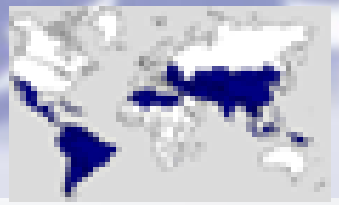
Providing Technical Support to EU Delegation to Trinidad and Tobago to organise and implement the Clean Energy Conference aiming at providing EU Expertise in the field of Sustainable Energy

Caribbean – GT#31/CSEE-EUDTT

EU Technical Assistance Facility (TAF) for SE4All Initiative

Trinidad and Tobago Sustainable Energy 2021/2030 Roadmap

8 June 2017



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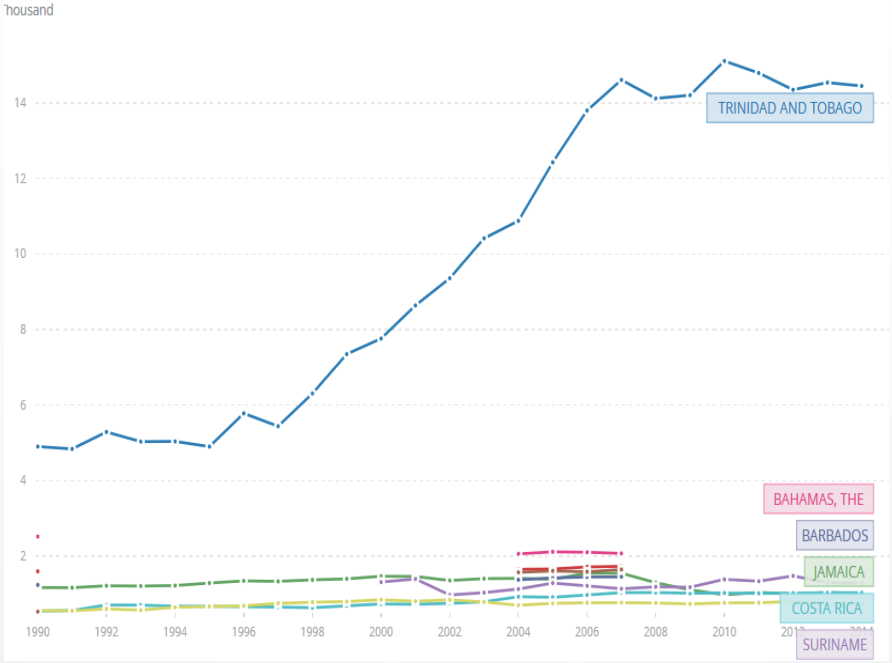
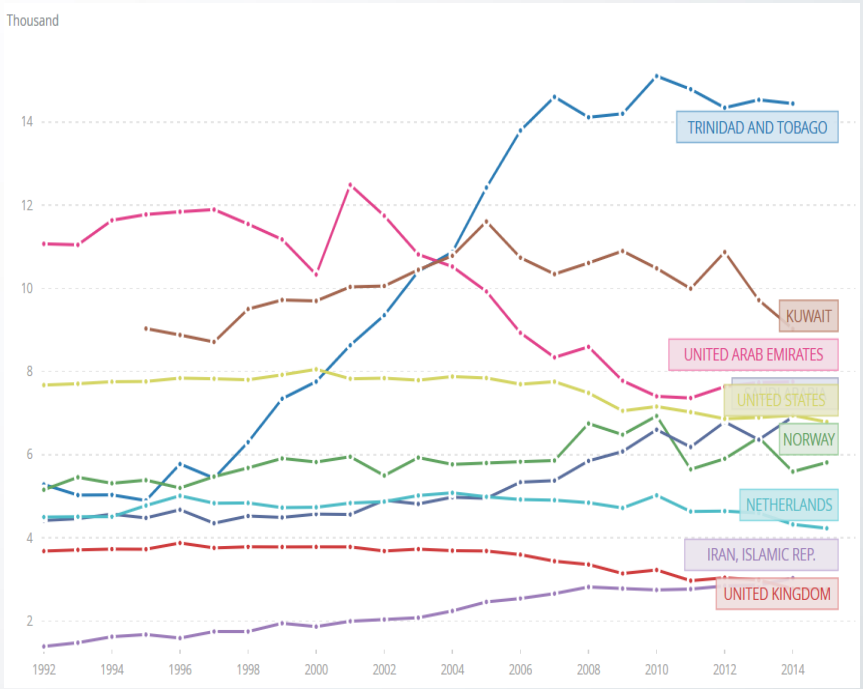
Energy Intensity of TT and selected countries

