoswitch TelecityGroup interxion	Level(3) BT colt kpn	previder the DATACENTERGROUP switch datacenters Interconnect

The hosting and infrastructure cloud market is fragmented with many small players and larger international players

| Infrastructure cloud giants	Enterprise hosters	Mass market hosters	Small local players
• Large international players • Offering infrastructure as a service, with storage and servers on-demand • Standardized offer	• Aiming at larger enterprises • Large contracts and specific needs • Often in combination with transformation and integration services	• Standardized portfolio of hosting services • Aiming at small and medium businesses • Large scale with international activities	• Small companies • Originating from web hosting and Internet access • Evolved into shared and dedicated hosting and cloud • Ability to provide local and personalized service

amazon webservices™

Azure

hp

BT

leaseweb
reliable hosting

SOFTLAYER®

Many

Size, growth and international ranking of the NL Digital Infrastructure sector

Digital Infrastructure in the Netherlands – Driver for the Online Ecosystem

AMS-IX Internet traffic has increased 13-fold in the past eight year, with 30% growth over the past 12 months

Monthly volume (in PetaByte) of AMS-IX Internet traffic of the last eight years

Source: AMS-IX website

Digital Infrastructure in the Netherlands – Driver for the Online Ecosystem
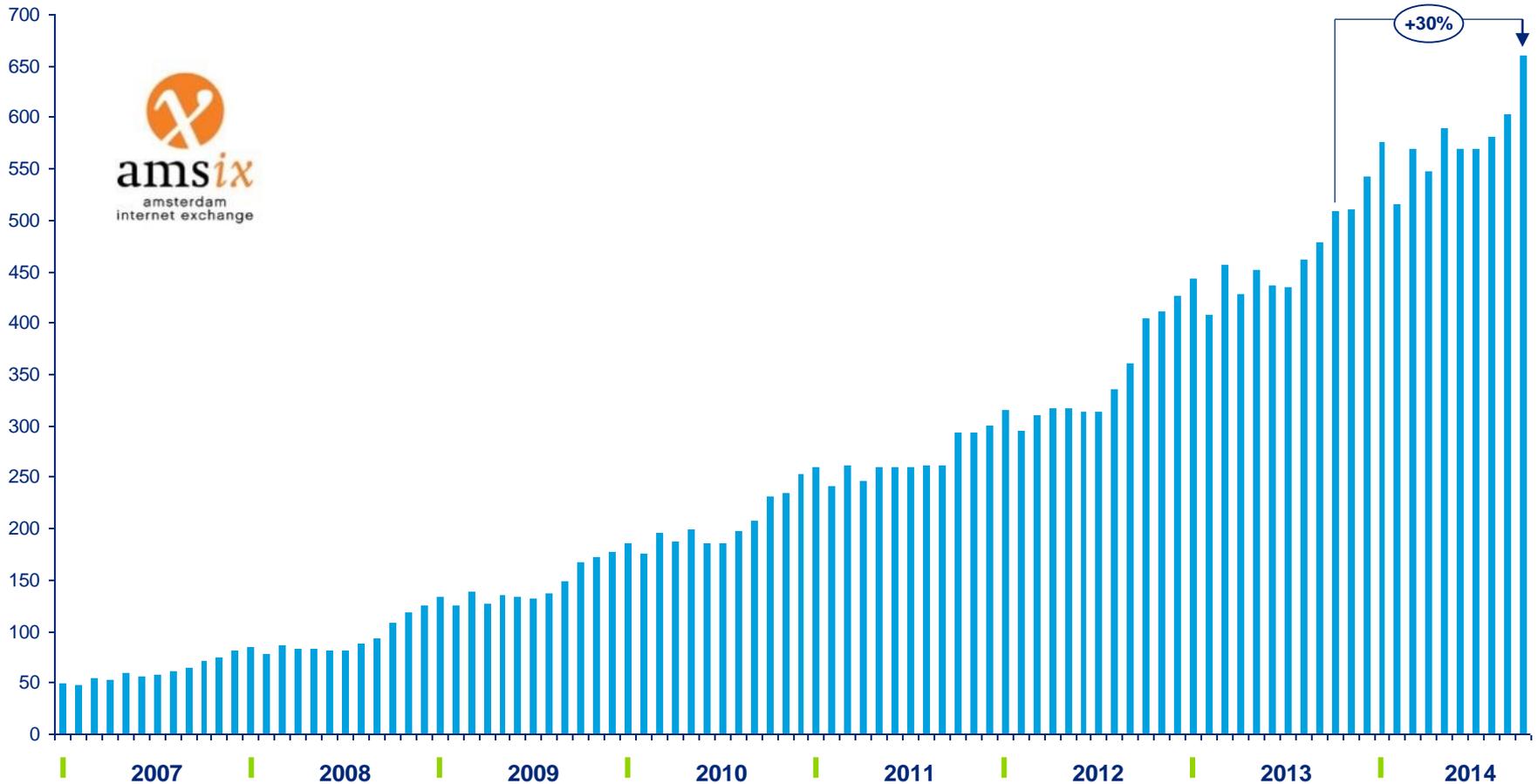
The Amsterdam Internet Exchange (AMS-IX) is the largest in terms of connected Autonomous System Numbers (ASN)

The significance of an Internet Exchange is measured by (a) the number of peering networks (Autonomous System Numbers) and (b) the Peak Internet traffic in Gigabit per second. The graph shows these two metrics for the largest IXP's in the world.
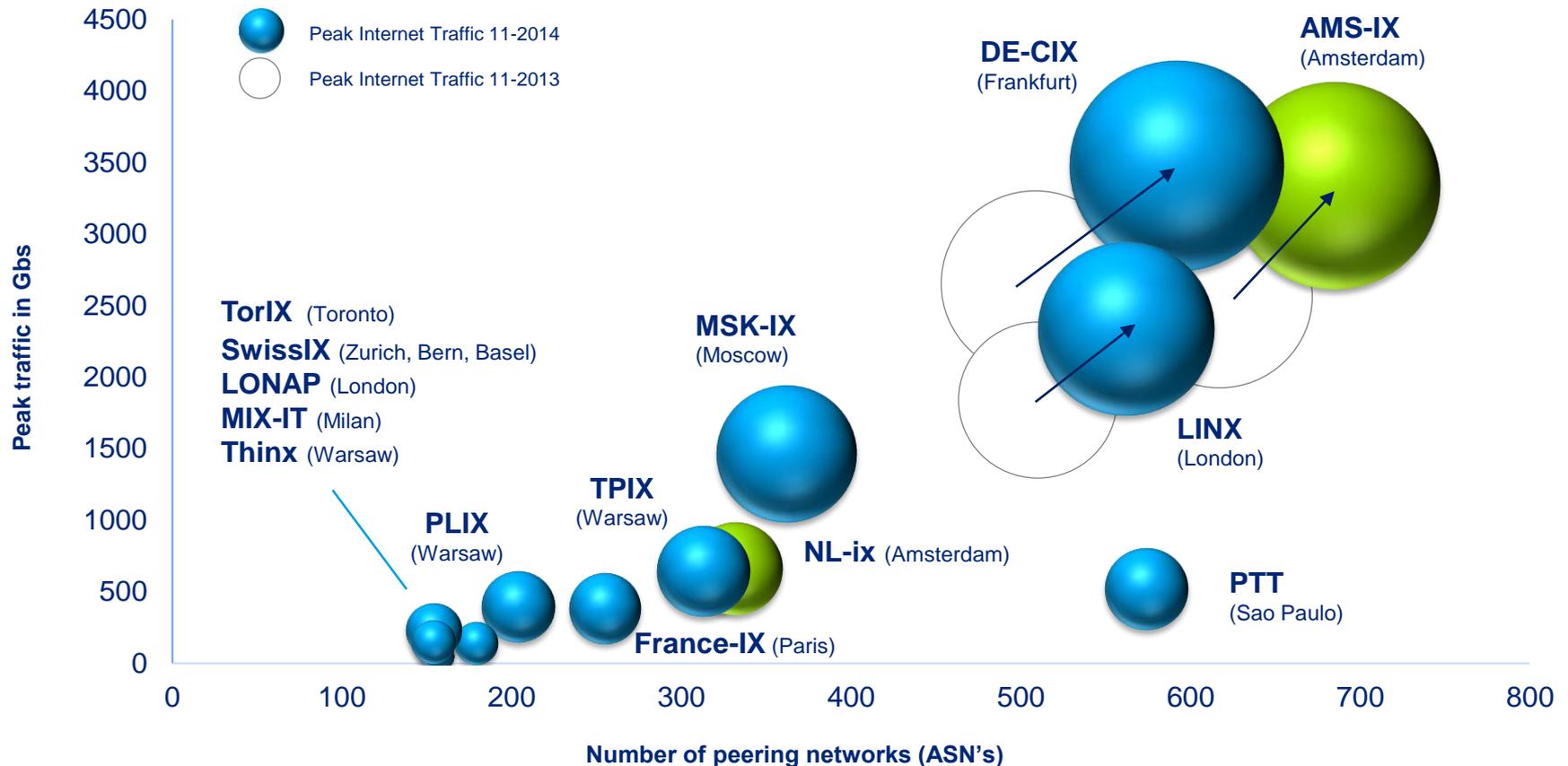
Note: The IXP's from Equinix (Zurich), Terremark (Miami) are not listed since traffic is not known
Sources: EURO-IX website; IXP websites

AMS-IX is a mainport for Internet traffic more than Rotterdam and Schiphol are for containers and passengers respectively

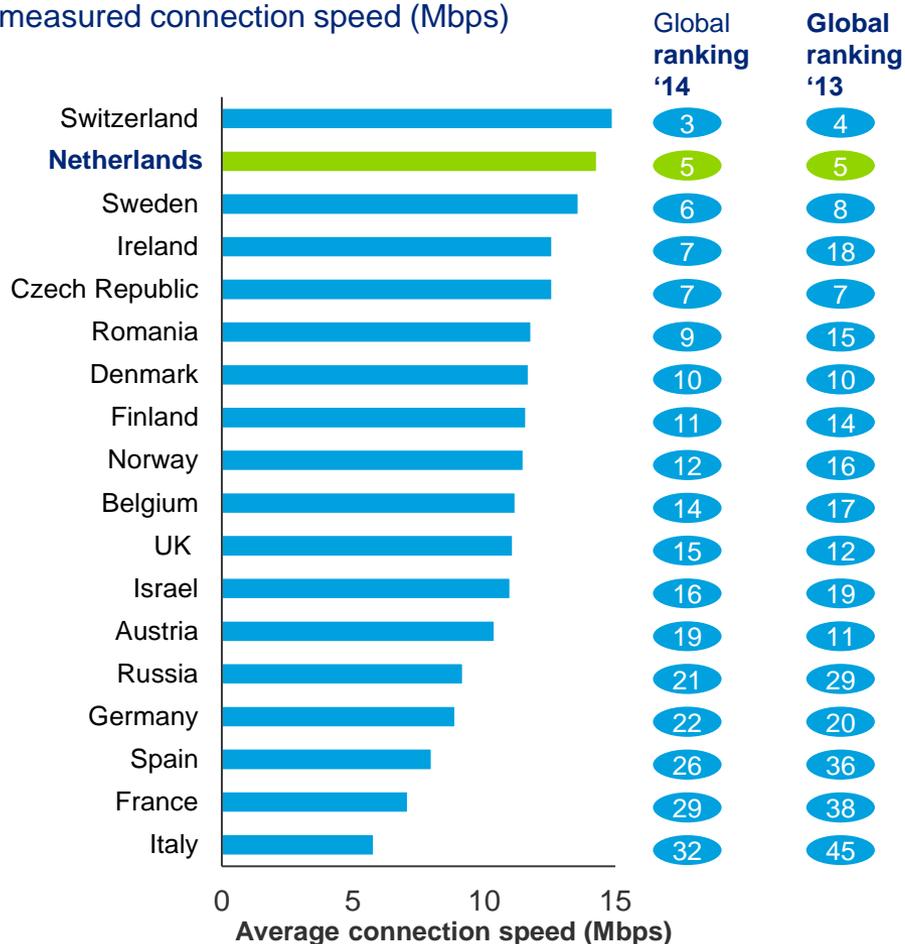| Rank	Top Internet exchanges (by number of peering networks, '14)	Rank '13	Top container ports (by volume, '13)	Rank '12	Top airports (by passengers, '14)	Rank '13
1	**AMS-IX, Amsterdam, NL**	**1**	Shanghai, CN	1	Atlanta GA, US (ATT)	1
2	DE-CIX, Frankfurt, DE	2	Singapore, SG	2	Beijing, CN (PEK)	2
3	PTT, Sao Paulo, BR	4	Shenzhen, CN	4	London, GB (LHR)	3
4	LINX, London, UK	3	Hong Kong, CN	3	Los Angeles CA, US (LAX)	6
5	MSK-IX, Moscow, RU	5	Busan, KR	5	Tokyo, JP (HND)	4
6	NL-IX, Amsterdam, NL	6	Ningbo, CN	6	Chicago IL, US (ORD)	5
7	TPIX, Warsaw, PL	-	Qingdao, CN	8	Dubai, AE (DXB)	7
8	Terremark, Miami, US	7	Guangzhou, CN	7	Dallas/Fort Worth TX, US (DFW)	9
9	France-IX, Paris, FR	13	Dubai, AE	9	Paris, FR (CDG)	8
10	PLIX, Warsaw, PL	8	Tianjin, CN	11	Hong Kong, HK (HKG)	11
11	Equinix, Zurich, CH	9	**Rotterdam, NL**	**10**	Frankfurt, DE (FRA)	12
12	TorIX, Toronto, CA	-	Dalian, CN	20	Jakarta, ID (CGK)	10
13	SwissIX, Zurich, CH	11	Port Kelang, MY	13	Istanbul, TR (IST)	18
14	LONAP, London, UK	14	Kaohsiung, TW	12	Guangzhou, CN (CAN)	16
15	MIX-IT, Milan, IT	15	Hamburg, DE	14	Singapore, SG (SIN)	13
16	Thinx, Warsaw, PL	10	Antwerp, BE	15	**Amsterdam, NL (AMS)**	**14**

Sources: Euro-IX website; World Shipping Council website; Airports Council International website

