Smart Energy 2019
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Sion – Switzerland

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

Trends for the Energy Sector and Overview of the World Economic Forum's Energy Future Initiatives

By Espen Mehlum

About the World Economic Forum

The World Economic Forum – committed to improving the state of the world – is the International Organization for Public-Private Cooperation

The Forum is a platform that engages the foremost political, business and other leaders of society to shape global, regional and industry agendas and have positive impact

Shaping the Future of Energy is one of the World Economic Forum's 18 platforms addressing major issues on the global agenda

Shaping the Future of Energy is a platform for strategic insights and collaborative action between companies from different sectors, governments and others - pushing the thinking and the boundaries of what will become the energy future

1 Energy transition policies and frameworks

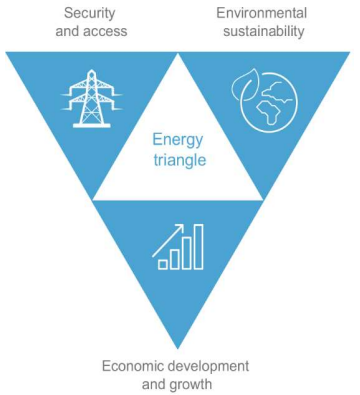
- Global Energy Transition Index
- Energy Policy lighthouses
- Energy Transition Narrative and dialogues

2 Systemic efficiency

- Building Value Chain
- Cooling and food chain
- Global Battery Alliance

3 Innovation and Clean Energy

- Sustainable energy innovation
- Mission Innovation
- Clean Hydrogen
- Energy Technologies 2030



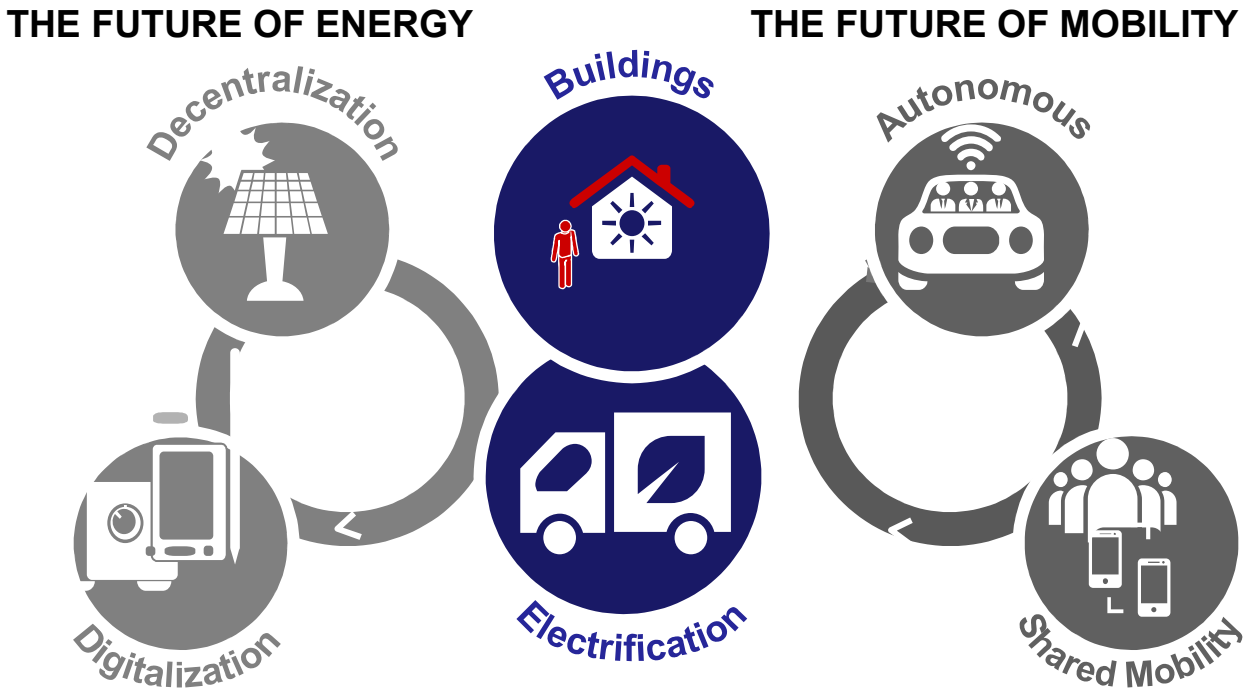
- ❑ Over 100 major companies from energy and related industries engage in our energy platform
- ❑ A high level Stewardship Board provide strategic guidance and anchoring
- ❑ Global Future Councils on Energy and on Advanced Energy Technologies contribute thought leadership

The Fourth Industrial Revolution – Sweeping across the economy and society is driving change

"The changes unleashed by the Fourth Industrial Revolution are so profound that, from the perspective of human history, there has never been a time of greater promise or potential peril."

