2020

THE BRIDGE TANK

In collaboration with the
Institut des mobilités durables
(IMD)

CHINA, RUSSIA, IRAN, G5

Energy trajectories in main markets

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I) An energy methodology for industrial questions

II) RUSSIA

III) CHINA

IV) IRAN

V) Europe G5 - Spain, Germany, Italy, France, United Kingdom

1) An energy methodology for industrial questions

NDCs don’t answer Heterogeneous demands on industrial companies

1 A public response to historic problems

- Research and international community convergence (Rio 1992, Kyoto 1998, Paris 2015)
- Biggest scientific expertise & instrumentation ever
- Varying political push on geographies & sectors

United Nations Climate Change

COP21 · CMP11 PARIS 2015 UN CLIMATE CHANGE CONFERENCE

2 A private recent financial shift

- Financial standardization via globalization institutions (G20) : TCFD
- Strong support form institutional investors and service providers : Blackrock, AXA,

TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

3 Private Macro risks not addressed by tools

- Legacy systems and stranded assets (

Return to fashion of climate-compatible legacy systems (like district heating legacy, nuclear…)

4 Mobility uncertainties

- Electrification controversies (raw materials, high costs) and few real plans
- Hydrogen: niche market or a commodity fuel?
- (Bio)-Gas transitory regimes?

We address 3 major risks for car manufacturers:

1. **Extra-financial risks on TCFD and ESR regulations: Risk of over-exposure in climatically off-track markets.**
2. **Company low carbon mobility strategy: Risk of slow growth contribution from ungreening mobility markets**
3. **Mid term strategic options to exit ICE at global level: Risk of stranded ICE kept in fossil mobility markets**

Energy transitions towards mobility scenarios - issues

On some countries: **very little data and independent studies (Russia, Iran)**

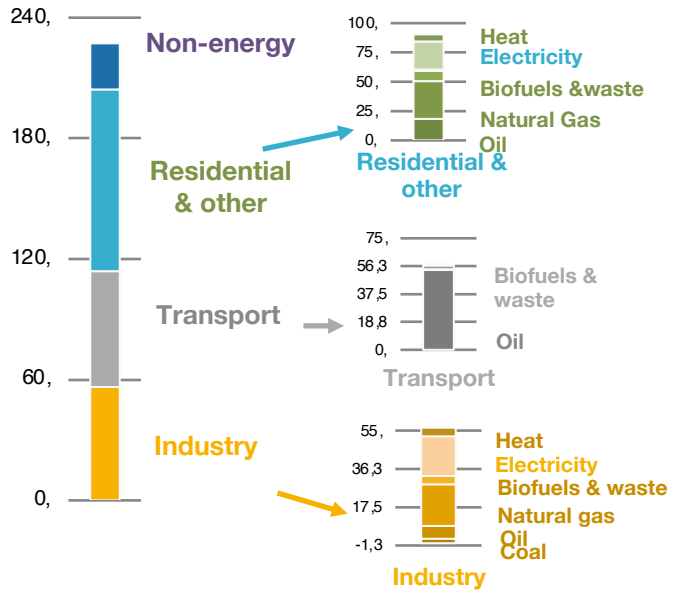
On most countries: **macro studies don’t handle transition path (China as an exception)**

- sectoral studies overlook inter-sectoral consistency
- state policies that don’t always state clear plan
- climate plans rarely few address necessary investment,
- nearly none take into account system changes (EU systemic approach is an exception but doesn’t lay sectoral breakups), usually lack timeframes test

Need for (i) articulating classical energies with new technologies, rising RE,
(ii) understanding industrial aspects of energy substitutions.

Couplings – why? what for? a systemic methodology

1. Mapping policy & industry/investment drivers (qualitative & targets/investment data) applying these to past investment (IAE data).



3. **Assessing credibility and timeframes** of energy substitution for others based on mapping and couplings

2. Assessing the "couplings":
- inter-energies / inter-technologies,
- inter-uses; these couplings can be in terms of specification, rivalry, complementarity, etc... (expertise)
- energy-to-use / technologies in silo vs commodity market creation),

Inter-energy Couplings
Example: RE will substitute polluting energy in the electricity mix - Gas + nuclear maintained as system base

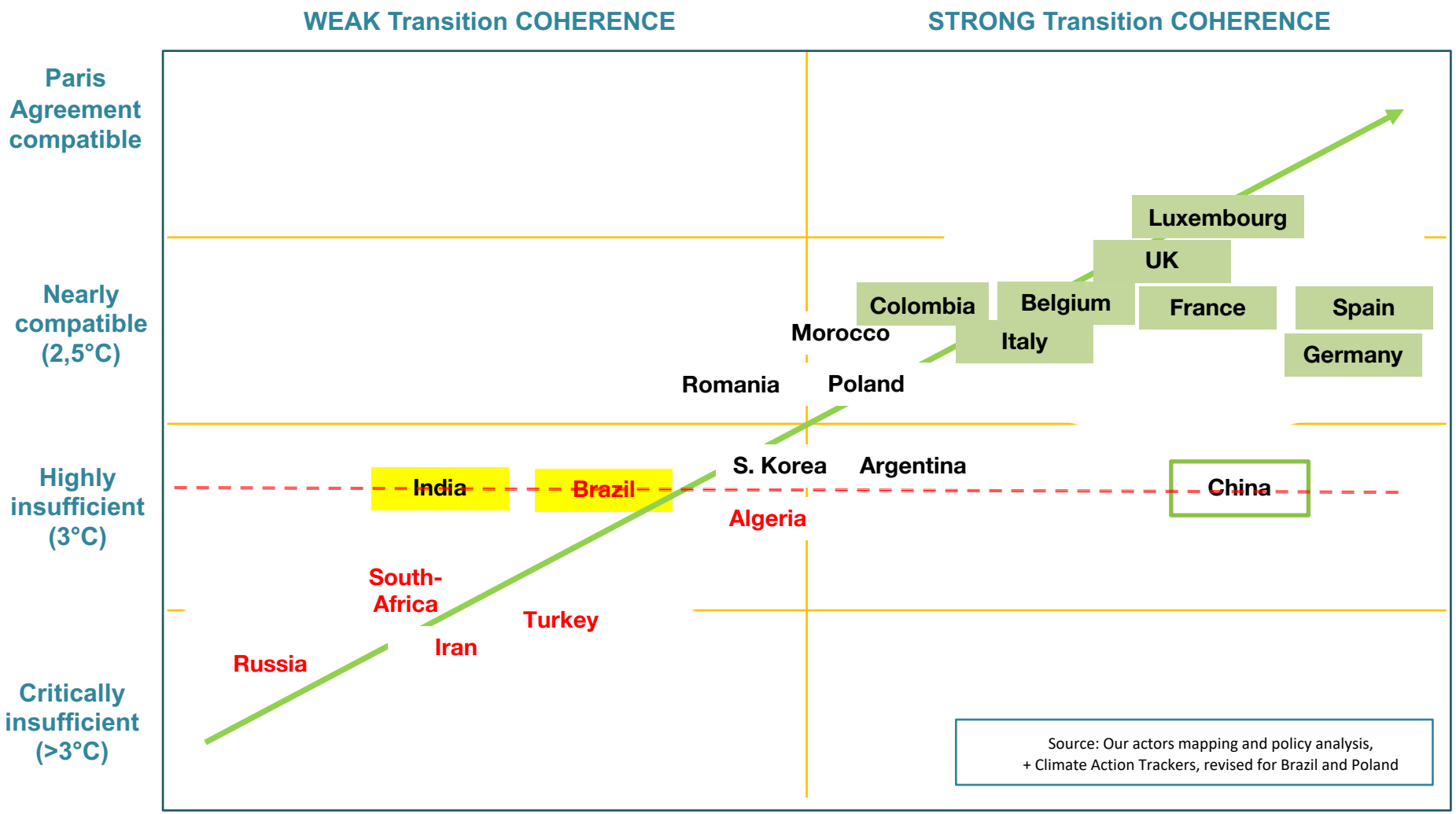
Energy-Use couplings
Example 1: alternatives energy will compete for sustainable mobility (electricity + biofuels + gas + H2)

