A Work Project, presented as part of the requirements for the Award of a Master's degree in Economics / Finance / Management from the Nova School of Business and Economics.

Market research on energy demand regarding sustainable energy transition

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In light of a sustainable energy transition, what are the key changes across the multiple sectors and what opportunities will emerge?

Abstract

1 Demand

Demand for energy and renewable sources is increasing. The buildings segment has the potential to have the largest share of renewable-produced energy followed by industry, yet transport can face the highest growth. Greater investment opportunities will emerge in buildings and transport with new technology and low-carbon policies unlocking new business models in areas like demand flexibility, efficiency and e-mobility

2 Transmission

Transmission development comes as a result of the rise in demand, generation capacity and the distance that separates these two. These constraints can be addressed through a set of solutions which complemented, meet the requirements of a flexible integrated transmission

3 Generation

The generation energy market once dominated by massive oil companies is experiencing changes that allow new types of players. The 2050 scenarios show large increases in renewable technologies total installation capacities and power generation mainly in wind and solar power as well as a great investment opportunity in wind power

4 Investment Opportunities

A cleaner energy market will diversify the ecosystem and change the nature of factors to succeed across demand, transmission and generation. Investment opportunities will be greater in energy demand and the total investment of the three areas combined represents 3.1% of the World GDP. This new ecosystem will allow new players to emerge and fragment a former highly concentrated market with increased uncertainty, encouraging partnerships

Keywords: buildings, transport, industry, investment

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Executive Summary: Demand

1.1 Demand Trends

Demand for energy and renewable sources is increasing

1.1.1 Primary energy demand is rising in emerging nations due to socioeconomic development, while demand in developed countries faces a slower growth

1.1.2 Renewables are expected to skyrocket and become the foremost energy source of primary energy consumption after 2045 driven by three main factors

1.1.3 End-use fuel mix increasingly shifts, at an average of 2.03% per year growth, toward renewable-produced electricity

1.2 Prominent Power Consumers

Regarding renewable-produced energy, buildings can have the largest share followed by industry, yet transport can face the highest growth. Furthermore, buildings and transport could actually reduce global energy demand if optimistic actions are set in motion

1.2.1 The three largest consumers are the buildings, transport and industry segments and they have all faced an increase in activities in the past decade

1.2.2 The industrial sector appropriates more than half of the world energy consumption while buildings leads on electricity demand

Buildings

- Lighting and data centres are adopting efficient measures while heating and energy Codes need fast action for a sustainable future
- The buildings segment can have the largest share of renewable-produced energy with clean electricity powering most of the activities
- Reducing energy need, foster distributed networks and support expansion of renewable fuels policies are key plays for sustainability

Transport

- Electric vehicles and rail are progressing positively to meet sustainable targets while Biofuels need urgent attention to get on track
- Transport can both grow its share of renewables and reduce total final energy consumed the most due to electric mobility and biofuels
- Reducing energy need, boost electric mobility and adoption of renewable fuels policies are key plays for sustainability

Industry

- Most of industry activities require more efforts to reach a cleaner future and projects involving low-carbon technologies have to speed up
- Industry is the only segment that cannot decrease consumption in 2050 but can still expand renewables share driven by electricity
- Reducing energy consumption, enable corporate sourcing of renewables and accelerate low-carbon solutions are key plays for sustainability

1.3 Investment

Greater investment opportunities will emerge in buildings and transport with new technology and low-carbon policies unlocking new business models in areas like demand flexibility, efficiency and e-mobility

1.3.1 Investments in demand flexibility, energy efficiency and electric mobility have been increasing

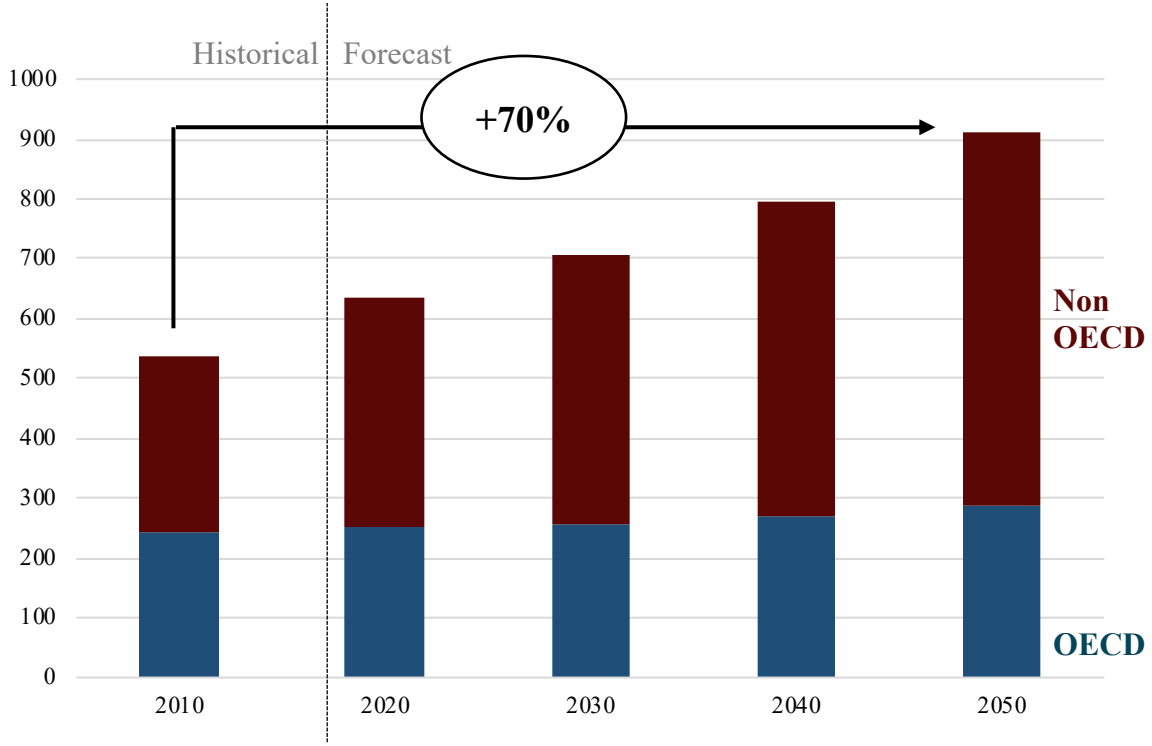
1.3.2 Virtual Power Plants (Next Kraftwerke), energy consulting firms (CCEnergia) and e-mobility start-ups (UZE) are some of the emerging players

1.3.3 Investments will be greater for buildings in one scenario and transport for another, while industry lags considerably behind in both scenarios

Primary energy demand is rising notably in emerging nations due to fast socioeconomic development, while consumption in developed countries faces a slower growth

World energy use will **increase by 70%** from 2010 to 2050, led by growth in **non-OECD nations**

1. World primary energy consumption [2010-2050, btu]



Drivers of primary demand expansion

Non-OECD

- **Rapid socioeconomic progress** is the main reason for increase in demand in emerging nations - high population and economic growth
- Non-OECD Asia, including China and India, is the largest and fastest growing region

OECD

- Demand faces a slower growth in developed nations because of lower socioeconomic development
- Gains in energy efficiency also enables savings in consumption

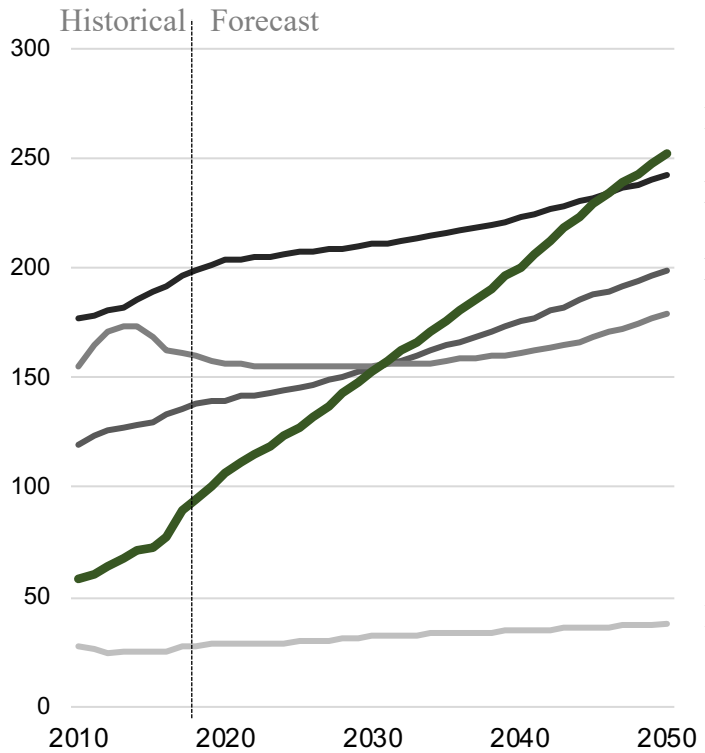
OECD – Organization for Economic Cooperation and Development, mostly developed economies
Non-OECD – Countries that do not belong to OECD, mostly emerging economies

1. Source: EIA 2019

Renewables are expected to skyrocket and become the foremost energy source of primary energy demand after 2045, driven by three main factors

Renewables **grow** in average **3.75% annually** becoming the dominant source after 2045