Caribbean countries



O&G countries



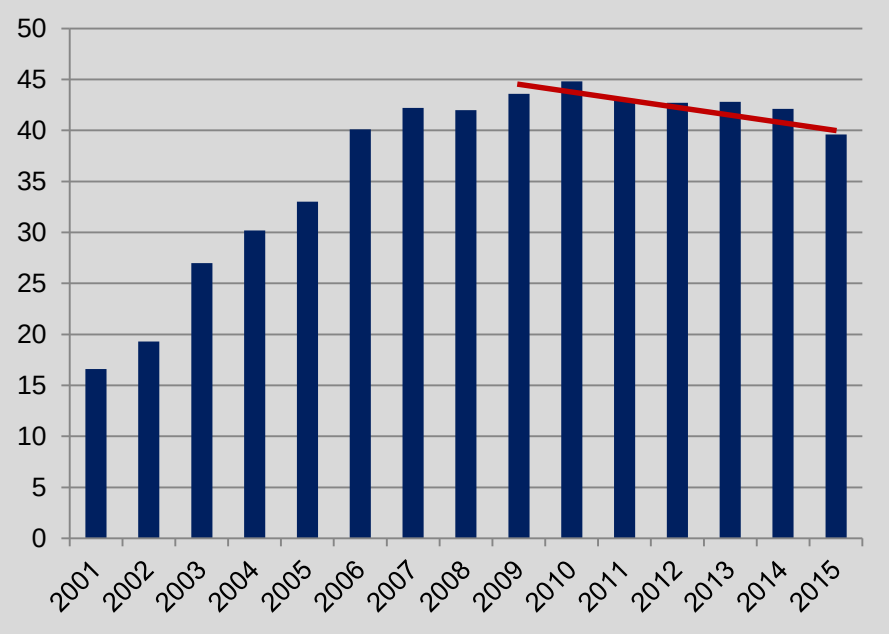
Energy use (thousand kg of oil equivalent per capita)

Source: The World Bank, IEA statistics

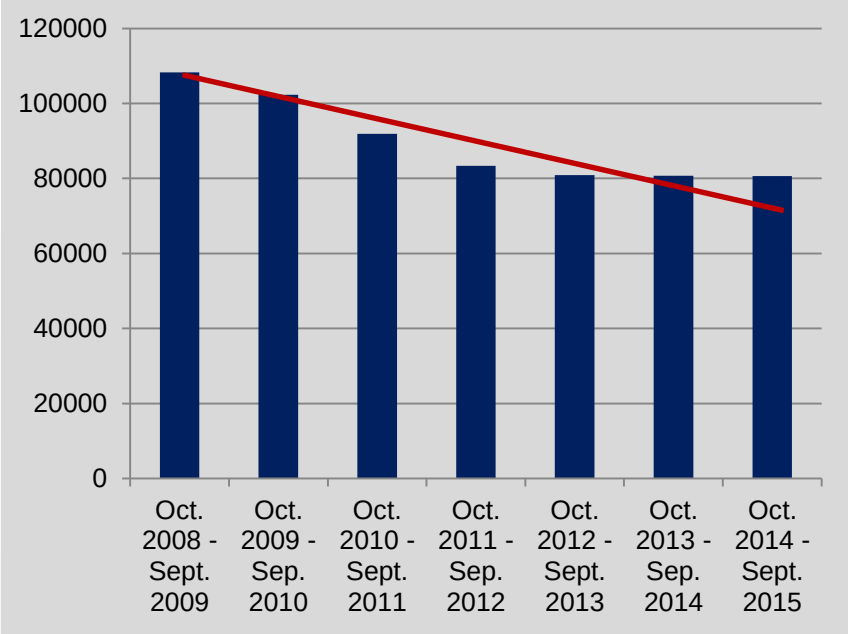
- **TT has by far the highest energy intensity of all the oil and gas producing countries examined, including Gulf, EU countries and USA**

Declining oil and gas reserves

Gas production history (billion cubic meters)



Oil and condensate production history (barrels of oil per day)



Source: BP statistical review of world energy, 2016

- In the last 13 years country's proved natural gas reserves decrease by an average of a 1 tcf/ year.

► **High energy consumption depletes rapidly country's fossil fuel reserves to the detriment of the economy and the society**

The case study of the Norwegian Oil Fund

- Norway has the 21st largest oil reserves and the 16th largest natural gas reserves in the world
- Basic principle: development and production must result in **maximum value creation for society**
- Oil Fund established on 1 January 1985
- The sucess is not only of high levels of petroleum revenue, but due to chanelling government revenue straight into the fund and investing abroad
- The Fund invests in real estate, stock markets, oil and gas renewables, IT, etc.
- As of March 2017 its total valuation is **~ USD 900 billion USD**