Inter-Uses couplings
Example: Gas-electricity equipment competition for industry or residential

Energy-Use couplings
Example 2: electrification will create a competition in electricity demand. Fear of electricity saturation

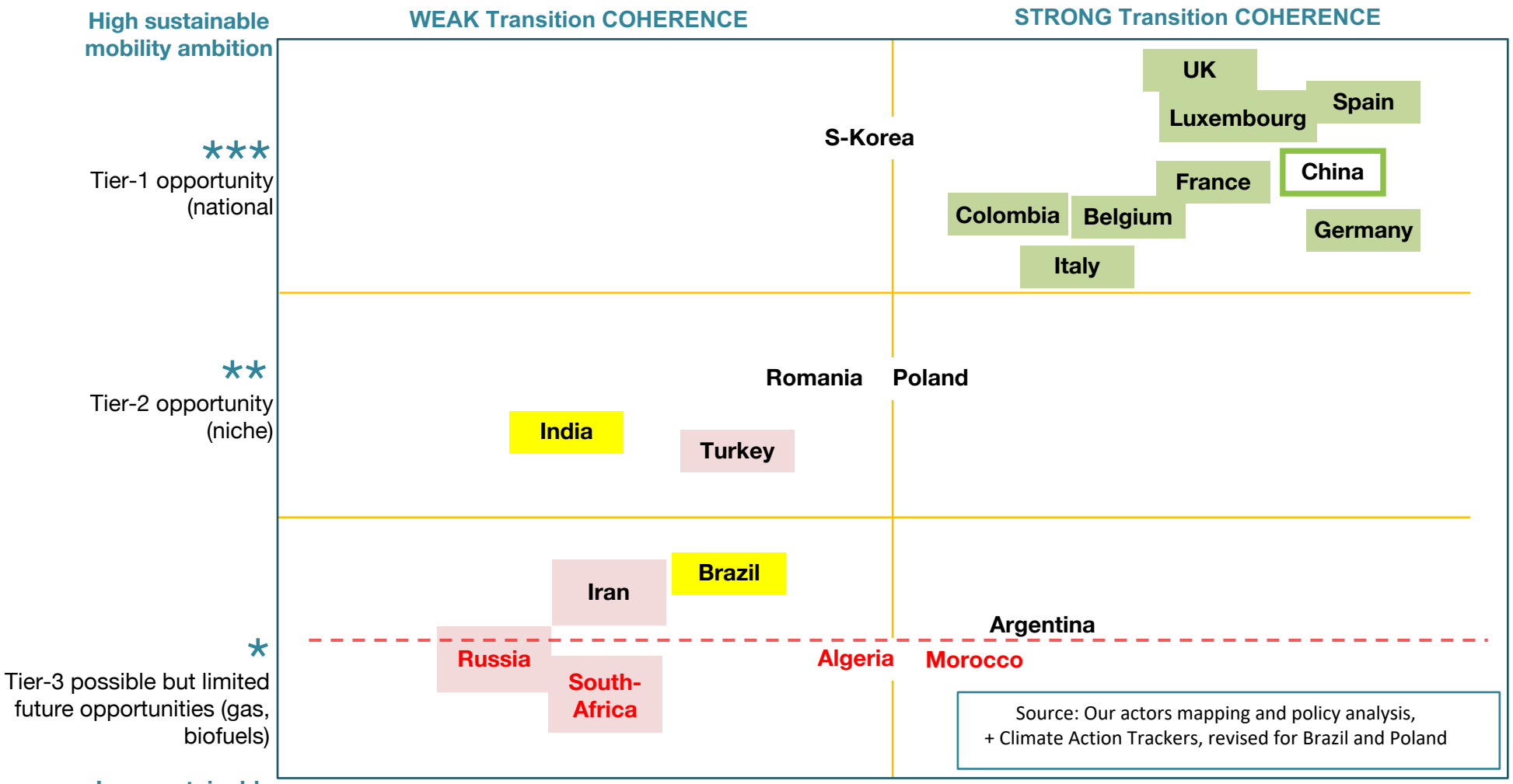
Substitutions of some sources of energy by others
Argentina (for electricity generation: oil 7% & coal 2% □ gas & RE)
Belgium (coal 3% □ gas & electricity)
India (biomass 26% □ gas)
Italy (for electricity generation coal 13% □ RE & gas)
Poland (for electricity generation: coal 85% & gas 6%□ LNG & RE)
Spain (for electricity generation: nuclear 30% & coal 19% □ gas & RE)
Turkey (for electricity generation: gas 26% □ coal & nuclear)

Analysis of Transition Coherence vs. INDC assessment (ambition + credibility)- Typology of countries



Financial and extra-financial risks on TCFD and ESR regulations for over exposure in climate off-track markets.

Transition Coherence vs. Sustainable mobility ambition- clean mobility market opportunities and risks



Risk that one star countries don't support overall company strategy towards low carbon mobility

Energy trajectories & mobility shifts timeframe: mid term risk for car manufacturers: stranded ICE asset in polluting country

COUPLINGS

Increasing coal
Turkey, China

Increasing RE
Algeria
Iran
Argentina
China
Colombia
India
Brazil
EU + UK (except Poland)

Limited RE development
Poland
Turkey
South Africa

Increasing gas/LNG
Algeria
Argentina
Belgium
India (residential)
Italy
Poland
Romania
Spain
China

Decreasing nuclear
Belgium
France
Spain

Increasing nuclear
Brazil
Poland
South Africa
Turkey
UK
China

Decreasing oil/coal for industry
Argentina
Europe
China
South Korea

Decreasing coal for electricity
Argentina
Europe

Decreasing gas
UK

Stable coal
Romania
South Korea
Russia
India

Decreasing coal
Poland
South Africa
China

2020 2025 2030

MOBILITY

Acceleration towards sustainable mobility
EU + UK
China
South Korea
Colombia

Partial shift towards lower carbon mobility
Turkey (electricity)
Iran (gas)
India (gas + electricity)
Argentina (gas + electricity)
Brazil (biofuels)