NL scores high on average measured connection speed and broadband penetration

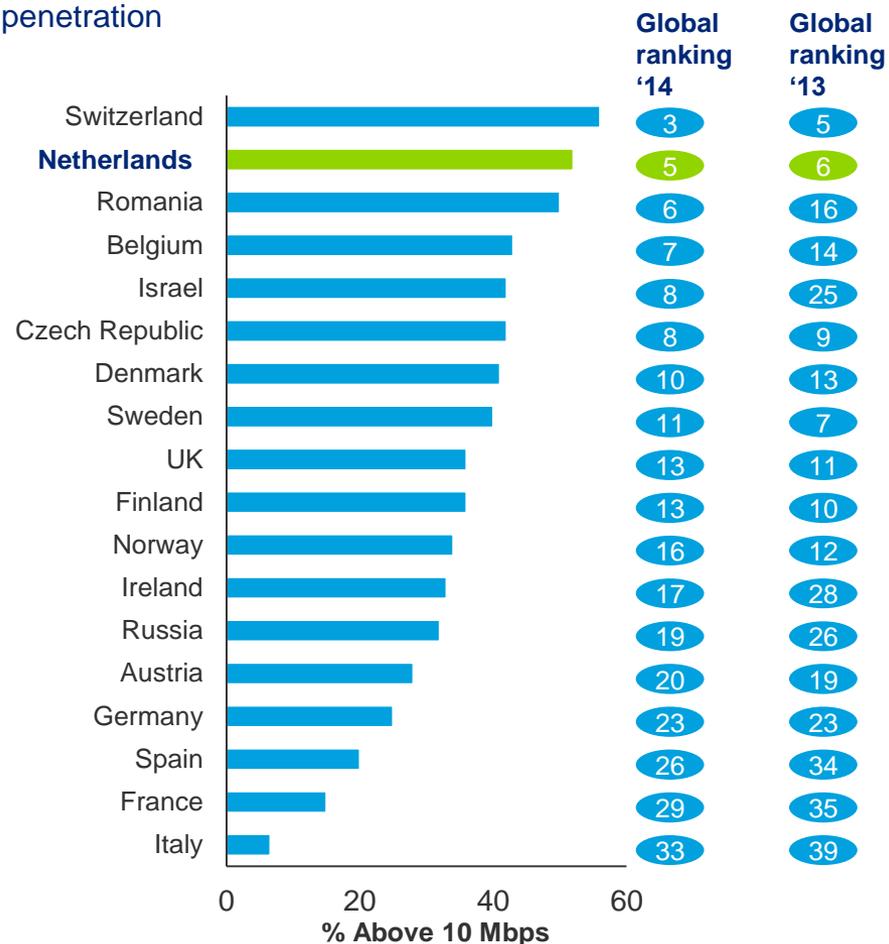## High average measured connection speed
Netherlands ranked 2nd EMEA country in average measured connection speed (Mbps)

Country	Global ranking '14	Global ranking '13
Switzerland	3	4
Netherlands	5	5
Sweden	6	8
Ireland	7	18
Czech Republic	7	7
Romania	9	15
Denmark	10	10
Finland	11	14
Norway	12	16
Belgium	14	17
UK	15	12
Israel	16	19
Austria	19	11
Russia	21	29
Germany	22	20
Spain	26	36
France	29	38
Italy	32	45

Average connection speed (Mbps)

High broadband penetration (>10 Mbps)
Netherlands ranked 2nd EMEA country in high broadband penetration

Country	Global ranking '14	Global ranking '13
Switzerland	3	5
Netherlands	5	6
Romania	6	16
Belgium	7	14
Israel	8	25
Czech Republic	8	9
Denmark	10	13
Sweden	11	7
UK	13	11
Finland	13	10
Norway	16	12
Ireland	17	28
Russia	19	26
Austria	20	19
Germany	23	23
Spain	26	34
France	29	35
Italy	33	39

% Above 10 Mbps

Source: Akamai Report

The Amsterdam region is part of a leading group of tier-1 data centres and shows strong increase in supply

| Region	Supply m²	Availability m²	Increase last year	Supply m² per € bn GDP
London	298	52	7.2%	138.9
Frankfurt	159	22	3.9%	56.2
Paris	111	14	4.7%	52.9
Amsterdam	**101**	**16**	**6.3%**	**168.3**

- London, Frankfurt, Paris and Amsterdam form the leading group of colocation data centres hot spots in Europe. There is a large distance between this leading group of four and the runner up on position 5 (Madrid)

- Measured in colocation supply m² per € bn GDP, Amsterdam exceeds all other cities

- Amsterdam has shown a strong increase in the past year, smaller than London but larger than Frankfurt and Paris

European Tier-1 data centres overview

Sources: CBRE Report; TeleGeography Report

Colocation supply m² per € bn GDP
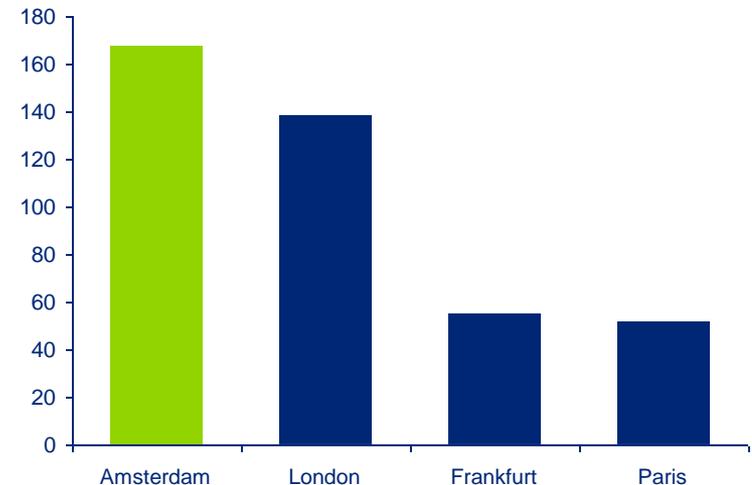
This position is the result of the combination of several criteria for data centre location decisions

Internet Connectivity

1. Extremely well connected to the core Internet (terrestrial & submarine cables)
   a) Lowest latency to other major Internet hubs
   b) Large available bandwidth
2. Presence of all major carriers and AMS-IX

Energy

3. Availability of required electricity capacity (production & distribution)
4. Reliable power supply
5. Favourable electricity prices (compared to EU average)

Geographical location

6. Good accessibility (Schiphol), central location in Europe
7. Small country with a neutral position

Political and economical climate

8. Economic and political stability
9. Highly-educated and multilingual workforce
10. Focus on international trade
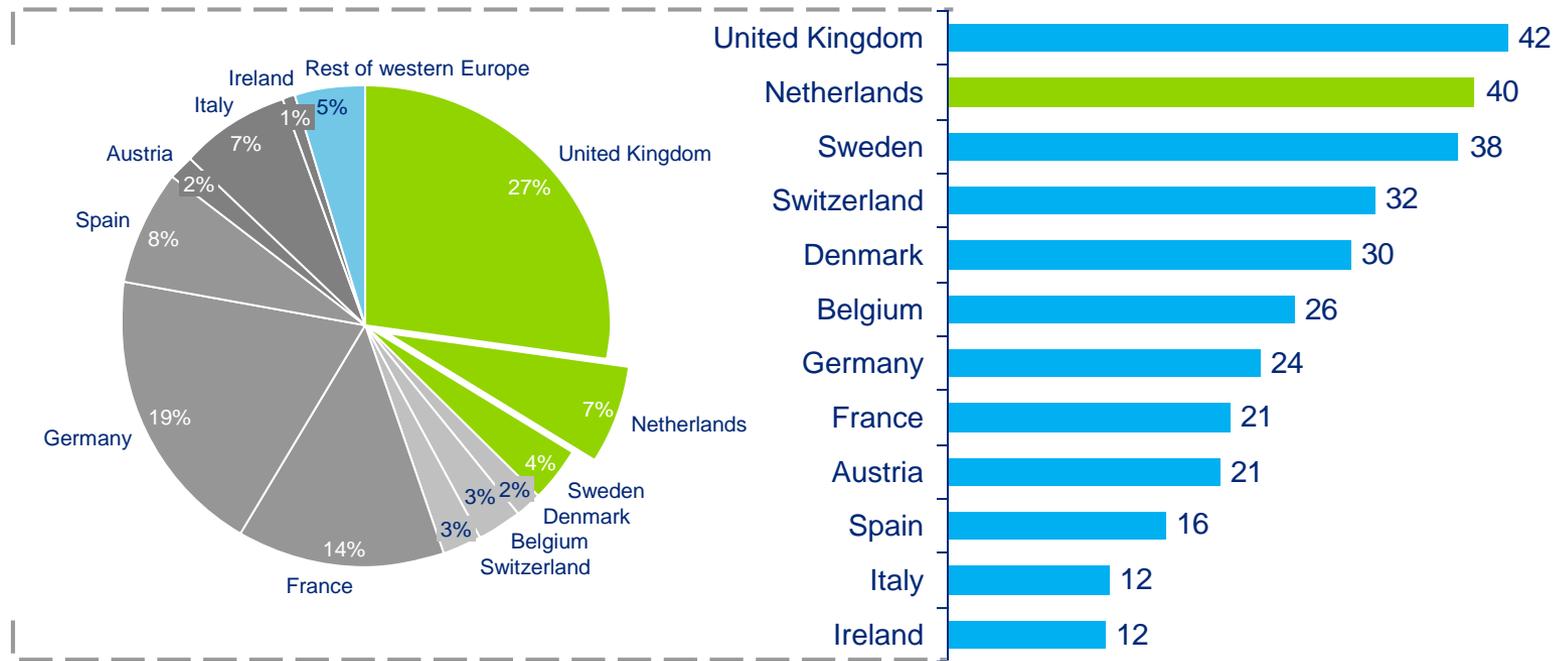11. Favourable laws and regulations
12. Favourable tax climate

- The market for data centres is characterised by a combination of large global players (e.g. Telecity, Equinix) and many smaller local providers

- The presence of most major global data centre providers in the Netherlands is prove of the country's attractiveness

- This attractiveness of the Netherlands (and the Amsterdam region in particular) is a combination of several causes of which the most significant are listed on the left

NL holds a strong position in hosting, ranking 2nd in relative market share and spending per capita

Share of Western Europe's €10 bn hosting market ('13)

Hosting revenue per capita (€) ('13)

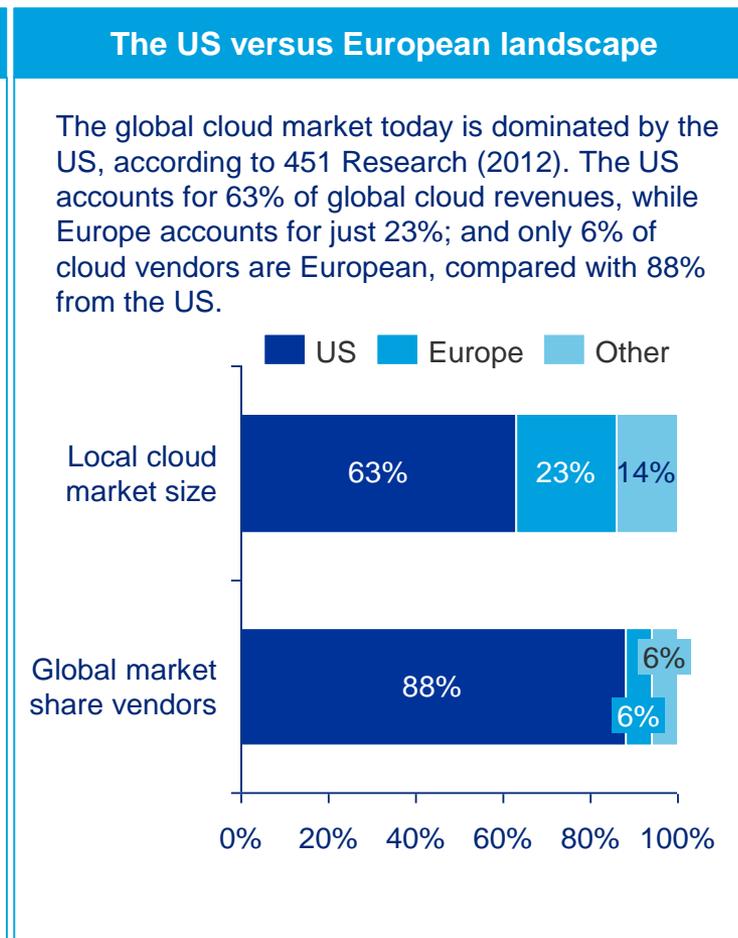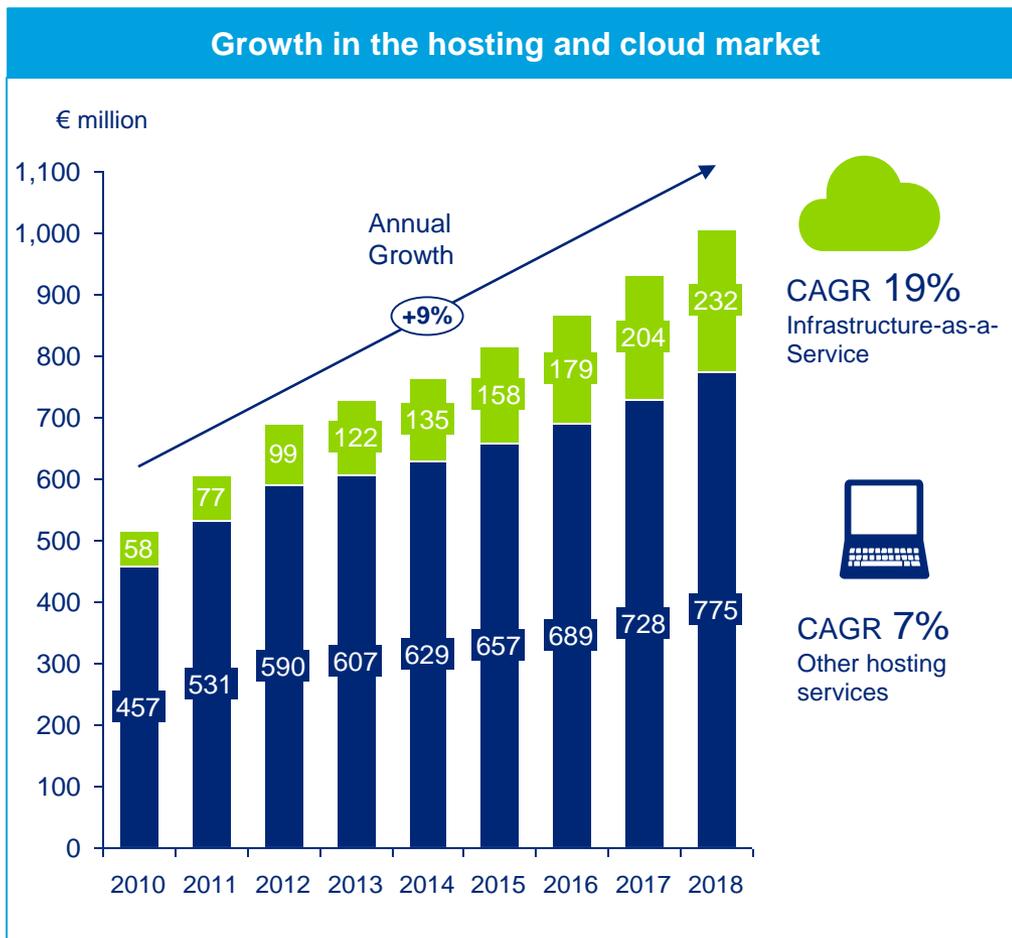| Country	Value
United Kingdom	42
Netherlands	40
Sweden	38
Switzerland	32
Denmark	30
Belgium	26
Germany	24
France	21
Austria	21
Spain	16
Italy	12
Ireland	12

Colors in the pie chart indicate whether or not a country is below or above its fair market share (hosting share relative to GDP share in Western Europe). After UK, NL ranks 2nd, 44% above its fair market share of 4.6% (= equal to share of GDP)

- Hosting share > 25% above fair market share
- Hosting share 0 - 25% above fair market share
- Hosting share 0 - 25% below fair market share
- Hosting share > 25% below fair market share