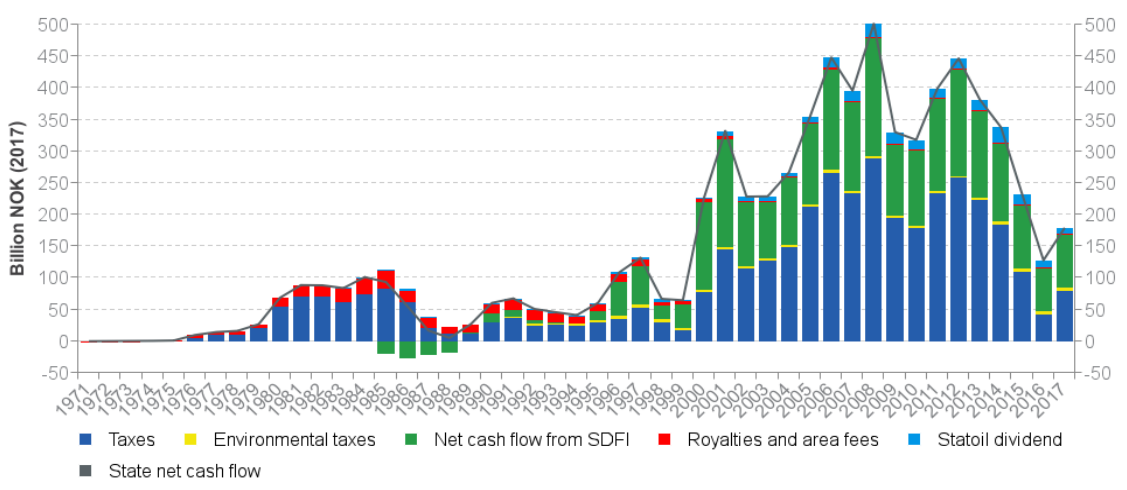
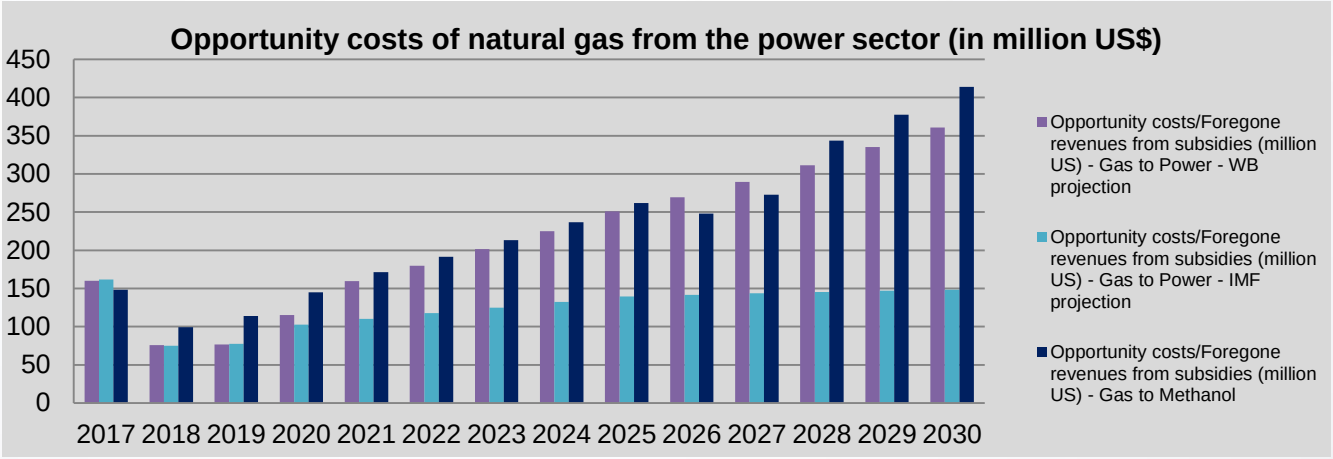


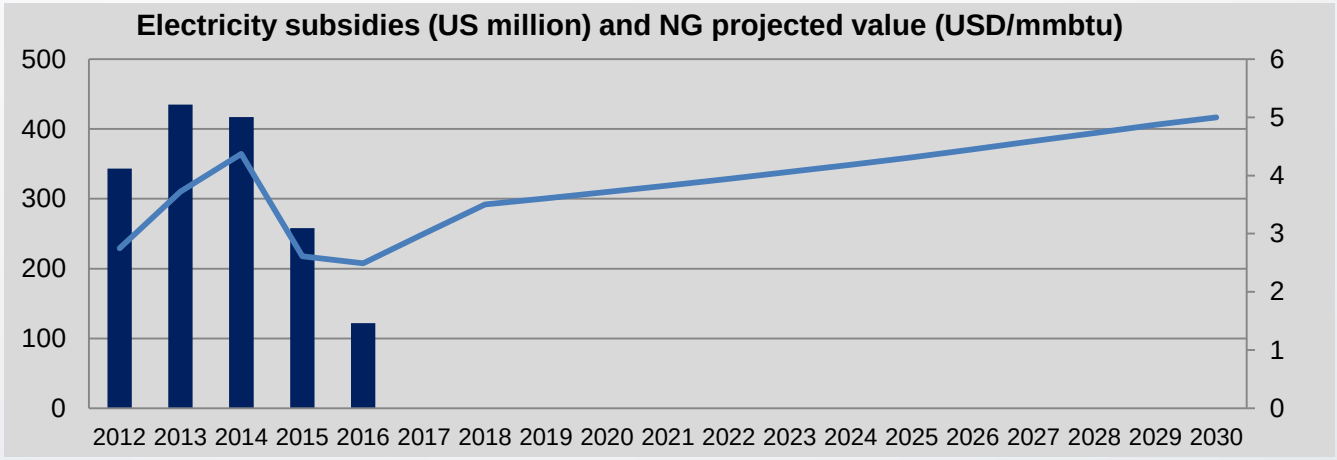
Figure: The net government cash flow from petroleum activities in billion 2017-NOK

(Source: The Ministry of Finance)

- **More than 50% of Oil and Gas revenues in 2017 comes from the Fund and not taxes, royalties, dividends, etc.**
- **Norway in 2016 generated over 99% of its total electricity from Renewables**