Still highly dependent on oil
Russia
Algeria
South Africa
Morocco

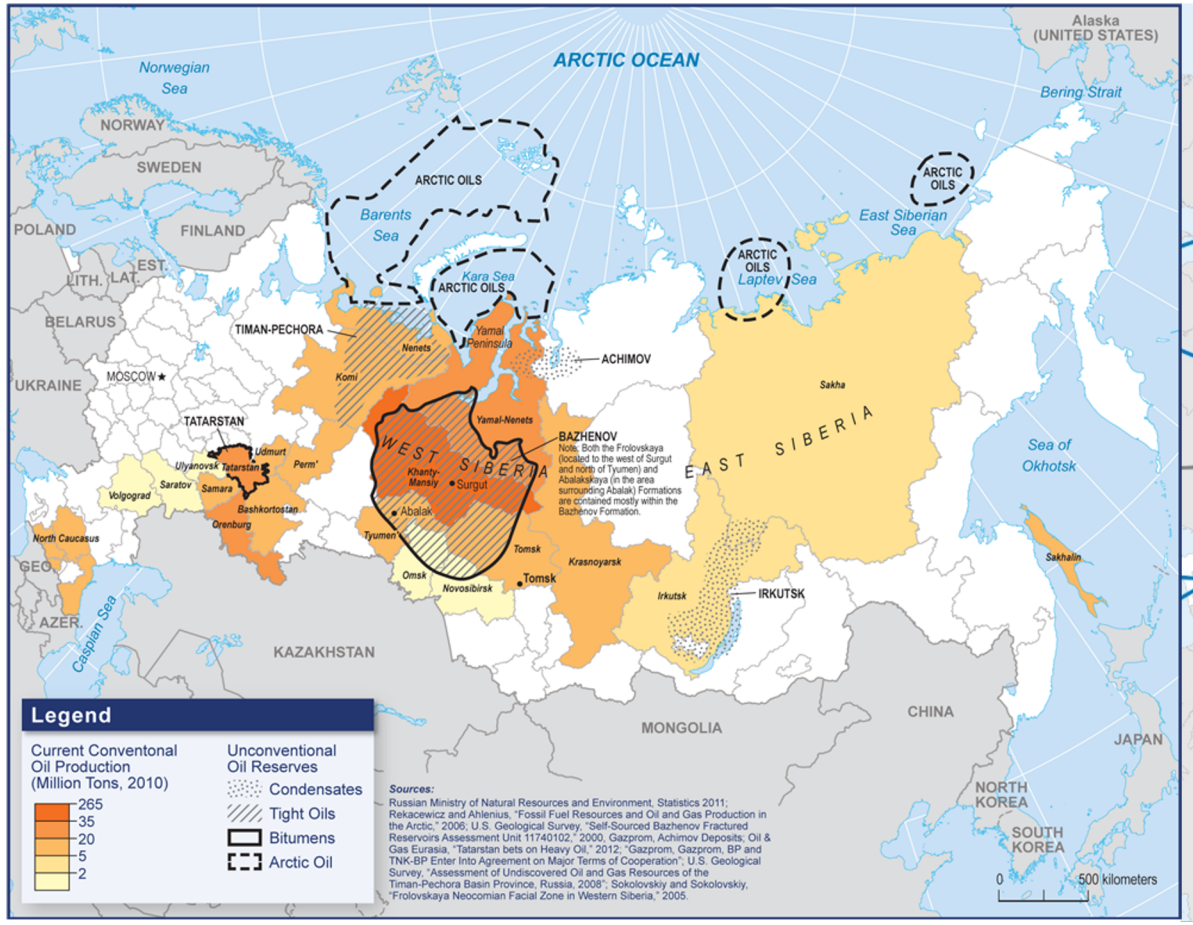
II) RUSSIA

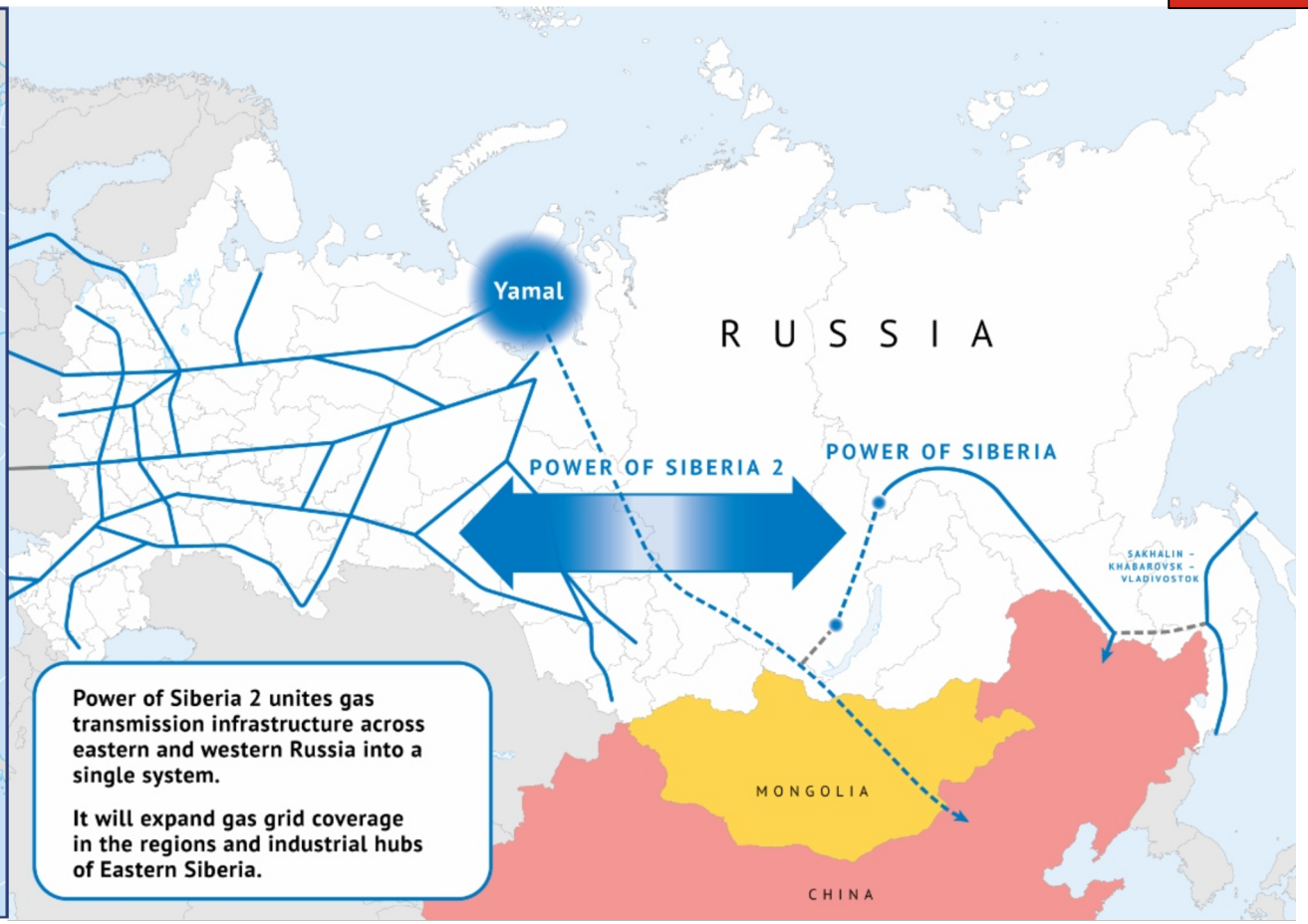
II) RUSSIA

Actualized energy scenario	Actualized mobility scenario
No climate-led energy transition but restructuring across classical energies as energy sector is central to Russian economy. Priority to exports revenues and territorial cheap access through hydrocarbons. 2025 partial gas substitution for oil & coal East/West rebalancing between electricity and gas	Oil-based transport to remain central. No major shift in mobility is likely to happen before 2030. There is no plan for sustainable mobility. Gas & electric mobilities might develop but only in some specific location.

Alternative energy scenario	Alternative mobility scenario
Energy mix depends mainly on hydrocarbon regulation. - It has a direct impact on hydrocarbon production via subsidies and foreign technology restrictions. - Directly impacts energy prices **Increase integration of foreign technologies on the national territory** - Could accelerate & secure both hydrocarbon & RE development - Will confront strong Russian interventionism to a market-rule approach	**Electric charging network deployed across Russian territory** - Could boost electric vehicles demand but not likely to happen before 2030. - Electricity system will be under pressure due to a lack of flexibility

Energy resources is more used for inward strategic objectives





- New oil fields require expensive investments and technologies that Russia does not possess.
- Bipolarisation of the energy system towards Asia.

Global energy transition is seen as a threat, not than an opportunity

"The country's energy security is threatened by the policy of decarbonization and the transition to green energy" Ministry of Energy

Coupling 1 : Inter-energy competition in export sector: decline of oil & increase of gas production

- Decreasing share of oil production (558Mtoe) due to declining production in existing fields. Share of gas in export will increase.

Coupling 2: Inter-energy substitution in industry because of industrial equipment modernization

- Industrial equipment renewal (Ural region grid-connected heavy industry)
- Coal industrial equipment shift to LNG + gas + electricity

Coupling 3 : Inter-energy addition/substitution across sectors in some regions

- In some regions, shifts are impossible because of energy transmissions & prices