2. World Primary energy consumption [2010-2050, btu]



	AAGR
Renewables	3.75%
Liquids	0.79%
Natural gas	1.28%
Coal	0.37%
Nuclear	0.83%

Drivers of renewable energy expansion

Fossil Fuels Limitations

- The supply of fossil energy is scarce and subject to rigid resource restrictions
- On the other hand, renewable energy resources are abundant and limitless

Energy Environment Constraints

- Global efforts to combat climate change have quickened low carbon energy development
- The current usage of energy resources is ecologically and environmentally unsustainable

Energy Policy Regulation

- Drives innovation in energy technology
- Supports energy and environmental improvements

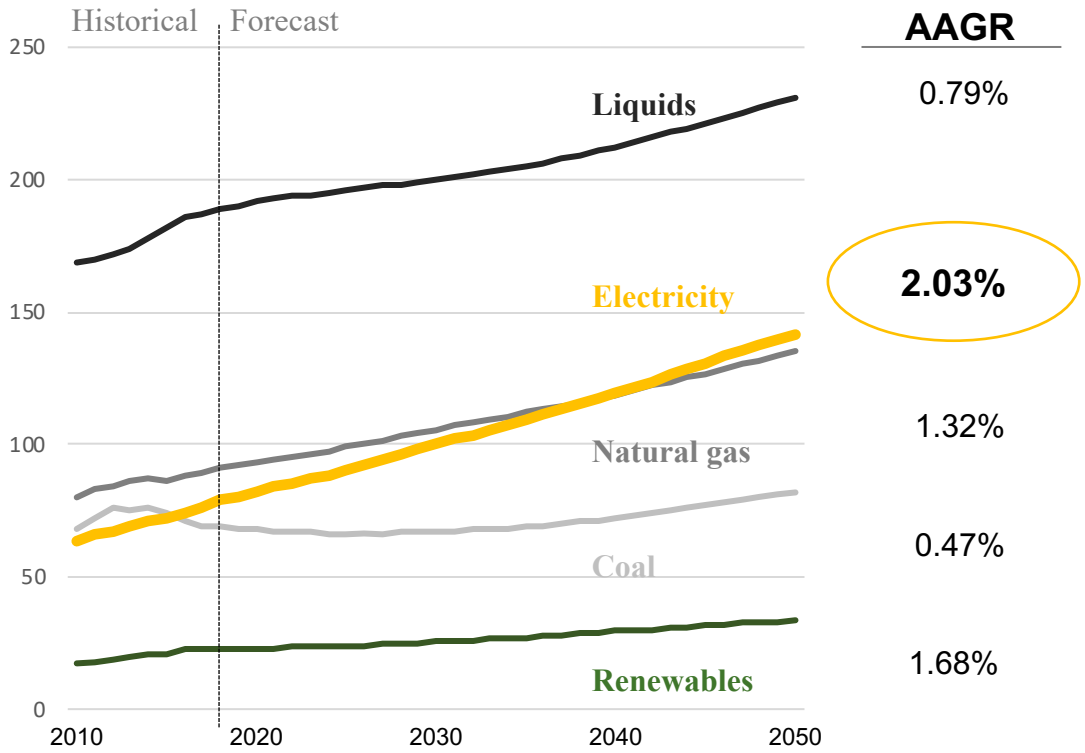
Primary energy demand refers to the energy directly harvested from the natural sources
It can be used directly by the user or transformed to other form like electricity

1. Source: EIA 2019
2. Source: Liu 2015

End-use energy demand fuel mix is increasingly shifting, at an average of 2.03% per year growth, towards renewables-produced electricity

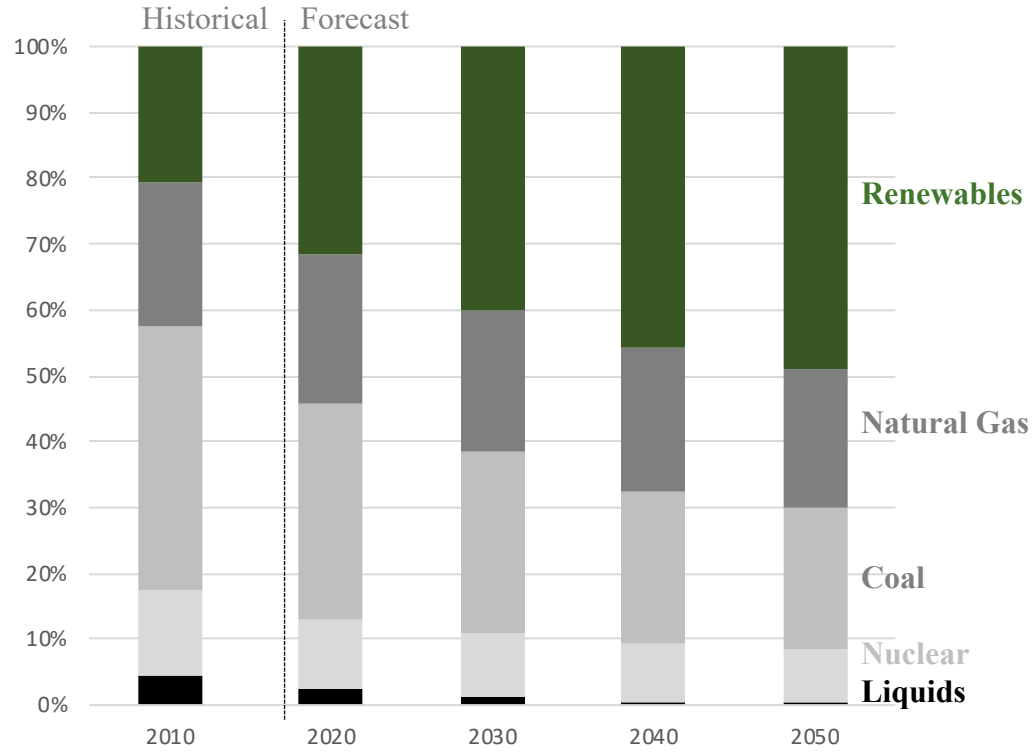
All sources of energy are expecting to increase but electricity faces the **fastest growth** in end-use energy demand

3. World end-use energy consumption [2010-2050, btu]



Renewables sources are progressively becoming the **main generator** of electricity reaching 50% of share in 2050

4. World share of net electricity generation [2010-2050, %]



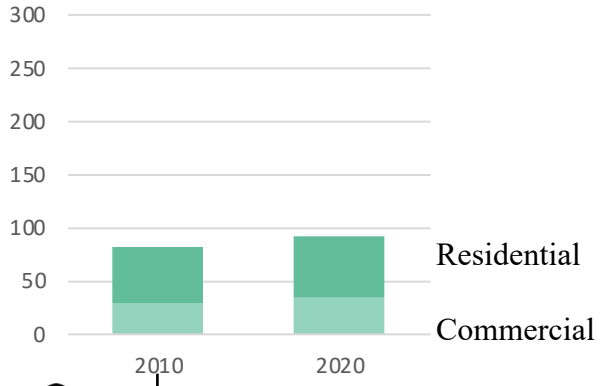
End-use energy demand refers to the energy consumed directly by the user
Renewables are little used for end-use means, however they can generate clean end-use electricity

1. Source: EIA 2019

The three largest consumers of energy are the buildings, transport and industry segments and they have all encountered an increase in activities in the past decade

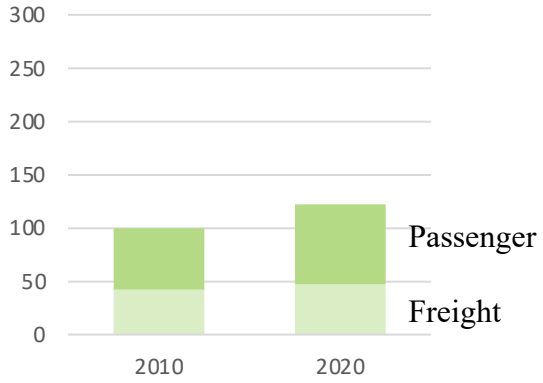
Within buildings, households considerably waste more power than commercial buildings and it is is mostly used for heating, cooling, lighting and appliances

5. Buildings energy consumption [2010-2020, btu]



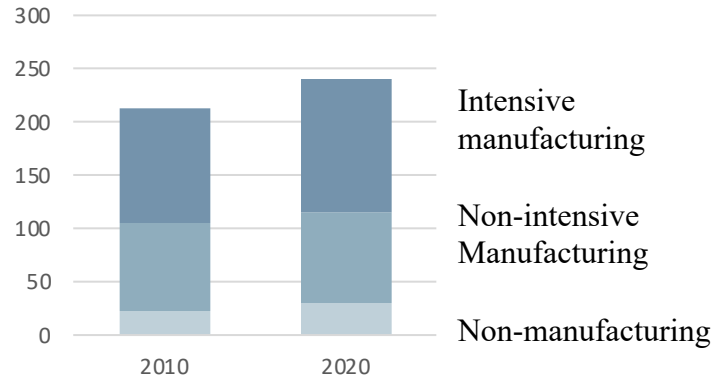
Within transport, passenger vehicles (cars, aircrafts, buses, 2/3 wheelers, rail) consume more energy than transportation of goods (trucks, marine, rail)