Klaus Schwab
Founder and Chairman, World Economic Forum

…With the borders between sectors increasingly blurring and change driven by multiple factors



Potential for disruption fuelled by

Decreasing technology costs (especially digital)	**Innovative new business models**	**Geopolitics**	**Policy and Climate change**	**Consumer expectations**

. . . Leading the global energy system to transform at unprecedented speed

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-88%
Solar PV LCOE reduction (2009 – 2018)[1]

- 69%
Onshore wind LCOE reduction (2009 – 2018)[2]

- 85%
Lithium ion battery price/kwh (2010-2018)[3]

191
RE100 companies committed to go 100% renewable

2%
Of total global electricity generation consumed by data centers in 2017 while Google became 100 renewable

3.5x
Expected increase in the number of air conditioners by 2050

199 billion USD
The estimated size of the Hydrogen generation market in 2023 compared to 135 billion in 2018

2013
The year since when annual global renewables capacity surpassed conventional capacity additions for electricity

135 million
People gained access to electricity each year between 2014 – 16 while in 2018
The total nr of people without access was below 1 billion for the first time

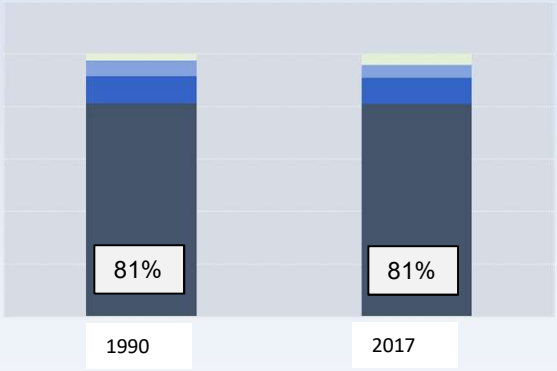
5.3%
Increase in employment in renewable energy sector, at 10.3 million in 2017. Solar and wind installation is now the fastest growing in the US in terms of employment

11.2 bpd
US crude oil production in August 2018, surpassing Russia and Saudi Arabia as world's largest producer

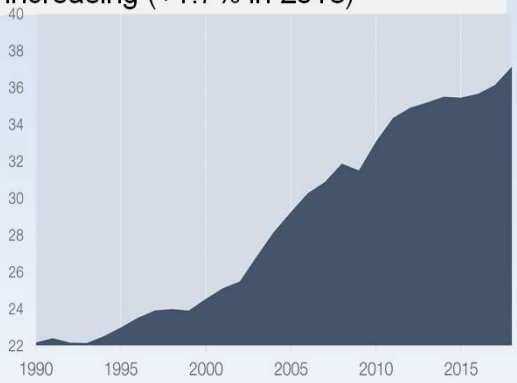
1 Unsubsidized, from 0.36 to 0.1 USD/kWh 2 Unsubsidized, From 0.135 to 0.042 USD/kWh 3 Li-Ion volume weighted battery pack price, BNEF 2019
SOURCE: Lazard, IRENA, BNEF, IEA, EIA, IHS, IFC, Tracking SDG7, New York Times

….But, the speed of transition isn't fast enough

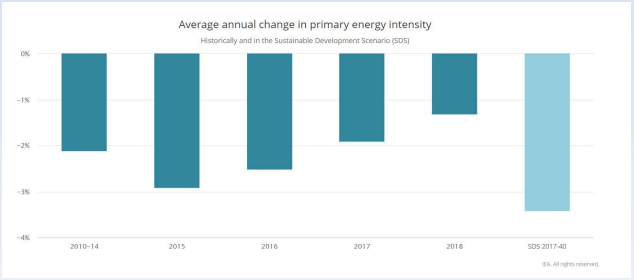
Share of fossil fuels in global energy mix is constant since 1990



Global CO2 emission from energy *increasing* (+1.7% in 2018)

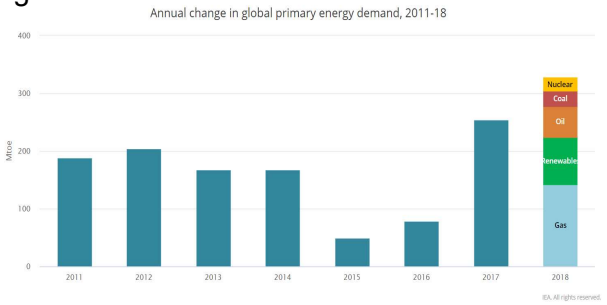


energy intensity fell 1.3% in 2018, a lower improvement rates than in recent years



The younger generations are expecting action now

Energy consumption worldwide grew 2.3% in 2018, while 1 billion still lack access to energy and the global population expected to grow