- Gas + electricity in the Western; Coal + heat in the Eastern
- Heat & gas competition in residential across territory

Coupling 4 : RE decoupling from domestic technologies

- Weight of RE on total electricity generation in 2018: 8%
- Foreign technologies technical & knowhow dependency
- Very located projects development (Rostov region)

Putin recently targeted CO2 emissions decrease by 70% by 2030 compared to 1990 levels (2019, already less 31% from 1990 levels.

So far this additional -40% is not credible

Urgent need to rethink dependence on energy exports in front of global major shift (LNG + RE increasing share worldwide).

High potential of RE resource is still not considered as a major opportunity.

Strong inertia in mobility, technology, uses

Energy & mobility trajectories in Russia – points of focus

Actualized Energy scenario Points of Focus

Energy transition in Russia is not a priority. No major energy shift are likely to happen.

- 2025 gas & LNG to rise in mix: production rise for domestic consumption (electricity generation + residential) & exports.
- Coal use will remain high in industry. Coal production will increase in the Far East for both electricity generation & industry.
- Developing RE is not the priority & is at a standstill except very specific locations.
- Oil production: slowly decrease as lack of subsidies & plans. Domestic availability for road transports to remain high.

Actualized mobility scenario Points of Focus

Cheap –and undisputed- access to oil makes alternatives uncompetitive.

- Gas mobility notably for HDVs & public transport is also to develop.

  - CNG is to develop for public transport, LDVs, cargo transport, motorcycle & public vehicle. **Will develop mainly in western regions.**
  - Promotion of LNG: MoU between India & Russia to foster LNG investment for mobility. LNG demand in main freight, railway & agriculture

- Weak electric mobility signals. Lack of charging points .

  - Electric public transport promotion program in most polluted cities.
  - **LDVs electric mobility opportunities mostly in Eastern regions** big cities because of infrastructures deployment & way of life.
  - Disparate and slow development of LDVs (Primorsky Krai, Moscow, Khabarovsk krai)

Possible trajectories turnpoints

O & G regulation

Willingness to integrate foreign technologies on the national territory

Long term strategy to connect Far East & Western Russia (gas-electricity rebalancing) + gas rebalancing from Europe to China