6. Transport energy consumption [2010-2020, btu]



Within industry, intensive manufacturing (chemicals, iron and steel, paper, etc..) activities drain more energy that non-intensive manufacturing or non-manufacturing

7. Industry energy consumption [2010-2020, btu]

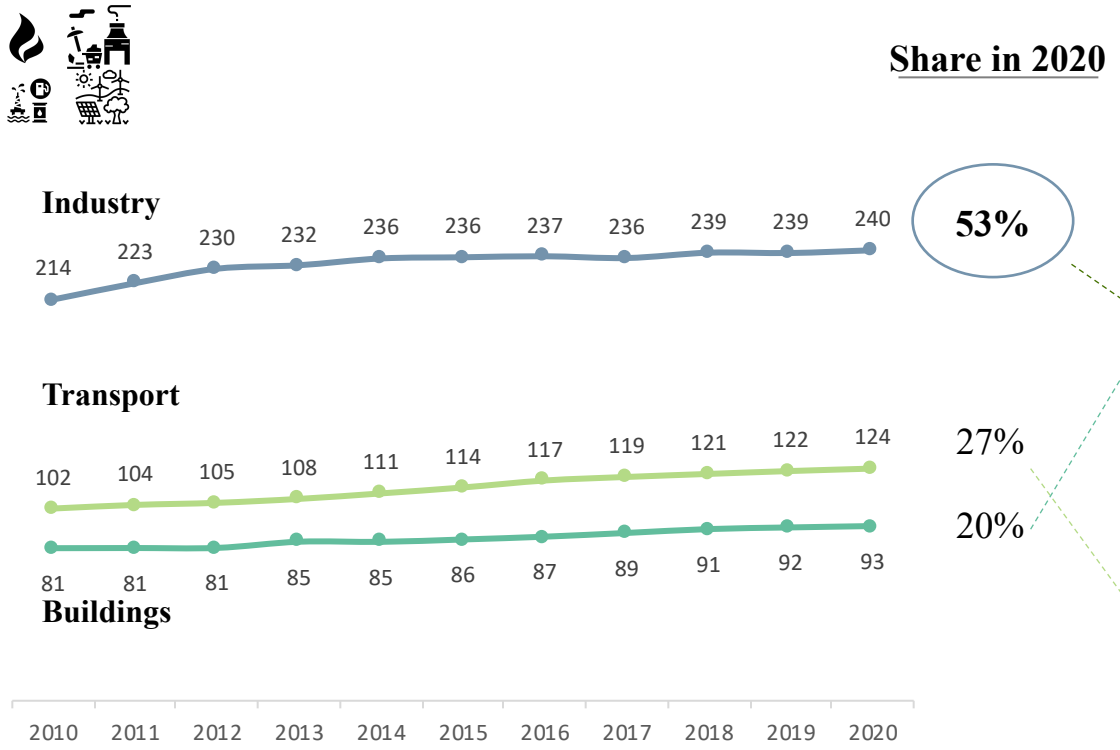


1. Source: EIA 2019

The industrial segment appropriates more than half of the world's energy consumption while buildings leads on electricity demand

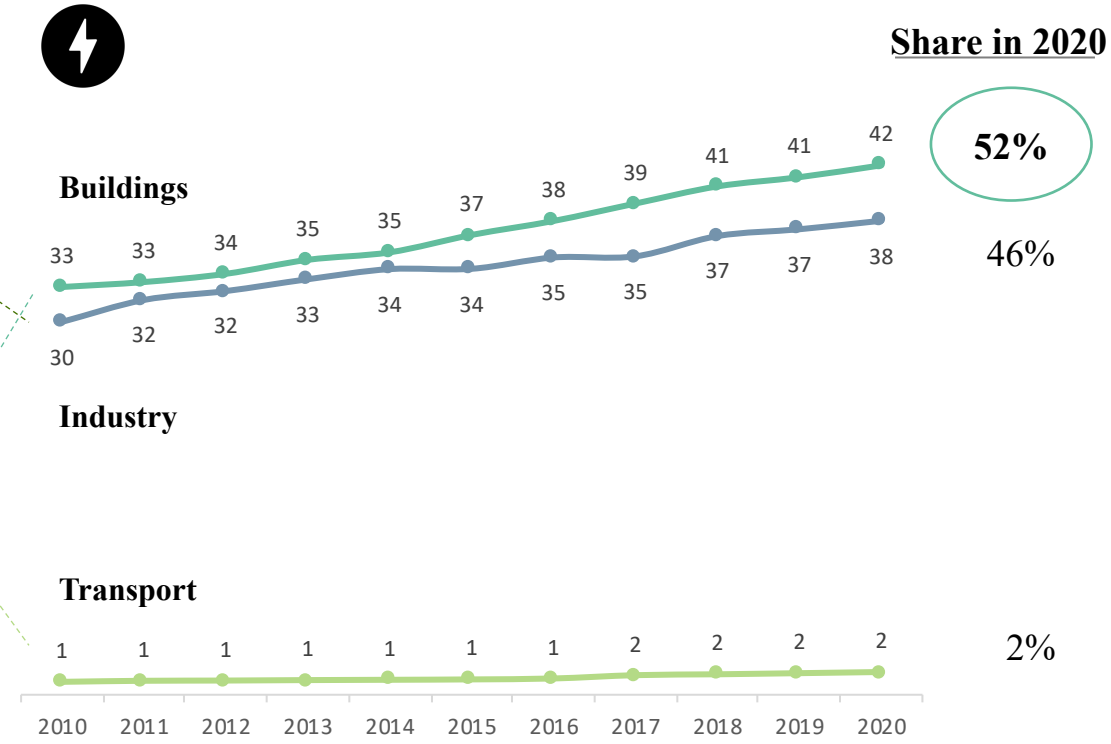
All segments tend to consume more energy throughout the years, but **industry** is by far the largest spender, consuming 53% of total energy in 2020

8. World end-use energy consumption [2010-2020, btu]



The figures change when the focus is on **electricity**, with **buildings** draining more power while transportation remains with an extremely low share

9. World electricity consumption [2010-2020, btu]



1. Source: EIA 2019

Lighting and data centres are adopting efficient and clean measures, at the same time heating and energy codes need fast action for a sustainable future scenario

Lighting

- In 2018 **LEDs** equalled less-efficient fluorescent lamps market share (40%)
- As LED costs continue to fall, it will make 90% of sales by 2030 while incandescent lamps phase out entirely

Data Centres

- Increasing **digitalization** leads to more use of data centres and data transmission networks
- Despite the increase in demand for these services, advances in **energy efficiency** have helped to limit electricity demand growth

Cooling

- Climate change is rising temperatures, therefore demand increases in the need for cooling
- Higher-efficiency air conditioners should be standard to improve performance and cut emissions

Appliances and Equipment

- Even though energy use of household appliances keeps growing, only 1/3 of appliance energy use is covered by mandatory performance standards
- Policy coverage and stricter regulations needed

Heating

- Sales of **heat pumps and renewable heating** equipment have increased 5% per year since 2010 but fossil fuel based and lesser efficient equipment still takes larger share
- Ambitious and innovative **policy** tools should accelerate the expansion of renewable heating and heat pumps

Buildings Envelopes

- **2/3** of countries lacked mandatory building energy codes in 2018
- **High-performance** new construction needs to increase so **does energy efficiency renovation** of existing stock

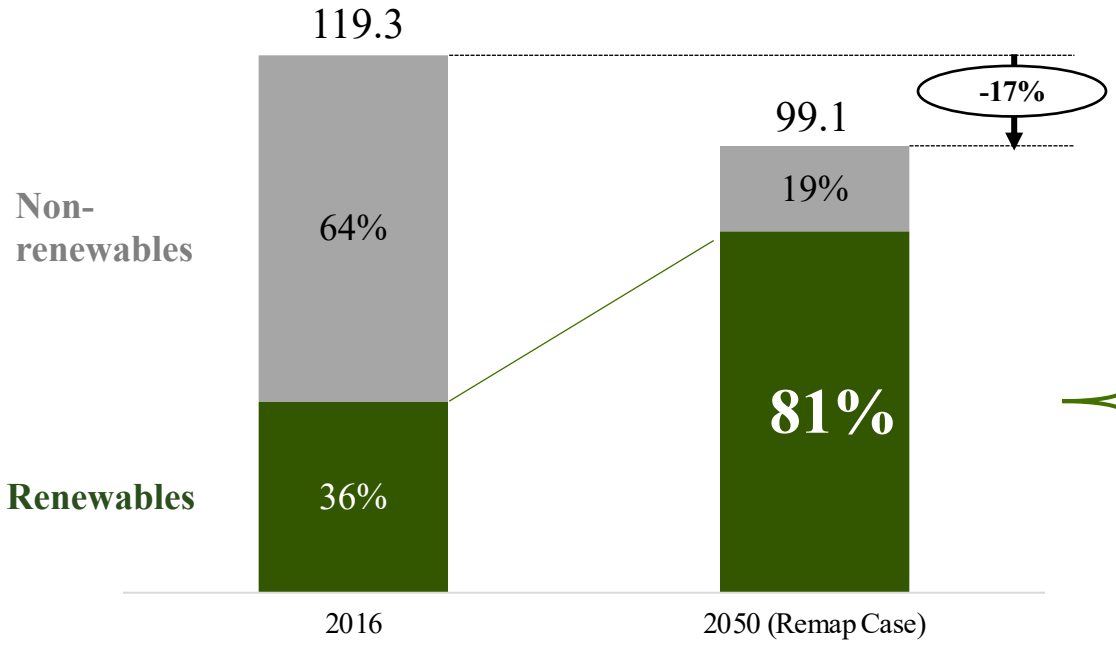
Tracking clean energy progress scale (2019): On track | More efforts needed | Not on track