Electricity sector subsidies and opportunity costs





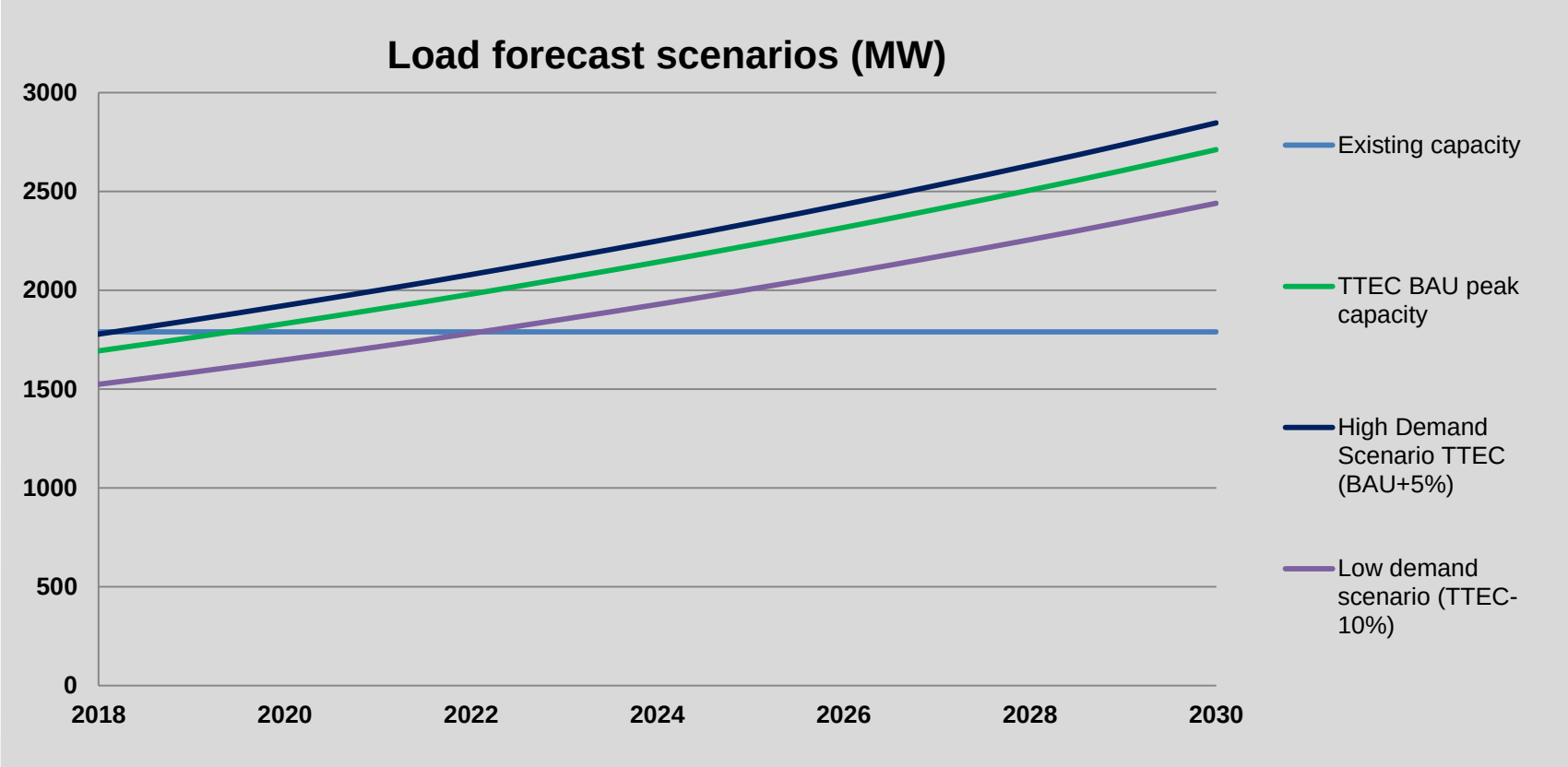
Opportunity costs up to 2030 between **1.7 - 3.2 billion US**

+

Cumulative deficit due to subsidies of **450-500 US million**

Effects in the order of at least 1% of GDP annually !

Forecasted demand



Source: IDB, author's estimates

- Forecasted annual growth rate 3-5% annually
- Between 2020 and 2023 new generation capacity will be required

Long term energy vision for the country

Important questions need to be answered by policymakers**:**

- **Question 1:** When and what extent introduce EE?
- **Question 2:** When and what extent introduce RES?
- **Question 3:** Upgrade existing OCGT units to CCGT?
- **Question 4:** Build a new CCGT plant at 2022-2023?
- **Overarching question:** What is the optimum mix of RES, EE, NG?