Note: GDP, hosting revenues per capita and market shares are adjusted for purchasing power
Sources: Gartner IT Services Report; Eurostat Database; Akamai Report; Deloitte analysis

The global cloud and hosting market has an average growth rate of 9% a year, with IaaS 19% growth rate being a main driver
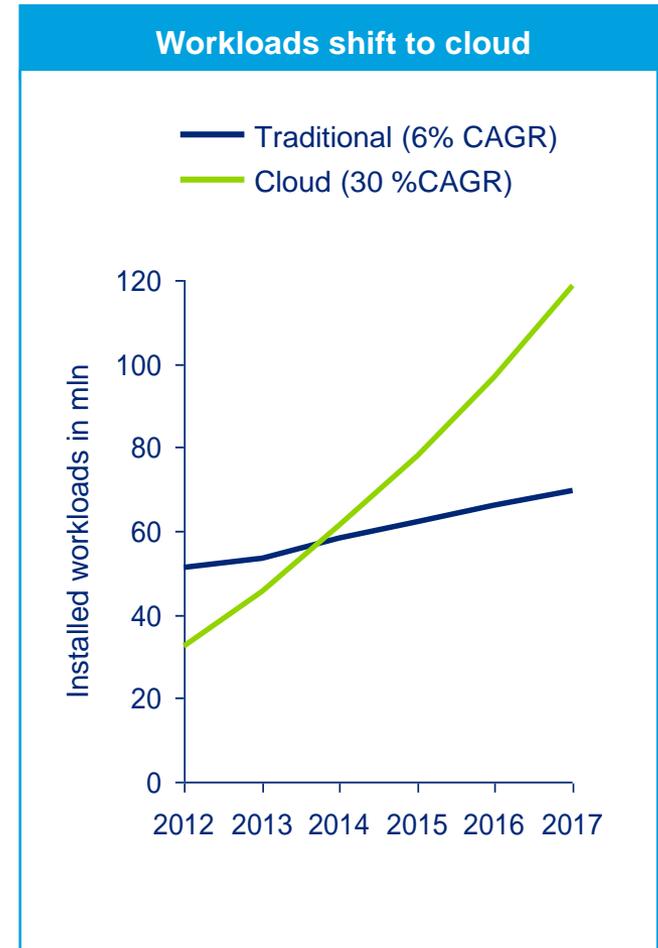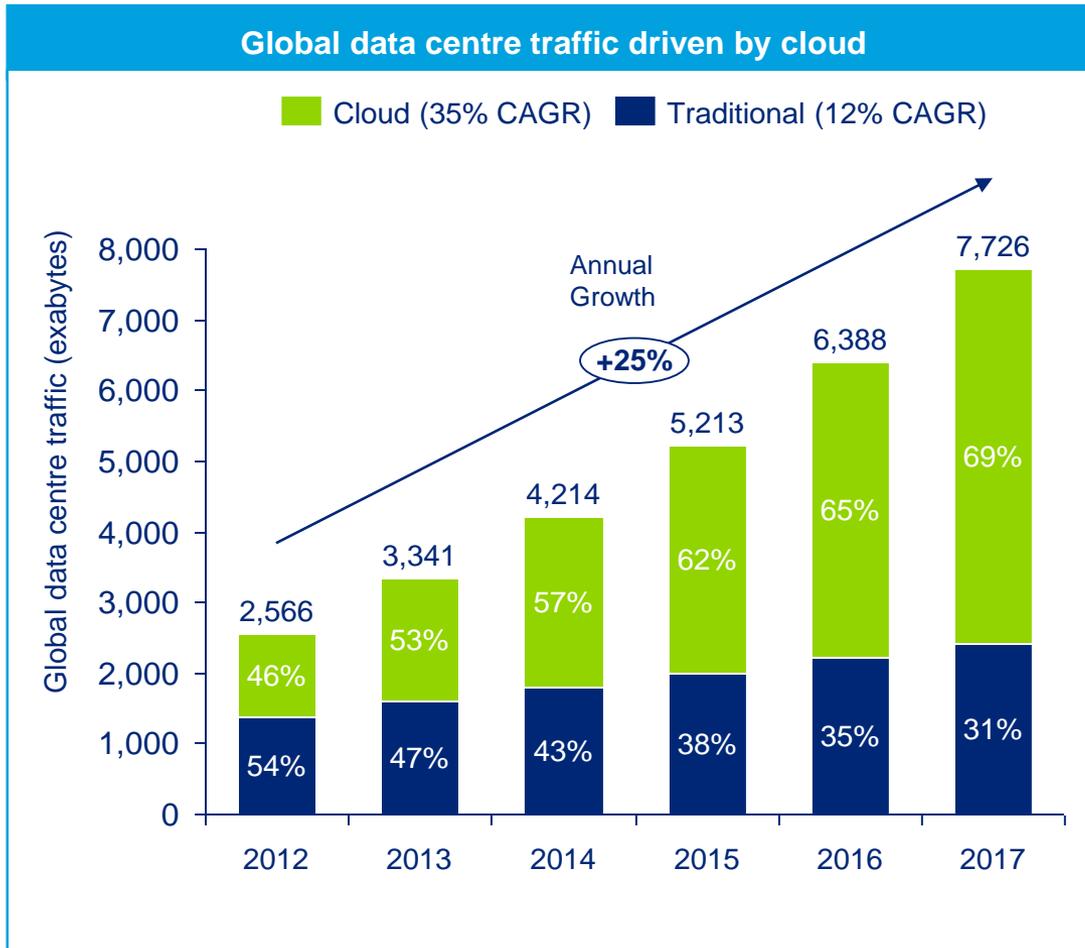
Growth in the hosting and cloud market

€ million

Annual Growth

+9%

CAGR **19%**
Infrastructure-as-a-Service

CAGR **7%**
Other hosting services

Year	Other hosting	Total
2010	58	457
2011	77	531
2012	99	590
2013	122	607
2014	135	629
2015	158	657
2016	179	689
2017	204	728
2018	232	775

The US versus European landscape

The global cloud market today is dominated by the US, according to 451 Research (2012). The US accounts for 63% of global cloud revenues, while Europe accounts for just 23%; and only 6% of cloud vendors are European, compared with 88% from the US.

US **Europe** **Other**

Local cloud market size: 63% | 23% | 14%

Global market share vendors: 88% | 6% | 6%

Sources: Gartner Public Cloud Report; InterXion Report; 451 Research report; Deloitte analysis

Greater virtualization drives data centre use away from traditional activities towards cloud services

Global data centre traffic driven by cloud

Cloud (35% CAGR)   Traditional (12% CAGR)

Global data centre traffic (exabytes)

Annual Growth   **+25%**

- 2012: 2,566 (Cloud 46%, Traditional 54%)
- 2013: 3,341 (Cloud 53%, Traditional 47%)
- 2014: 4,214 (Cloud 57%, Traditional 43%)
- 2015: 5,213 (Cloud 62%, Traditional 38%)
- 2016: 6,388 (Cloud 65%, Traditional 35%)
- 2017: 7,726 (Cloud 69%, Traditional 31%)

Workloads shift to cloud

Traditional (6% CAGR)
Cloud (30 %CAGR)
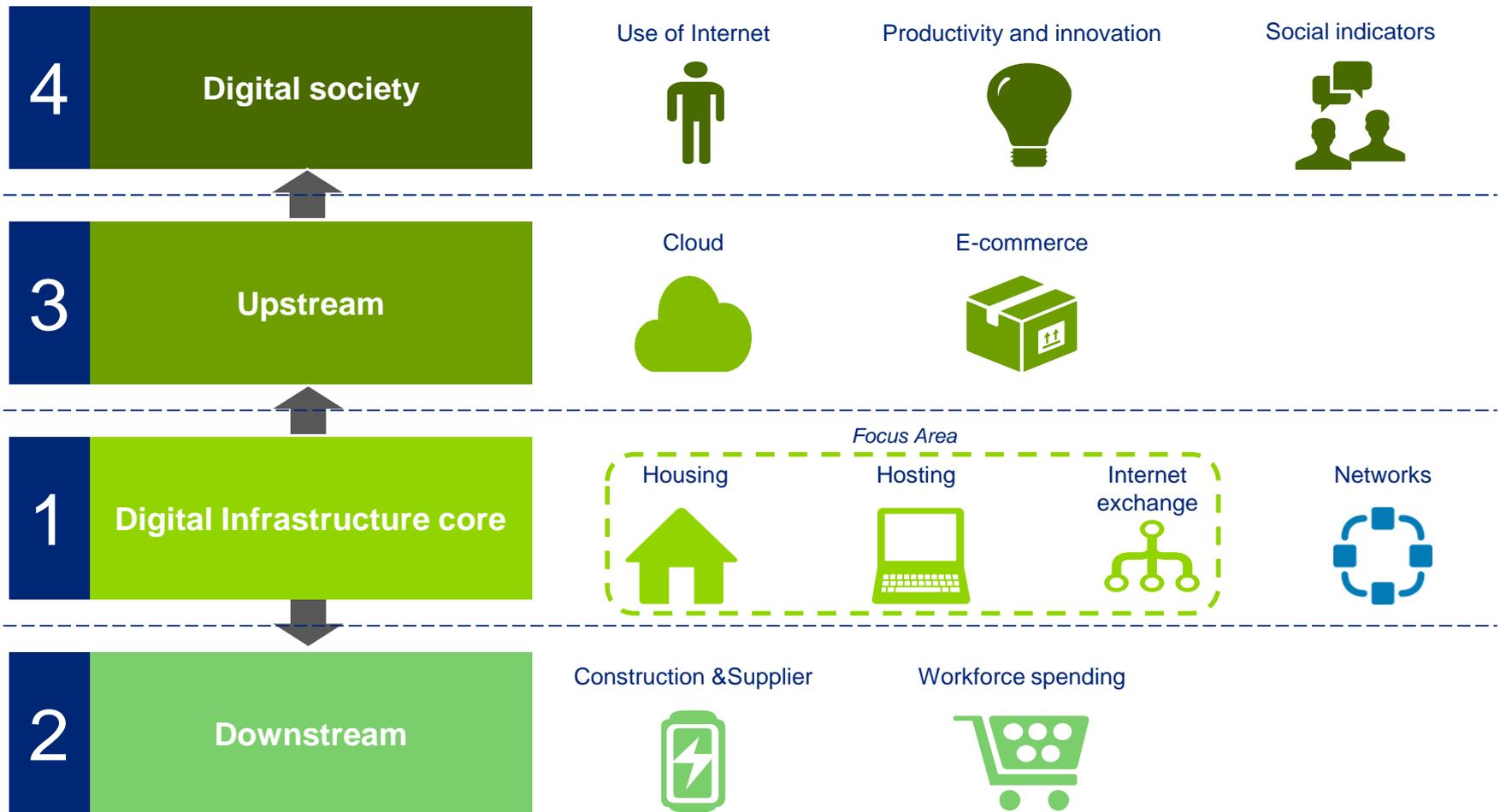
Installed workloads in mln

Note: data on cloud services includes IaaS, as well as SaaS and PaaS
Source: Cisco Report

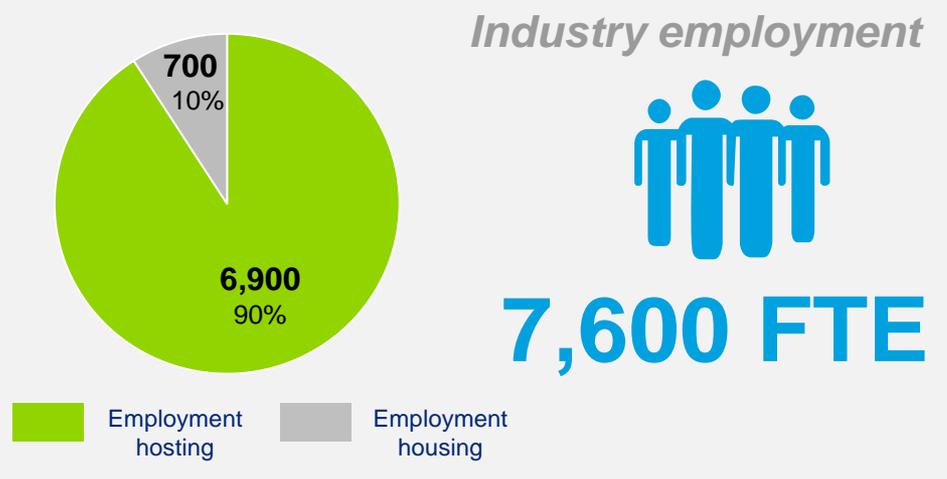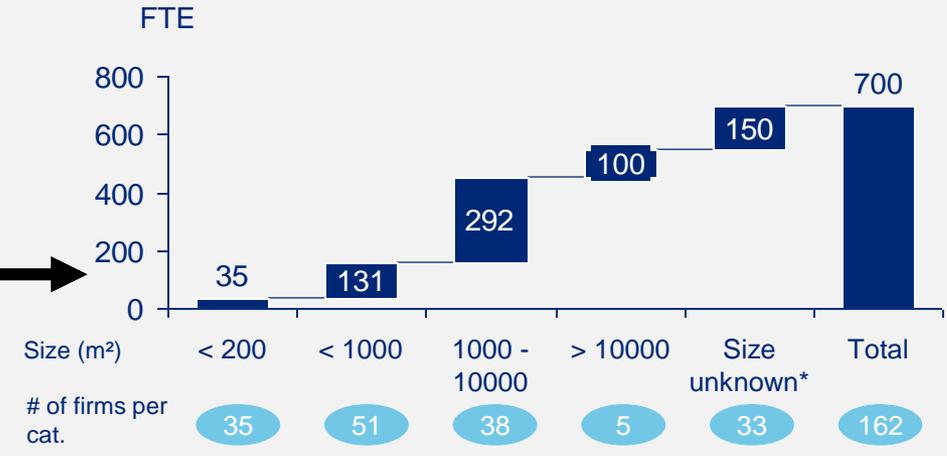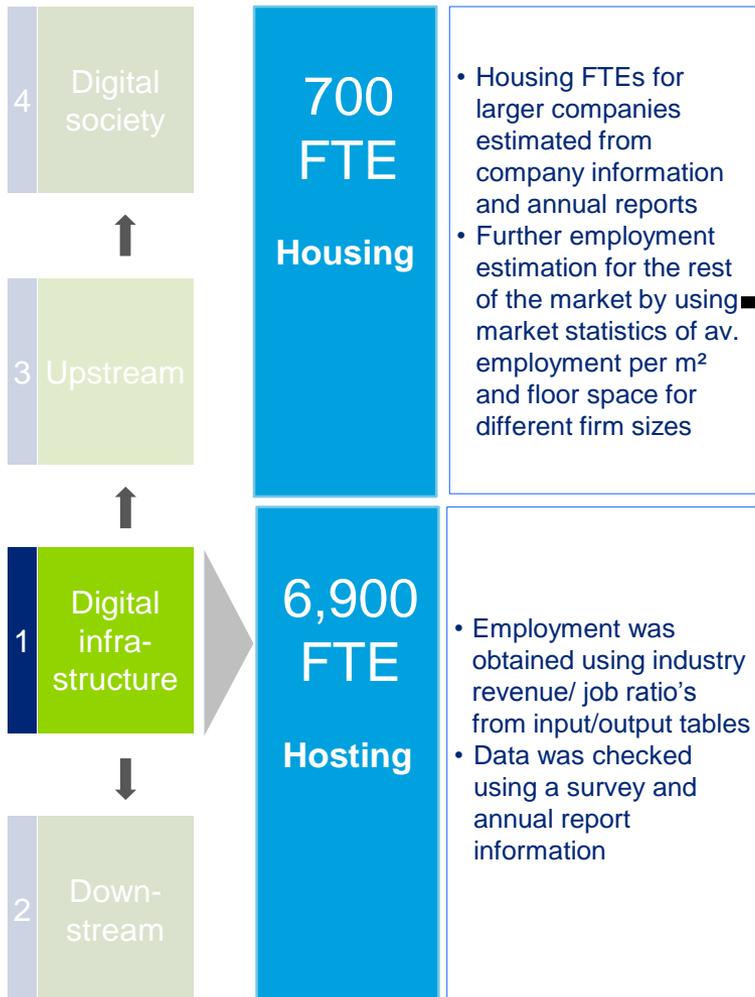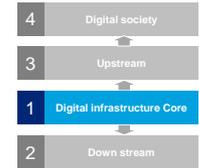**3. Significance of the Digital Infrastructure sector for the Dutch economy**
- Core contribution
- Downstream contribution
- Upstream contribution
- Contribution to the digital society