3. Source: IEA 2019

The buildings segment has the potential to have the largest share of renewable-produced energy with clean electricity powering most of the activities

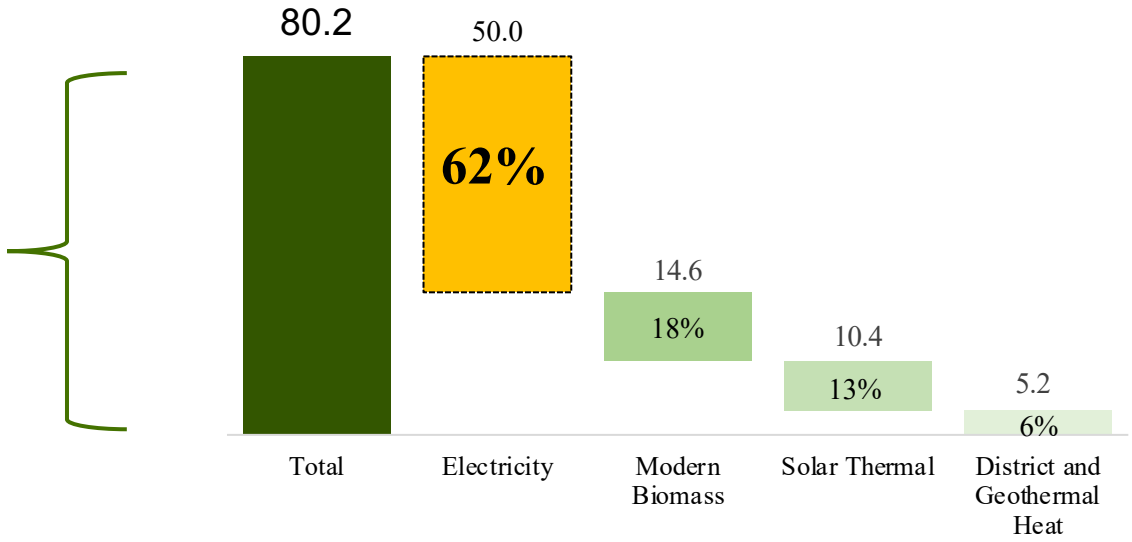
Buildings have the potential to **decrease** its final consumption by **17%** while noticeably **increase** the share of renewables **to 81%** in 2050, bigger than any other segment

10. World buildings final energy consumption
[2016-2050, Petajoules]



Clean generated electricity will be, by far, the most used source of renewable energy in the buildings segment with a **share higher than 60%**

11. Renewables consumption by source
[2050 (Remap Case), Petajoules]



4. Source: IRENA 2018

Reducing energy consumption, foster distributed networks and support the expansion of renewables are essential measures for a clean buildings future

Reduce energy consumption	• Establish and improve **energy efficiency building codes and standards** • Exploit synergies between renewable heat and energy efficiency policies • Adopt programmes for retrofitting/renovation including financial schemes
Foster Distributed Energy Networks	• Support prosumers to take an active role in the energy system transformation • Promote **community ownership** models and innovating financing schemes • Capitalise on **smart-homes and digitalisation to allow demand management**
Support expansion of renewables	• Promote **low carbon heating technologies** and apply them to district heating • Incentivise renewable based cooling solutions • Replace traditional biomass as cooking fuel with clean and efficient cookstoves

5. Source: IRENA 2019

Electric vehicles and rail are progressing positively to meet sustainable targets while biofuels need urgent attention to get on track

Electric Vehicles

- Global electric car sales increased 68% in 2018 and Bloomberg states that in **2040 EV sales will surpass ICE ones**
- Supportive policies and technological advances are driving this rapid uptake, specially **cheaper and higher capacity batteries**

Rail

- Urban and high-speed electric rail infrastructures **have scaled up rapidly** over the past decade
- **Rail investment is expensive** and high passenger and freight movement is necessary for project to pay off

Buses and Trucks

- Emissions from trucks and buses have risen 2.2% annually since 2000
- Standards to improve logistics and operational efficiency are needed as well as electrification of urban heavy vehicles

Aviation

- Air transport demand has more than doubled since 2000 and emissions have grown 32% in the past 5 years
- Energy efficiency needs to improve at a higher rate so does more stringent carbon pricing

Marine Shipping

- CO_2 emissions from international shipping are projected to be 50% higher in 2040 than they were in 2008
- Urgent need for policy action and innovation is need to minimize the gap between conventional and low-carbon fuels

Biofuels

- 3% of annual production growth is expected for the next 5 years but stronger policy support and innovation to **reduce costs** are needed
- **Scaling up advanced biofuels** use and foster its adoption in aviation and marine transport as low carbon solutions is vital

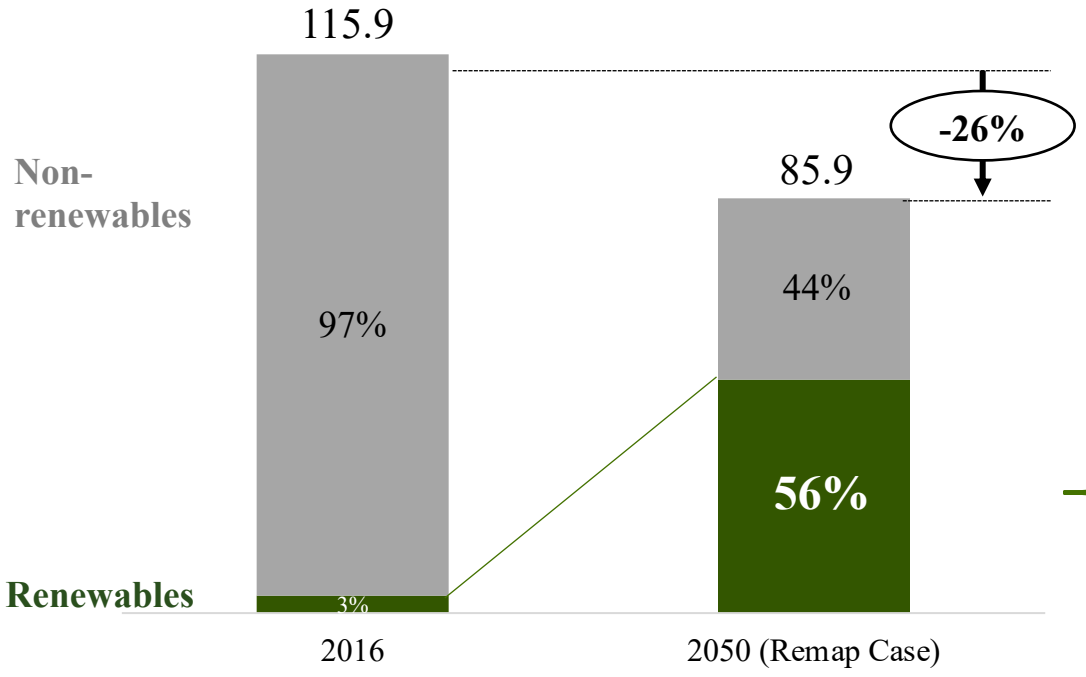
Tracking clean energy progress scale (2019): On track | More efforts needed | Not on track

3. Source: IEA 2019
6. Source: BloombergNEF 2019

Transport can both grow considerably its share of renewables and reduce the total final energy consumed by 26% due to electric mobility and biofuels

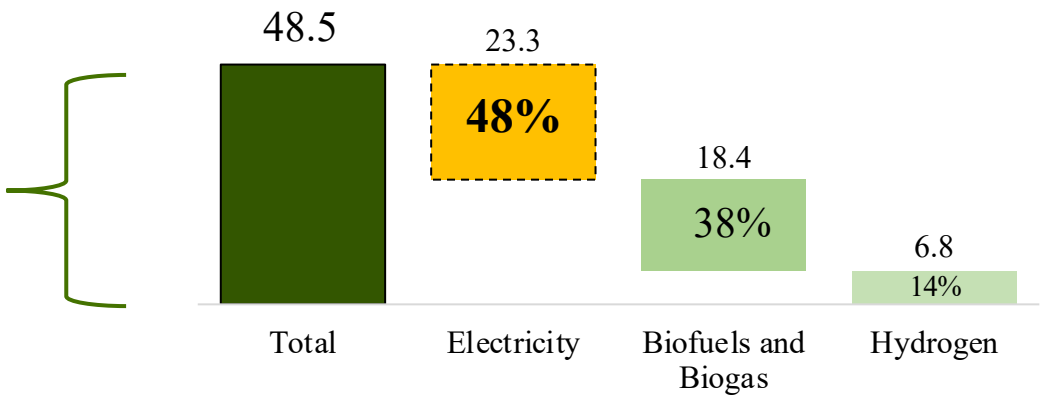
Transport has the potential to **rise** its share of renewables by **53%** and **reduce** final power consumption by **26%** in 2050 under the Remap scenario