► **A combination of options and technological solutions will be required**
► **A series of policy decisions have to be made soon and proactively**

Definition of policy objectives

- Develop a Sustainable Energy Roadmap to achieve the following policy targets:
  - Target for 10% of electricity generation coming from RES by 2021
  - Target of GHG emission reduction targets by 15% by 2030
- Additional policy objectives for developing the Roadmap:
  - Fostering economic diversification
  - Contribute in economic growth and employment creation
  - Consistency with country's Innovation Policy
- Focus primarily on RES and EE focusing on the power sector, dealing also with the residential and industrial sectors

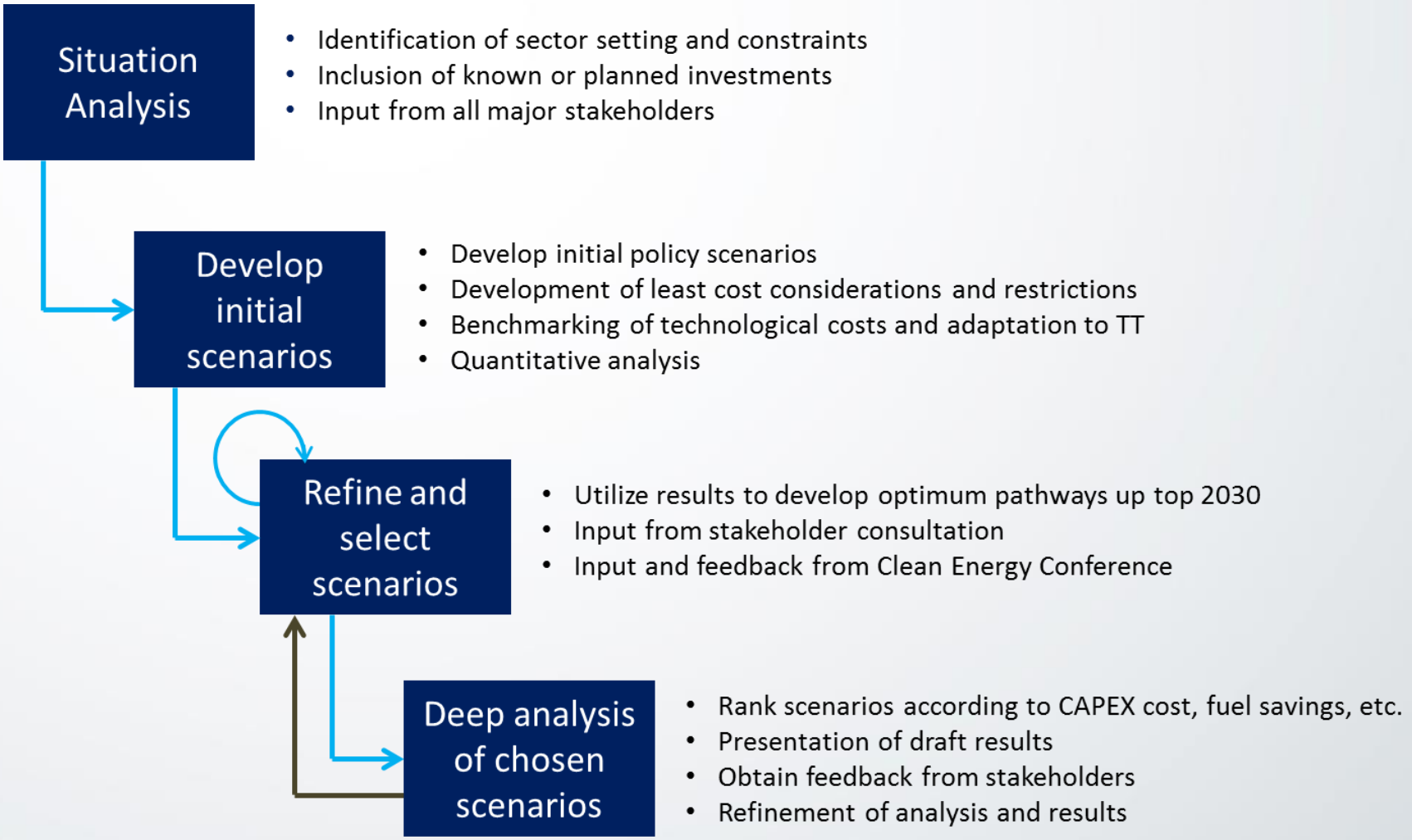
Barriers for deploying RES/EE in TT

- ✘ RES/EE are inextricably related to a series of policy choices
- ✘ Low electricity prices create distortions
- ✘ Lack of necessary legal and regulatory environment
- ✘ Legal complexities (PPAs, take or pay terms of existing contracts)
- ✘ Lack of institutional capacities
- ✘ Land availability and ownership for RES utility scale projects
- ✘ Lack of awareness among population and private sector

► **An essential question that the Roadmap tries to reply is this:**

"What needs to be done to overcome those barriers and enable the environment for fostering Renewables and Energy Efficiency?"