The contribution of the Digital Infrastructure sector is a combination of four effects: Core, Downstream, Upstream and Digital society

4 | **Digital society**

Use of Internet

Productivity and innovation

Social indicators

3 | **Upstream**

Cloud

E-commerce

1 | **Digital Infrastructure core**

Focus Area

Housing

Hosting

Internet exchange

Networks

2 | **Downstream**

Construction &Supplier

Workforce spending

1. Core effect: employment in the Digital Infrastructure sector

Direct employment in the Digital Infrastructure sector adds up to 7,600 FTE, of which 90% in the hosting sector and 10% in capital intensive housing
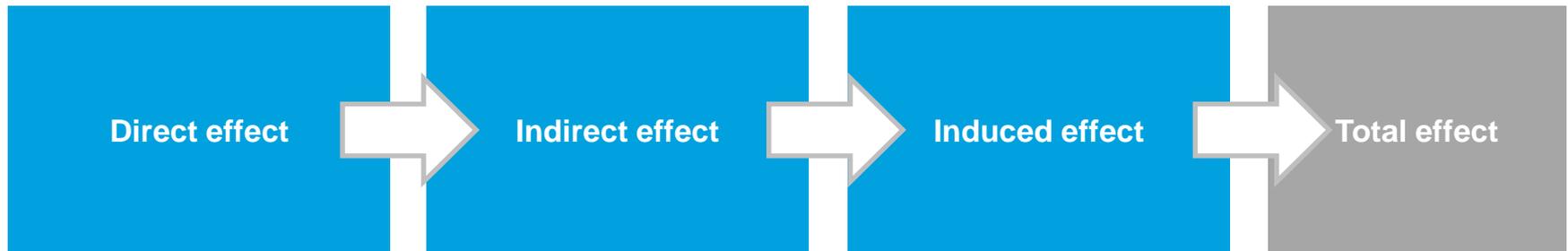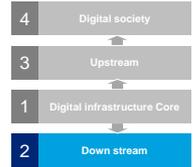
700 FTE

Housing

- Housing FTEs for larger companies estimated from company information and annual reports
- Further employment estimation for the rest of the market by using market statistics of av. employment per m² and floor space for different firm sizes

6,900 FTE

Hosting

- Employment was obtained using industry revenue/ job ratio's from input/output tables
- Data was checked using a survey and annual report information

Digital society		
3 Upstream		
1 Digital infra-structure		
2 Down-stream		

FTE

Size (m²)	< 200	< 1000	1000 - 10000	> 10000	Size unknown*	Total
FTE	35	131	292	100	150	700
# of firms per cat.	35	51	38	5	33	162

Industry employment

700
10%

6,900
90%

7,600 FTE

Employment hosting Employment housing

Note: numbers are based on 2013
Sources: Annual reports; Datacentrum Gids website; Gartner IT Services Report; CBS database; Deloitte analysis

2. Downstream effect

To quantify the economic impact of the housing and hosting industries on the Dutch economy we make use of an input/output analysis
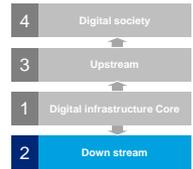
| 1 | Digital Infrastructure | 2 | Downstream |

Housing **Hosting** **Internet exchange**

Construction &Suppliers

Workforce spending

Direct effect → **Indirect effect** → **Induced effect** → **Total effect**

- The direct effect quantifies the economic impact within the Digital Infrastructure sector and is the direct result of added value in the industry
- The direct job effect is 7,600

- Indirect jobs are created when other sectors supply materials for production and construction
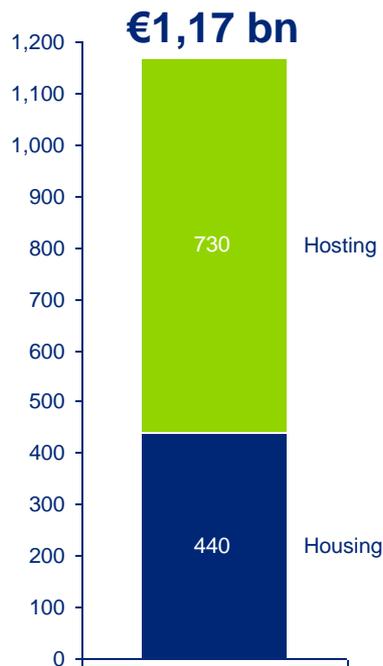- Also known as the supply chain effect

- The result of consumption by workers directly or indirectly related to the production or investments in the Digital Infrastructure sector

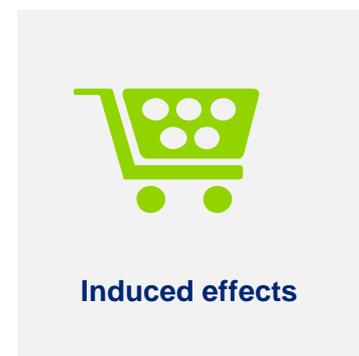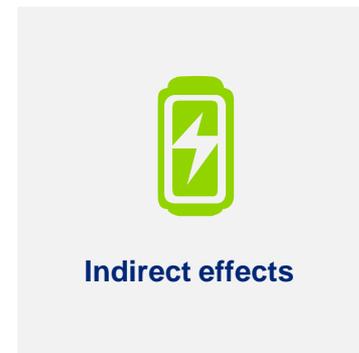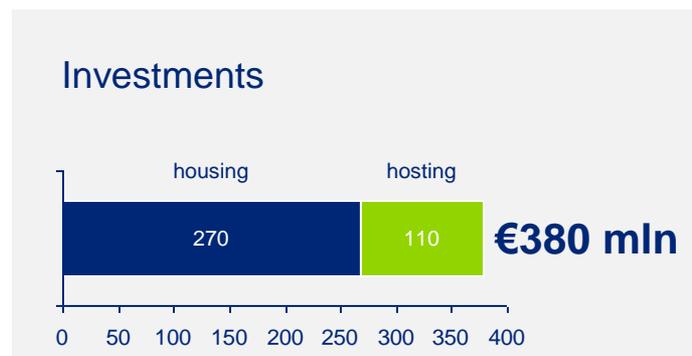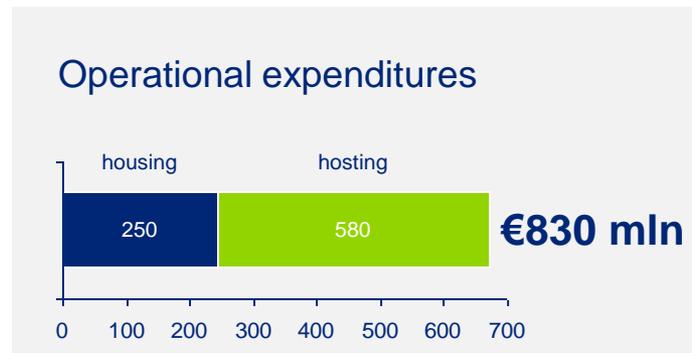- Combined job effect of direct, indirect and induced effects

Operational expenditures and investments in the housing and hosting sectors drive indirect and induced effects to create additional jobs

| 1 | Digital Infrastructure | 2 | Downstream |

Sector revenue

€1,17 bn

730	Hosting
440	Housing

1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0

Sector expenditures

Operational expenditures

housing: 250
hosting: 580

€830 mln

0 100 200 300 400 500 600 700

Investments

housing: 270
hosting: 110

€380 mln

0 50 100 150 200 250 300 350 400

Indirect effects

Induced effects

Note: operational expenditures include inputs for production and wages
Sources: Annual reports; Datacentrum Gids website; Gartner IT Services Report; CBS Database; BCG Digital Infrastructure Report; Megabuyte Report; Deloitte analysis

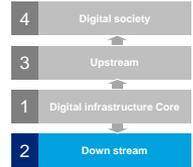# The indirect and induced effect of the Digital Infrastructure sector add up to an employment of 11,700 FTE

4	Digital society
3	Upstream
1	Digital infra-structure
2	Down-stream
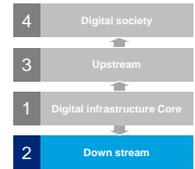
Indirect effect

Induced effect

Employment from operational expenditures

Supplier

Workforce spending

4,000 FTE

5,700 FTE

Employment from investments

Construction & Suppliers

Workforce spending

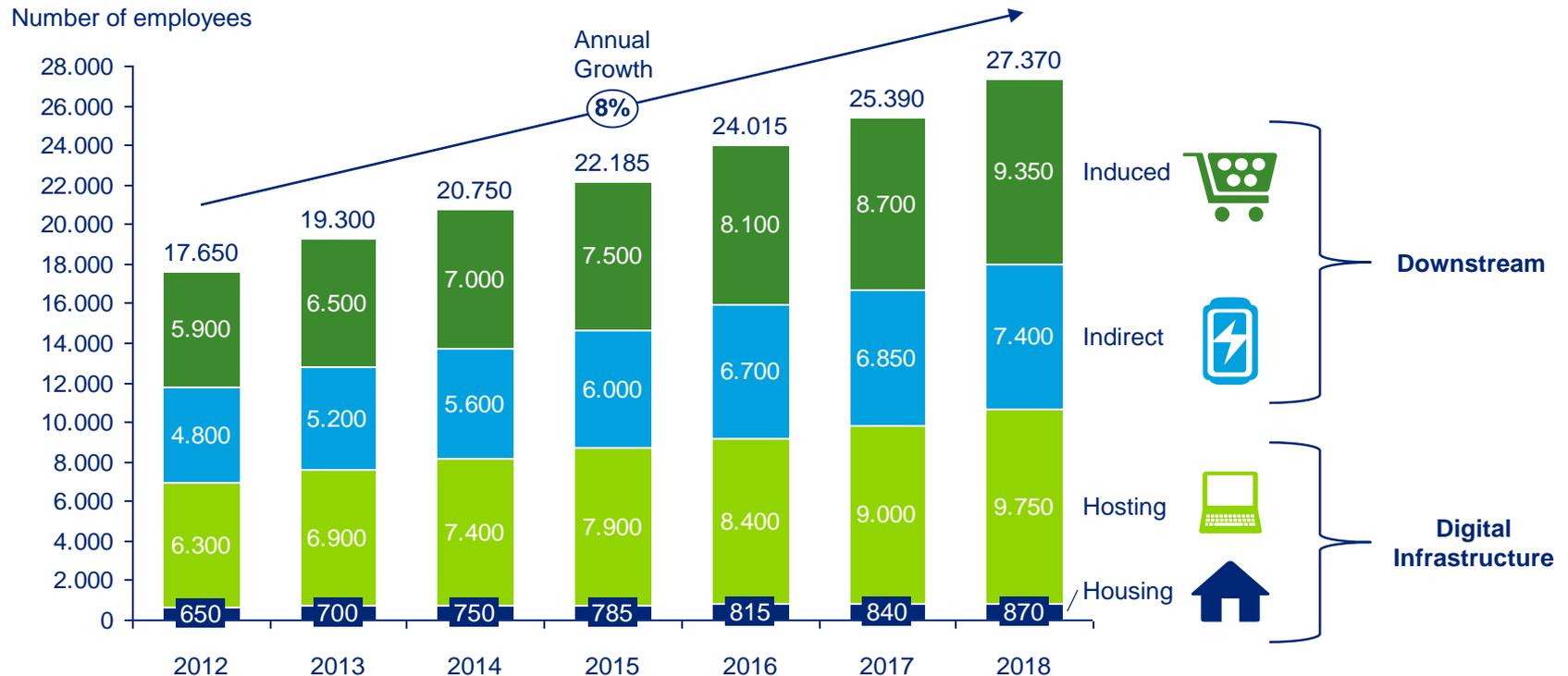**1,200 FTE**

800 FTE

Employment

11,700 FTE
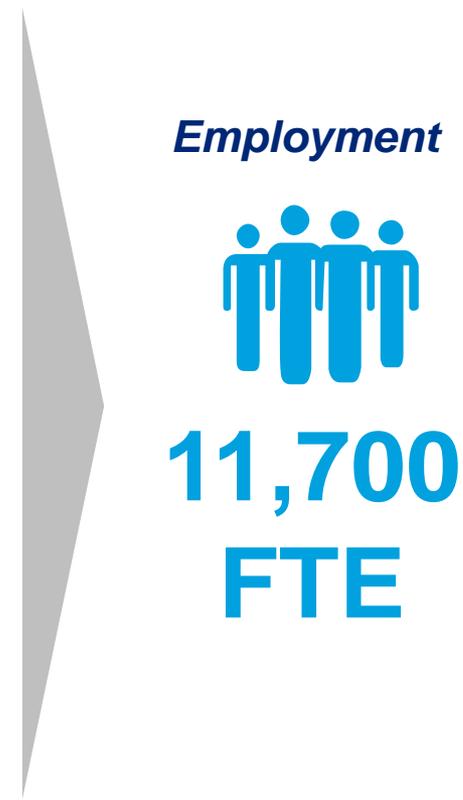
Sources: CBS Database; Deloitte analysis

Combined effects for the Digital Infrastructure add up to 19,000 jobs in 2013 with a projected growth of 8% a year

Core & downstream employment growth from hosting and housing

Number of employees

Annual Growth **8%**

Year	Induced	Indirect	Hosting	Housing	Total
2012	5.900	4.800	6.300	650	17.650
2013	6.500	5.200	6.900	700	19.300
2014	7.000	5.600	7.400	750	20.750
2015	7.500	6.000	7.900	785	22.185
2016	8.100	6.700	8.400	815	24.015
2017	8.700	6.850	9.000	840	25.390
2018	9.350	7.400	9.750	870	27.370