12. World transport final energy consumption
[2016-2050, Petajoules]



Electric mobility will be responsible for almost **half** of renewables usage, followed by **Biofuels** with almost **38%** reinforcing the need to **accelerate its development**

13. Renewables consumption by source
[2050 (Remap Case), Petajoules]



4. Source: IRENA 2018

Reducing energy consumption, accelerate electric mobility and foster renewable fuel solutions are key measures for a sustainable transport future

 Reduce energy consumption	• Better mobility services and **modal shift from car ownership to public transport** • Implementation of advanced digital communication technologies to avoid the need to travel • Promote **vehicle sharing** and increase efficiency of traffic and parking related technologies
 Accelerate Electric Mobility	• Prioritize electric vehicles through **environmental subsidies** and emission standards incentives • Boost the **evolution** of the e-mobility **ecosystem** (accelerate charging infrastructures) • Deploy low emission light-duty vehicles and freight trucks
 Foster Renewable fuel solutions	• Remove fossil fuel subsidies and enforce carbon pricing to **leverage biofuels competitiveness** • Scale-up sustainable production of advanced biofuels over supporting policies • Incentivise the use of **biofuels across ships and aircrafts**

5. Source: IRENA 2019

Most of industry activities require more efforts to reach a cleaner future scenario and projects involving low-carbon technologies have to urgently speed up

Chemicals

- Strong growth in demand is expected with CO_2 emissions increasing
- Incentive adoption of CCUS and use and disposal of chemical products (recycle plastic)

Iron and Steel

- Production grew 4% in 2017 and emissions rate need to lower at a faster rate
- Governments should provide R&D funding for low-carbon processes (CCUS)

Cement

- CO2 intensity of cement increased 0,3% from 2014 to 2017
- Deploying innovative technologies and increase uptake of alternative fuels is necessary

Pulp and Paper

- Energy use needs to decline while paper production increases
- Recycling and higher share of bioenergy is necessary

Aluminium

- A decline is needed requiring scrap collection and sorting to enable recycling
- Further development of new low-carbon policies and technologies is also required

CCUS (Carbon Capture, Use, Storage)

- One of the few technology options available to **significantly reduce CO_2** emissions across many industries
- **Policy measures, greater funding, low-carbon incentives** are needed to accelerate more projects (only **17 projects in 2019**)

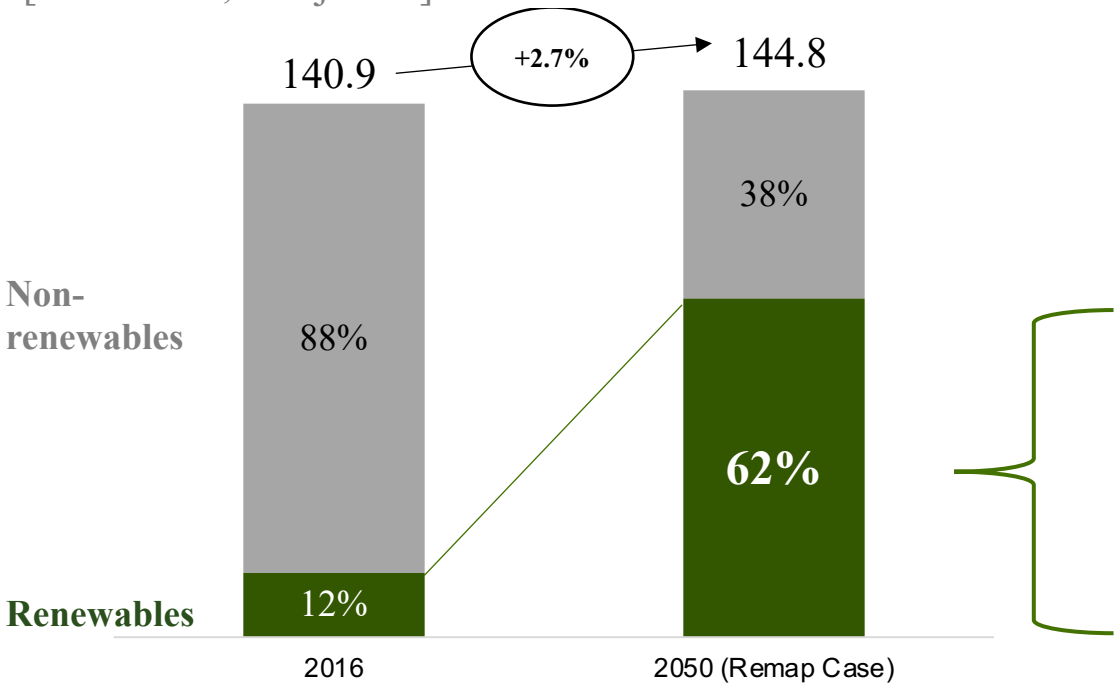
Tracking clean energy progress scale (2019): On track | More efforts needed | Not on track

3. Source: IEA 2019

Industry is the only segment that will increase the power consumed in 2050 but can still expand renewables share to 62% with electricity accounting for more than half of it

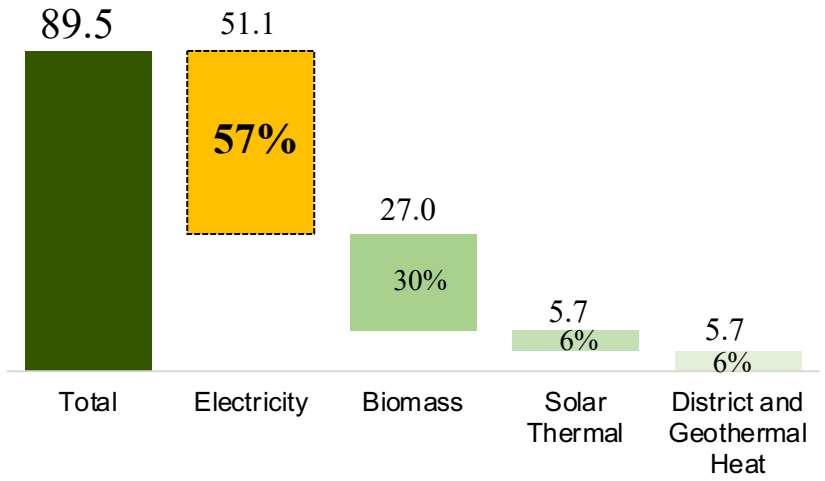
Industry **increases** its consumption by **2.7%** in the most optimist scenario, but it can **largely expand by 50%** the share of renewables in the energy mix by 2050

14. World industry final energy consumption [2016-2050, Petajoules]



Renewable-produced electricity will account for **57%** of the Renewables portfolio in 2050 followed by **biomass powering 30%** of activities

15. Renewables consumption by source [2050 (Remap Case), Petajoules]



4. Source: IRENA 2018

Reducing energy consumption, enable corporate sourcing of renewables and accelerate low-carbon solutions are necessary measures for a clean buildings future

Reduce energy consumption	• Promote **circular economy** (material recycling, efficiency and waste management) • Adopt best available technologies and efficiency standards • Reinforce funding for further **CCUS projects**
Corporate Sourcing of Renewables	• Empower companies to engage in **direct investment for self-generation** • Promote **direct trade** between companies and renewable energy developers • Work with utilities or electric suppliers to provide green corporate procurement options
Accelerate low-carbon solutions	• Implement **carbon pricing** considering real costs of externalities • Encourage **low-carbon heating technologies** deployment (biomass, solar thermal, heat pumps) • Elimination of existing subsidies for carbon-intensive fuels

5. Source: IRENA 2019

Smart grids and smart meters help unlock demand flexibility benefits and although investment increased 10% in 2018, it still represents a small share of network investment

An efficient energy transition will require a shift towards increased flexibility

Demand Flexibility increases overall capacity of the system to integrate variables renewables and reduces peaks in demand

- Accelerates electrification of heating, cooling and industry at a lower cost

Smart grid infrastructure enable demand flexibility and **consumer participation** in the energy system

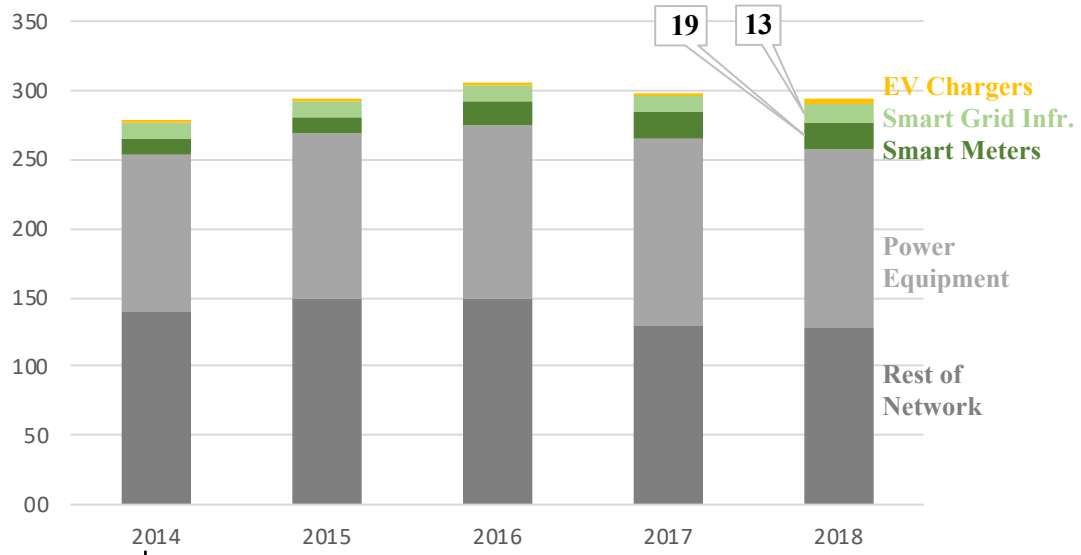
- Demand response, electric vehicle (EV) charging and self-produced distributed generation and storage