Risks for a car manufacturer

- TCFD & ESR risk
- Stranded ICE assets risk

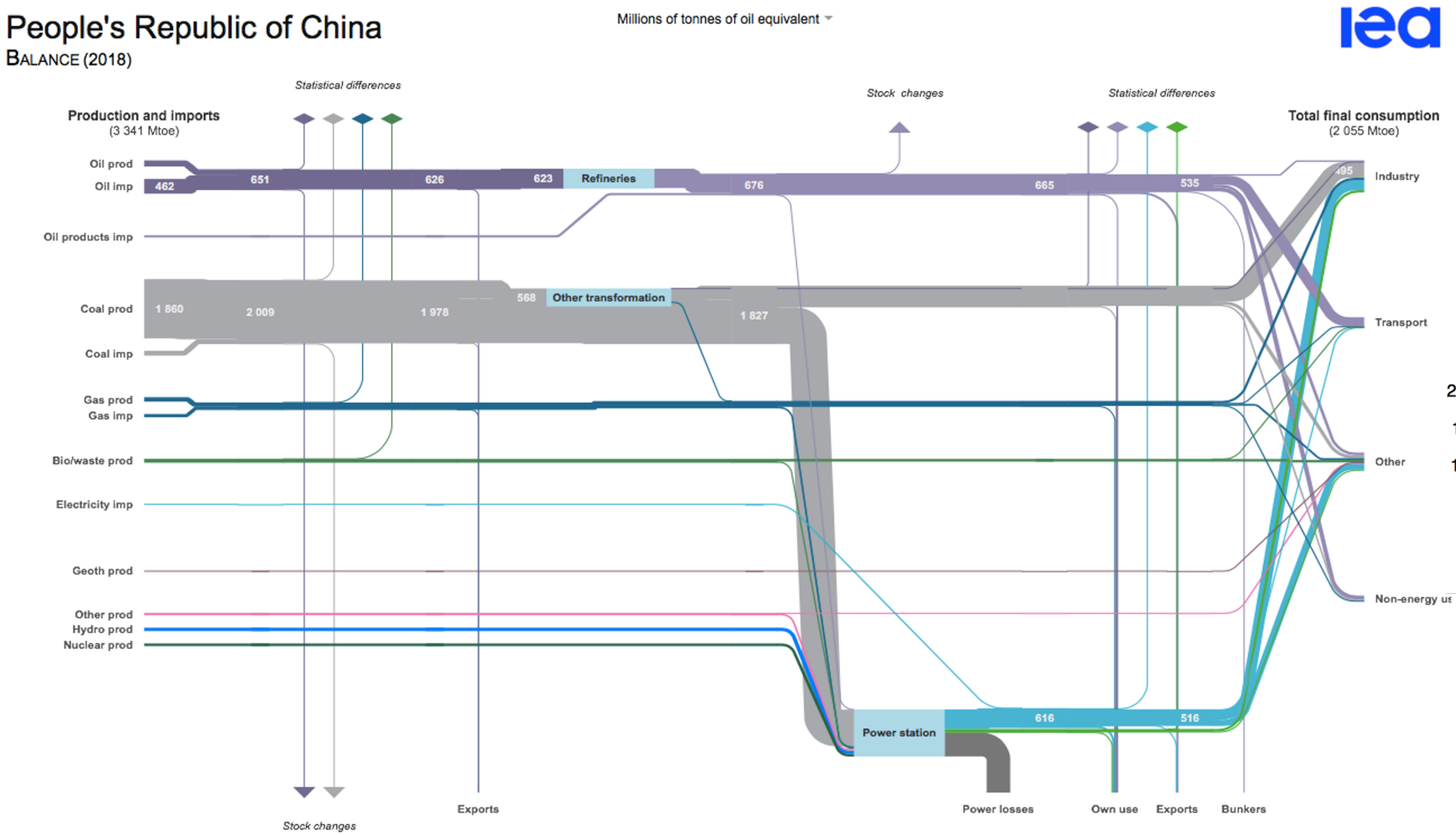
III) CHINA

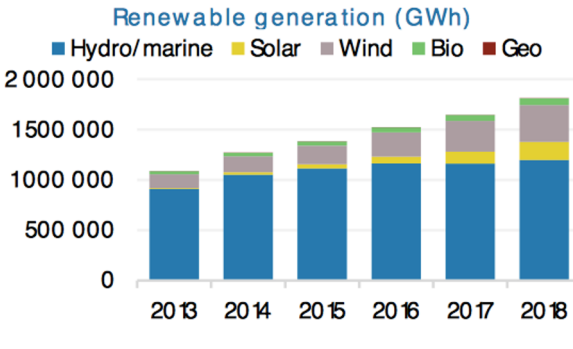
III) CHINA

Actualized energy scenario	Actualized mobility scenario
2030 - Transitional maintenance but modernization of coal-fired power plants for energy security and economic growth. Massive investments in gas, RE & nuclear for coal substitution. 2010-2019 China's renewable energy investments were about USD 800 billion, more than total Europe (UNEP, 2019). Zero carbon 2050-60: Massive investment in RE + CCS hydrogen. Continued development of nuclear power.	2019, 5.6% of new vehicles sold were electric. Entry into a post-subsidy phase of electric vehicles. Target of 25% NEV by 2025 (electric, fuel-cell). Investments in hydrogen for heavy-duty vehicles, buses and commercial vehicles 2030.
Alternative energy scenario	**Alternative mobility scenario**
Efficient energy efficiency policies accelerate decarbonation & electrification To relieve pressure on the grid & enable faster increasing RE in the electricity mix. **By 2030, shift toward green H2 possible for industry & heavy/collective mobility uses.**	Relieve on the electric system due to better energy efficiency will accelerate shift toward electric mobility.

1.1 Energy system picture : key system realities

https://www.iea.org/sankey/#?c=People's%20Republic%20of%20China&s=Balance



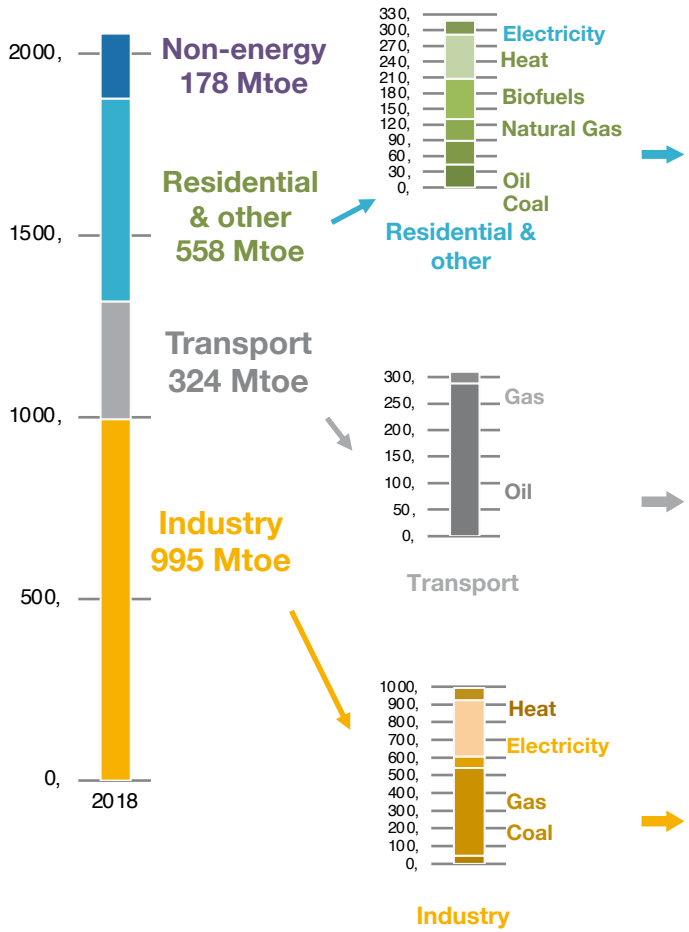


Electric generation from renewables (Irena 2017 data, GWh)
https://www.irena.org/IRENADocuments/Statistical_Profiles/Asia/China_Asia_RE_SP.pdf

Primary energy supply depends largely on coal and oil, though RE and Gas is increasing. Final consumption mainly by industry, only 24% via electricity.

1.2 Energy system picture : final uses analysis

China final energy consumption 2018: 2055 Mtoe



Inertias
(by sectors)

Inertia1 : electricity dominates
Inertia2: coal, oil and biofuel shares are relatively balanced

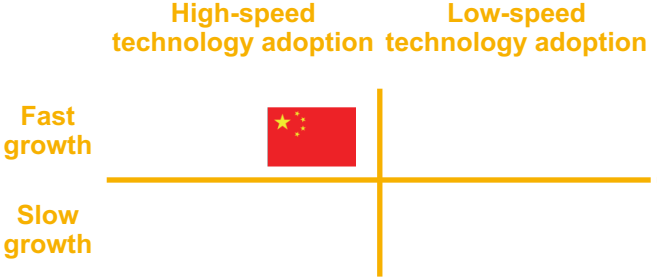
- Residential: 61% (345Mtoe)
  - Biofuels (22%), electricity (24%), oil (13%), coal (13%), gas (12%)
- Commerce & public: 16% (91Mtoe)
  - **electricity (40%), coal (19%),** oil (18%), gas (15%)
- Agriculture: 8% (45Mtoe)
- Oil (42%), coal (31%), electricity (24%%)

Inertia3 : oil dependent

- Road :80% (262Mtoe)
  - Oil (89%), **gas (8%),**

Inertia4 : coal/electricity duality
Interia5: steel-making still mainly running on coal equipment

- Chemical & petrochemical: 20% (208Mtoe)
  - **Coal (40%),** electricity (26%), heat (18%)
- Non-metallic minerals: 18% (181Mtoe)
  - **coal (135%), electricity (17%)**
- Iron & Steel: 24% (247Mtoe)
  - **coal (75%),** electricity (20%)



Policy drivers
(on energy and/or sector)

Objectives : Paris Agreement + peak of CO2 emissions by 2030, carbon neutrality by 2060
Our view: clear objectives that pave the way for global progress, but roadmap still vague and insufficient to limit global warming to 2°C.
Timeframe : 2025, 2030, 2060
Governance type : central government (CCP General Secretary), 22 provinces.

