

WORLD ENERGY OUTLOOK

2100

Base Case Scenario

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FOREWORD



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Energy is one of the most important issues for all countries. While dealing with such a strategic issue, long term projections and the coherency of the due estimations follow a vital role for determining energy and energy related policies.

There are many huge organizations, which are annually preparing new estimations about the global energy trends and demand projections. In the literature, estimation periods are taken usually up to 2040's or 2050's.

Of course, there will be many unknowns for longer estimations, which requires lots of assumptions. However, in order to build more successful policies and to design a global system based on more sophisticated structures, we all have to see the farther future.

On the other side, while usually the high budgeted existing estimations do not meet the coherency demands, how can we succeed for longer periods with smaller budgets?

This is an important question. And as an answer, (according to our evaluations) existing Western popular projections do not seem as reverberating the real life for the mid and low income groups. Because they are making mistakes by trying to model the world directly from their own perspectives. How? By considering the whole World similar to their own life standards, incomes and development levels! But the future of the energy policies will not be determined by the preferences of the high incomer – developed countries.

Contrarily, low incomers and the undeveloped countries will have the highest effect on energy dynamics. Their preferences will shape the tendencies. And their energy hunger will ransack all the existing estimations and unrealistic expectations.

There is a popular word in Turkish literature: «if it burns, poor people burn the World» and we will observe this social effect in the global dynamics.

That's why incase by modelling the scenarios on a foreseeable unsuccessful de-carbonizing politics, it seems more coherent to initially understand the tendencies and reflexes of the low income groups.

In this study, we have tried to build a different model (up to 2100's), by considering many altering social, technical, technological, commercial and political issues in the same cauldron.

We are waiting for your comments. Hence, for a healthier and happier World, we have to help each other!

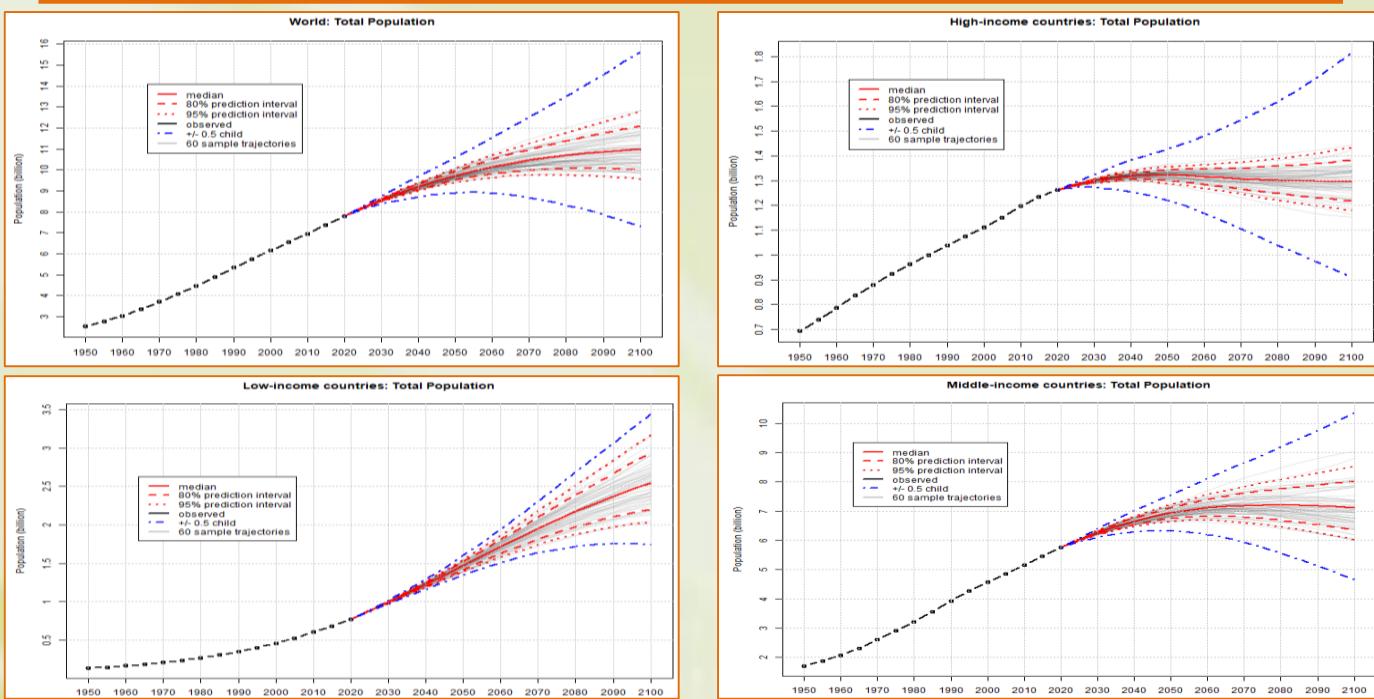
KEY DRIVERS

- There are many important key drivers to consider, while analysing and estimating the long term energy balances and consumption projections. Our main key drivers taken into consideration are:
 - Population & Income
 - Social effects and preferences
 - Unit Costs and Technology Access
 - World economy
 - Global warming
 - Efficiency
 - Force majeure effects
 - Reserves, facilities and logistics
 - Investment
 - Market conditions

KEY POINTS

- Oil & Gas will continue to be the most important energy resources.
- Oil demand may start to decrease after 2070's, while the electrical vehicles will have pervaded in the low & mid income groups.
- Preferences of low income groups will determine the future scenarios. Which means, social analysis is very important for coherent estimations.
- Electricity demand will highly continue to increase.
- Renewable energy production will continue to increase with a high incremental rate (with the leverage of new technologies and decreasing costs) in all income groups.
- For the estimated scenarios, much more new oil and gas reserves have to be discovered. Otherwise all scenarios have to be updated.
- Although the World tries to consume less coal, prices, unit costs and the new technologies may change the existing scenarios. That's why, less decrease in coal consumption may be observed. In addition, in the case of inadequate oil and gas reserves discoveries, the coal consumption may start to increase again.
- In addition to these approaches in coal consumption estimations, with possible new cheaper technologies on cleaner coal power plants and coal to hydrogen processes, all these scenarios will have to be updated.
- Decarbonizing policies will continue to be unimportant for the low and mid income countries. This means CO2 emission policies of the Western countries will not be successful. In addition, there is not enough fund to reach the global de-carbonizing targets.
- China and India will be the most important consumers and future of energy markets will mainly be directed by their choices and policies.
- Total primary energy consumption will increase around % 91 globally in 2100.
- Biological threats and CBRN attacks will also be important issues for the global population growth, economical and energy dynamics.

POPULATION & INCOME



Graph 1,2,3,4: World Population Projections and due Income Groups¹

- Population is one of the most important drivers in energy consumption.
- According to median case scenarios of UN, population incremental rate will start to decrease in 2040's.
- Another important aspect from the sight of population is «incremental trends of different income groups».
- Low-income group is the most important part of global population growth. This situation is very important, because, high income group means more renewable, less CO₂, more efficiency and existing high consumption rates. For the low income groups, this fact is vice versa.
- Table below summarizes the due trends.

| | current consumption | funding for efficiency | sensitivity on CO ₂ | vitality of energy | incremental rate for consumption | tendency on renewables | tendency on oil consumption | tendency on gas | tendency on coal | technology investments |
|---------------------|---------------------|------------------------|--------------------------------|--------------------|----------------------------------|------------------------|-----------------------------|-----------------|------------------|------------------------|
| high income group | high | high | high | high | low | high | middle | middle | low | high |
| middle income group | middle | middle | low | high | high | middle | middle | middle | middle | low |
| low income group | low | very low | very low | middle | high | middle | high | high | high | very low |

Table 1: Energy Tendencies of Diffrent Income Groups

- As can be understood from the graphs above;
 - Middle income group is growing, with a decreasing incremental rate,
 - Low income group has a higher incremental rate than the others,
 - High income group's population will start decreasing after 2040's.
- This means, through 2050's, global energy trends will be affected by:
 - The low income group's preferences by %20,
 - The middle income group's preferences by %65,
 - The high income group's preferences by %15.
- But in 2100's, the situation will be as; global energy trends will be affected by:
 - The low income group's preferences by %23,
 - The middle income group's preferences by %64,
 - The high income group's preferences by %12.
- In addition due to continuation of the population incremental rates of the due groups, low income group's effect will extensively increase in the global dynamics. Hence, highest population growth rate will belong to low income groups.
- But social expectations of the low income groups regarding with the energy preferences are highly different than the high income groups. So, the World will not follow a cleaner and less

- CO₂ oriented pathway in the future dynamics.
- To intervene this situation, high income groups have to give some donations and funds for the middle and low income groups. Otherwise, non of the de-carbonizing policies will be successful.
- From a realistic approach, we can easily estimate that high income groups' funds and donations will not be enough to change these dynamics.
- That's why, from the population and income modelled social sights, estimations show:
 - An increasing energy hunger of the middle and low income groups,
 - Not enough fund for de-carbonizing policies,
 - Efficiency and renewable issues will directly be affected according to the unit costs and the low & mid income groups' capability to access the cheap technology

NOTE: Epidemical threats and CBRN attacks will be important issues, which will have an increasing influence on the global population growth. In addition to these, such threats and risks will also effect the global economics, trade and energy dynamics.