Methodology for Roadmap Development



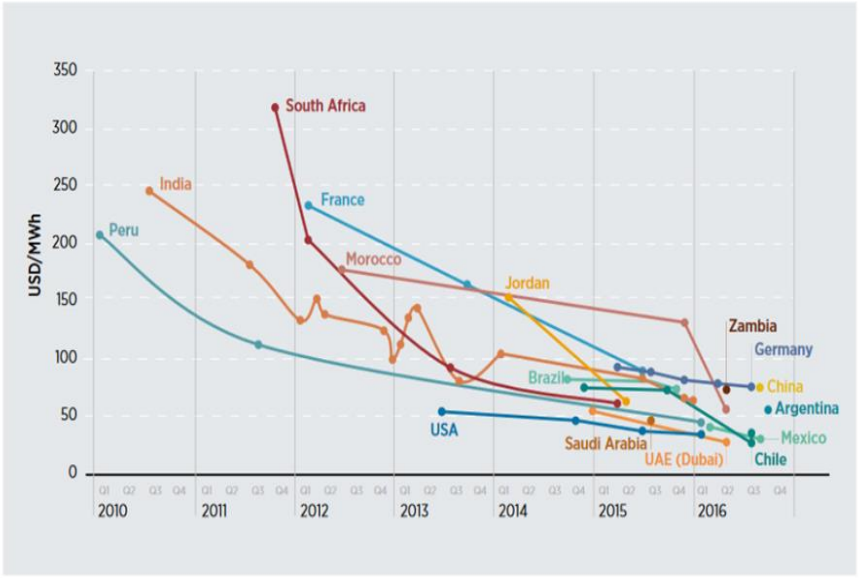
Policy challenges for RES

- The RES target should be expressed clearly as a percentage of nominal installed capacity (and not peak capacity)
- The **target of 2021 refers to 195 MW** of installed RES capacity.
- A clear vision for renewables could be set up to 2030.
- Questionable whether the RES target is fully achievable.
- Emphasis at this stage should be placed on enabling the environment

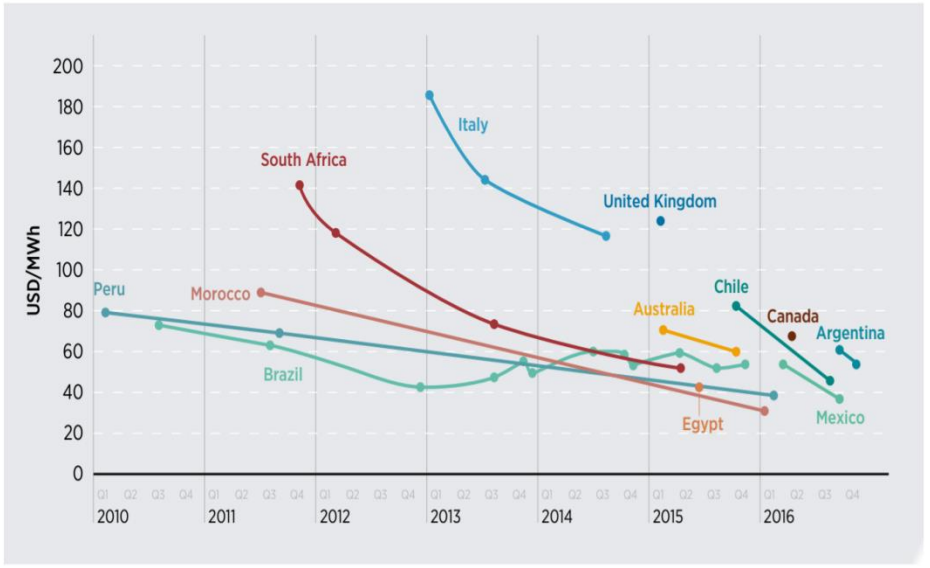
Renewable Energy Costs

Latest utility scale PPA auction prices (USD/kWh)