Driver 1 : Phase out coal and oil in the long-term

Weight of coal on total energy supply: 61% and oil: 20%.

- Almost completely phase out coal by 2050 to reach its carbon neutral goal by 2060
- Gas and RE replacing coal : consumption growth 2010-2019 : coal = 1.3%, NG = 11.9%, RE = 9%

Driver 2 : RE, H2, gas and nuclear investments

- In 2030 : reach a non-fossil fuel (renewables and nuclear energy) share of 25% in primary energy
- Raise combined wind and solar power capacity to 1,200GW in 2030
- RE: current 8.5% => 17% under 14° Five-Year Plan => 26% by 2030 => 60% by 2050
- Nuclear: current 2% -> 10% by 2035 -> 28% by 2050
- Green H2 from 3% in 2019 to 70% in 2050 : by 2030, shift toward green H2 possible for industry & heavy/collective mobility uses.

Driver 3 : Energy efficiency

- >70% of energy use by industry has mandatory efficiency policies
- The national Emission Trading Scheme push energy-efficiency tech
- Urban area - biomass heating replace coal
- Projects : 2019 buildings efficiency invt $30 bn, 2019 RE heat equipment invt $12 bn

Minor driver 4 : electrification of mobility

- In 2018, “China Automobile Low Carbon Action Plan (CALCP)”
- By 2030, 1) under current policy scenario – M1 and BEV will reduce full life-cycle emission by **19.9%** and **18%** respectively; 2) under low carbon scenario : by **27.5%** and **32.8%**.

1.3 Coupling analysis - Coupling & issues in transition pathway

Inertias (by sectors)	Policy driver (on energy and/or sector)
Residential - Inertia1 : electricity dominates	Gas investments
Residential – Inertia2 : coal, oil and biofuel shares are relatively balanced	Energy efficiency
	RE and nuclear investment
Transport – Inertia3: oil dependency	Electromobility
	Energy efficiency
Industry- Inertia4 : coal/electricity duality	Gas investments
	RE investment
Industry- Inertia5 : steel-making still mainly running on coal equipment	Energy efficiency

Coupling
(dynamics on energy-to-energy, energy-to-use and use-to-use)

Coupling1 : replace use of coal by alternative sources

- Modernisation of coal sector towards gas with CCS.
- Share of electricity will increase in every sector especially in industry. Industrial equipment may shift toward gas & electricity.
- Urban area – centralised heating system (gas) replace coal
- Rural area – developing biogas system to reduce raw coal
- Green H2 from 3% in 2019 to 70% in 2050
- Nuclear to represent 10% of energy mix by 2035 & 28% by 2050

Coupling2 : From energy diversification by 2030 to accelerated greening by 2060

- Fossil growth slows down except natural gas.
- Wind & solar grow fast but still small compared to coal-fired power.
- Nuclear as alternative resource: 10% of energy mix by 2035, 28% by 2050
- By 2060 RE will substitute coal in electricity generation

Coupling3: greening mobility and electrification of uses

- Active policy & massive investments towards sustainable, smart and shared mobility.
- Electricity and H2 will substitute oil in road mobility, with also increasing public supporting infrastructure (charging station, smart grid).
- Competition in electricity demand – industry, residential & electric mobility.

Structuring issues

Issue1 : crucial stake of China

- With 24% of global energy consumption and 51% of global coal consumption, China is a crucial stake in achieving climate change goals.
- China has clear transition targets and is actively promoting green energy and electrification, limiting carbon emission, developing strategic industries of new energy vehicles and hydrogen economy.
- Current policies are not sufficient to reach the objective of the COP-21. Further acceleration in climate policy is a must.
- The energy transition is a national ambition, but the carbon neutrality by 2060 objective will require more investment and structural changes

Issue2: Energy efficiency

- Efficient energy efficiency policies accelerate decarbonation & electrification => relieve pressure on the grid & enable faster increasing RE in the electricity mix.
- Relieve on the electric system due to better energy efficiency will accelerate shift toward electric mobility.

Issue3 : regional disparities

- Regional disparities raise difficulties of integrated and efficient national energy/electricity systems.

Issue4 : energy security

- 50% energy weight of industry greatly challenges a transition prioritizing energy security.

Energy & mobility trajectories in China – points of focus

Actualized Energy scenario Points of Focus	Actualized mobility scenario Points of Focus
The energy transition is a national ambition, but the carbon neutrality by 2060 objective will require more investment and structural changes. - Fossil energy will decrease. Gas as transitional source for electricity in industry and residential. - Non-fossil electricity share 31% in 2019. - Coal-fired power peak by 2030, then slow decline. - Coal-to-liquid/coal-to-gas, CCS to ”green up” coal uses. Heavy industry coal-dependent for a while. - Massive investment in RE & nuclear will electrify uses. RE & nuclear: 60% & 28% of the energy mix by 2060 in an accelerated scenario. **Impact of climate mitigation** • Peak CO2 emission will be achieved earlier around 2025 (+2.6% in 2019) • Non-fossil share 20% in 2030 will be achieved, even reaching 25%-30%	**The decarbonization of mobility is one of the pillars of the energy transition. Mobility is thus prone to major technological changes.** - Target: by 2025, the yearly sales of NEVs & connected intelligent cars will reach 25% and 30% respectively. - Sustainable mobility will benefit from a greening electricity if the energy transition is achieved in time. - Electrification of mobility in massification; stage; national policy changing from subsidy support to market competition. - “Hydrogenization”: demonstration projects, sustained by national and regional programs and investments. - Initiative in LCA Annual Report under international collaboration.