Induced / Indirect → **Downstream**
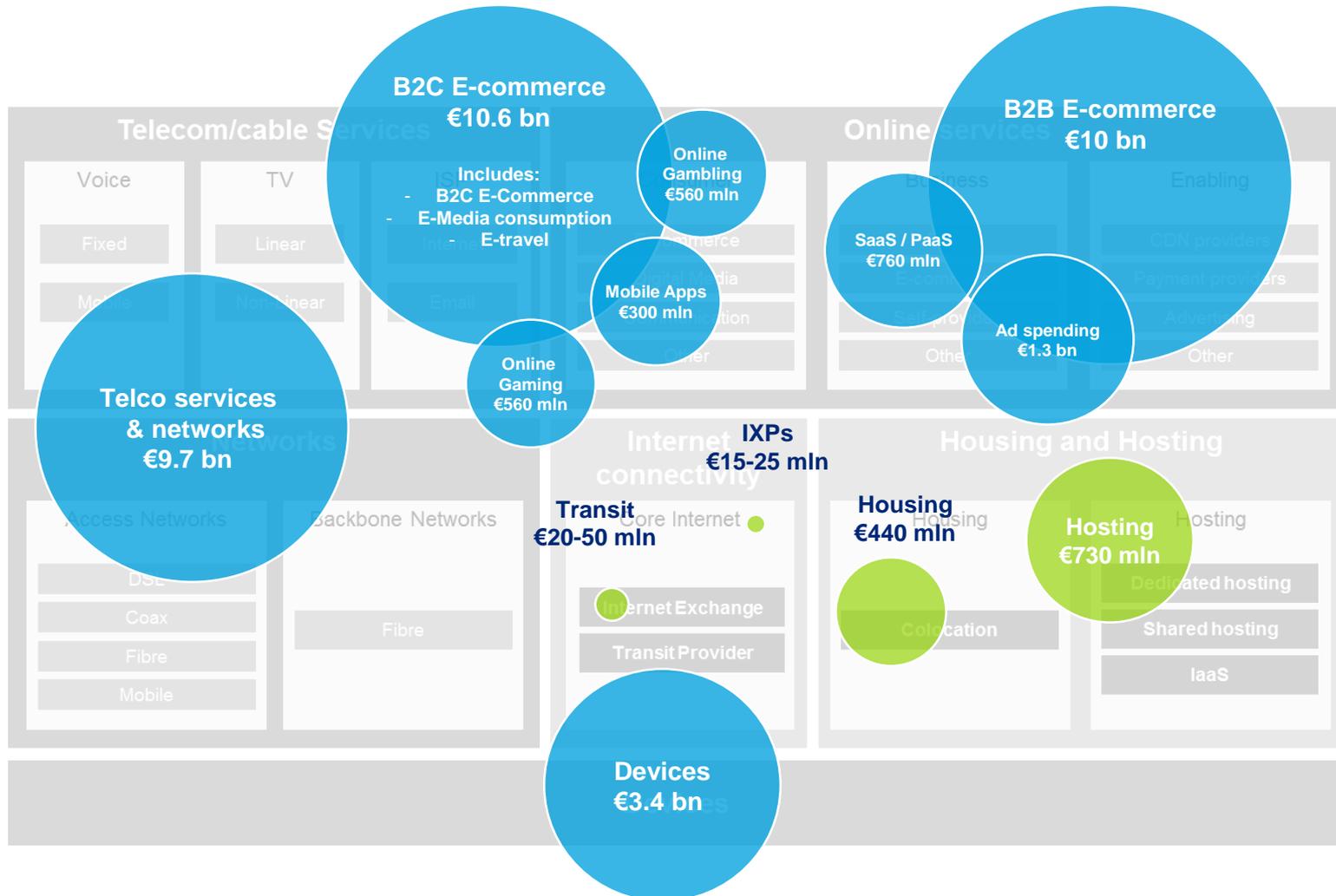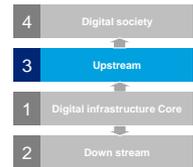
Hosting / Housing → **Digital Infrastructure**

Sources: Gartner IT Services Report; CBS Database; Deloitte analysis

3. Upstream effect, contribution to the wider Internet value chain

A continues interaction between Digital Infrastructure, service innovation and online usage drives growth in the online ecosystem

Digital Infrastructure

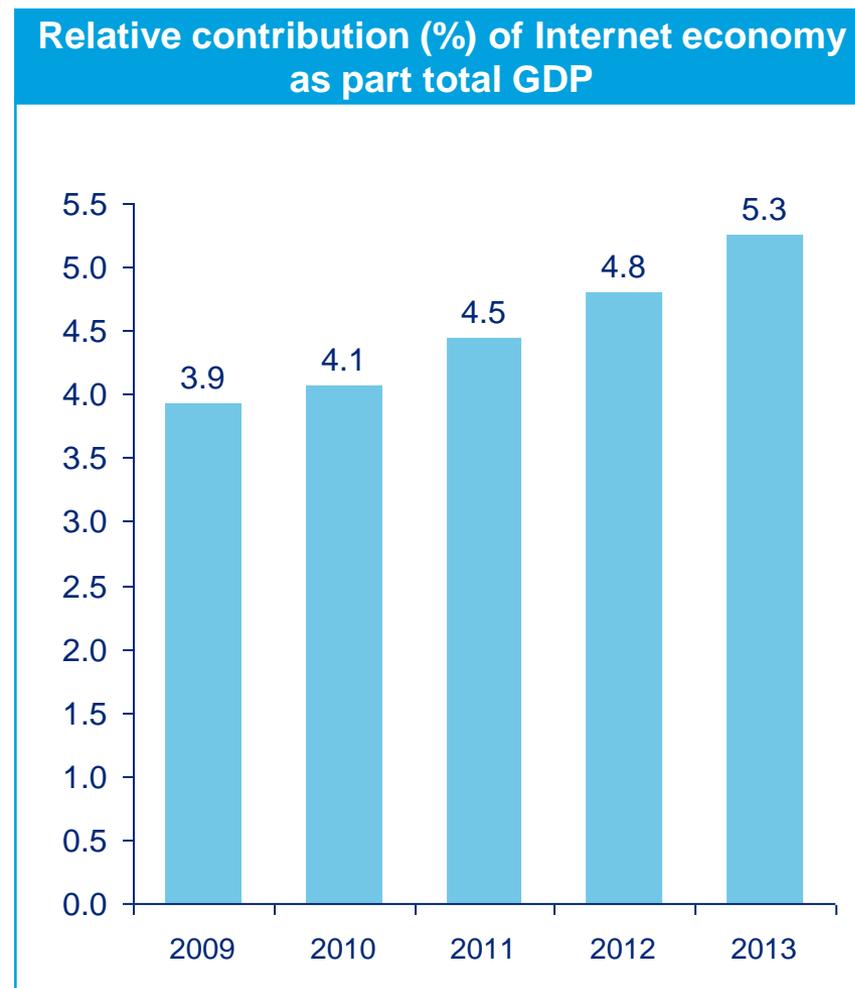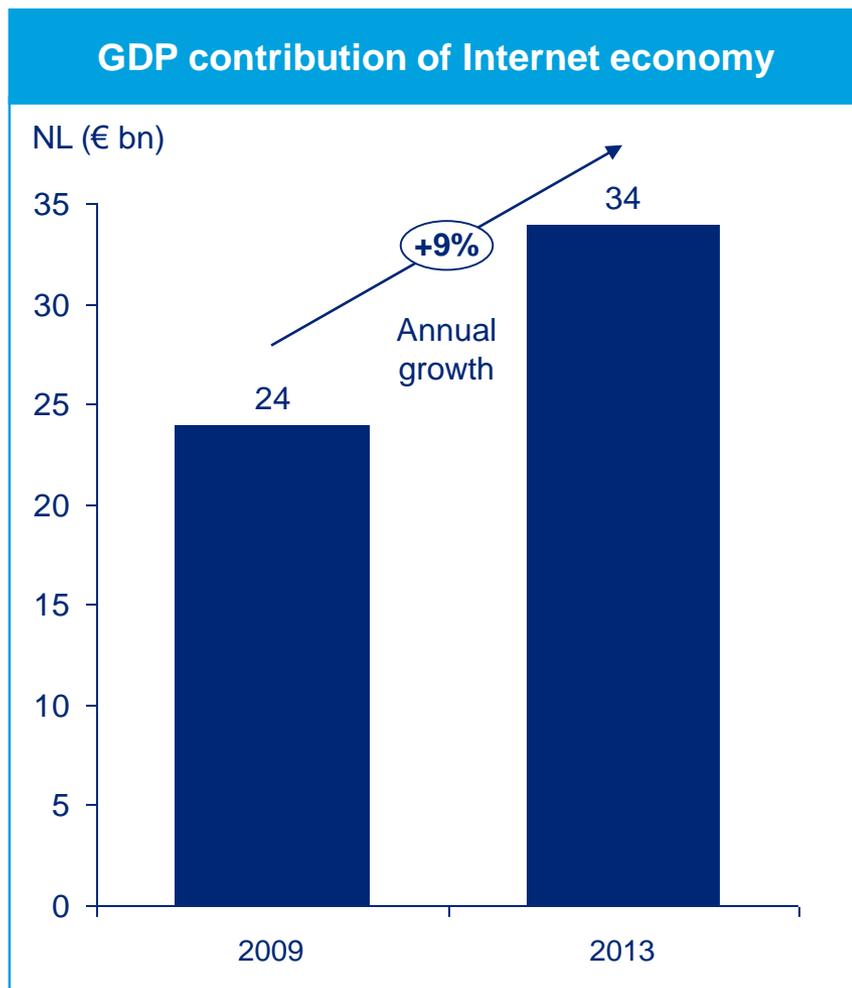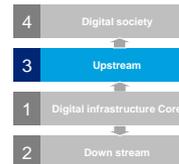**Service Innovation**

Online Usage
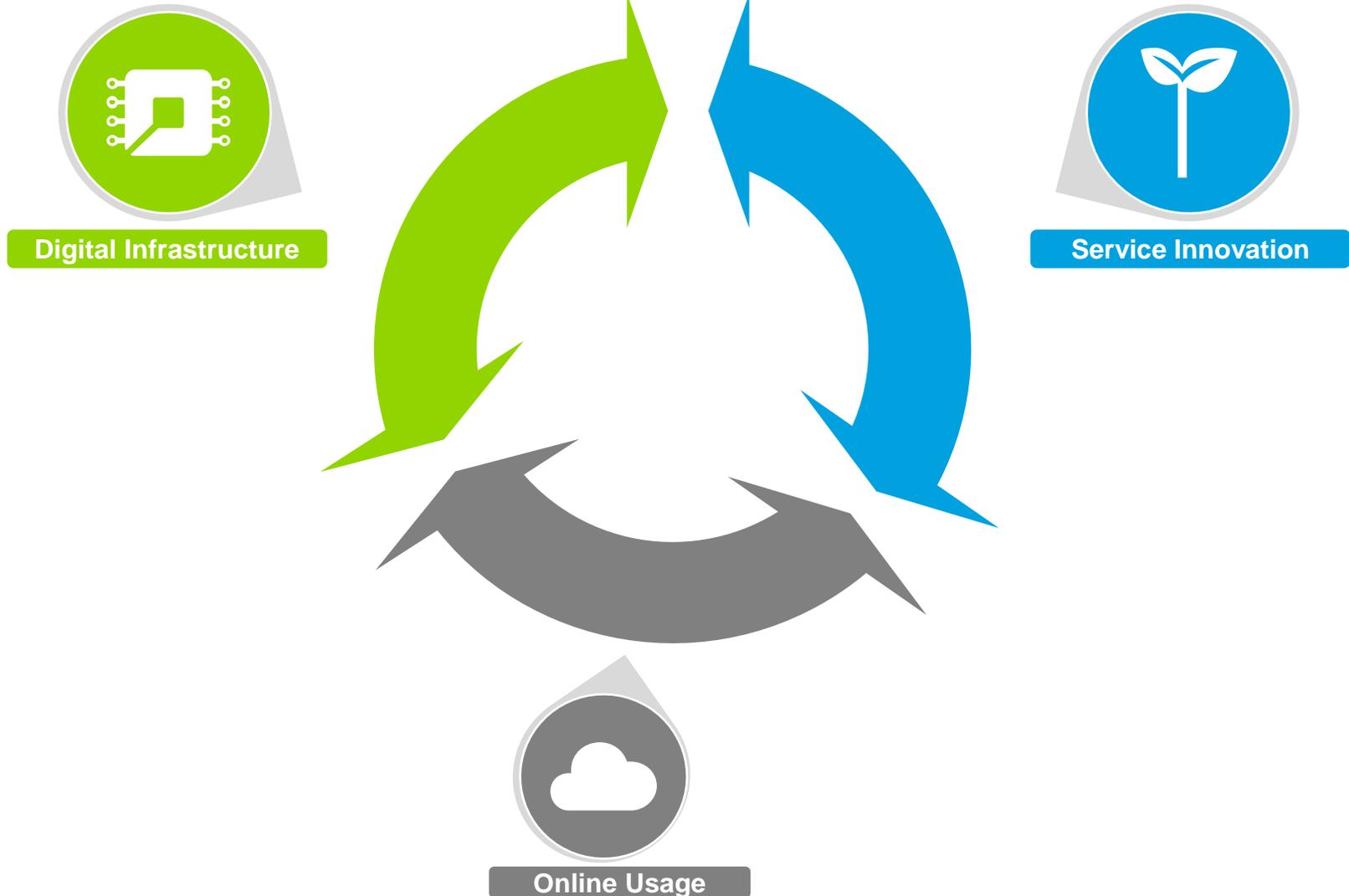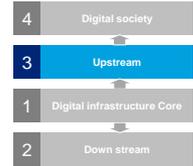
Digital Infrastructure is part of a much larger online ecosystem generating at least ~ €39 bn in revenue in the Dutch economy

Telecom/cable Services

Voice — Fixed, Mobile

TV — Linear, Non-linear

B2C E-commerce
€10.6 bn

Includes:
- B2C E-Commerce
- E-Media consumption
- E-travel

Online Gambling
€560 mln

Mobile Apps
€300 mln

Online Gaming
€560 mln

Online services

Business — Enabling

SaaS / PaaS
€760 mln

B2B E-commerce
€10 bn

Ad spending
€1.3 bn

Telco services & networks
€9.7 bn

Access Networks — DSL, Coax, Fibre, Mobile

Backbone Networks — Fibre

Internet connectivity

IXPs
€15-25 mln

Transit
€20-50 mln

Core Internet

Internet Exchange

Transit Provider

Housing and Hosting

Housing
€440 mln

Housing — Colocation

Hosting
€730 mln

Hosting — Dedicated hosting, Shared hosting, IaaS
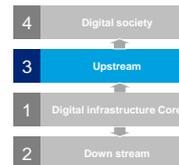
Devices
€3.4 bn

Sources: Ecommerce Europe Report; Gartner Public Cloud Report; Gartner IT Services Report, Deloitte analysis