Smart meters help smart grids unlock these benefits

16. Example of a Smart Meter

Smart meters, smart grids and EV chargers investment have been rising but their value is quite inferior to the rest of network funding

17. Global network investments [2014-2018, $ Billion]



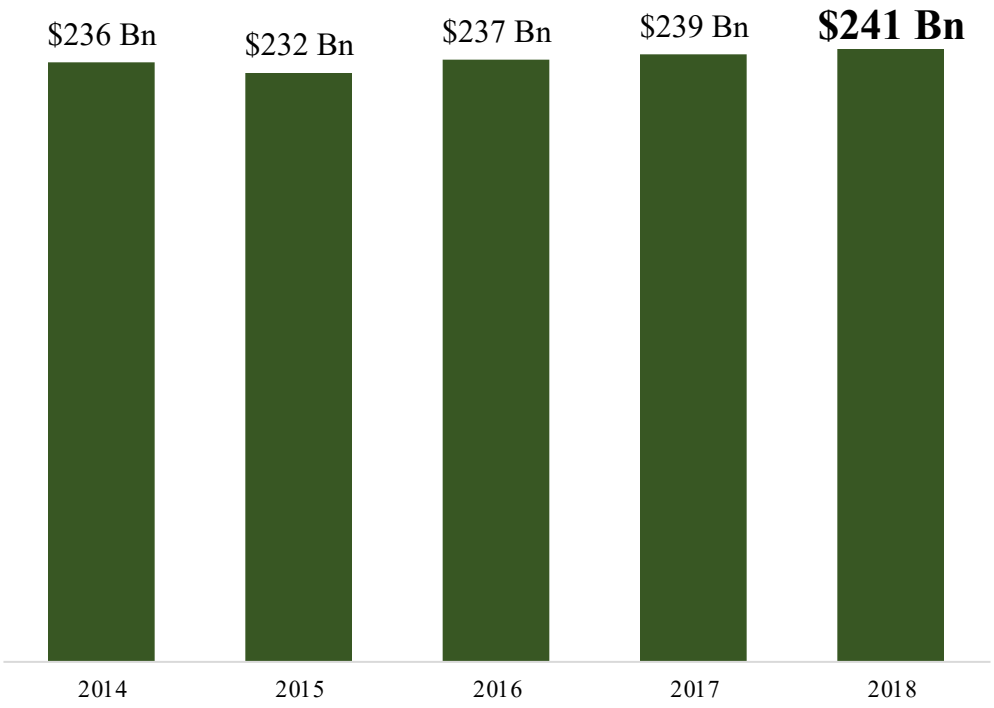
- **Smart meters** investment reached **$19 billion** in 2018 while **smart grid infrastructures** figures were around **$13 billion**
- Their share combined still only totals only 10% of all network infrastructure investment in 2018
- To capture all potential flexibility available, existing markets need to be opened to new business models such as **virtual power plants**

7. Source: IEA 2019

Investments in energy efficiency reached $241 Billion in 2018 whereas investments in electric mobility have considerably grown to an average of $11.4 Billion since 2014

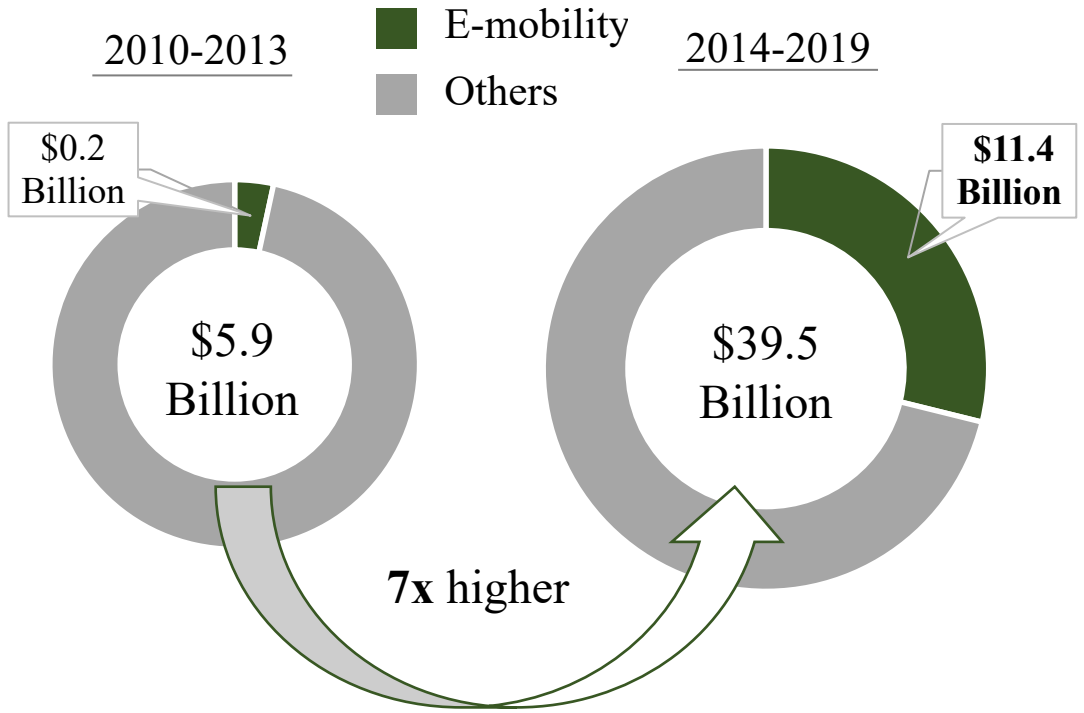
Levels of investment targeting **energy efficiency** across buildings, industry and transports have been consistent and in 2018 figured **$241 billion**

18. Investments in energy efficiency
[2014-2018, $ Billion]



Investments in **mobility start-ups increased sevenfold** from the period of 2010-13 to 2014-19 and **e-mobility is growing faster** since 2014 at $11.4 billion per year

19. Average annual investment in mobility start-ups
[(2010-2013)-(2014-2019), $ Billion]



8. Source: IEA 2019
9. Source: McKinsey & Company 2019

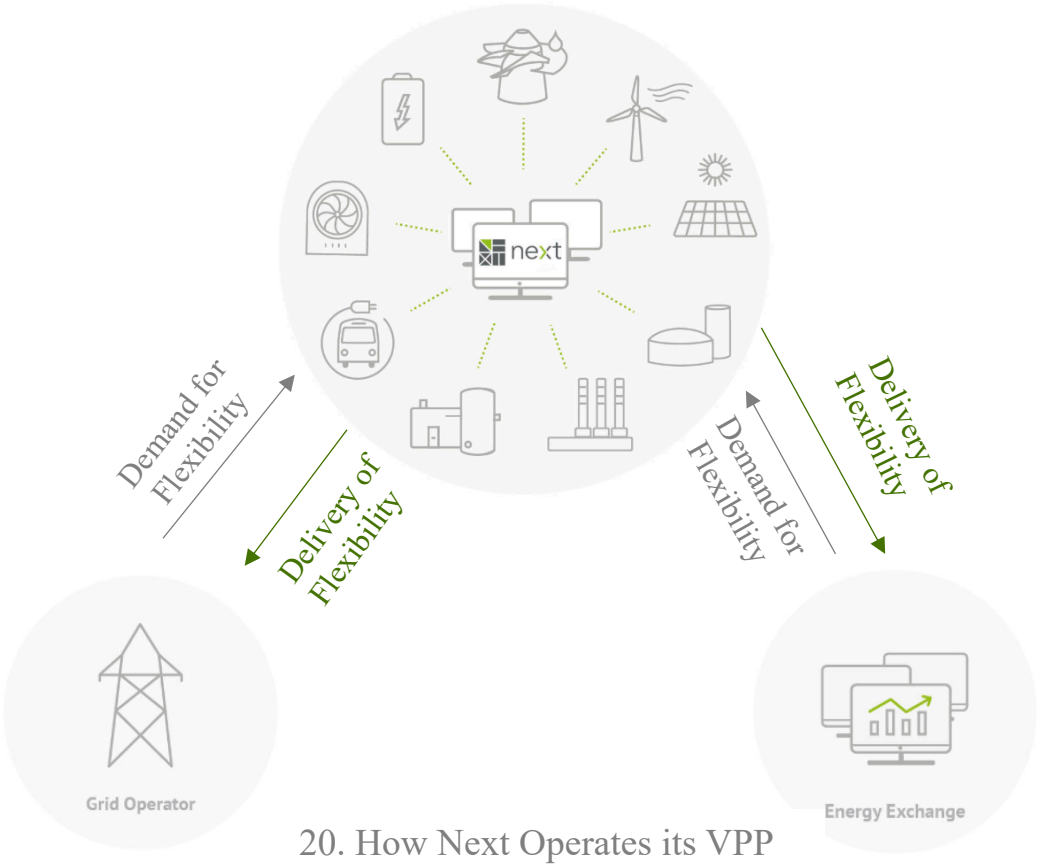
Next Kraftwerke is a virtual power plant which made almost 628M€ of sales in 2018 by efficiently delivering flexibility and profitably trade energy generation and consumption