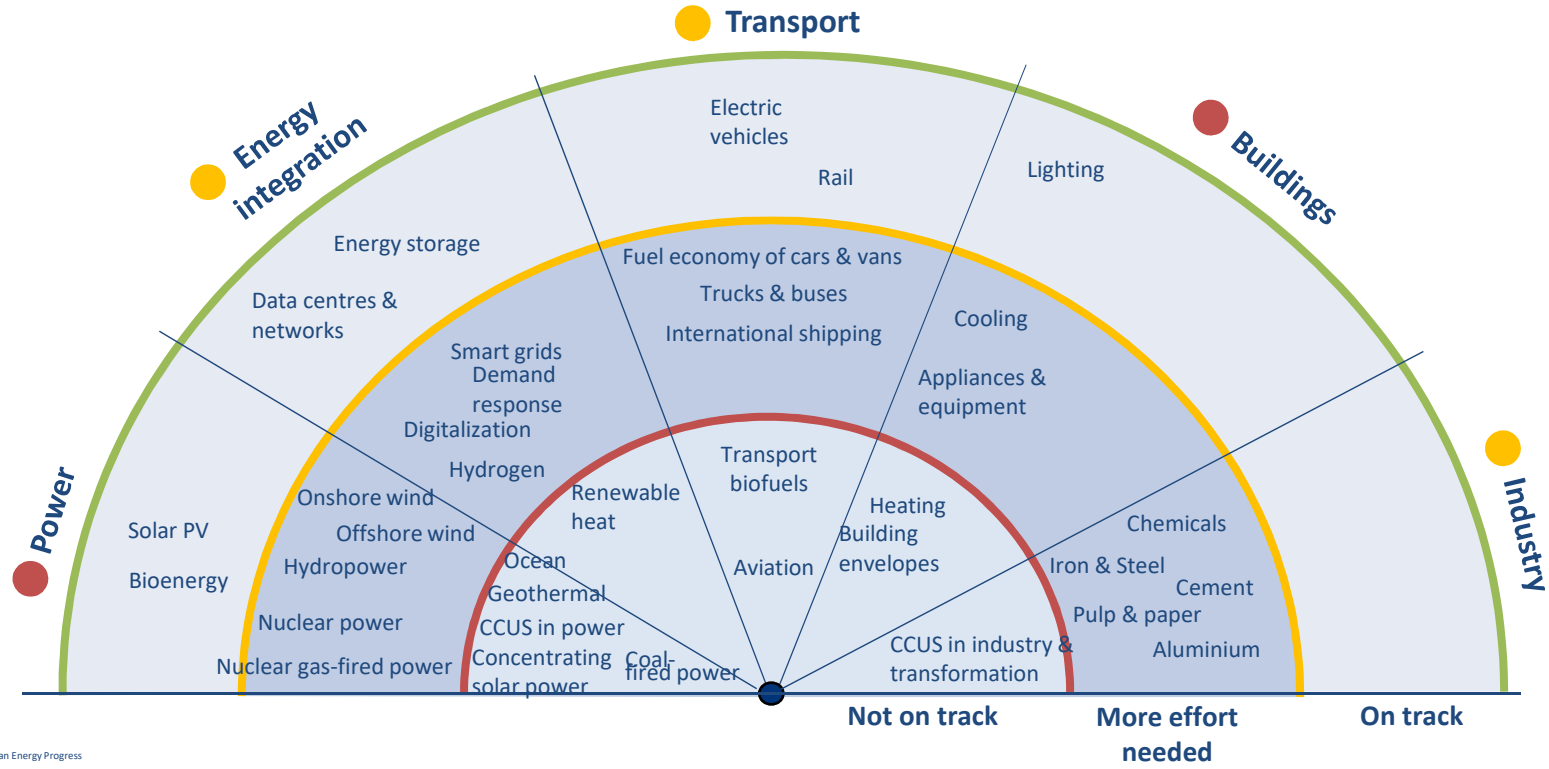


The biggest challenges to meet the Paris agreement lie in the harder to abate sectors

Sources: IEA, World Economic Forum, Mission possible, IEA

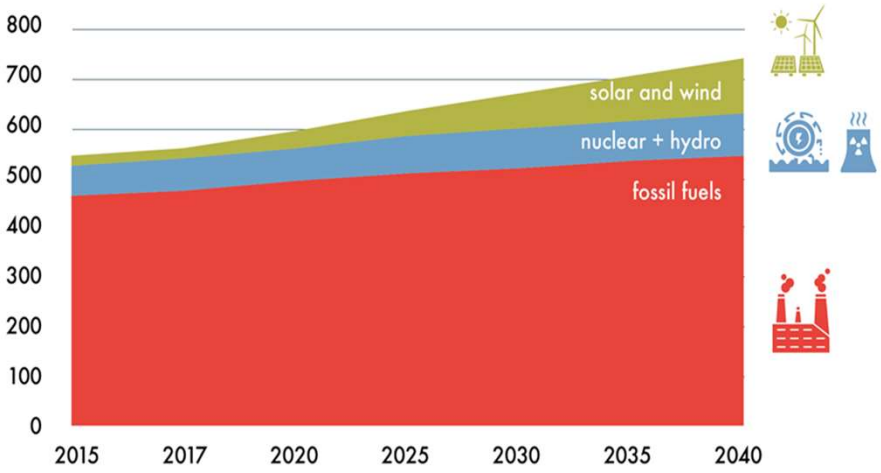
…and we are not innovating and adopting new solutions at the speed possible and required

IEA finds that only 7 out of 45 energy technologies and sectors are on track to meet long-term climate and sustainability goals (2019)