SOCIAL EFFECTS AND PREFERENCES

➤ Many factors affect our energy preferences. Such as:

- Income Levels,
- Living Standards,
- Hunger for Luxury,
- Funding and Financing Opportunities,
- Education Level,

- Social Habits,
- Energy Type to Be Cheap, Practical to Utilize and Easy to Access,
- Tax Policies,
- Grants and Incentives,
- Legal Framework and Legislative Issues,
- Exemplary Attitudes of the Elites Society.

| | direction | more efficiency | less CO2 | more renewables | electrical cars | environmental sensitivity | more technology |
|---|-----------|-----------------|----------|-----------------|-----------------|---------------------------|-----------------|
| income levels | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ |
| living standards | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ |
| hunger for luxury | ↑ | ↓ | ↓ | ↓ | ↓ | ↓ | ↑ |
| funding and financing opportunities | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ |
| education levels | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ |
| social dependency and conservatism | ↑ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| being customary & cheap | ↑ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| prevalence | ↑ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| tax amounts | ↑ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| grants and incentives | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ |
| clear and stable legal framework and legislative issues | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ |
| exemplary attitudes of the elites society | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ | ↑ |

Table 2: Energy Tendencies According to Some Issues

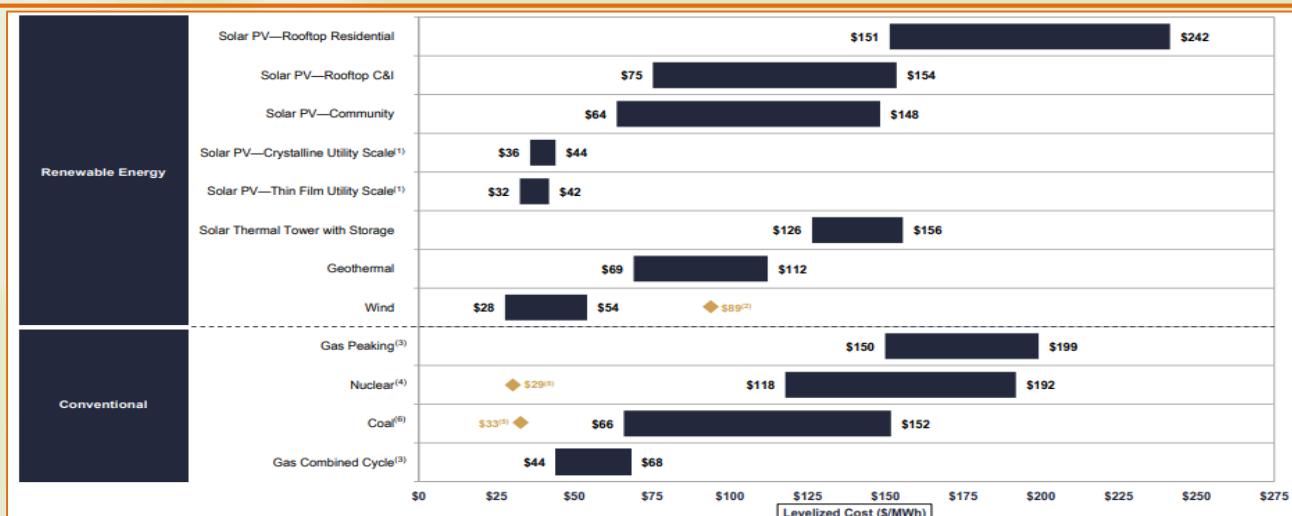
- Above, the table shortly gives clues about how the due factor's directional tendency affects some important issues in energy preferences.
- As can be understood from the table, for the mid and low income groups;
 - Efficiency, de-carbonization, electrical cars and other environmental issues will not be so important.
 - While the living conditions are low, then again there will not be enough consciousness about the environmental issues.
 - Hunger for cheaper luxury can be resulted in having more energy consuming vehicles.
- While the funding and financing opportunities are low, then it will not be easy to invest in locally unusual technologies such as some of the renewables. This situation directly affects the de-carbonization policies.
- Education levels are also related with the income which directly effect the development standards. Usually the higher the education levels the higher the tendency for cleaner energy.
- Social dependency and conservative approaches usually have negative effects on new ideas and new types of energy.
- Being customary and cheap (such as coal) usually will be an important sight for being a preferable option, which directly changes the CO2 policy balances.
- Prevalence is another important issue to consider the preferences. If something is easy to supply (this changes according to location) then usually it will be chosen.
- Tax regimes of a country on different types of

energies also another differing point for preferences. Naturally while the taxes are higher, coefficient of preference will decrease. Consequently, for the mid or low income countries, usually there aren't enough tax relief policies to encourage the investments on renewables, which means inefficient de-carbonizing policies. In addition, in some countries, due to being cheaper and having somehow plenty of coal resources, lower taxation policies are applied for coal. Like the tax rates, grants and incentives will also play an important role for development of clean energy policies. Granted and incentive supported energy investments are usually preferred.

To take attention, legal framework and the due legislative issues of a country also have to be clear and stable. Otherwise, the gaps and uncertainties in the legislative system will impose risks for the investor, which means having problems in further energy policies.

➤ In addition to all, exemplary attitudes of the elites of a society will also be another important leverage for preferences. Usually, the societies are influenced and directed according to the choices of the elites. Middle or lower classes usually target to reach the chances those elites have. But at the same time they usually can not find enough budget. This situation directs them for luxury but less efficient options. That's why this issue will be important to direct a society's preferences.

UNIT COSTS AND TECHNOLOGY ACCESS

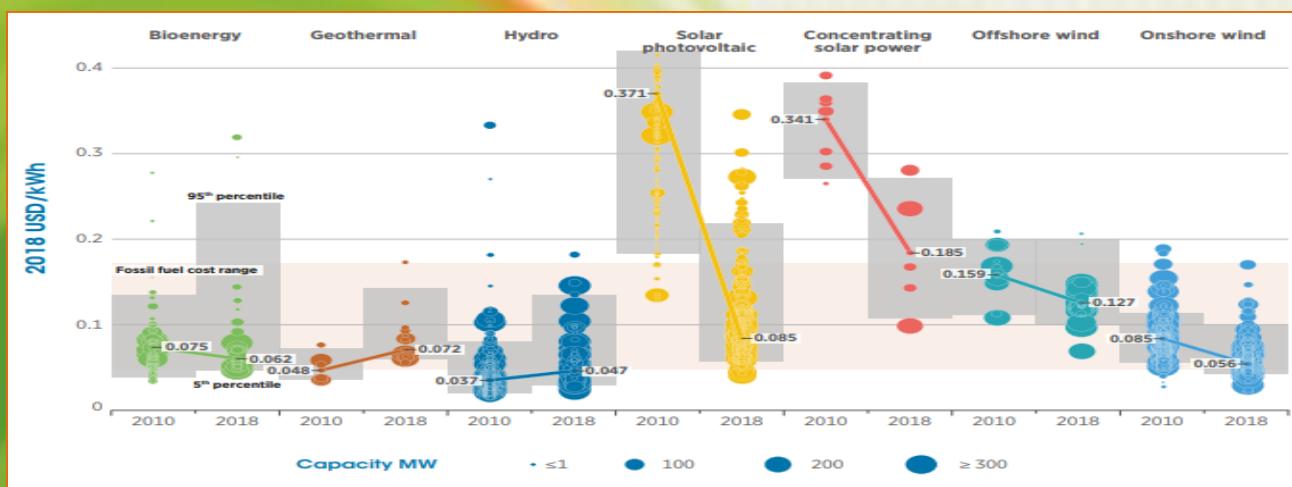


Graph 5: Current Unit Cost Ranges of Different Energy Types²

- Unit capital and operational costs of an energy type is also another important aspect for preferences. In addition to preference side, cost altering's (usually due to technological developments) will play an important role for the new investments on different energy types.
- As can be seen in the figures above and below, from the sight of CAPEX:
 - Firstly wind and then the gas seems to be the most commercial energy type for investment.

- Solar usually has less preference by comparing with coal.

Of course these cost estimations are not enough for long term strategies, hence these costs change from region to region. In addition there is no OPEX value. For investment options, all kinds of costs, taxes and other commercial issues have to be analyzed together. However, to give an idea (the graph below), renewable costs are decreasing with the new technologies. So, the important point here is: low costs with higher technology.