Possible trajectories turnpoints

Increasing economic weight of «light» industry (ICT, AI, big data)
Relocation of heavy industry GVC
Energy efficiency
Smart and integrated grid
National carbon trading market

Risks for a car manufacturer

- Need to be a proactive actor
- Strong domestic competition and very different demands big cities/rural zones
- Ongoing electrification rivalries: mobility – residential – industry

IV) IRAN

III) IRAN

Actualized energy scenario	Actualized mobility scenario
The targets extending O&G exports, absolute levels of O&G in total energy output will increase for export. 2025-2030 relative share of O&G in domestic final consumption will decrease while RE share will rise. Search for foreign investments to diversify its energy mix while. But US sanctions leave Iran with China (planned bn 280 USD investment)	No major shift in mobility is likely to happen by 2030 because. Lack of effective policy. Share of gas is high and is likely to increase, notably in public transportation, HDVs, and taxis. Though RE-based electrification will remain slow, limited competing uses for it may leave a scope to electric mobility
Alternative energy scenario	**Alternative mobility scenario**
Central government's decision to electrify transportation: Electrification of transport through green sources will pioneer & encourage electrification of other uses (residential, industry) Rapidly decreasing domestic use of gas & oil, increasing amounts of exports	**Central government's decision to electrify transportation:** To avoid increasing the share of oil & gas to respond to this growing demand for electricity, an ambitious RE development program will have to be implemented Public vehicles (buses, taxis) will be electrified first resulting from government's directives, followed by private LDVs & HDVs

Gas will remain core in Iran's energy mix

Coupling 1 : RE addition in the electricity mix to decrease share of oil & gas for generation

- RE addition in the electricity mix, but gas & oil will remain the electricity base until RE infrastructure produce at scale
- Weight of gas & oil for electricity generation: 65.3%

Coupling 2 : inter-energy use substitution: hydrocarbon exports will substitute part of domestic consumption

- Energy efficiency, increased RE, to lower domestic use of hydrocarbon
- In parallel, hydrocarbon production will expand for greater exports
- Weight of oil & gas on total energy consumption: 88%

Minor coupling 3*: *2030-increasing electricity consumption

- Growing demand for electricity together with economic development
- Growing electricity generation in coherence with the increased share of RE for power generation
- Potential electrification of mobility

Major investments likely to modify the energy mix in the future, but no clear energy transition plan.

Focus on energy efficiency to reduce GHG and shift to RE to respond to a growing demand for electricity.

Sustainable mobility is not a government priority. Pollution & congestion management are opportunities for lower carbon mobility in select cities.

Energy & mobility trajectories in Iran – points of focus

Actualized Energy scenario Points of Focus

Iran's energy transition plan lacks a clear framework of action.

The country relies on foreign investments to diversify its energy mix while extending exportations of gas & oil - **$400bn invested by China over 25 years.**

- Absolute levels of gas in total energy output will keep increasing
  - **$280bn (out of 400) investment from China**
- Oil production will increase for exports
- Increasing relative share of RE in the electricity mix thanks to major foreign investments (China)
- 2025 electrification to support Iran's economic development.
  - **$120bn (out of 400) invested in upgrading Iran's transport and manufacturing infrastructure.**

Actualized mobility scenario Points of Focus

No major shift in road mobility is likely to happen by 2030 because of a lack of effective policy.

2025 railways will continue to develop and substitute for a minor part of LDVs & HDVs in the mid to long-term.

High share of gas, likely to increase in public transportation, HDVs (bus, freight), taxis

- Scheme to convert 1.4 million vehicles ***to CNG hybrid***. 25,000 vehicles have been converted. **Less gasoline subsidies & increase fuel prices to promote CNG**
- CNG stations exceeds 2,500 in the country in 2020

- Shift towards a more sustainable mobility in cities with slow mobility & electric public transportation (Tehran & Esfahan)

Possible trajectories turnpoints

Central government's options to electrify transportation in cities

Sustainable electric mobility could benefit from a greening electricity mix

Risks for a car manufacturer

- TCFD risk at international level
- U.S. extraterritoriality law
- Stranded ICE assets risk

V) Europe G5 - Spain, Germany, Italy, France, United Kingdom

IV) EUROPE G5 - Germany, Italy, France, Spain, United Kingdom

Country	Actualized energy scenario	Actualized mobility scenario
G5	Despite disparities, G5 has a structured pathway toward carbon neutrality by 2050 (and Brexit won't change it; COP26 will accelerate it for UK). Electricity system reinforcement is the priority since electrification of uses is core of energy transition strategies (except for Italy, gas priority; UK has an hybrid priority: electricity + gas: first NG then H2) Energy efficiency to rise as a tool to relieve electric system pressure Gas will be used as a *transitory* energy waiting for RE (and potentially H2) infrastructures to produce at scale	2020 is a pivotal year for electric mobility. EV market resisted to Covid-19 crisis and have shown significant progress across Europe. Electricity will be dominant for sustainable mobility but gas mobility will also develop particularly in Italy. Biofuels blending will increase due to EC promotion. Bioethanol + biodiesel will be used as transitory energy for mobility to decrease ICEs pollution. Urban plans question the future of personal car in cities & Strong promotion of shared mobility & slow-mobility

Country	Alternative energy scenario	Alternative mobility scenario
G5	**Energy efficiency accelerates decarbonation & electrification** Energy efficiency aims to decrease electricity consumption in buildings & relieve pressure on the electric system. **By 2030, H2 shift will be possible both mobility & industry uses**. Nuclear will be used for low carbon H2 production.	Energy efficiency policy is to relieve pressure on the electric system & enable acceleration of electrification of mobility. Shift toward green H2 mobility for HDVs will be possible by 2030.

Energy transition through electrification of uses

Coupling 1 : RE will substitute polluting energy in the electricity mix

Coal power generation will be substituted by massive RE investments.
Nuclear (France, UK) + RE + gas will shape the electric base.
Interconnections between countries will increase due to fear of electricity generation.
Gas to rise over few years waiting for RE infrastructure to be build (Spain, Italy, UK)

Coupling 2: Electrification and competition in demand should prevent electric saturation

Electrification of transport and industry uses, rising competition of Power uses
In Italy, competition based on industry and residential demand for gas & electricity

Coupling 3: Alternative energies will compete for sustainable mobility

ICE ban in Spain (2040) & UK (2030)
Inter-energy coupling for sustainable mobility
Alternative competition (electricity, biofuels, H2) for mobility

Coupling 4 : Major country specific couplings

- **Spain:** Some industries to shift equipment from coal to undecided sources
- **Germany:** Gas/electricity competition in renewing industrial equipment
- **Italy:** Infrastructure coupling Legacy system in the North that distributes energy between urban centres and industrial districts.
- **France:** Maturity in residential sector Inter-energy coupling : biogas substitution in residential by electricity & biogas competition
- **UK**: From 2030, uncertainty on gas' role in energy transition Gas remains key for energy transition whilst industry & transport equipment might shift to H2 and electricity

G5 countries: world leaders in energy transition. Their energy systems are being transformed towards a green electrification of uses.

Framed by the ambitions of the EC with a growing influence by Germany (and COP26 for UK)

Despite an overall ambition to green transportation, the strongest of inertia remains oil. Oil weight in energy transition is hardly mentioned, except for UK.

Mobility's impact on the environment will only be positive by greening electricity (& green/low carbon H2 for heavy duty).