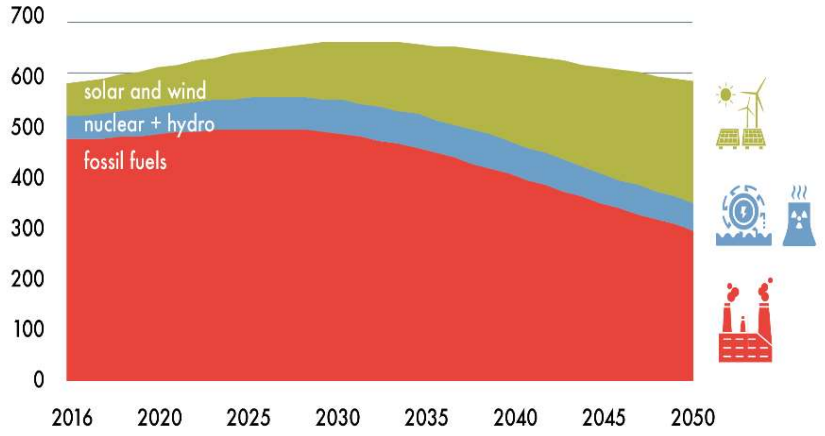


IEA,2019, Tracking Clean Energy Progress

Looking forward: Will the Energy Transition be gradual or rapid? – The answer will make a real difference



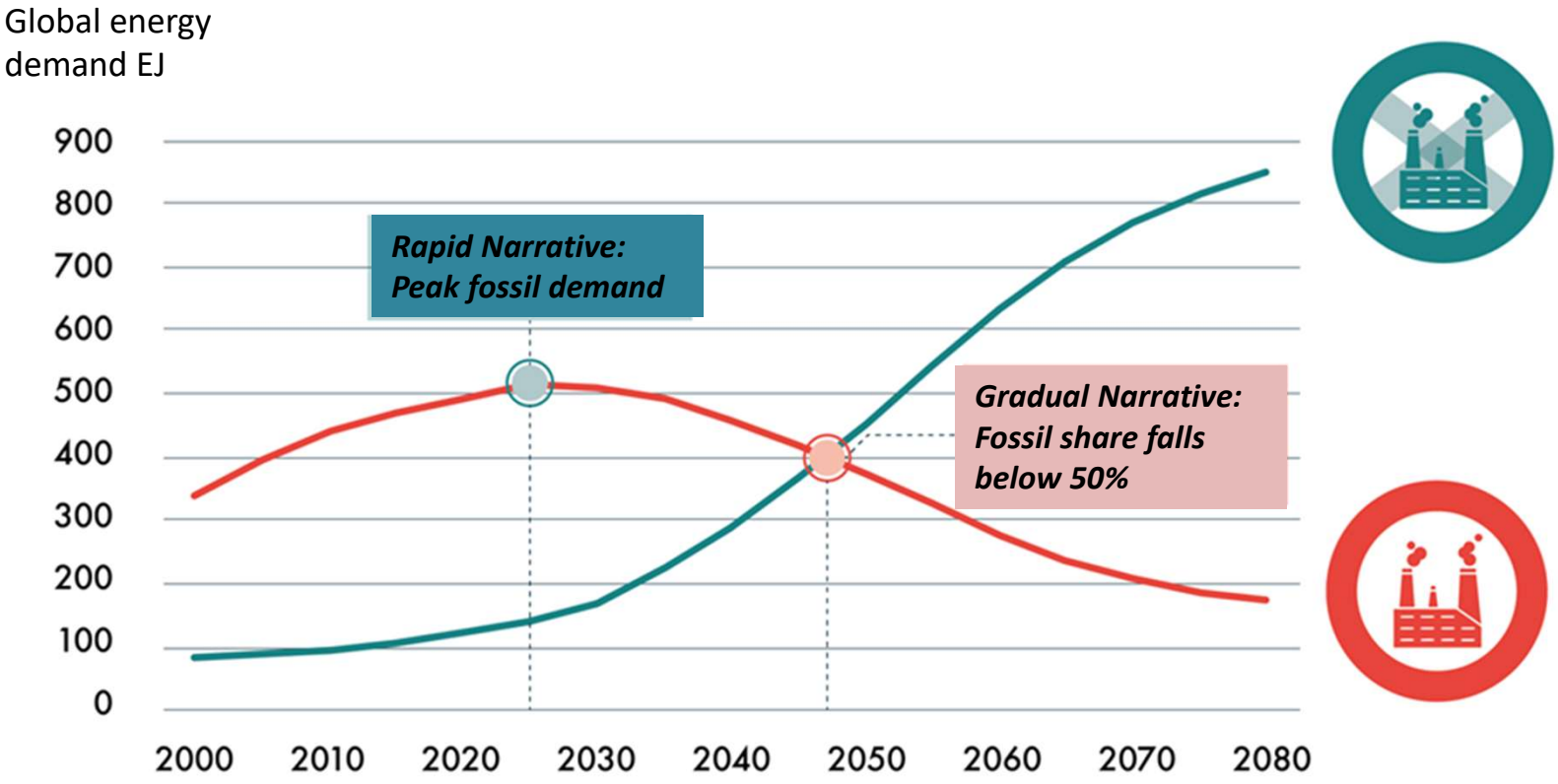
Source: BP Energy Outlook 2019. Evolving Transition Scenario