Case In Point

next

German operator of a VPP connecting decentralized renewable energy producers and large scale power consumers as well as a certified power trader on various European energy exchanges

Concept	Digital network of energy assets that smartly distribute supply and demand while profitably trading the generated and consumed power
How it works	Power generating units, flexible consumers and storage systems are connected to a VPP control system that efficiently manages energy flow
Pros	Ability to balance fluctuations in the generation of renewables and aggregation of several units to augment reliability and redundancy
Investment	• Founded in 2009 with venture capital • Sales of **627.7 Million €** in 2018



20. How Next Operates its VPP

10. Source: Next Kraftwerke 2019

Energy consulting firms like CCEnergia help enterprises succeed in the desire to become more efficient and cost effective while contributing to reduce overall energy demand

Case In Point

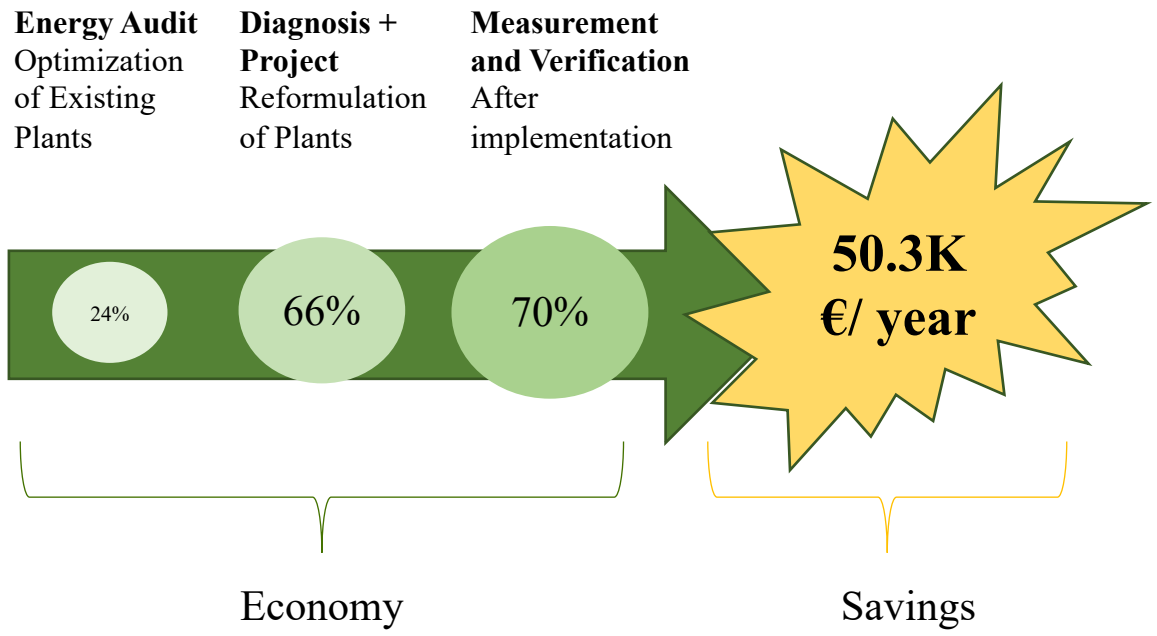
ccenergia

Portuguese energy consulting company that aims to increase energy efficiency of their clients by offering customized strategies with the ultimate goal of minimizing natural resources consumption

Concept	Increase companies competitiveness in the buildings and industry segments by implementing integrated solutions of energy efficiency
How it works	Offer of multiple energetic services such as diagnostics and monitoring plans, energetic certification and energy consulting
Pros	Minimize costs in power consumption and contribute for global decarbonisation and energetic transition (158.140 Tons of Co_2 saved)
Investment	• Founded in 2004 • Total savings of **27.3 Million €**

Example of a successful project that resulted in savings of more than 50 thousand of euros per year for an enterprise

21. Industrial Refrigeration in the Automotive Industry



11. Source: CCEnergia 2019

German start-up Uze Mobility is looking to disrupt electric mobility by adopting an innovative business model allowing users to drive e-vans free-of-charge

Case In Point

UZE MOBILITY

German start-up that aims to provide free-of-charge e-mobility services though an intelligent open innovation platform in which the vehicles can be used for multiple purposes simultaneously

Concept	Rent out StreetScooter electric vans for free to customers while smartly advertising mobile billboards according to the area driving through
How it works	The adverts are adjusted depending on the area (**reminiscent of social media business model**) and extra revenue is generated by selling data of the van surroundings like state of roads or traffic
Pros	Boost electric mobility to reduce city emissions and exploit maximum use of vehicles for transportation, deliveries and data analysis
Investment	• Founded in 2018 with pre-seed funding • Investment of **2.25 Million €** in 2018

22. Example of an UZE StreetScooter

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12. Source: Uze Mobility 2019
13. Source: electrive 2018

Buildings and transport will require higher investment due to higher potential to meet sustainable scenarios while Industry investments are considerably lower

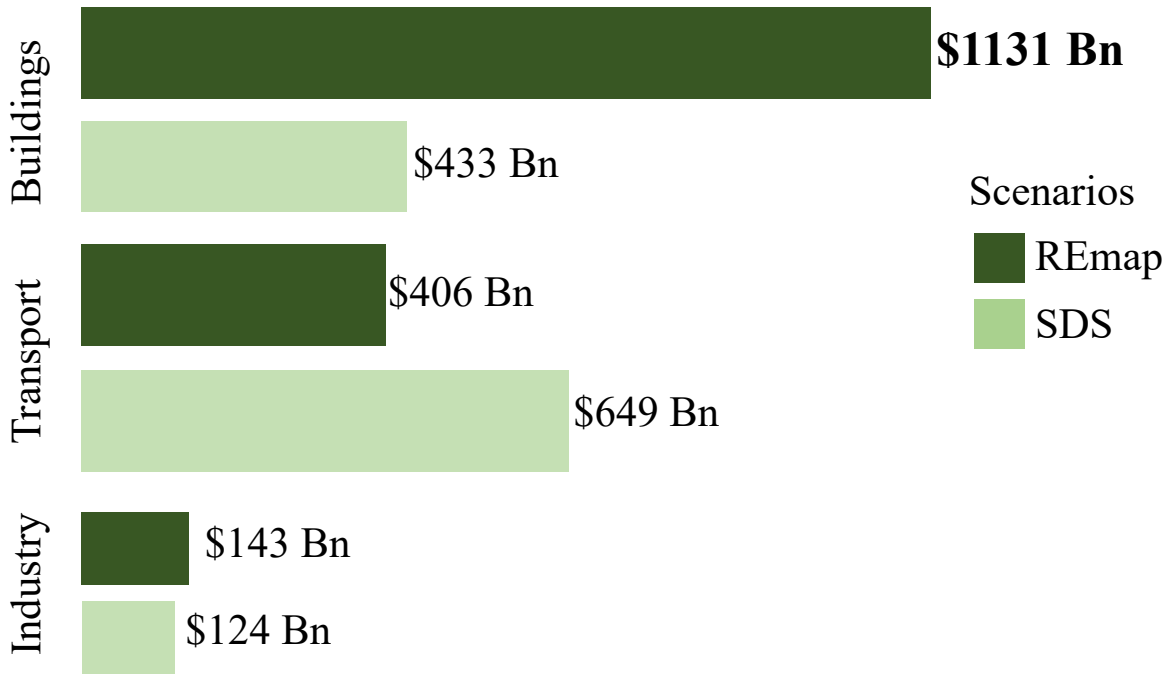
Buildings will require higher investment in the **Remap scenario** whereas **transport** has more opportunities in the **SDS**, meanwhile Industry comes last in both scenarios

23. Total investment for each segment
[Remap and SDS scenarios, $ Trillion]

Segment \ Scenario	REMAP (IRENA) 2015-2050	SDS (IEA) 2018-2040
Buildings	**$39.6 Trillion**	$9.5 Trillion
Transport	$14.2 Trillion	**$14.3 Trillion**
Industry	**$5.0 Trillion**	**$2.7 Trillion**

Opportunities of investment for the **buildings** and **transport** ranges from 433 billion dollars annually to over a **trillion dollars annually** while industry is the least attractive segment

24. Average investment per year for each segment
[Remap and SDS scenarios, $ Billion]



4. Source: IRENA 2018
14. Source: IEA 2018

A Work Project, presented as part of the requirements for the Award of a Master's degree in Economics / Finance / Management from the Nova School of Business and Economics.

Investment Opportunities

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NOVA SCHOOL OF BUSINESS & ECONOMICS

In light of a sustainable energy transition, what are the key changes across the multiple sectors and what opportunities will emerge?