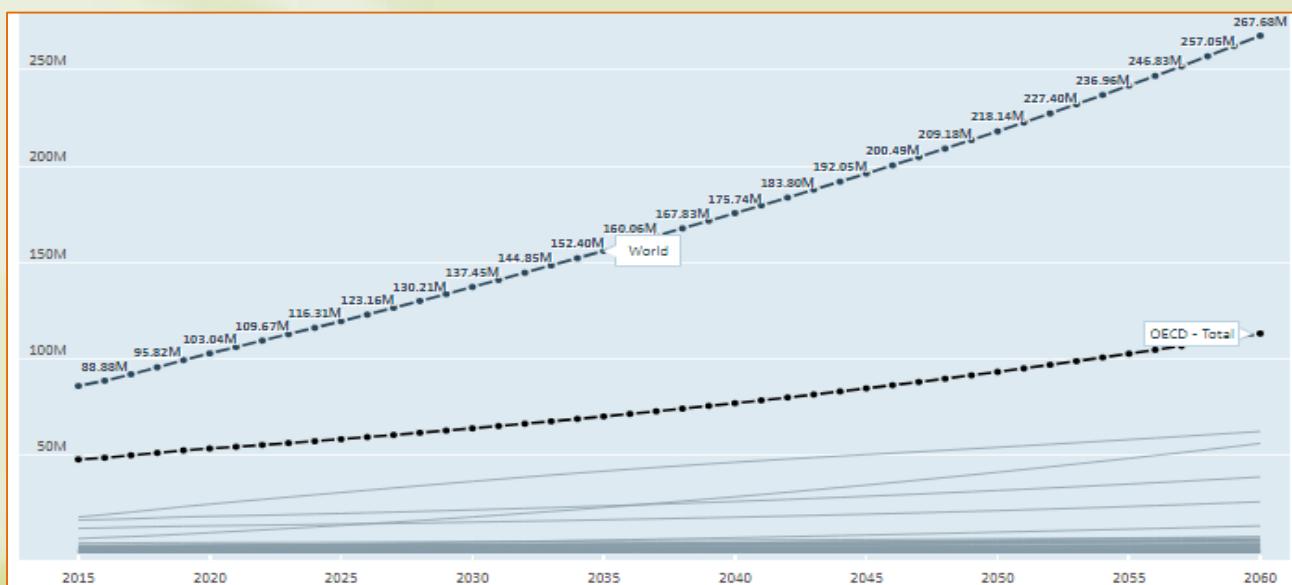


Graph 6: Alteration in Unit Cost Ranges in Renewables³

- While the costs are directly affected by the existing technology level, accessibility to the latest technology within a cheap way is also another important item for long term energy policies.
- High level technology access naturally means; investment, research and good relations with the other technology partners. Consequently, for low or

mid income countries, accessing the high technology and the due know-how does not seem an easy target to reach. This reality directly affect the future scenarios. Although the international environment seem as a liberal model, the main players of the system (countries) usually put more realistic steps within their relations.

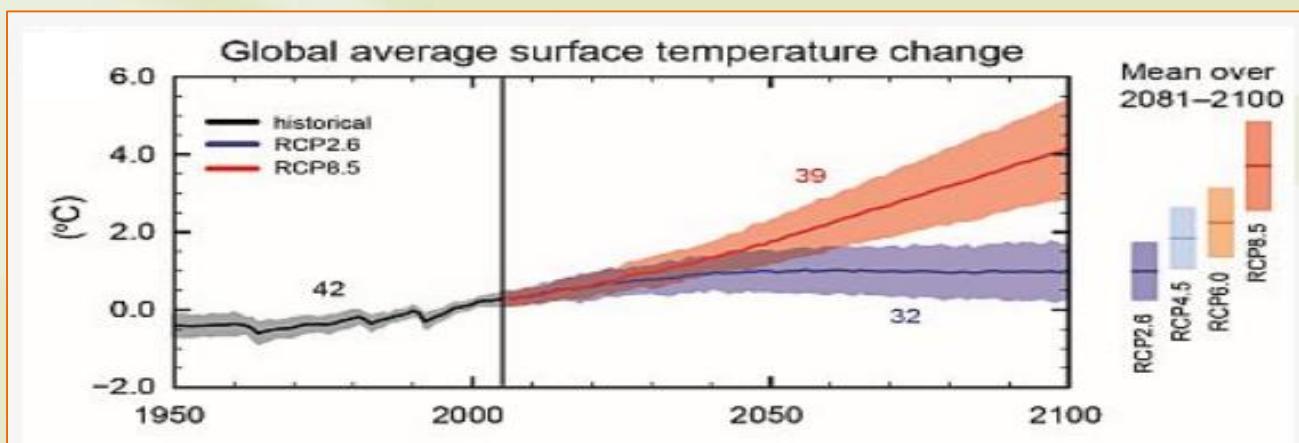
WORLD ECONOMY



Graph 7: Global GDP Projections⁴

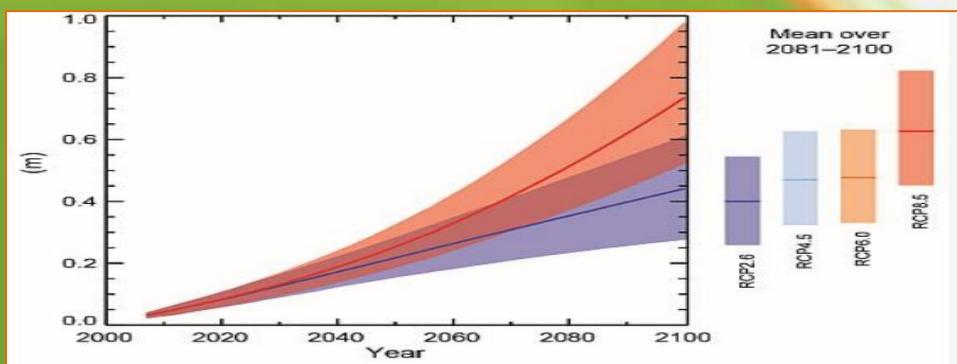
- Global economy is one of the most important factors directly affecting the energy dynamics. Hence in better economic environments, more investments can be done, more funds for research activities can be allocated and trade capacities will increase.
- At the initial steps of a higher economy, the consumers without less anxiety may result in consuming more energy. (At least the society do not force itself to save some portion of energy.) However as the social development steps continue to be followed, better economies will make social consciousness understand the importance of efficiency. In addition to this approach, naturally, high income communities will buy higher technology equipment, which will be more efficient than the cheaper ones.
- The question here is «While the commercial dynamics of the World is changing and while the high income West is trying to follow a cleaner and more efficient policies, what will be the reaction of the Eastern and Southern (African) societies on energy preferences by considering their income levels are increasing?»
- According to our predictions, for the due energy starving and commercially growing societies, CO2 emissions will not be accepted in the priority agenda to deal with. This reality will effect the projections. That's why, the initial issue has to be studied on is; whom to control the economy in the future, other than the global GDP incremental rates.
- The developing societies will start to have different preferences with higher incomes and this will be related with the global economy's effect on energy projections. (Moreover, the coherency of the long term GDP trends are also important for estimations.)
- As can be seen from the graph above, while the incremental rates are altering for each countries, global GDP is going to increase. But here the question is, while the political and social (ethical, cultural and religious) conflicts are becoming more important, trade wars are continuing within the superpowers, World order and the commercial flow trends are changing in favor of growing China and the east, how can we calculate a realistic global economic growth rate?
- In our calculations, from the economical sight of the estimations, we have accepted a less growth rate than these projections of OECD.
- In addition, we have added more social reflections, by considering the energy preferences of different commercially differing societies.
- For the future trends, high populating economics have the highest economical growth rates. This will result in suppressing the energy hunger without considering the environmental sights.