PV



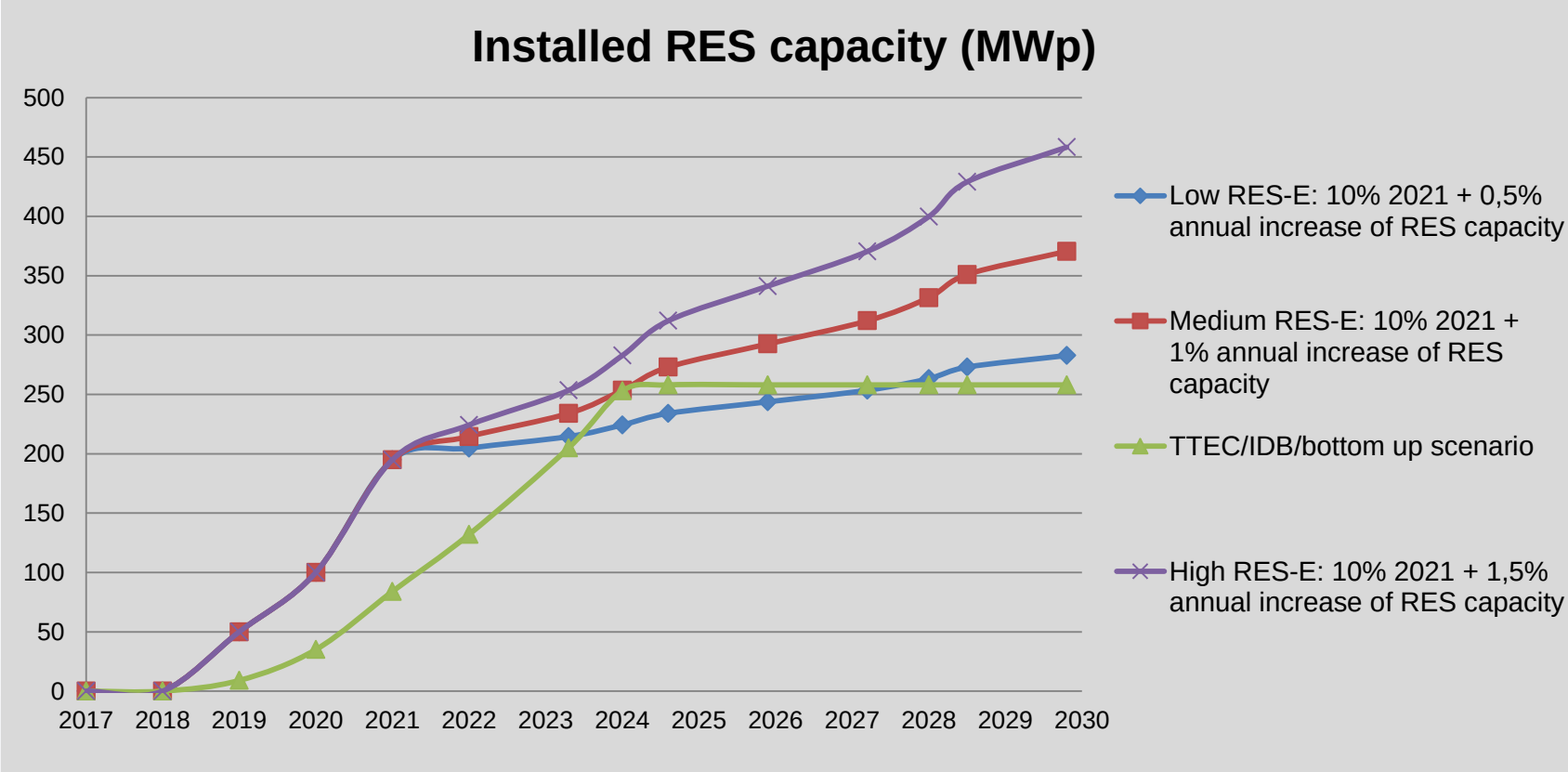
Onshore Wind



Source: IRENA, IEA

- Wind and solar have witnessed huge decrease in costs over the last years
- Renewables and especially PV are already competitive compared to the true cost of electricity in TT

Long term RES targets for TT



- **A target of 15% RES installed capacity by 2030 (283 MW) seems to be both cost-efficient and fully feasible**

Feasibility of RES Technologies for TT

- **Large scale PV is highly competitive**. Even medium utility scale PV plants (20-60MW) can be highly competitive taking into consideration the very high solar potential of TT
- **Onshore Wind Energy is a cost effective technology for TT** in general. Detailed site measurements are required.
- Waste to Energy **appears to be an expensive technology**. Nonetheless, this is the case only when seen as a power generation technology and not as part of a wider waste management strategy.
- Introduction of **residential and small scale commercial PV** is relatively more expensive when compared to utility scale PV. However, it increases awareness and engages people at low cumulative costs.
- Other technologies such as **tidal and ocean** are currently at less commercially viable than other technologies but need to be assessed in detail

Optimum RES penetration scenario per technology

- Considerations for determining options:

Achievement of policy targets | **Least cost CAPEX** | **Least cost to serve** | **Policy considerations**

Technology	2017	2021	2030	Share
PV	**0**	**137**	**198**	**70%**
PV utility scale (>10MW)	*0*	*109*	*158*	
PV small scale (5kW>, <20kW)	*0*	*14*	*20*	
PV residential (<5kW)	*0*	*14*	*20*	
Wind	**0**	**41**	**57**	**20%**
Waste to Energy	**0**	**20**	**28**	**10%**
Total	**0**	**195**	**283**	

- **To installed 15% of RES capacity by 2030 will require between 500 and 600 US million**
- **The RES mix is dominated by solar 70% and to a lesser extent wind and waste**

Energy Efficiency - Generation side

- EE upgrades in the generation side can lead to **significant fuel savings**
- There is **no incentive to IPPs to proceed** with these upgrades as there is no mechanism to recollect this amount.
- Part of this cost can be **recovered by fuel savings** and sales of NG to the international market
- **Detailed feasibility studies** need to be carried out
- The 2 mechanisms that could finance pass these upgrades inevitably pass part of upfront costs to consumers (like any other option):

  1. The 150% allowance scheme (implicitly)
  2. Increase of electricity tariffs to respective levels (explicitly)

Energy Efficiency - Consumption side

- **Potential of at least 10 % of savings** in the demand side up to 2022
- **Focus is primarily in the residential sector**, but also in the industrial and commercial sector (essentially hotels)
- Target achievement entails large **behavioral change** from consumers
- Initial estimates of the **overall CAPEX costs can be up to 300-400 US million** from all sectors (residential, hotels, industrial)
- EE measures should be **partially financed by the government**, while the existing measures appear to be insufficient
- **Existing low electricity prices** main hindrance for the promotion of EE measures