Source: DNV GL. Energy Outlook 2018

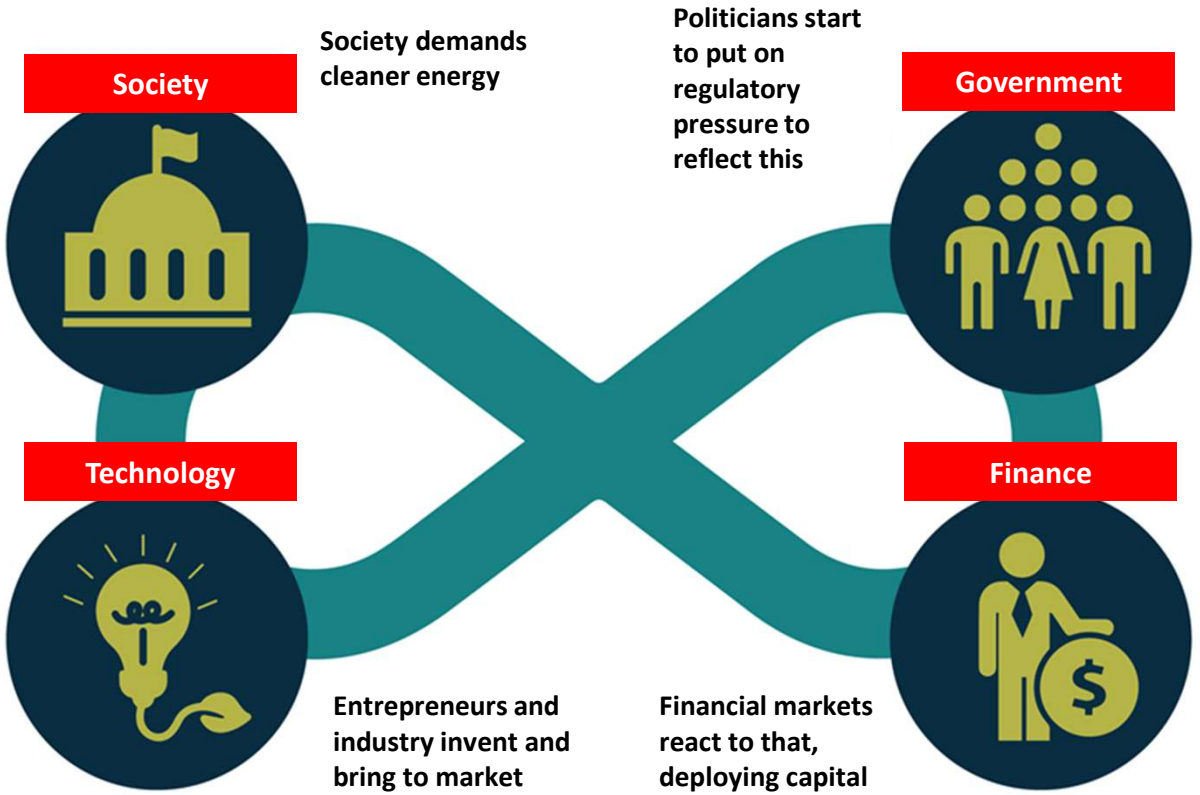
Source: The Speed of the Energy Transition, Global Future Council on Energy, World Economic Forum 2019

Looking forward: Will the Energy Transition be gradual or rapid?



Source: The Speed of the Energy Transition, Global Future Council on Energy, World Economic Forum 2019. Based on data from Shell Sky scenario

An interconnected feedback loop and decisions can increase speed of transition – or slow it down



Source: Carbon Tracker and World Economic Forum Speed of Energy Transition

Our Energy Transition index tracks global and national progress on transition and can help countries compare and prepare

Benchmarks Energy Systems of 115 countries on 42 indicators: Current performance and readiness for transition