GLOBAL WARMING



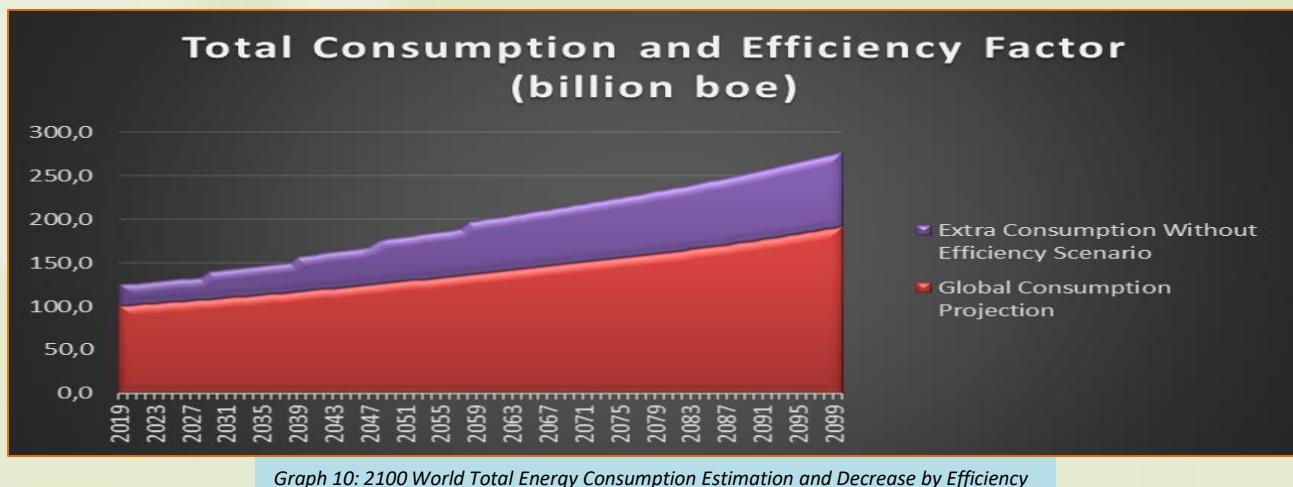
Graph 8: Global Average Surface Temperature Change⁵

- Global warming is another important driver regarding with the future policies. Usually the developed Western countries (mainly European ones) are putting some targets to tussle with the CO₂ emission, but on the other hand there is not a unified global act for this important issue. In addition by looking from the other side of the mirror, the developing countries urgently need more energy by neglecting the environmental sides. Hence, they need to develop their technologies, systems, industries, cities and societies. They do not have the same conditions with the due Western countries. That's why, in reality, commercially growing high populated countries by neglecting to deal with the CO₂, have to focus on their sustainability of development targets.
- The developed countries have to encourage financially the undeveloped (but growing) side of the World for better results in emission targets. However, this seems impossible. There is not such a fund to spend in none of those countries.
- According to our personal surveys in different developing countries, people usually say that:
 - Why I have to care about the emission amounts, US didn't signed the Paris protocol,
 - There is not a unified understanding on this issue, so I don't want to spent money on unsuccessful targets,
 - Global warming is a reality, but we can not change the end of the World,
 - Estimations about the results of global warming are not true
- About the global warming issues. Unfortunately this is the realistic reflection of different societies on this issue.
- In addition to these issues, there are many unknowns in the existing estimation models of global warming. Consequently, global warming is an important issue for evaluating the future dynamics of energy balances. However, according to our studies, average of future's global society does not conscious and willing about this issue. That's why, although the costs are decreasing and renewable trends seem high, low carbon scenarios do not seem realistic.
- In addition, nearly all the people agree on the increase of the global average surface temperature (as can be seen in the graph above) and the rise of the mean sea levels, but existing de-carbonizing targets seem not easy to deal with by making benefit and cost analysis. And it takes decades for Earth to react for a sudden decrease of a current emission. This means, we are not sure about the results.
- The costs of decarbonizing policies are different for each countries and usually there are more urgent problems to deal with. For example China (the strongest economy of the future) is applying only local de-carbonizing policies (not for its sensitivity on global warming) for solving the air pollution in some crowded cities. This reality have to be considered for more realistic estimations.



Graph 9: Global Mean Sea Level Rise⁵

EFFICIENCY



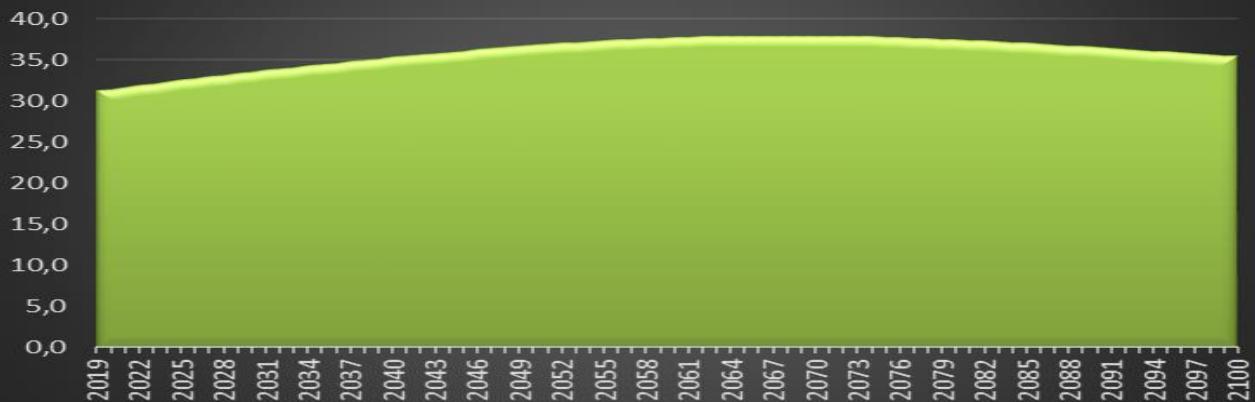
- Efficiency is one of the most important drivers in energy balances. We can imagine the term «efficiency» as a new type of energy, because within a direct effect of efficiency, energy consumption decreases.
- Efficiency is a continuing process. Everyday with the new technologies and new products, by evaluating the costs, our budgets and accessibility; we are utilizing more efficient materials.
- In this regard, we can denote that, efficiency is everywhere. We can follow this turn in our bulbs, refrigerators, washing machines, cars, airplanes, telephones, vacuum cleaners, factories, air conditioners and shortly, in all of our energy-consuming equipments.
- Of course, to develop the efficiency, new technologies, costs, accessibility and prevalence are very important issues. Discovering a new technology is not enough without the vast majority of people have not been able to access that technology easily and have started to use it economically, by considering the benefit - cost analysis.
- This means, the global spread of new technology that provides efficiency will vary among the countries. During the spread of a new technology for utilization, undoubtedly, tariffs, tax policies and incentive mechanisms of countries will also be important.
- From these regards, as can be seen in the above graph, our estimations show that global energy consumption will be higher around %30's without efficiency investments. By the way we have to accept that, hence being lots of different variables, such approaches are not so easy to estimate and be coherent.

FORCE MAJEURE

- Force majeure is a French term that literally means "greater force." It is related to the concept of an act of God, an event for which no party can be held accountable, such as a hurricane or a tornado. Force majeure also encompasses human actions, however, such as armed conflict. Generally speaking, for events to constitute force majeure, they must be unforeseeable, external to the parties of the contract, and unavoidable. These concepts are defined and applied differently by different jurisdictions.⁶
- Naturally force majeure issues have to be considered as other important effecting factors in energy estimations. However, as can be understood from the definition, hence being not easy to be able to be predicted, we can not add these kind of acts into our estimations and equations.

2100 PROJECTIONS (OIL & GAS)

Oil Consumption (billion bbl)



Graph 11: Oil Consumption Projection up to 2100

- Oil consumption will continue to increase with a decreasing incremental rate up to 2070's.
- We are expecting the beginning of a decrease in total consumption after 2070's.
- This late expectation about the peak time is mainly due to high increasing demand of India and other low income societies.
- Currently, according to BP Statistical Review of World Energy 2019, total proved oil reserves in the World is 1730 billion barrels. According to our scenario, up to the 2100, total demand will be 2946 billion bbl. This means an additional 846 billion barrels of reserves is needed.
- While considering the oil market, development scenarios, new development technologies, possible unconventional and plenty of unexplored regions, this amount of reserves will be able to be added to the global markets.
- In addition, we do not expect an important narrowing in the oil investments.

Gas Consumption (billion boe)

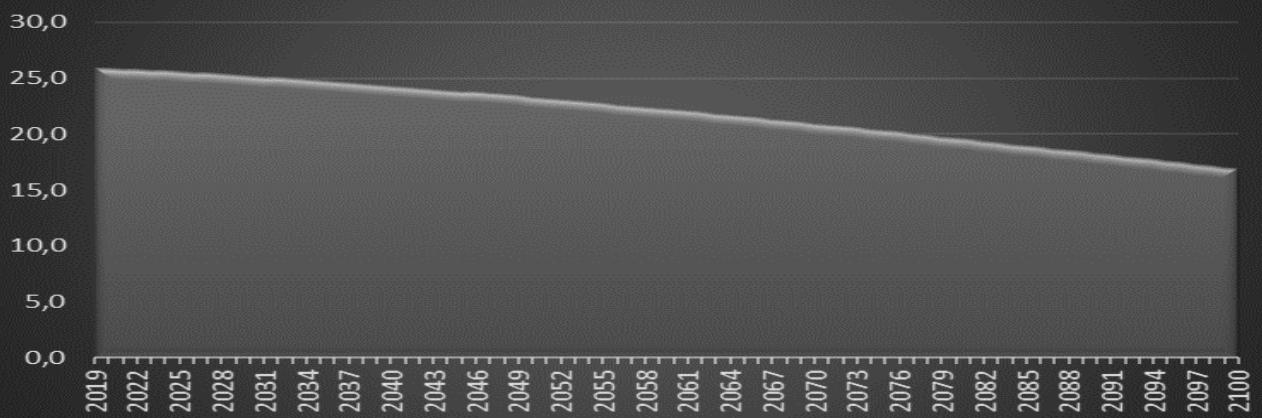


Graph 12: Gas Consumption Projection up to 2100

- Gas consumption will continue to increase up to the end of 2100's.
- Currently, according to BP Statistical Review of World Energy 2019, total proved gas reserves in the World is 197 trillion m³. According to our scenario, up to the 2100, total demand will be 539 tcm. This means an additional 342 tcm of reserves is needed. This amount seems very high to be able to handle. In such a case, we may expect:
 - Higher gas prices,
 - More unconventional,
 - More exploration activities,
 - Less consumption than our scenario and more increase in the renewables,
 - More coal,
 - With new technologies, shining star of methane hydrates.
- By the way, while considering the gas markets, development scenarios, new development technologies, possible unconventional, methane hydrate potentials and plenty of unexplored regions, this amount of reserves may have a chance to be able to be added to the global markets. However, to meet such a demand, very huge amount of investments will have to be paid.