Particular couplings analyses in G5, major particularism highlighted in red

France	Germany	Spain	UK	Italy
Coupling1 : RE addition for electricity	**Coupling1 : inter-energy substitution**			
More RE & nuclear reduction	• FROM coal + nuclear to RE • **Electric mix saturation focus**	• From nuclear + coal to gas + RE	• Gas to RE + nuclear imports • Will shape the electric base	• Coal to RE substitution • Competition RE-gas for electricity
Coupling2 : inter-use electricity demand competition				**Coupling2 : inter-use competition gas & electricity**
• Rise of electricity in energy mix ⍰electricity demand competition	• Competition electric mobility rise & industry/residential stable demand			• Competition industry & residential demand for gas & electricity
Coupling3 : Maturity in residential sector	**Coupling3 : inter-energy : gas/electricity competition**	**Coupling3 : fossils exit for specific industries**	**Coupling3 : From 2030, uncertainty on gas role in the energy transition**	**Coupling3 : infrastructure coupling**
• Biogas substitution in residential, electricity-biogas competition	• Equipment competition gas - electricity	• Cement factories to substitute fossils to undecided sources	• Gas keeps a role; industry & transport equipment might shift to H2 + electricity	• Gas is key for energy transition; gas infrastructures for green gas
Coupling4 : Unspecified Role of biogas	**Coupling4 : car industry uncertainty**	**Coupling4 : technology shift in fossil liquid fuel mobility**	**Coupling4 : technology shift in fossil liquid fuel mobility**	**Coupling4 : mobility coupling**
• Biogas & electricity : uncertainty on energy use for low carbon mobility	• Low commitment of local car makers	• ICE ban for 2040 • Competition (electricity, biofuels, H2) for sustainable mobility	• ICE ban for 2030 • Alternative competition (electricity, biofuels, H2) for sustainable mobility	• Inter-energy coupling : gas, biogas and electric competition for mobility

Energy & mobility trajectories in G5 countries – points of focus

Country	Actualized energy scenario Points of Focus	Actualized mobility scenario Points of Focus
Germany	Coal & nuclear substituted with ER and gas. Investments in H2.	Not a priority. Incentive for renewable gases. Hybrid transportation also encouraged
Spain	Coal & nuclear substituted with gas & major RE ambition (100% RE 2035 electricity mix). In the meantime, gas is key to the transition to renewables.	Prohibition of new ICE LVDs from 2040. Promotion of shared mobility + electricity price increase = potential decrease of the private fleet LVDs
Italy	Energy transition using old gas and electricity infrastructure (via European interconnections)	Development of gas-powered mobility (mainly biomethane), Encouragement also of EVs and PHEVs
France	Nuclear to account for 50% in electricity mix by 2050, rise of RE but uncertainty on partial substitution of nuclear future role of H2	Post-Covid recovery plan has as a priority the development of EVs and PHEVs. Decrease in car use in cities
UK	"Nearly decarbonized society": coal phase-out & reinforcement of the power system (nuclear, RE, imports), Investments in H2	High ambition for slow & sustainable mobility. ICEs ban for 2030 will boost electric mobility. Strong promotion of shared & slow mobility

Possible trajectories turnpoints

EU regulation for mobility

Deployment of electric infrastructures

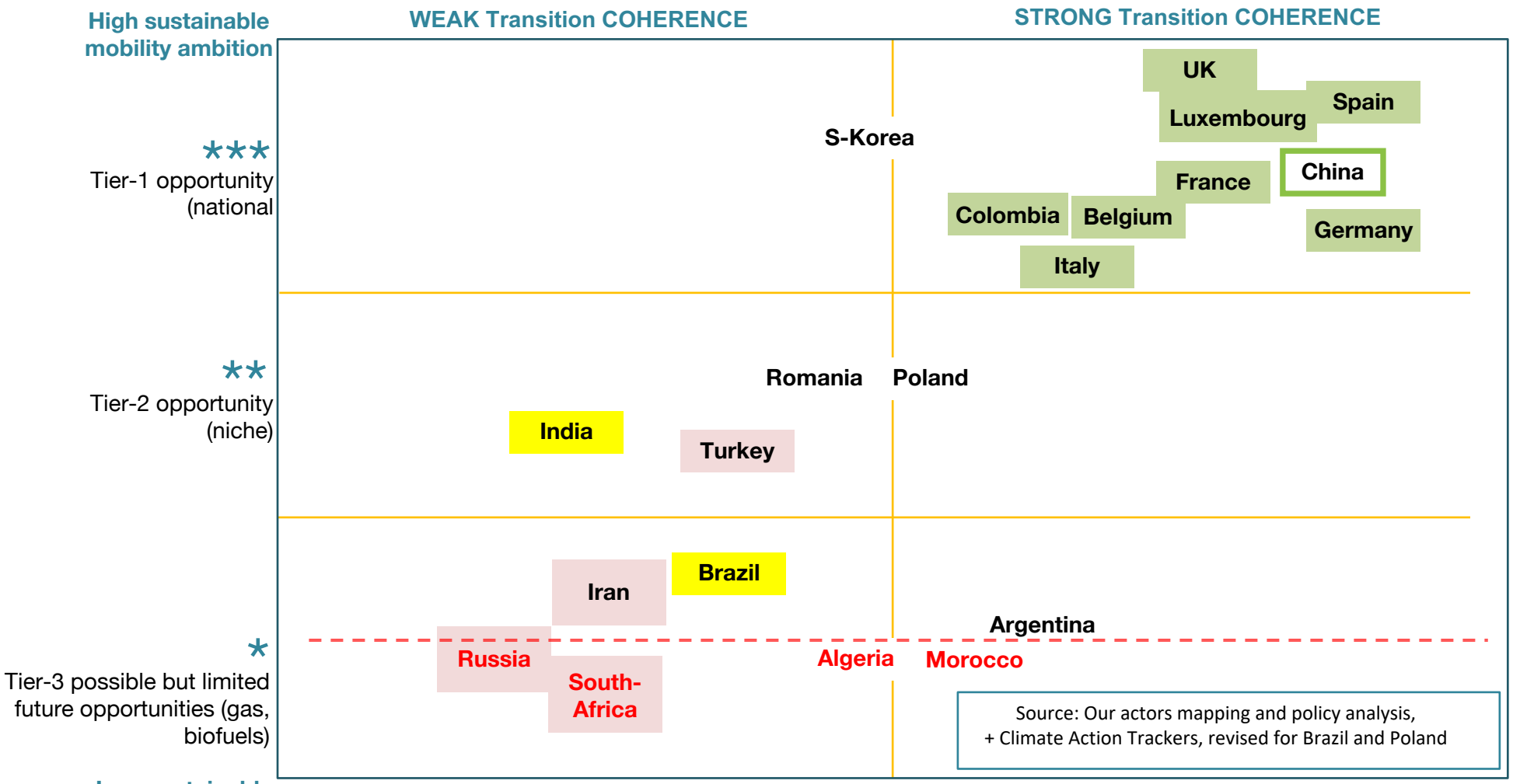
H2 penetration

Risks for a car manufacturer

- Need to anticipate TCFD
- Ongoing electrification rivalries: mobility – residential – industry

Conclusion

Transition Coherence vs. Sustainable mobility ambition- clean mobility market opportunities and risks



Risk that one star countries don't support overall company strategy towards low carbon mobility