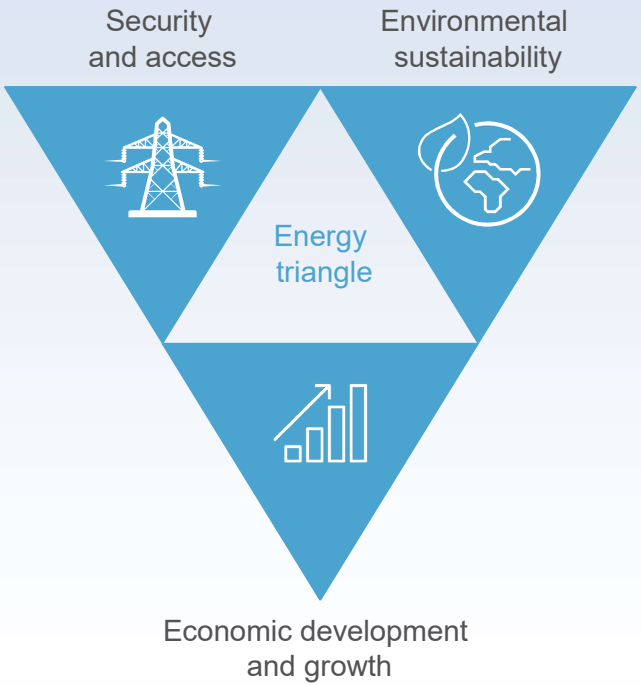
7 editions 2013- 2019

Globally, energy transition has slowed or even stalled: In 2019 the improvement of the global average score on the Energy Transition Index was the lowest of the last five years

Some countries are progressing faster – and all have room for improvement

ETI: Measures Current System Performance

System performance imperatives



Economic growth and development

Extent to which a country's energy system adds or detracts from the economy

Environmental sustainability

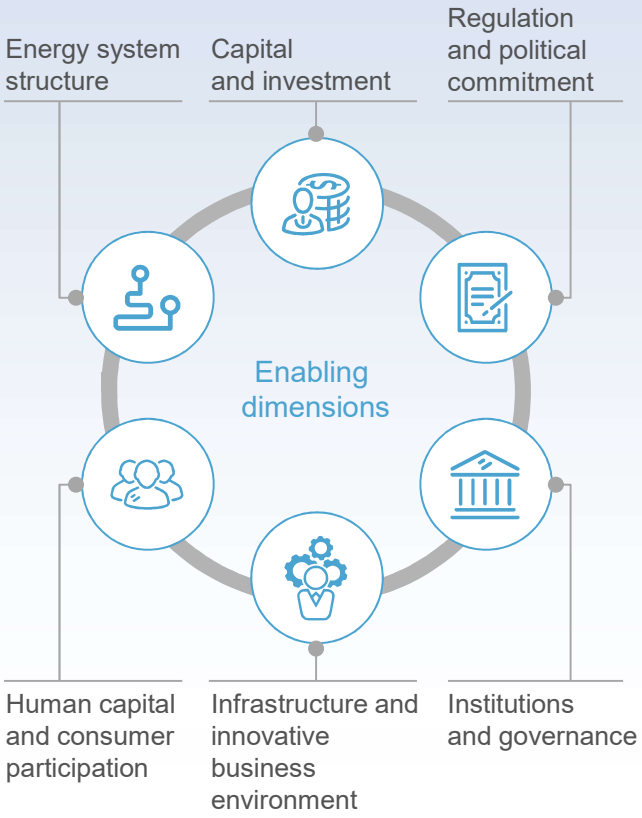
Environmental impact of energy supply and consumption

Energy access and security

Extent to which a energy supply is secure, accessible and diversified

….as well as transition readiness and enabling dimensions

Transition readiness enabling dimensions



Energy System Structure

- Technology path dependency
- Energy consumption per capita

Capital and Investment

- Access to credit
- Investment in energy efficiency and renewable energy

Regulation and Political Commitment

- Regulatory Stability and Commitment
- Policy and regulatory support for sustainable energy