2100 PROJECTIONS (COAL & NUCLEAR)

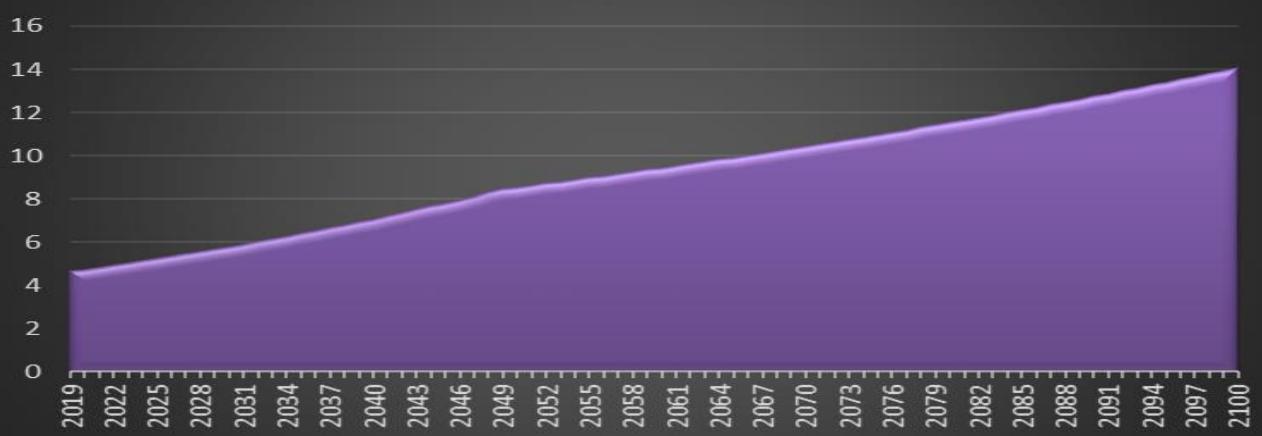
Coal Consumption (billion boe)



Graph 13: Coal Consumption Projection up to 2100

- Coal consumption will continue to decrease with an increasing decrease rate.
- Decrease rate did not estimated so much due to high increasing demand of India and other low income societies.
- Currently, according to BP Statistical Review of World Energy 2019, total proved coal reserves in the World is 1054 billion tones. According to our scenario, up to the 2100, total demand will be 361 billion tones. This means:
 - An additional discovered 693 billion tones of proved coal reserves will be waiting for consumption,
 - Cheaper and decreasing prices for coal,
 - Possible lower and lower decreasing rates in coal consumption than our existing scenarios,
 - Possible increase in consumption of coal while the gas supplies are not enough to meet the demand.
- In addition to these, cleaner technologies and cheaper coal to hydrogen applications may be resulted in an increase in global coal demand. Hence there is important levels of reserves and further potentials.

Nuclear Consumption (billion boe)

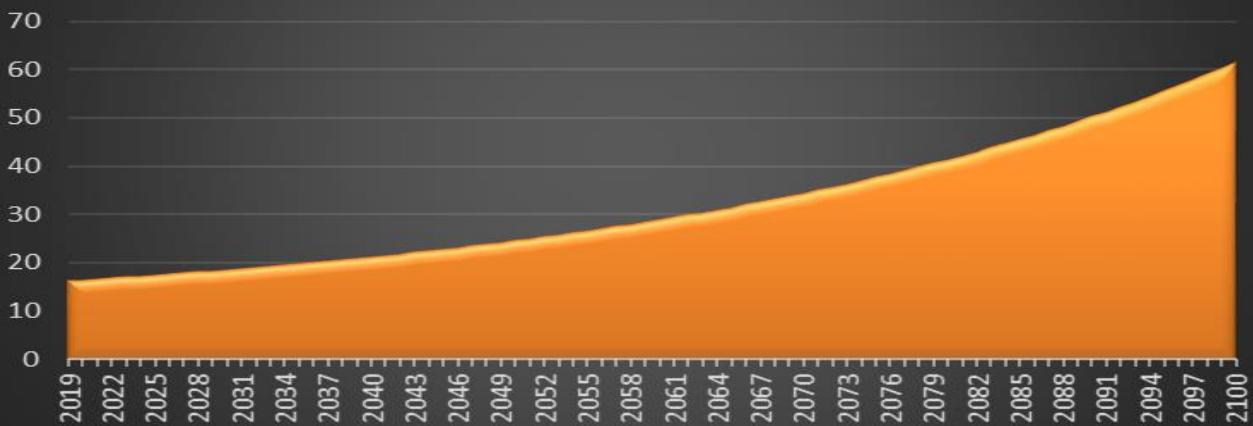


Graph 14: Nuclear Consumption Projection up to 2100

- Nuclear consumption will increase in undeveloped countries and also in energy suffering countries such as China.
- In the developed countries usually investments for new nuclear energy power plants will decrease.
- Current nuclear energy demand (and naturally the production capacity) is expected to increase around %201 up to 2100.
- With new technologies thorium may become much more important resource for the nuclear markets.

2100 PROJECTIONS (RENEWABLES)

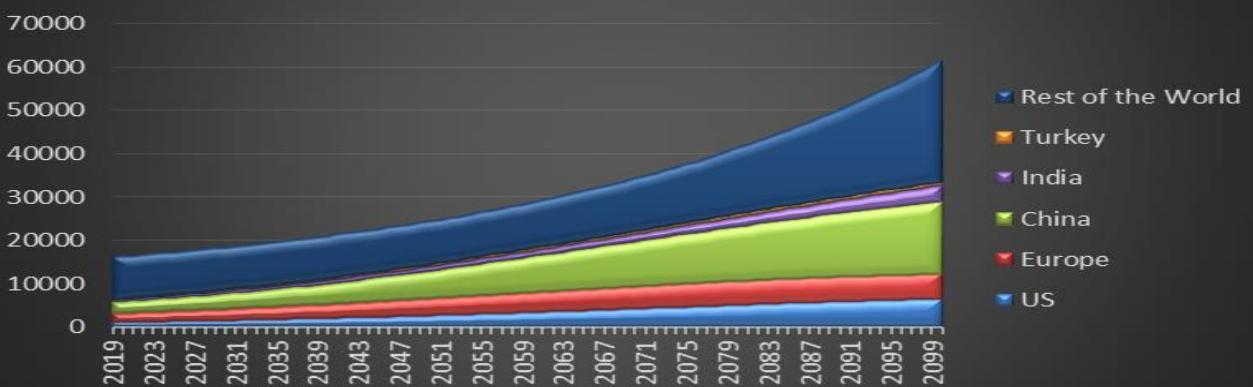
Renewables (wind,solar,hydro,geo, bio) Consumption (billion boe)



Graph 15: Renewable Consumption Projection up to 2100

- We accepted all kinds of wind, solar, hydro, hydrogen, geothermal, biogas, biomass and biofuel as the renewables group.
- From this regard, we can easily say that the renewable consumption will continue to increase in all income groups and development levels.
- Mostly, wind and solar will have a higher incremental rate, by comparing with the other renewables.
- Accessibility to the cheapest technology, unit prices (while compared with the other types of energies), efficiency of the equipment, governmental grants and supports and lastly the investment budget depending on income level will play an important role in these scenarios.
- Current renewable energy demand (and naturally the production capacity) is expected to increase around %274 up to 2100.
- Highest increase in renewable consumption will be in China.
- India although needs huge volumes of energy, due to lack of finance, will not be able to follow efficient strategies to increase its renewable power plants capacity as the other developing countries.