Abstract

1 **Demand**

Demand for energy and renewable sources is increasing. The buildings segment has the potential to have the largest share of renewable-produced energy followed by industry, yet transport can face the highest growth. Greater investment opportunities will emerge in buildings and transport with new technology and low-carbon policies unlocking new business models in areas like demand flexibility, efficiency and e-mobility

2 **Transmission**

Transmission development comes as a result of the rise in demand, generation capacity and the distance that separates these two. These constraints can be addressed through a set of solutions which complemented, meet the requirements of a flexible integrated transmission

3 **Generation**

The generation energy market once dominated by massive oil companies is experiencing changes that allow new types of players. The 2050 scenarios show large increases in renewable technologies total installation capacities and power generation mainly in wind and solar power as well as a great investment opportunity in wind power

4 **Investment Opportunities**

A cleaner energy market will diversify the ecosystem and change the nature of factors to succeed across demand, transmission and generation. Investment opportunities will be greater in energy demand and the total investment of the three areas combined represents 3.1% of the World GDP. This new ecosystem will allow new players to emerge and fragment a former highly concentrated market with increased uncertainty, encouraging partnerships

Keywords: diversify, demand, ecosystem, fragmentation

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A cleaner energy market will diversify the energy ecosystem and change the nature of plays and factors to succeed across the three main stages of the energy market

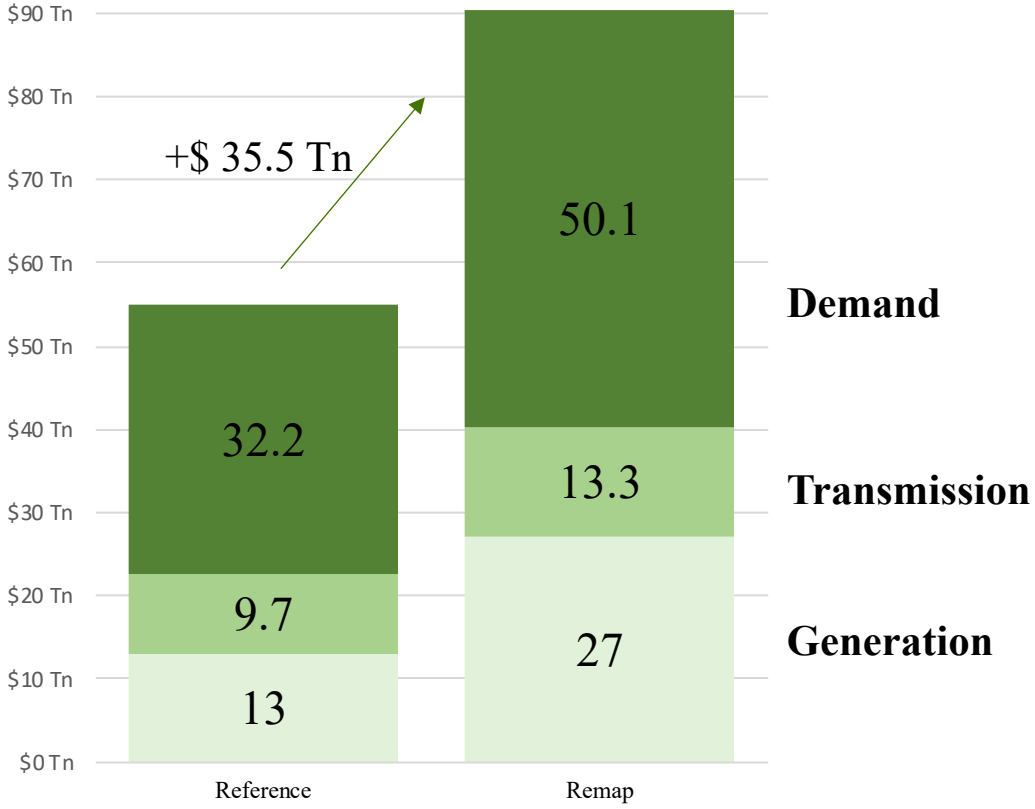
	Energy Demand	Transmission	Generation
Nature	• Virtual Power Plants • Efficiency Energetic Consultancy • E-Mobility Services	• Grid connection • Connect farms • Storage	• New plays/players • Innovative Technologies • Hybrid Systems
KSFs	• (F) High initial investments incentivise partnerships to lower costs down the line • (T) Rapid deployment of smart meters, smart grids and electric mobility technology • (R) Subsidies to electric mobility and incentives for buildings to adopt efficiency standards	• (F) Public private partnership to finance the high costs of projects such as power storage batteries • (T) Reduce CSP installation costs • (R) International and intercontinental cooperation	• (F) Pay-as-you-go: reducing upfront costs for the consumers • (T) Smarter Balance-of-System technologies • (R) Support regulatory and pricing policies to allow consumers to become prosumers and sell electricity

(F) Financial (T) Technological (R) Regulatory

Investment opportunities will be greater in energy demand, meanwhile total investment per year in the three areas combined represents 3.1% of the World GDP

Regardless from the scenario, **demand** investments will be far superior than the other two and the REmap scenario will require almost $35.5 Trillion more

Total investment in USD Trillion from 2016-2050 in 2 Scenarios



- **Demand**

Includes efficiency measures deployed across the end-use sectors – buildings, transport and industry

Investment per year (Remap): $**1.47 Trillion**

- **Transmission**

Includes investments made for transmission and distribution grid extensions as well as storage

Investment per year (Remap): **$391 Billion**

- **Generation**

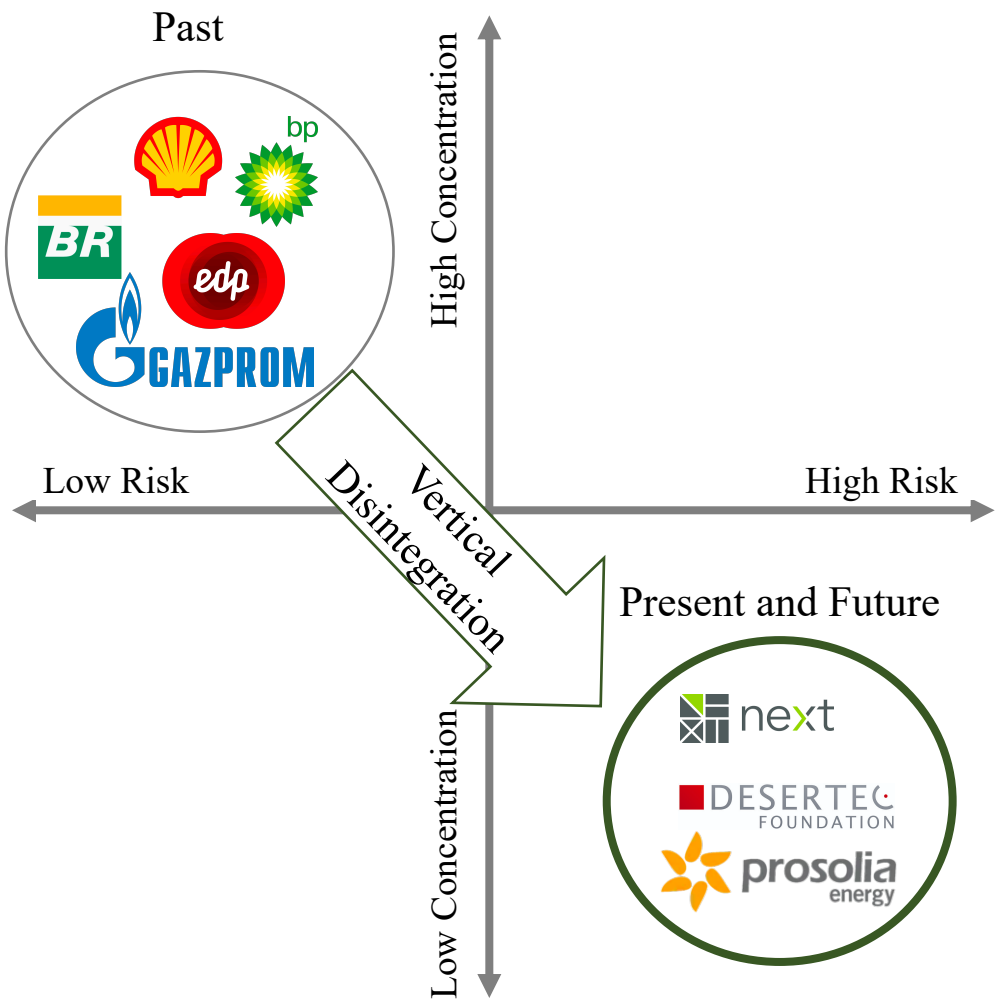
Includes investments for the deployment of renewable technologies for power generation such as capacity construction, operation and management

Investment per year (Remap): **$794 Billion**

Total combined investment per year = **$2.655 Trillion** which represents **3.1%** of the **World GDP** ($85.909 Trillion in 2018)

1. Source: IRENA 2019
2. Source: World Bank 2019

The new ecosystem will allow new players to emerge and fragment the former highly concentrated market encouraging partnerships to split risks and costs due to uncertainty



1. For the past century, **large players have dominated the energy ecosystem**, funded solely by public markets and governments

2. Technology and sustainability concerns are spawning **new business models and types of players** funded by pension funds and private-equity firms

3. This **fragmentation** is diminishing the power of scale to shape market

4. With so many players interacting in different ways and locations, **uncertainty and risk** are higher than ever

Recommended Strategy

- Companies should make smaller initial investments and be flexible in adjusting strategies as circumstances change
- Partnerships can help companies splitting the cost and risk of large capital projects under high risk and uncertainty

3. Source: McKinsey & Company 2017

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