Institutions and Governance

- Manageable risk
- Increased transparency
- Ease of doing business

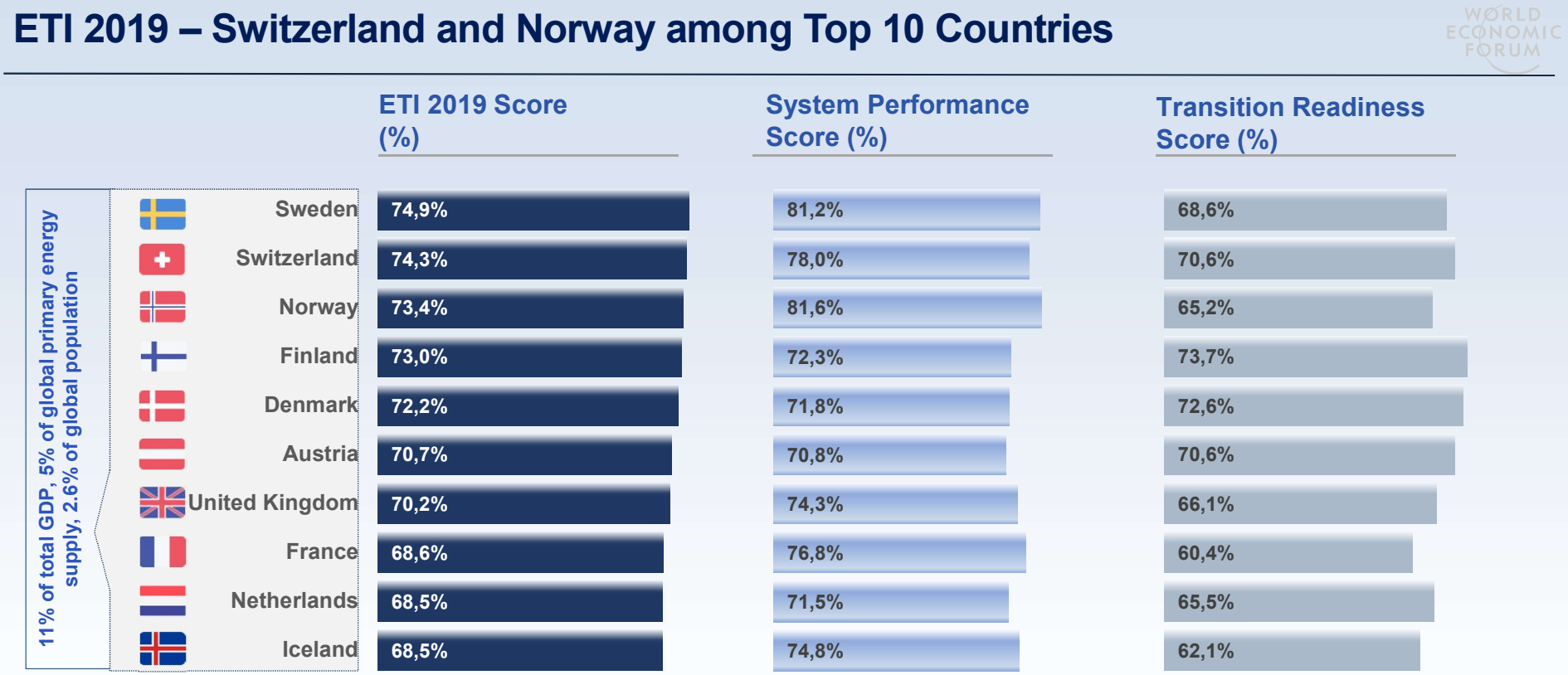
Infrastructure and Innovative Business Environment

- Transport infrastructure
- Trade logistics
- Technology availability

Human Capital and Consumer Participation

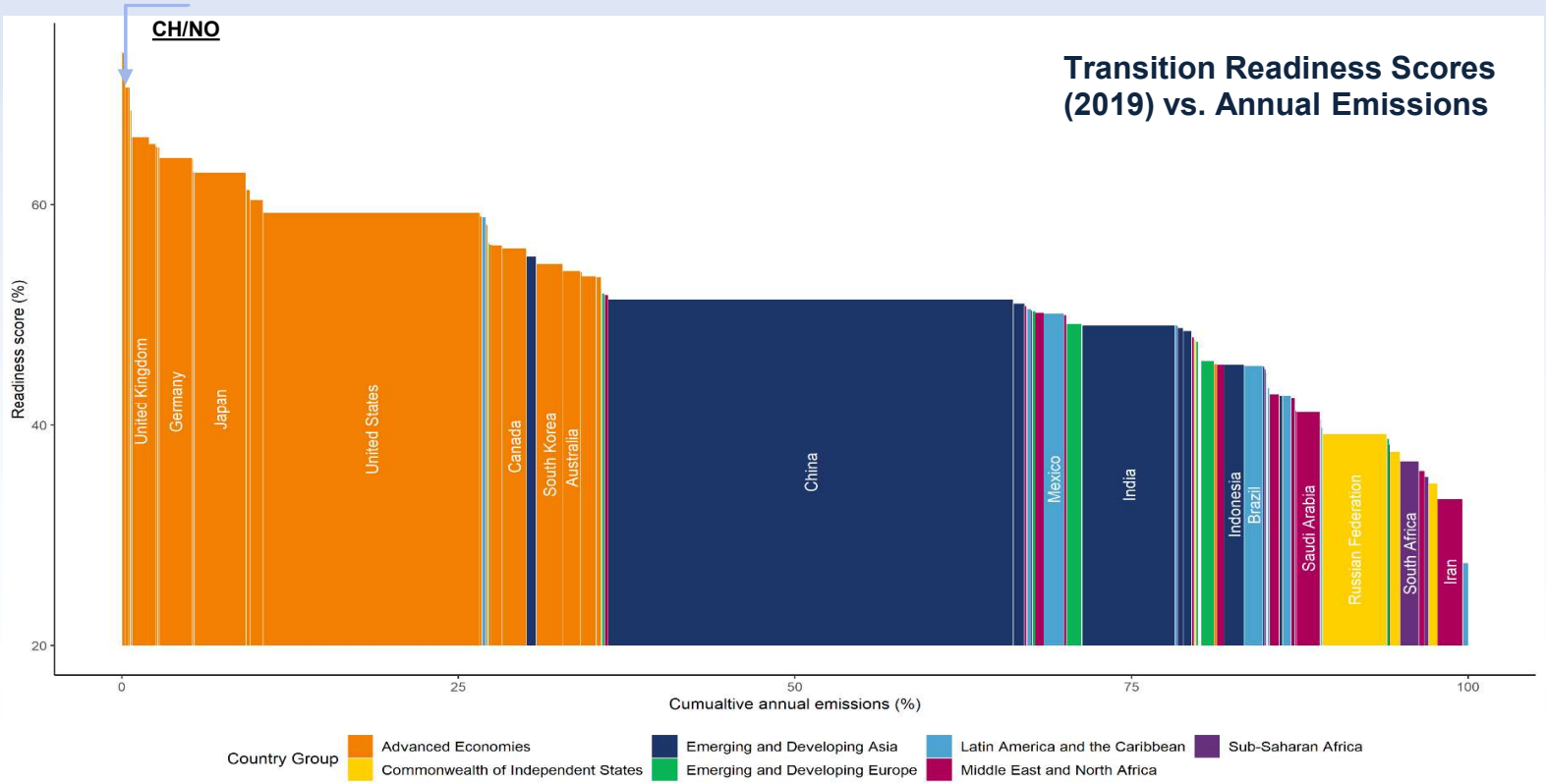
- Jobs in low carbon industry
- Quality of Education