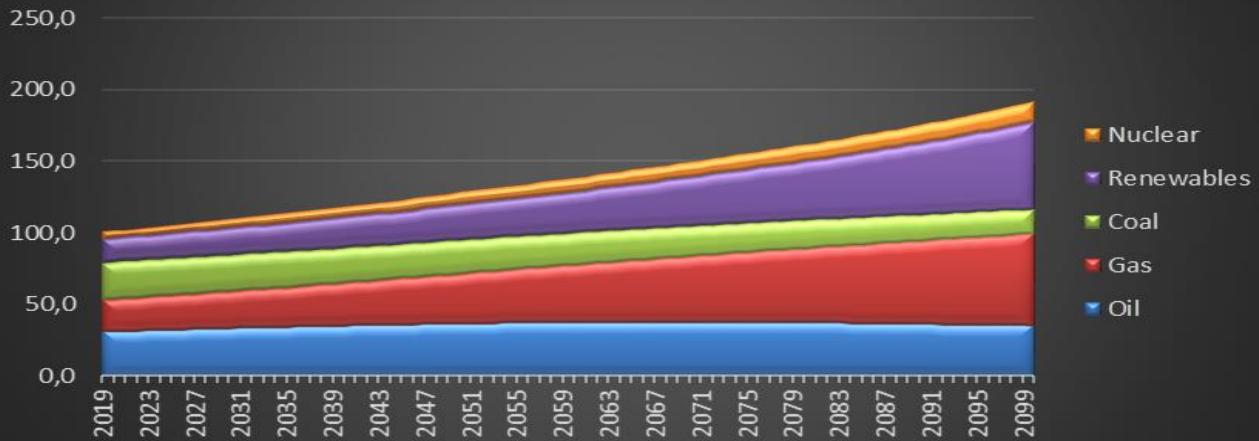
Renewable Energy Consumptions of Some Countries (million boe)



Graph 16: Renewable Consumption Projections of Some Countries up to 2100

PRIMARY ENERGY CONSUMPTION & ELECTRICITY

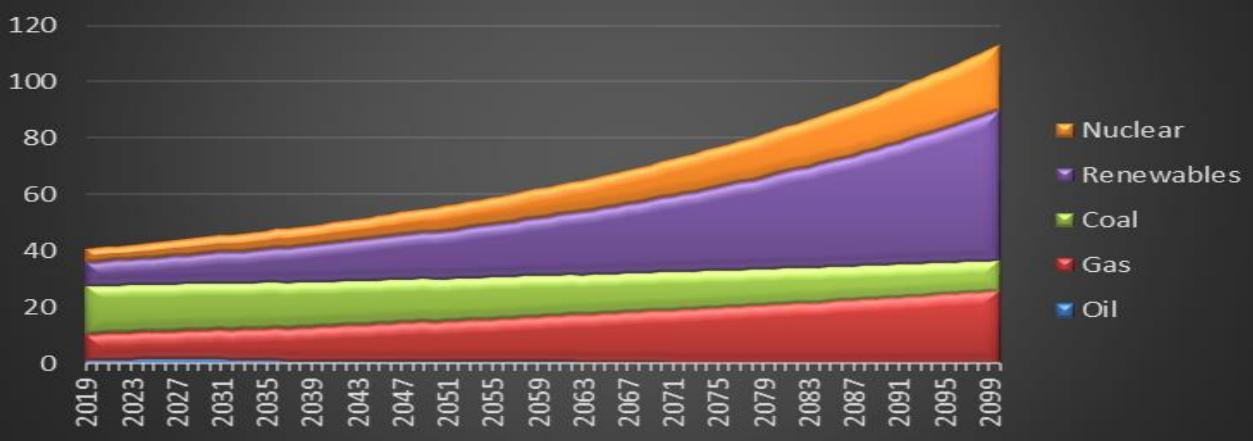
Total Primary Energy Consumption (billion boe)



Graph 17: Global Primary Energy Consumption Projection up to 2100

- Total global primary energy consumption will be nearly doubled (around %91) in 80 years period.
- Highest incremental rates will be observed in renewables, nuclear and natural gas.
- Oil consumption will start to decrease after 2070's and coal will follow a higher decline rates.
- Gas and renewables will be the most important energy resources in 2100.

Electricity Consumption by Sources (billion boe)

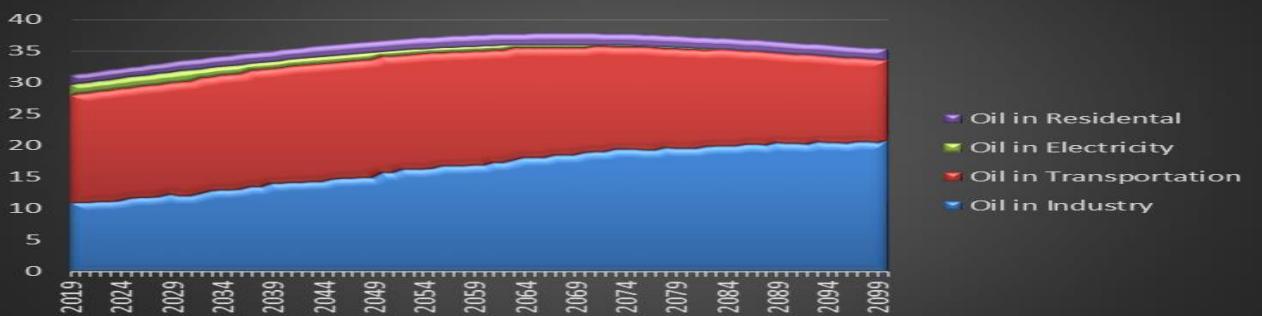


Graph 18: Global Energy Consumption and the due Energy Types Projection up to 2100

- Electricity consumption will have a high incremental rate around %175.
- Renewables' share in the general electricity equation will increase and it will be the most important energy type for electricity production.
- Coal's share will decrease and oil power plants share will be negligible for making a comparison (will nearly be zero after 2080's).

WHERE HYDROCARBONS WILL BE CONSUMED?

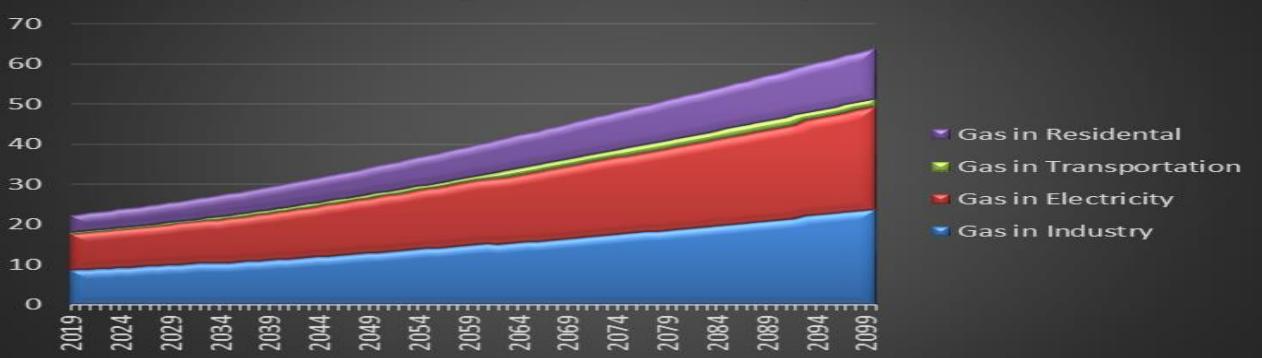
Oil Consumption Areas (billion boe)



Graph 19: Oil Consumption Areas Projection up to 2100

- Oil will be consumed mainly in industry area. Consumption for electricity production will nearly be ended after 2070's. Oil consumed for transportation will decrease while the electrical and hybrid cars will be more accessible and cheaper.
- For electrical cars to be pervaded, initially charging systems and due demanded electrical distribution grids have to be accomplished.

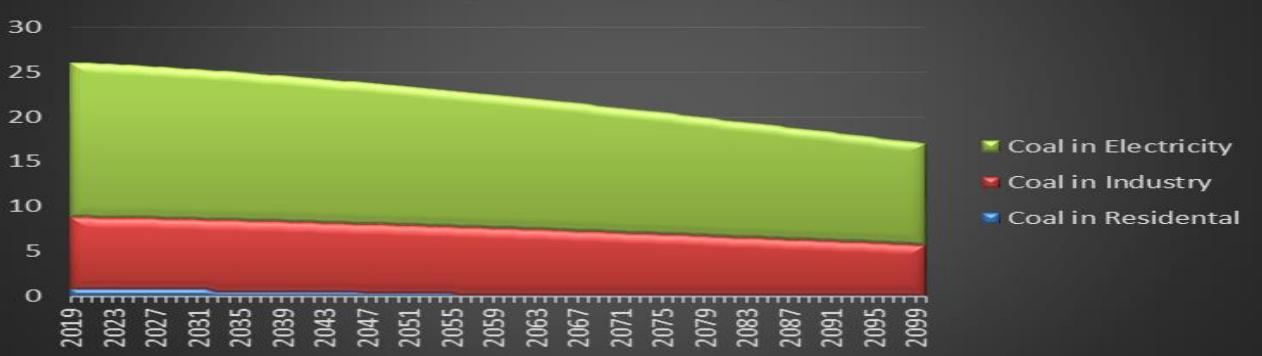
Gas Consumption Areas (billion boe)



Graph 20: Gas Consumption Areas Projection up to 2100

- Gas will be consumed mainly in electricity production and industry.
- Utilization in the industry will have an incremental rate of 177.44%. And the rate is 184.94% for the electricity production. There is a small portion of utilization for transportation. Residential consumption is expected to increase from 4,5 billion boe levels to 12,8 billion boe.