Including private investments, government spending and trade, the Internet economy in NL adds an estimated €34 bn to the GDP which is approximately 5.3% of the total GDP and steadily growing
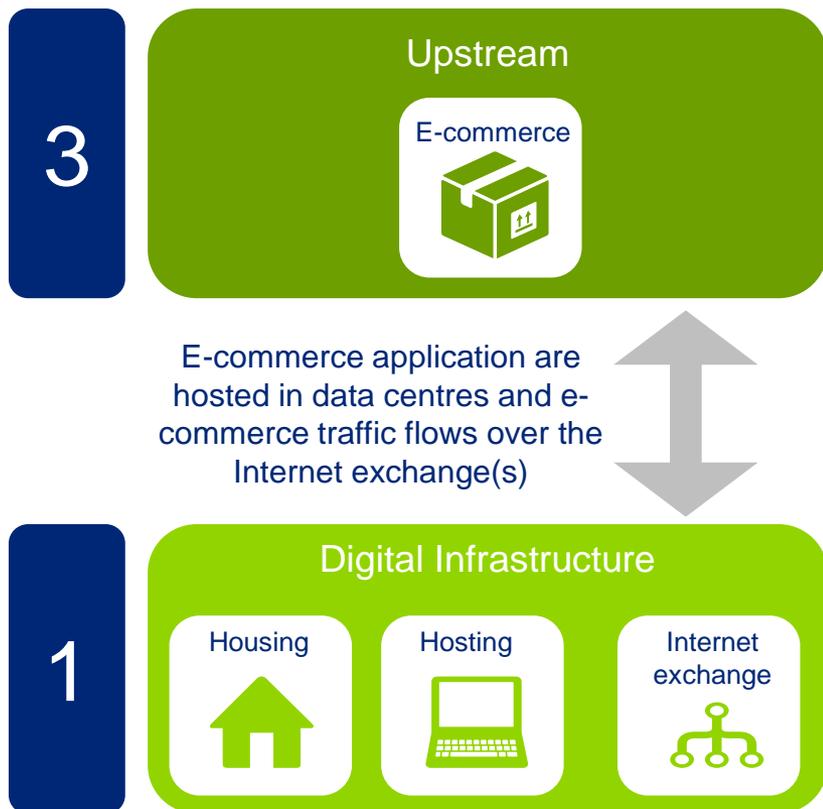
4	Digital society
3	Upstream
1	Digital infrastructure Core
2	Down stream

GDP contribution of Internet economy

NL (€ bn)

+9% Annual growth

- 2009: 24
- 2013: 34

Relative contribution (%) of Internet economy as part total GDP

- 2009: 3.9
- 2010: 4.1
- 2011: 4.5
- 2012: 4.8
- 2013: 5.3

Sources: BCG NL Report; Eurostat Database; Gartner IT Services Report; Deloitte analysis
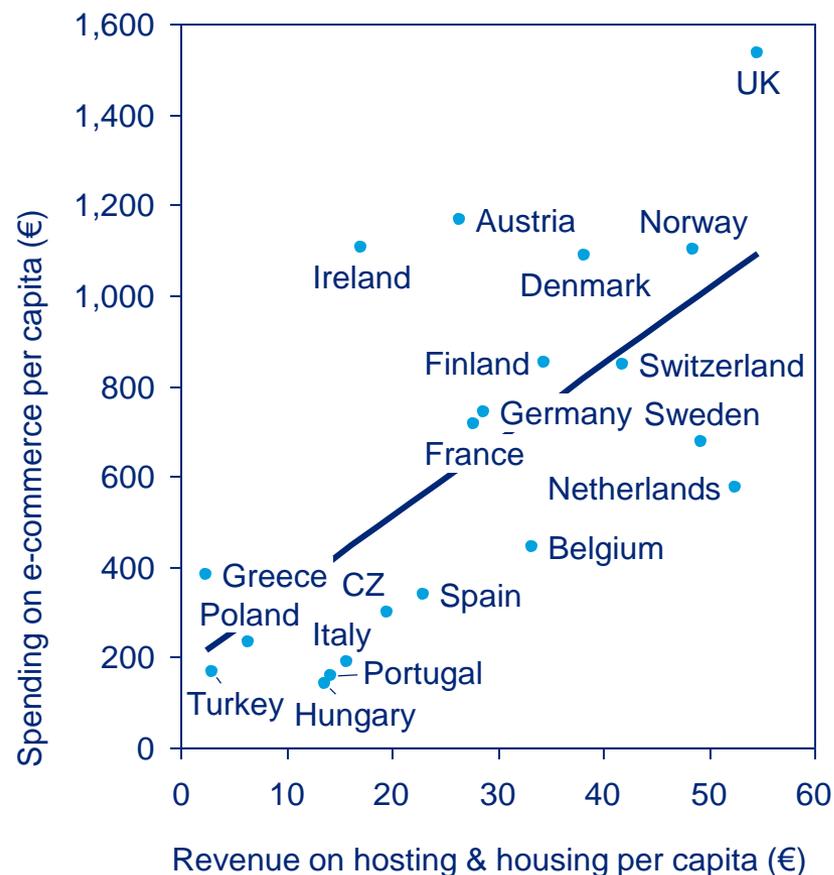
There is a strong correlation between the Digital Infrastructure and e-commerce which shows that the former is a key enabler

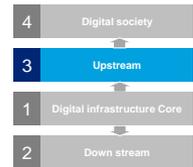## Strong correlation between Digital Infrastructure and e-commerce

3 Upstream

E-commerce

↕

E-commerce application are hosted in data centres and e-commerce traffic flows over the Internet exchange(s)

1 Digital Infrastructure

Housing | Hosting | Internet exchange

The correlation between hosting & housing revenue and spending on e-commerce per capita

Scatter plot — Spending on e-commerce per capita (€) on the y-axis (0 to 1,600) versus Revenue on hosting & housing per capita (€) on the x-axis (0 to 60). Countries plotted: UK, Austria, Norway, Ireland, Denmark, Finland, Switzerland, Germany, Sweden, France, Netherlands, Belgium, Greece, CZ, Spain, Poland, Italy, Portugal, Turkey, Hungary.

Note: revenue on hosting & housing per capita is adjusted for purchasing power
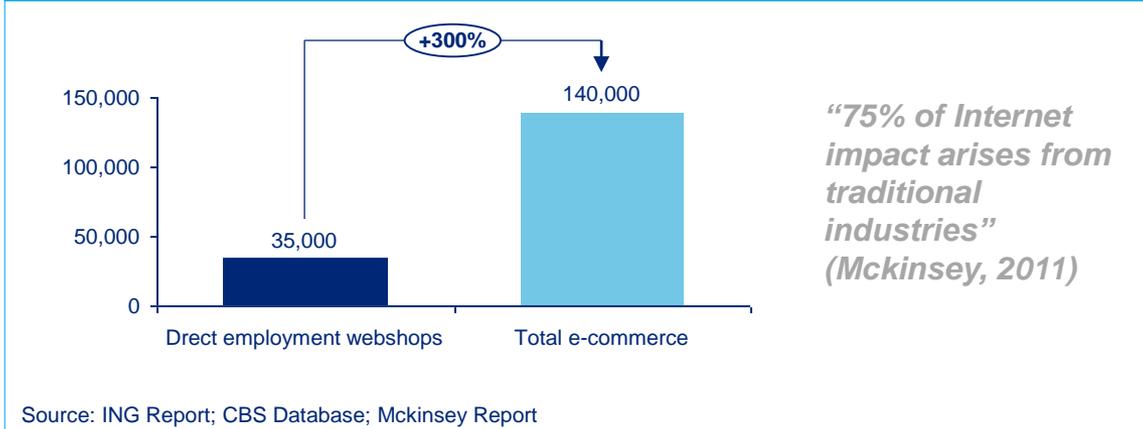Source: Eurostat Database; Ecommerce Europe Report

The employment generated by e-commerce in NL is estimated between 100,000 and 140,000
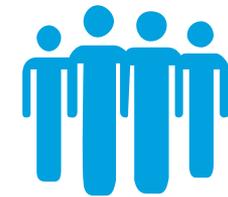
Estimating total employment based on e-commerce jobs ratio in UK

	UK		NL
E-commerce size	€107 bn	: 10 →	€10.6 bn
Jobs	930,000 – 1.1 mln	: 10 →	100,000 – 110,000

Sources: Ecommerce Europe Report; EMRG Report; Deloitte analysis

Estimating employment based on CBS data

+300%

- Drect employment webshops: 35,000
- Total e-commerce: 140,000

"75% of Internet impact arises from traditional industries" (Mckinsey, 2011)

Source: ING Report; CBS Database; Mckinsey Report

Employment

100,000 -140,000

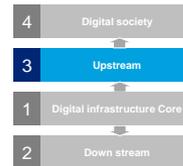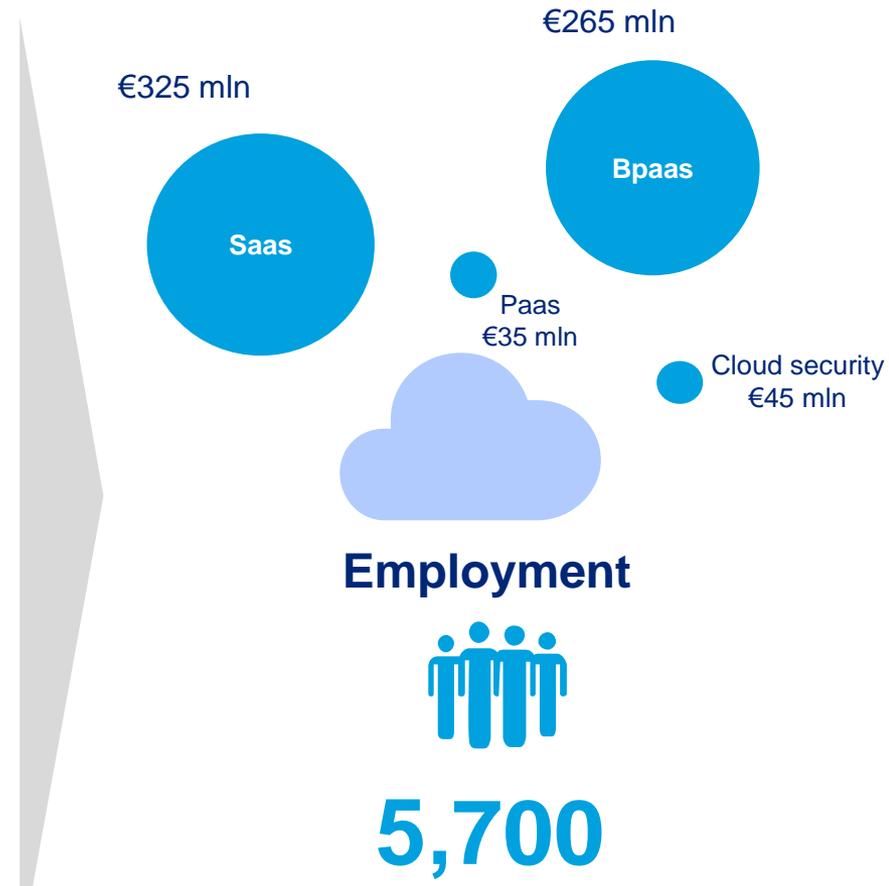# While Traditional Retail is almost flat in revenues and shows only a slight increase in employment, the revenues and employment in web-shops are strongly increasing

Jobs in Traditional Retail in NL

,000 Jobs

+5%

739 → 776

800 | 600 | 400 | 200 | 0

2007 — 2013

Revenue development for Traditional Retail

Index 2007 = 100

Annual growth

-1%

120 | 100 | 80 | 60

2007 2008 2009 2010 2011 2012 2013

Jobs in web-shops in NL

,000 Jobs

+154%

14 → 36

40 | 30 | 20 | 10 | 0

2007 — 2013

Revenue development for web-shops in NL

Index 2007 = 100

Annual growth

+14%

250 | 200 | 150 | 100

2007 2008 2009 2010 2011 2012 2013

Sources: CBS Database; ING report

SaaS and PaaS are two of the Digital Infrastructure's closest relatives, generating 5,700 jobs in the Dutch economy

Spending on Saas per capita (€)

	2012 YR	2013 YR	2014 YR	2015 YR
NL	13	18	22	26
UK	13	16	21	26
DE	6	7	9	11
FR	7	8	10	12
ES	2	2	3	3

€325 mln — Saas
€265 mln — Bpaas
Paas €35 mln
Cloud security €45 mln

Employment

5,700
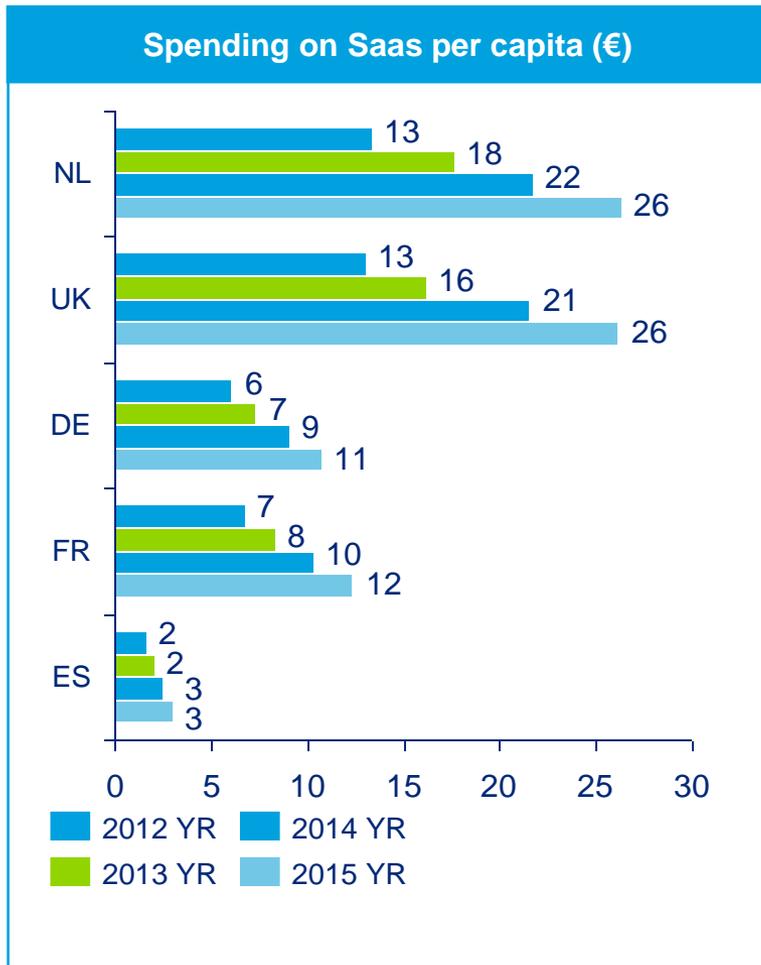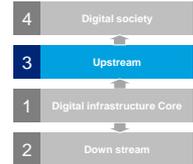
Sources: Gartner IT Spending Forecast Report; CBS Database; Deloitte analysis

Given its age, the Internet economy has already a large impact on the Dutch economy and is growing at a rapid pace relative to other growth enablers

 # FTE (k)

Annual Growth '07-'13

~1250

Port of Rotterdam

184 [1]

2014

- The Port of Rotterdam is contributing to 3.8% of the Dutch GDP
- The port is contributing to 2.3% of country employment

1 %

1916

Amsterdam Schiphol Airport

166 [1]

2014

- Schiphol is contributing to 3.4 % of the Dutch GDP
- The airport is contributing to 2.1% of the country employment

2 %

1995

Internet Economy

>100 [2]

2014

- The Internet economy is currently adding 5.3% to GDP
- Employment in e-commerce cloud and Digital Infrastructure is estimated to be 1.5% of total employment

7-9 %

1: Direct + Indirect FTE; 2: Direct FTE in E-commerce and cloud services
Sources: RHV Erasmus University; Ecquants Report