ETI 2019 – Switzerland and Norway among Top 10 Countries



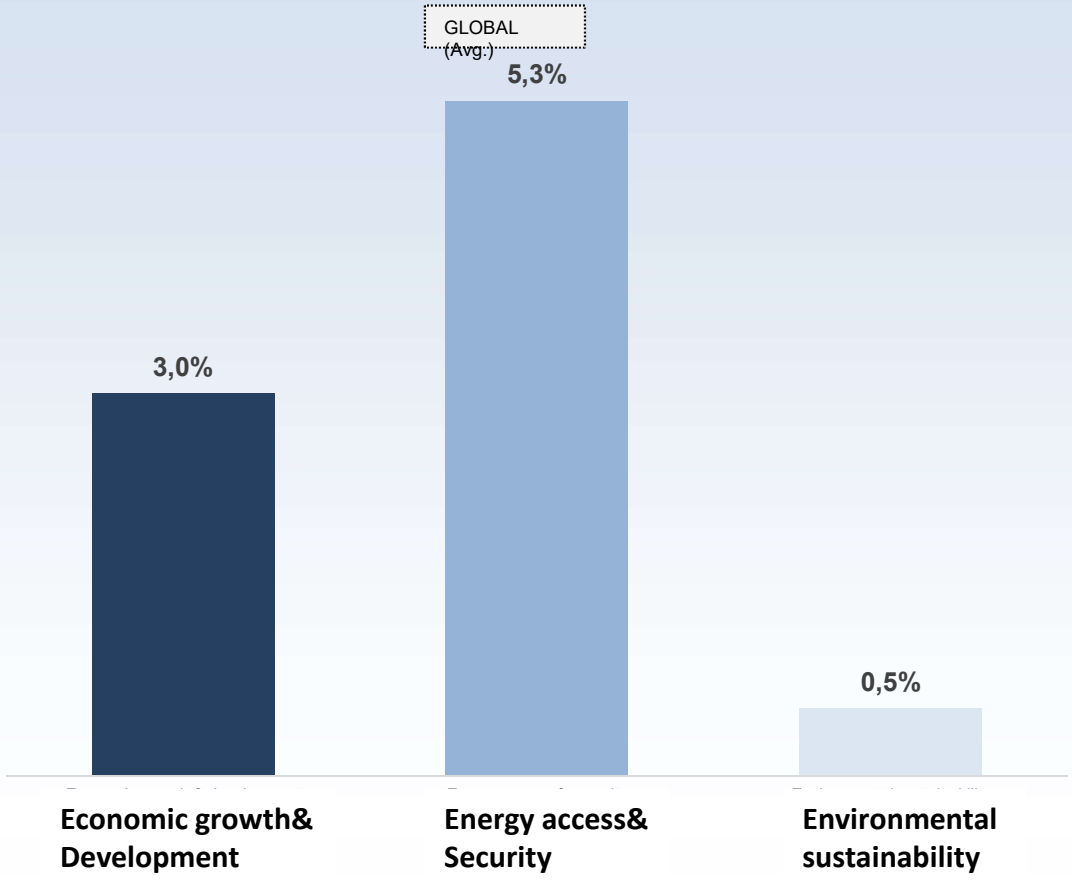
…But many of the countries who matter more in the global context lag behind

- Countries ranking high on transition readiness contribute less to CO_2 emissions from fuel combustion
- Large economies lagging behind on transition readiness and todays' performance



…So in aggregate the Global Performance Trends: 2015 – 2019 are weak

- Globally, highest improvement on “Energy Access and Security” dimension, and progress on “Environmental Sustainability” dimension negligible.
- Slow improvement on energy intensity and continued dominance of fossil fuels in energy mix primary reasons



An example of how you can make a difference: Accelerating sustainable energy innovation

Financial	Regulatory	Institutional
Aligning public and private investment through automatic co-investment mechanisms	Increasing the role of strategic public procurement in energy innovation	Creating national institutions for energy innovation
Establishing an independent sustainable energy innovation fund (SEIF)	Developing energy technology roadmaps through public-private collaboration	Establishing "super-transparency" of public R&D expenditure

.. By engaging in a Global Sustainable Energy innovation Fund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