Coal Consumption Areas (billion boe)

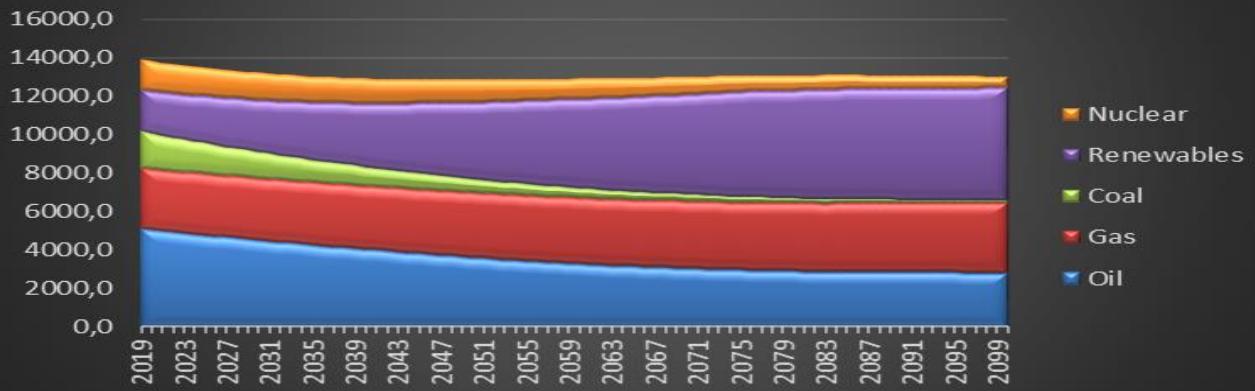


Graph 21: Coal Consumption Areas Projection up to 2100

- Coal consumption in electricity production will decrease around %35 and in industry around %30 levels.

HUGE CONSUMERS (EU & US)

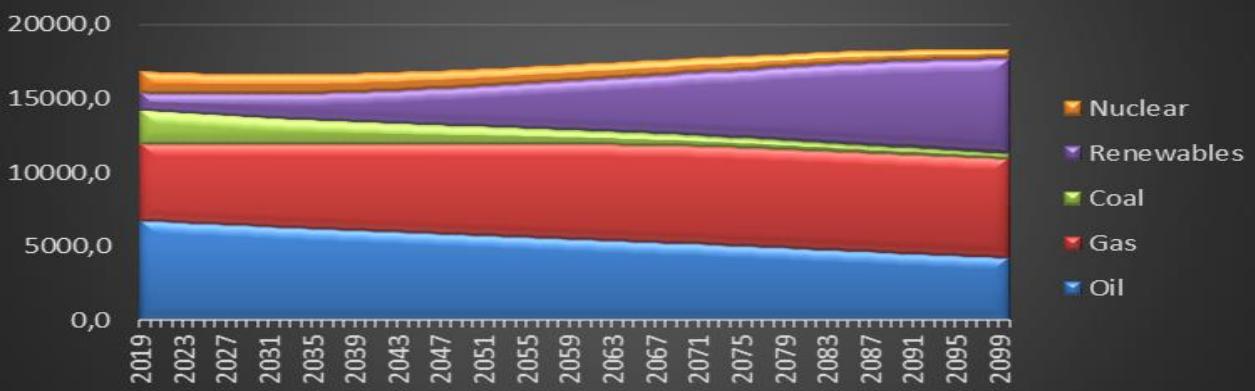
Total Primary Energy Consumption of Europe by Sources (million boe)



Graph 22: European Primary Energy Consumption Projection up to 2100 (without Turkey)

- Total energy consumption will have a small portion (%6) of decrease in Europe (by excluding Turkey).
- Renewables will have a high incremental rate with around %168.
- Gas consumption will increase by %15.
- Coal consumption will decrease 164 million boe levels.
- Nuclear will decrease by %62 and oil by %44.

Total Primary Energy Consumption of US by Sources (million boe)

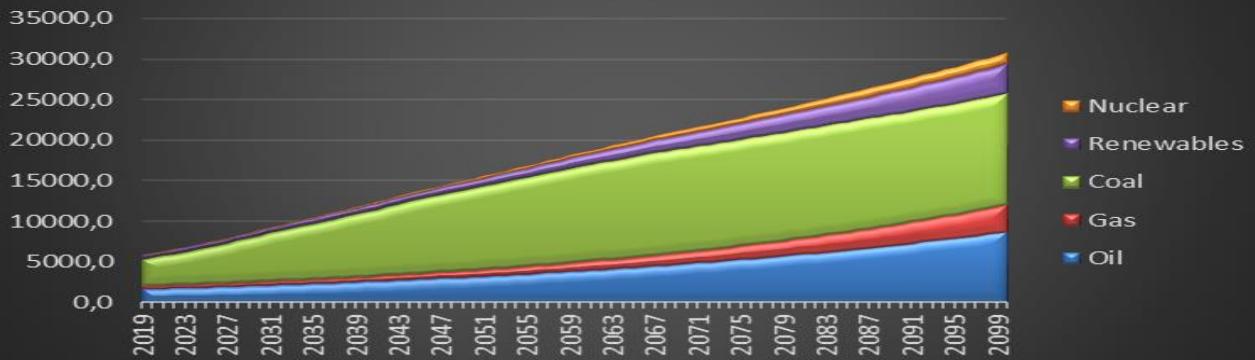


Graph 23: US Primary Energy Consumption Projection up to 2100

- Total energy consumption will have a small portion (%8) of increase in US.
- Renewables will have a high incremental rate with around %414.
- Gas consumption will increase by %29.
- Coal consumption will decrease 383 million boe levels.
- Nuclear will decrease by %63 and oil by %36.

HUGE CONSUMERS (China & India)

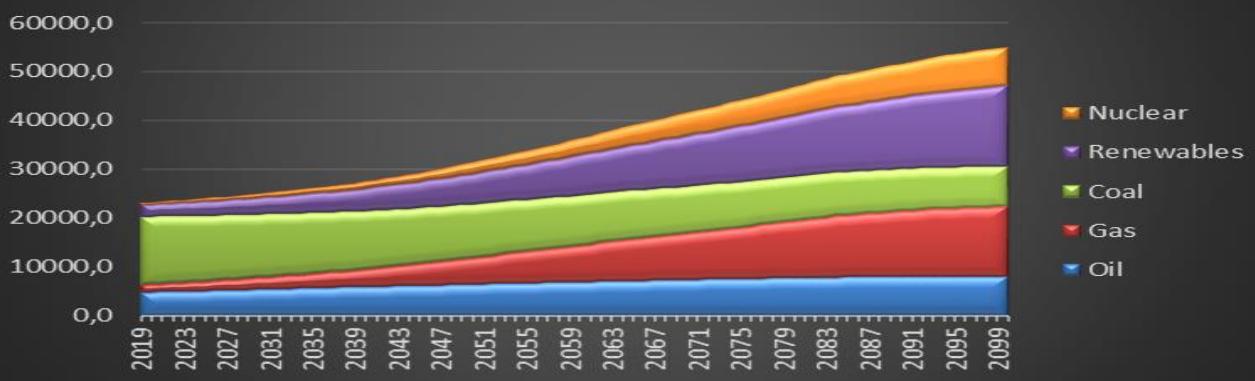
Total Primary Energy Consumption of India by Sources (million boe)



Graph 24: India Primary Energy Consumption Projection up to 2100

- Total energy consumption will highly increase around %420 levels in India.
- The cheapest energy type coal will have a high incremental rate with around %311.
- Gas consumption will increase by %837.
- Oil consumption will increase up to 8,7 billion boe levels.
- Nuclear will also have very high incremental rates.