In addition to the global market, the Digital Infrastructure is a key driver for global companies to locate in NL to serve the EU
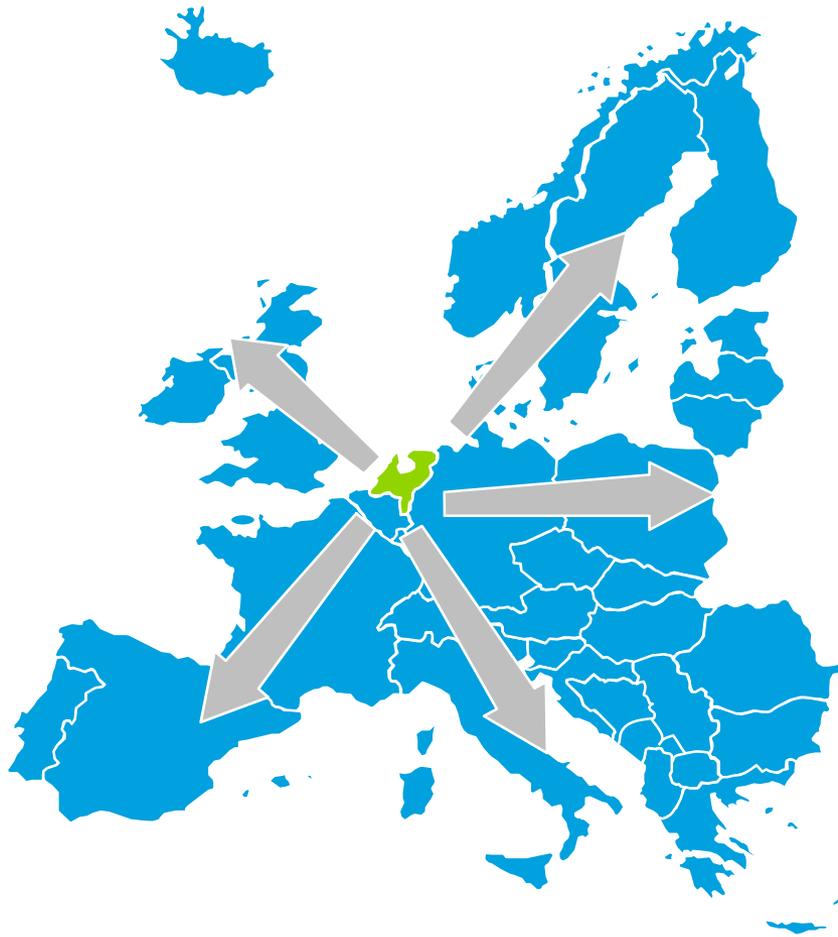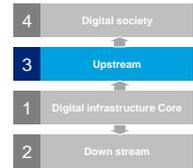
"Our world-class Digital Infrastructure is an important driver for foreign IT companies to locate in the Netherlands and from there serve the European market and beyond."

Henny Jacobs, director Investment Projects, NFIA (Netherlands Foreign Investment Agency)

"GoGrid has chosen Amsterdam due to its good network connectivity, central location in Europe, and the proximity of companies looking for an IaaS provider."

Bobby Brown, Vice President of Operations and Support at GoGrid

Source: Netherlands Foreign Investment Agency

As a result NL is hosting the top of the world's technology and Internet companies as gateway to Europe and the Internet
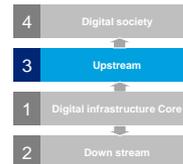
Twitter
Online social networking service with more than 271 mln active users with $664 mln revenue and 3,300 employees globally

Akamai
One of world's largest providers of content delivery networks with $1.5 bn revenue and 4,200 employees globally

CDNetworks
Full-service delivery network of Internet content and applications, accelerating more than 40,000 websites globally

Netflix
Provider of on-demand Internet streaming media, present in over 40 countries with $4.3 bn revenue and 2,000 employees globally

Softlayer
One of the world's largest cloud infrastructure providers, owned by IBM with over 80,000 servers and 26,000 customers

Amazon
One of the largest commerce companies and major provider of cloud computing services with over $74 bn revenue and 132,600 employees globally

Facebook
The largest online social networking service with more than 1.3 bn active users, $7.9 bn revenue and 8,400 employees worldwide

Go Daddy
One largest domain registrars and web hosting companies in the world with over $1.1 bn revenue and 4,000 employees worldwide
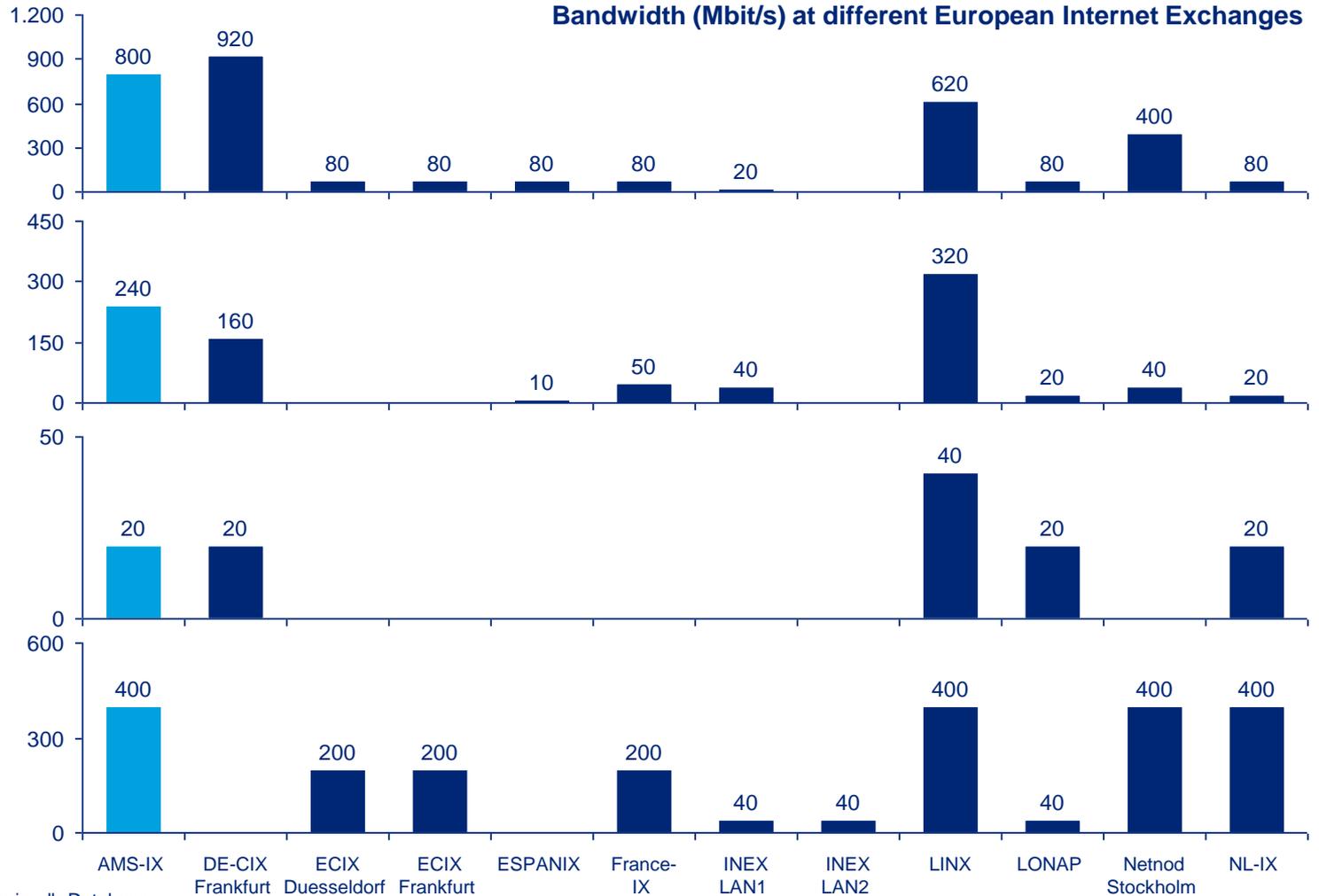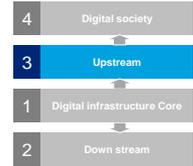
Google
Corporation specialized in Internet-related services and products with around $60 bn revenue and over 55,000 employees

Microsoft
Corporation that develops, manufactures, licenses, supports and sells e.g. computer software, consumer electronics with over $86 bn revenue

Source: AMS-IX Report

The world's largest service providers and e-commerce companies have chosen Amsterdam as their #1 or #2 Internet Exchange position in the EU

Bandwidth (Mbit/s) at different European Internet Exchanges

Akamai: AMS-IX 800, DE-CIX Frankfurt 920, ECIX Duesseldorf 80, ECIX Frankfurt 80, ESPANIX 80, France-IX 80, INEX LAN1 20, LINX 620, LONAP 80, Netnod Stockholm 400, NL-IX 80

amazon.com: AMS-IX 240, DE-CIX Frankfurt 160, ESPANIX 10, France-IX 50, INEX LAN1 40, LINX 320, LONAP 20, Netnod Stockholm 40, NL-IX 20

twitter: AMS-IX 20, DE-CIX Frankfurt 20, LINX 40, LONAP 20, NL-IX 20

NETFLIX: AMS-IX 400, ECIX Duesseldorf 200, ECIX Frankfurt 200, France-IX 200, INEX LAN1 40, INEX LAN2 40, LINX 400, LONAP 40, Netnod Stockholm 400, NL-IX 400

Categories: AMS-IX, DE-CIX Frankfurt, ECIX Duesseldorf, ECIX Frankfurt, ESPANIX, France-IX, INEX LAN1, INEX LAN2, LINX, LONAP, Netnod Stockholm, NL-IX

Sources: Euro-IX website; Peeringdb Database

Large investments in data centres within the Netherlands by corporate multinationals like Google and IBM generate additional employment
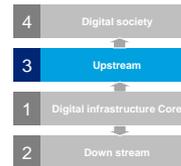
- Google invests **€600 million** on a data centre located in Delfzijl, the Netherland.

- The estimated additional employment that the data centre will provide is **150 FTE** from operations and a **1000 FTE** at the peak of constructio**n**

- Planned year of the data centre to be operational is **2017**
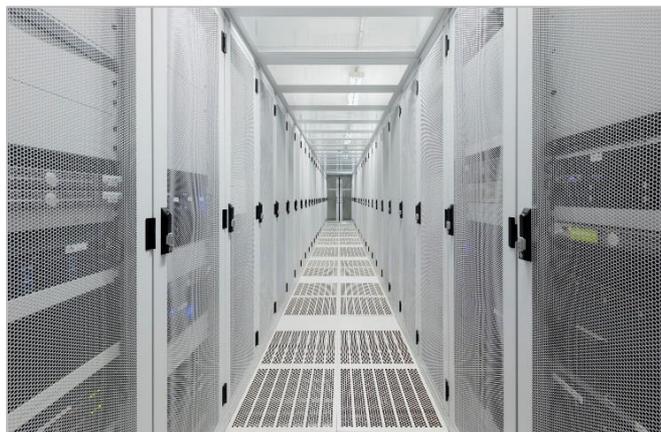
- In 2011 Softlayer, an IBM company, chose NL as its European headquarters

- It built a large data centre and invested over **€100 mln**

- Softlayer chose NL because of its fast connections to the rest of Europe

Sources: NFIA, NRC website; Parool website

D. Contribution to the digital society

Digital Infrastructure is a key enabler for the broader digital society, affecting the use of Internet, the broader economy and society
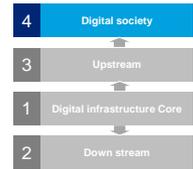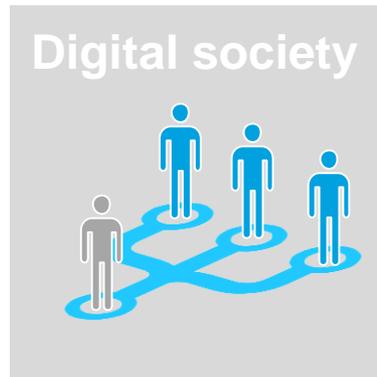
Disruptive technologies like cloud, that impact every sector's productivity, heavily depend on Digital Infrastructure

Economic impact

Internet is used for sales, purchases, marketing, with Dutch firms profiting from storage facilities and Internet exchange points close by

Business use of Internet

Digital society

Dutch Digital Infrastructure forms the backbone to a society with the strongest social impact of Internet in the world
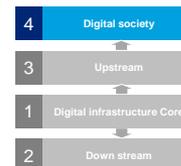
Social impact

Digital Infrastructure in NL enables the Dutch to use super fast Internet, making it easy to communicate, consume media, bank etc.

Individual use of Internet

1 **Digital Infrastructure**

The Digital Infrastructure sector highly correlates with the use of Internet by businesses …
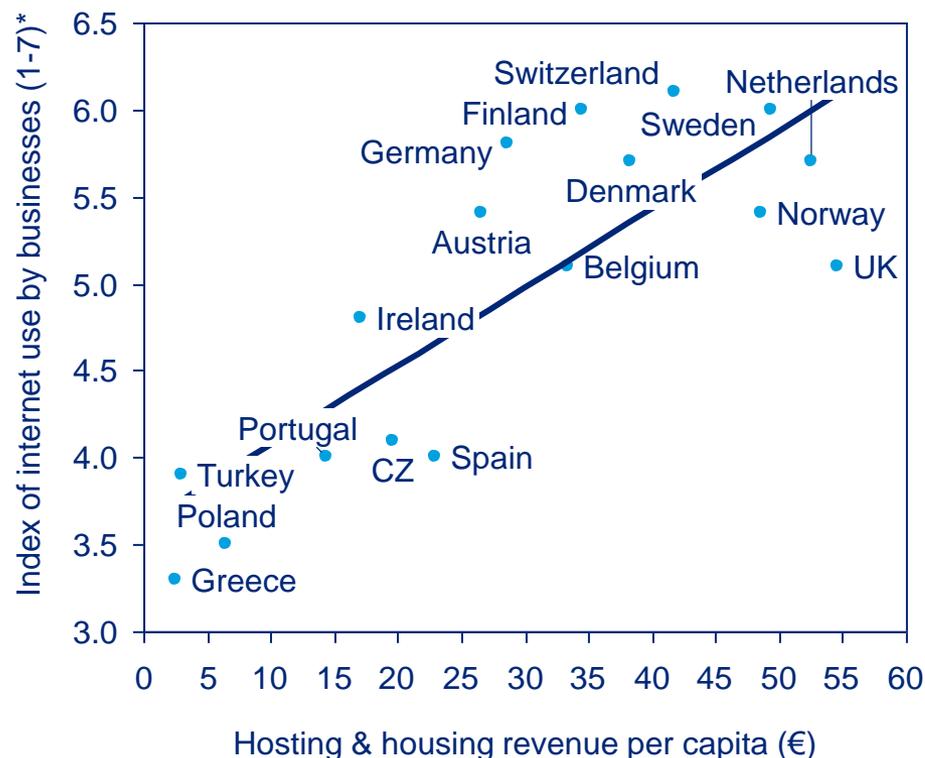
55% of the Dutch buy goods/services over the Internet at least ones per 3 months vice a vice an EU average of 38%