Energy Efficiency – Consumption Side

	Residential	Hotels	Industrial	TOTAL
Required CAPEX, US$ million	413*	2	9	**424 million US**
Aggregate Energy Savings, GWh	930	10	33	**973 GWh**
CO2 Emissions avoided, kt	651	7	23	**681 kt CO2**

Source: IDB, author's estimates

* CAPEX costs for the residential sector are very rough estimates based on benchmarking data for the required investments per avoided MWh of electricity due to interventions

► **The investment of ~400 million could lead to energy savings of approximately 1 TWh of electricity by 2022 according to rough estimates**

Combination of options

EE — EE demand side / 10% savings

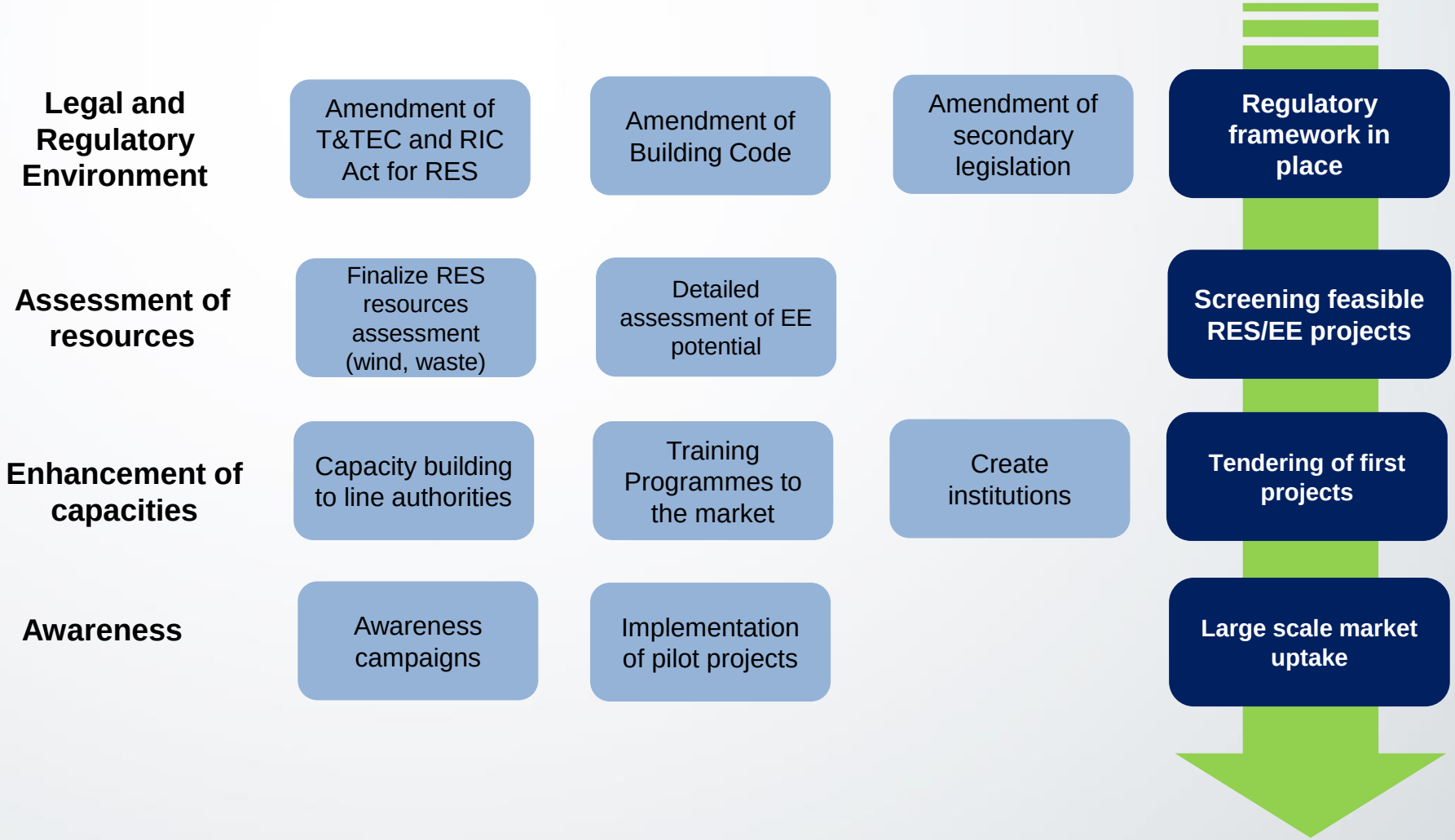
EE — Upgrade of OCGTs 10% savings

CCGT — CCGT 300 MW

RES — Renewables 15% by 2030
283 MW of total capacity

► Optimum combination of all possible technological options in right time

Enabling the environment for RES/EE - Next steps



Overall Conclusions

- Both RES/EE lead to significant fuel and financial savings, stimulate economic growth and create employment
- Large scale RES plants can be in operation by 2019
- Promotion of EE measures can and should be a constant process
- A series of **concrete actions** are required to enable the environment
- With **sufficient commitment** many of these actions can be completed by the end of 2018
- **Roadmap of the Roadmap:**

EU Technical Assistance Facility for the “Sustainable Energy for All” Initiative

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Thank you for your kind attention