Total Primary Energy Consumption of China by Sources (million boe)

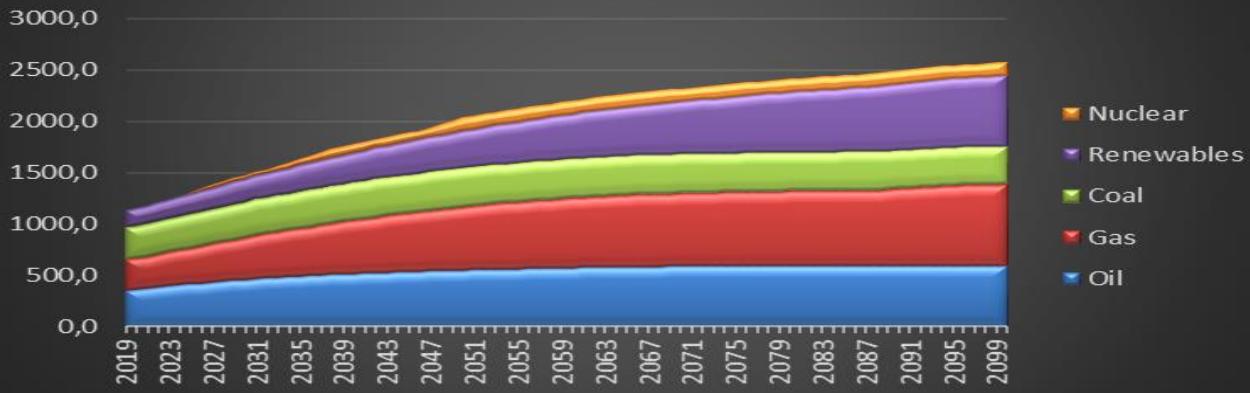


Graph 25: China Primary Energy Consumption Projection up to 2100

- China has a cleaner and more secure energy future by comparing with India.
- Total energy consumption will increase around %135 levels in China.
- Coal consumption is estimated to decrease by %40.
- Gas consumption will increase up to 14,3 billion boe levels.
- Oil consumption will increase around %69.
- Nuclear will also have very high incremental rates.

CONSUMPTIONS of TURKEY & THE WORLD

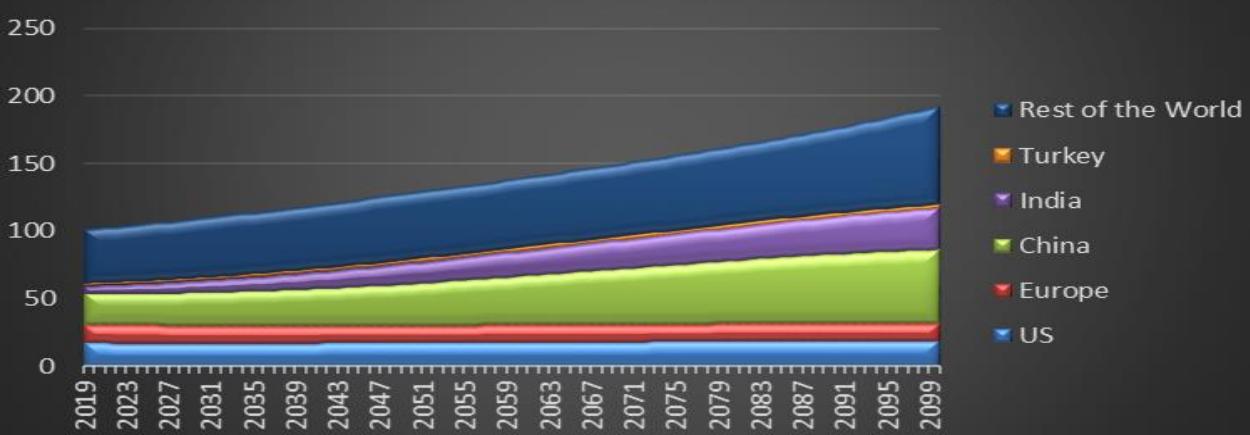
Total Primary Energy Consumption of Turkey by Sources (million boe)



Graph 26: Turkey Primary Energy Consumption Projection up to 2100

- Turkey's total primary energy consumption will increase around %127 levels.
- Coal consumption will increase by %17.
- Gas consumption will increase up to 0,796 billion boe levels.
- Oil consumption will increase around %66.
- Renewables will follow a high increase about %329.

Total Primary Energy Consumption by Some Countries (billion boe)



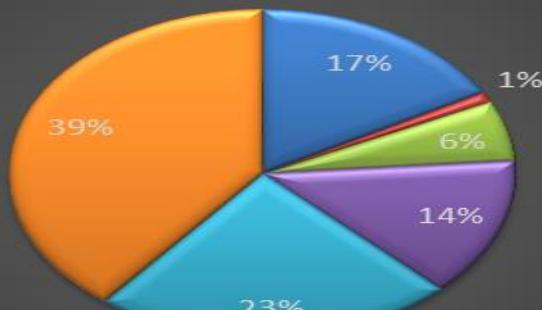
Graph 27: Global Primary Energy Consumption (by Some Countries) Projection up to 2100

- In the global energy consumption equation, China with an increasing portion, will have the largest share.
- India will be the second biggest consumer.

SHARES of WORLD ENERGY

2019 Shares of World Energy

Graph 28:
2019 Shares of the
World Energy

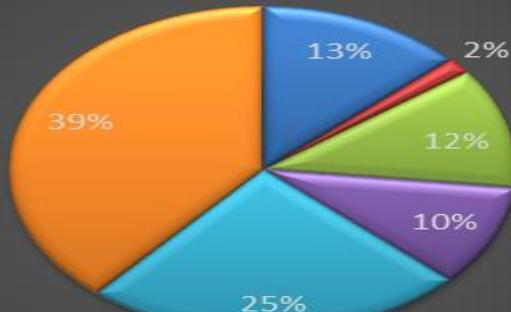


ROW: Rest of the
World

▼ US ▷ TR □ IND ▷ EU □ CH ▷ ROW

2050 Shares of World Energy

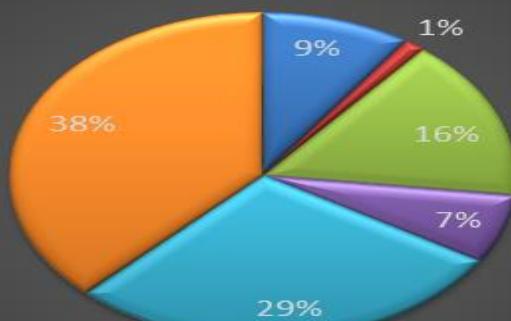
Graph 29:
2050 Shares of the
World Energy



▼ US ▷ TR □ IND ▷ EU □ CH ▷ ROW

2100 Shares of World Energy

Graph 30:
2100 Shares of the
World Energy

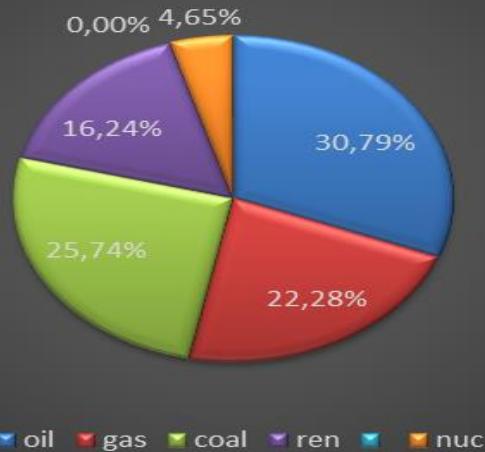


▼ US ▷ TR □ IND ▷ EU □ CH ▷ ROW

SHARES of ENERGY TYPES

2019 Shares of Energy Types

Graph 31:
2019 Shares of the
due Energy Types



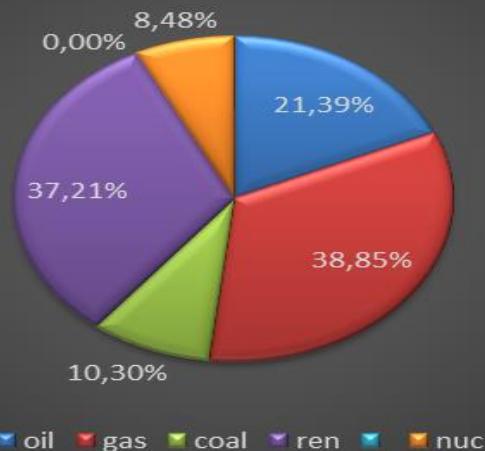
2050 Shares of Energy Types

Graph 32:
2050 Shares of the
due Energy Types



2100 Shares of Energy Types

Graph 33:
2100 Shares of the
due Energy Types



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NOTES

- During the modelling, by taken into consideration the proved reserves, preferences, finance capacity, investment environment and existing environmental targets, we assumed that demand will be equal to the supply.
- We haven't done detailed analyses regarding with the existing facility and reserves constrains for each countries and we assume that for an economic project, budget can be prepared, while there is a huge increasing demand.
- We assumed humanity will discover much more oil and reserves in the World.
- According to these scenarios, we will continue to publish more focused reports dealing with:
 - Oil price tendencies up to 2100,
 - Gas price tendencies up to 2100,
 - Coal price tendencies up to 2100,
 - Electricity price tendencies up to 2100,
 - Unconventional oil and gas production and development expectations up to 2100,
 - The age of methane hydrates.
- In addition to this base case scenario, we will publish the cases for:
 - Cheap renewable technology
 - Not enough gas & oil
 - More efficient CO2 policies
 - Apocalypse