98% of Dutch businesses make use of the Internet vice a vice an OECD average of 94%

Digital Infrastructure highly correlates with business use

Index of internet use by businesses (1-7)*

Hosting & housing revenue per capita (€)

* Index of measures on Internet use by businesses, including B2B & B2C Internet use, firm capacity for innovation and tech absorption, extent of staff training, PTC patents applications (all measured on 1-7 scale)

Note: revenue on hosting & housing per capita is adjusted for purchasing power
Sources: Eurostat database; OECD Report; World Economic Forum, Insead, Cornell University Report
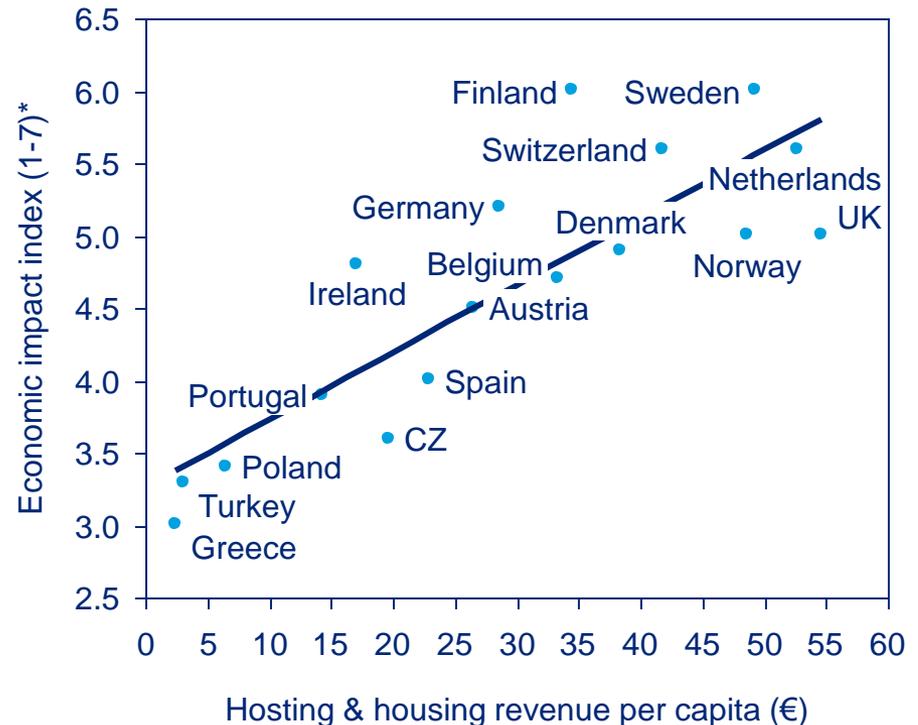
… and with economic impact through innovation and productivity gains
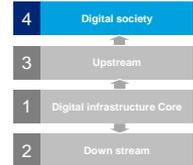
According to Etro (2009), fast adoption of innovative cloud services could have

created as much as **10,800** new Dutch SMEs during the past 5 years in retail, wholesale, tourism, transports, communication, and real estate & business activities

"Displacing in-house IT, software and support, makes

5% or greater additional time available for other tasks (…) with efficiency savings likely to spur training and redeployment rather than lay-offs" (LSE, 2012)

Digital Infrastructure highly correlates with economic impact of Internet through innovation and productivity gains

Scatter plot — Economic impact index (1-7)* on y-axis (2.5 to 6.5) vs. Hosting & housing revenue per capita (€) on x-axis (0 to 60). Countries plotted: Finland, Sweden, Switzerland, Netherlands, UK, Germany, Denmark, Belgium, Norway, Ireland, Austria, Portugal, Spain, CZ, Poland, Turkey, Greece.

* Index consists of measures on impact of ICTs on new services & products, patents, organizational models (surveys, 1-7 scale), and knowledge intensive jobs as % of workforce

Note: revenue on hosting & housing per capita is adjusted for purchasing power
Sources: F. Etro (2009); LSE Report; World Economic Forum, Insead, Cornell University Report

Furthermore, the market size of the Digital Infrastructure sector is highly correlated with the use of Internet by individuals
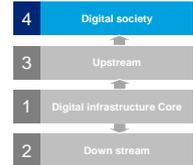
93% of Dutch households have Internet access, ranking the Dutch number 1 in Europe

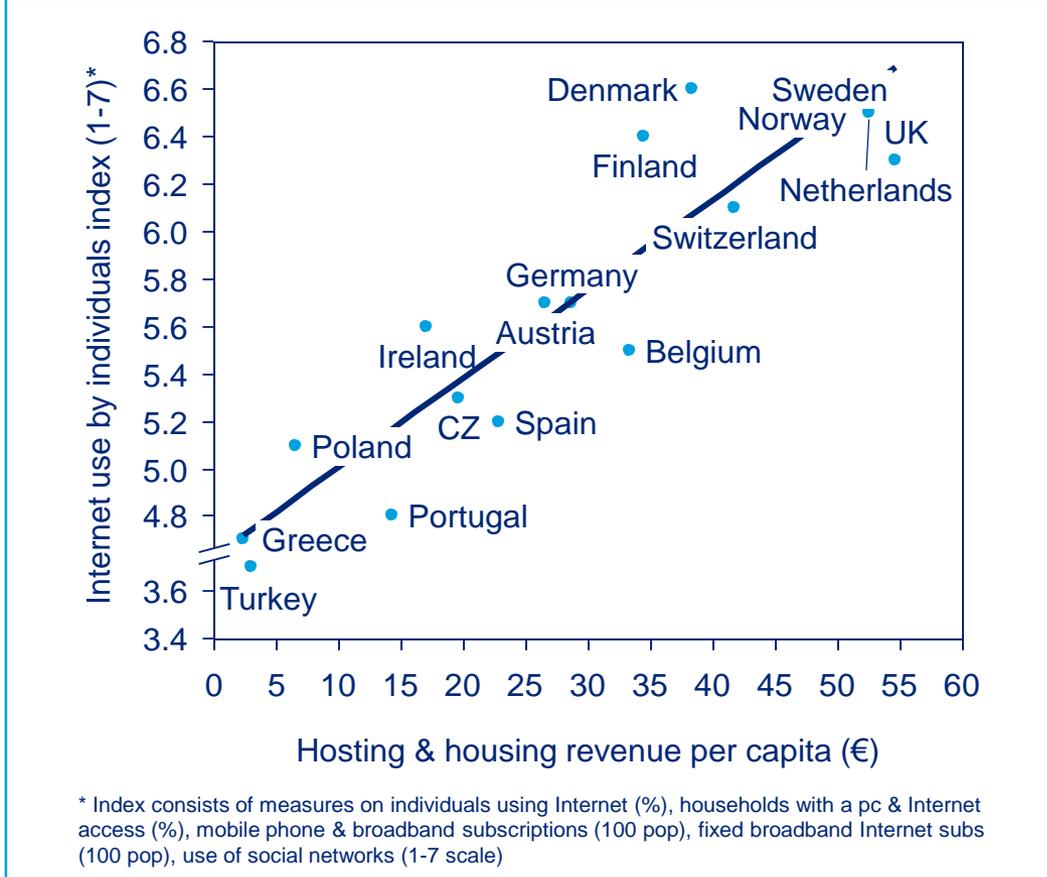**79%** of the Dutch use Internet for banking, almost double that of the OECD average

88% of the Dutch use Internet to communicate

Digital Infrastructure highly correlates with Internet use by individuals

Scatter plot — Internet use by individuals index (1-7)* versus Hosting & housing revenue per capita (€).

Countries: Denmark, Sweden, Norway, UK, Finland, Netherlands, Switzerland, Germany, Austria, Belgium, Ireland, CZ, Spain, Poland, Portugal, Greece, Turkey

* Index consists of measures on individuals using Internet (%), households with a pc & Internet access (%), mobile phone & broadband subscriptions (100 pop), fixed broadband Internet subs (100 pop), use of social networks (1-7 scale)

Note: revenue on hosting & housing per capita is adjusted for purchasing power
Sources: OECD Report; World Economic Forum, Insead, Cornell University Report

… which in turn has a positive effect in the social impact of the Internet in a country
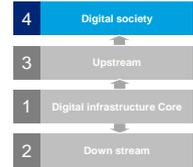
79% of the Dutch interact with e-government in the past year vice a vice an EU average of 41%

The Dutch rank number 1 in Internet access at schools, covering **100%**
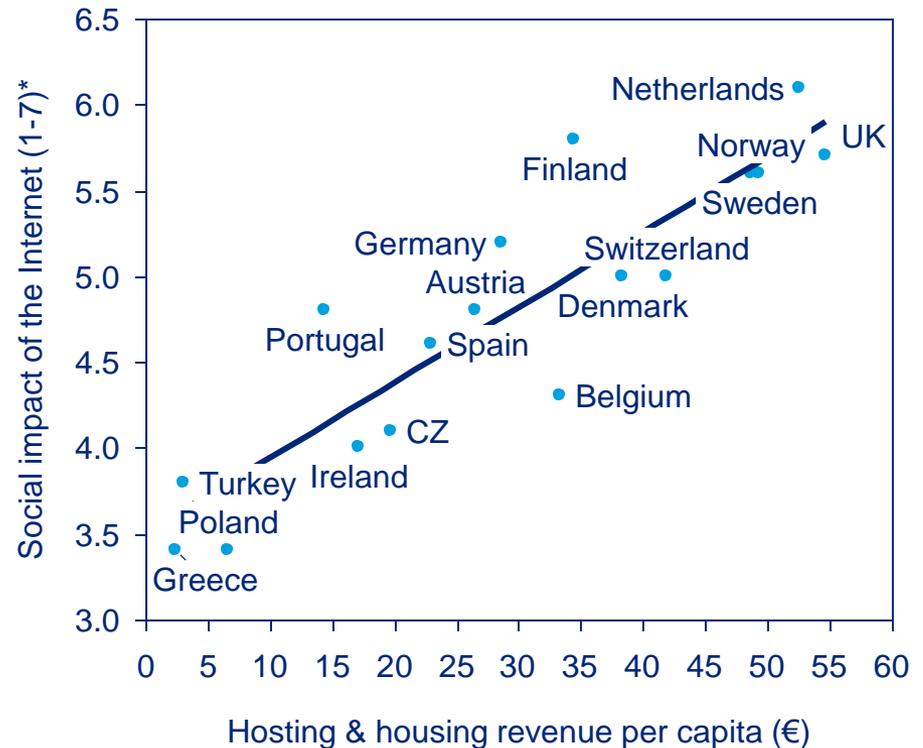
Digital Infrastructure highly correlates with social impact of Internet

Scatter plot — X-axis: Hosting & housing revenue per capita (€), Y-axis: Social impact of the Internet (1-7)*. Countries plotted: Netherlands, Norway, UK, Finland, Sweden, Germany, Switzerland, Austria, Denmark, Portugal, Spain, Belgium, CZ, Ireland, Turkey, Poland, Greece.

* Index consists of measures on impact of ICTs on access to basic services, Internet access in schools, ICT use & government efficiency (all measured on 1-7 scale), E-Participation index (0-1)

Note: revenue on hosting & housing per capita is adjusted for purchasing power
Sources: Eurostat Database, World Economic Forum, Insead, Cornell University Report

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4. Future of the sector
- Conclusions
- Recommendations

The NL Digital Infrastructure sector is rapidly expanding, but employment in the sector itself, although growing, is limited

In Europe the Netherlands remains a frontrunner in the rapidly expanding Digital Infrastructure sector

- The Netherlands has a leading position in internet exchanges, datacenter housing and hosting, three sectors that together with telecommunications form the Digital Infrastructure

- Amsterdam based AMS-IX holds on to its position as the largest Internet exchange point in the world (in terms of number of peering networks). In the last 12 months, total Internet traffic increased by 30%

- NL scores 2nd place in EMEA and 5th globally on broadband penetration and average connection speed

- The Amsterdam region has cemented its position as a European hotspot for colocation with a year-on-year growth in supply of 6.3%

- NL holds a strong position in hosting services, ranking 2nd in revenue per capita and relative market size

- Cloud will become a key driver for growth in the Digital Infrastructure sector. In the next years, global data centre traffic is expected to show an increase of 25% a year, in which Cloud contributes with an annual growth rate of 35%

The impact of the sector itself on the Dutch economy is relatively small, though on a steep growth trajectory

- The NL Digital Infrastructure sector is capital intensive with an annual revenue of €1.18 billion and investments of €380 million

- Direct employment from operations in the sector adds up to 7,600 jobs

- An additional 11,700 jobs are created in sectors supplying inputs for production and construction, as well as workforce spending in the broader economy

- Employment in the sector grows on average 8% a year, translating in ~3,000 extra jobs within 5 years in the sector itself

However, the real impact of Digital Infrastructure lies in its growth enabling effects on the much larger digital economy and society

Digital Infrastructure is a driver for the Internet economy with much higher revenues and employment

– The NL Internet economy is estimated to be 5.3% of GDP and increasing 9% a year.

– Digital Infrastructure is an important enabler for direct employment in e-commerce and cloud services, providing jobs for at least 100,000 people

– While in theory a footloose Internet economy could blossom at distance from local Digital Infrastructure, our research shows that the size of the Internet economy is highly correlated with the size of the national Digital Infrastructure sector

– Our explanation for that is a mutual amplification of the following effects:

  o The online sector and the Digital Infrastructure sector both profit from the same root causes

  o Demand-effect: growth in the Internet economy increases demand for Digital Infrastructure

  o Supply-effect: the presence of strong Digital Infrastructure attracts suppliers of online products and services

Digital Infrastructure is a pre-condition for a strong digital economy and society

– Countries with a strong Digital Infrastructure sector tend to have more individuals and businesses using the Internet, with the Netherlands consistently ranking high on Digital Infrastructure and Internet use

– Countries with a strong Digital Infrastructure sector benefit more from the economic impact of the Internet through innovations and productivity gains

To benefit even more from its strong position in Digital Infrastructure and raise economic growth, we have the following six recommendations

1. **Support investments and developments in the Digital Infrastructure sector.** Barriers for investments and additional national or European legislation have a negative impact on economic growth as the sector is a driver for the international internet economy and the digital society

2. **Create incentive measures for the online ecosystem as a whole.** Do not only look at the core Digital Infrastructure sector, but also to the down- and upstream sectors as they strengthen each other

3. **In particular, stimulate innovations that depend on the Dutch Digital Infrastructure.** Chances for growth can be found in E-commerce, online services and by stimulating cloud innovations by Dutch firms

4. **Stimulate the choice of NL as a host nation for multinationals who offer digital services**. In the wake of stiff international competition and growing importance of Digital Infrastructure for business operations, attracting foreign firms who are heavy users of our digital facilities can contribute significantly to the growth of the Dutch online ecosystem

5. **Form regulatory frameworks which focuses on the broader picture**. The size and growth of the Digital Infrastructure and the Internet economy justifies its own frameworks, avoiding unnecessary legislation

6. **Align education to ensure a workforce that meets the needs of the digital economy**. The rate of change and growth of the digital economy and the impact on our society requires a proactive approach to teach digital skills in all aspects parts of the educational system

5. Appendices
- List of Sources
- List of Authors

List of sources

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List of authors

Digital Infrastructure in the Netherlands – Driver for the Online Ecosystem

About the Authors

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