REmap

A Renewable Energy Roadmap

Dr Dolf Gielen – Director IITC, 28 July, 2016, Santo Domingo

About IRENA

International Renewable Energy Agency – IRENA

MANDATE

To promote the widespread adoption and sustainable use of **all forms of renewable energy** worldwide

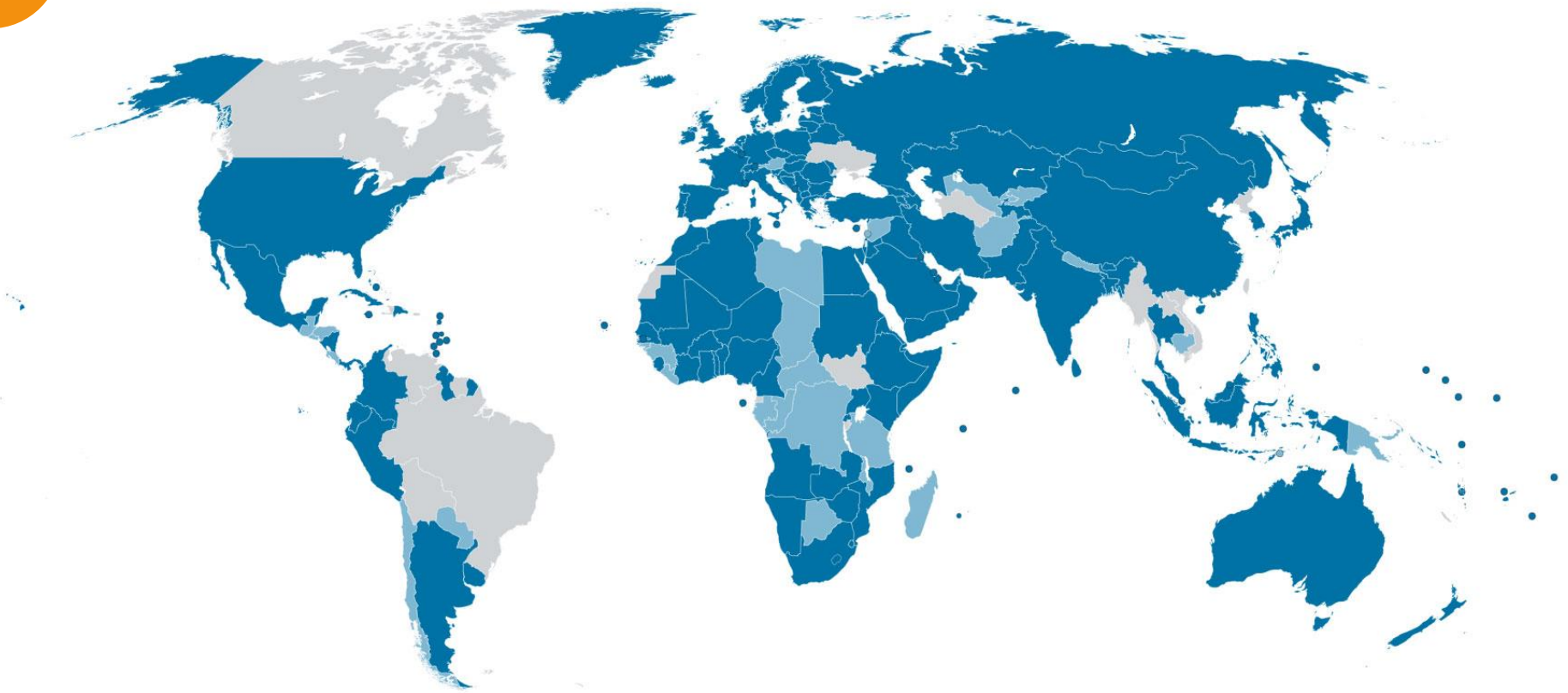
OBJECTIVE

To serve as a **network hub**, an **advisory resource** and an **authoritative, unified, global voice** for renewable energy

SCOPE

All renewable energy sources produced in a **sustainable manner**

IRENA's Membership



149 Members

27 States in Accession

Mandate: Assist countries to accelerate RE deployment

SIDS Lighthouses Initiative

Launched on 23 September 2014 at the Climate Summit, 34 SIDS & 19 Development Partners

STRATEGIC OBJECTIVE:

- Enabling a sustainable energy transformation for people on the front line of climate change on small islands around the world
- Enhancing energy independence and economic prosperity on SIDS

MAIN ELEMENTS:

- Accelerated RE deployment in the power sector
- Well structured systems transitions
- Information Exchange
- Capacity Building

TARGETS by 2020:

- USD 500 mil mobilized
- 100 MW of new solar PV
- 20 MW of new wind
- Significant quantities of other RE technologies
- All participating SIDS have RE roadmaps

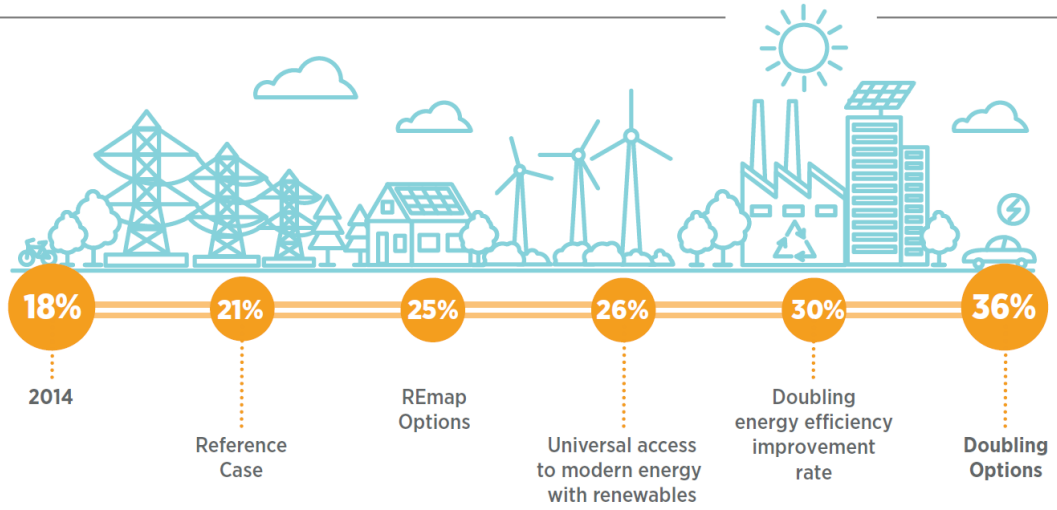
About the REmap programme

REmap

- IRENA's **Global Renewable Energy Roadmap**
- Shows feasible, cost-effective ways to **increase renewable energy deployment** in world's energy mix by 2030 **in line with SDG7**
- Identifies concrete **technology options** for countries and sectors
- Assesses policy and investment **implications**
- Outlines **benefits** (economic, social, environmental)
- In cooperation with 50 countries
- 30 publications to date

REmap
A Renewable Energy Roadmap

REmap 2016 edition highlights



- **Doubling the share of renewable energy by 2030 is critical** for the achievement of sustainable energy and climate change objectives
- Doubling renewables in the world's energy mix by 2030 will lead to **savings exceeding costs up to 15 times**
- The transition to renewables, with greater energy efficiency, can **limit the global temperature increase to below 2 degrees**
- Doubling the share of renewable energy by 2030 is feasible, but only with **immediate, concerted action in transport, buildings and industry**
- **Doubling the world's renewable energy share requires concerted action, reinforcing growth in renewables with energy efficiency and universal access – the three pillars of SDG 7**

REmap Dominican Republic, main findings

The energy situation in the Dominican Republic and the renewable energy drivers

Key facts of the energy system

- Demand is growing fast, 2% per annum in the past decade
- USD 5 billion per annum of fossil fuel imports, 7% of GDP and 90% of primary energy supply
- High operating costs of power generation, system largely based on hydrocarbons
- Electricity subsidies USD 1 billion per annum, 2% of GDP
- Electrification rate is 96%, lack of electricity access mostly in rural areas

RE drivers

- → Affordable and sustainable energy supply
- → Energy diversification
- → Energy independence
- → Reduce the energy bill
- → Reduce GHG emissions
- → Energy access

Existing measures to integrate renewable energy

General

- The Law 57-07 provides a broad range of fiscal and financial incentives for power, liquid biofuels, solar thermal and storage technologies
- Climate change NDC target: 25% reduction of GHG emissions by 2030 compared to 2010 the level in 2010 (3.6 tonnes of CO_2-eq per capita)

Sector-specific

Power

- The Law 57-07, set a non-binding **renewable energy target** of 10% and 25% for 2015 and 2025 respectively
- **Net-metering** (residential and comercial)
- **Rural electrification** carried out with **RE technologies** (small hydro and PV)

End-use sectors

Transport

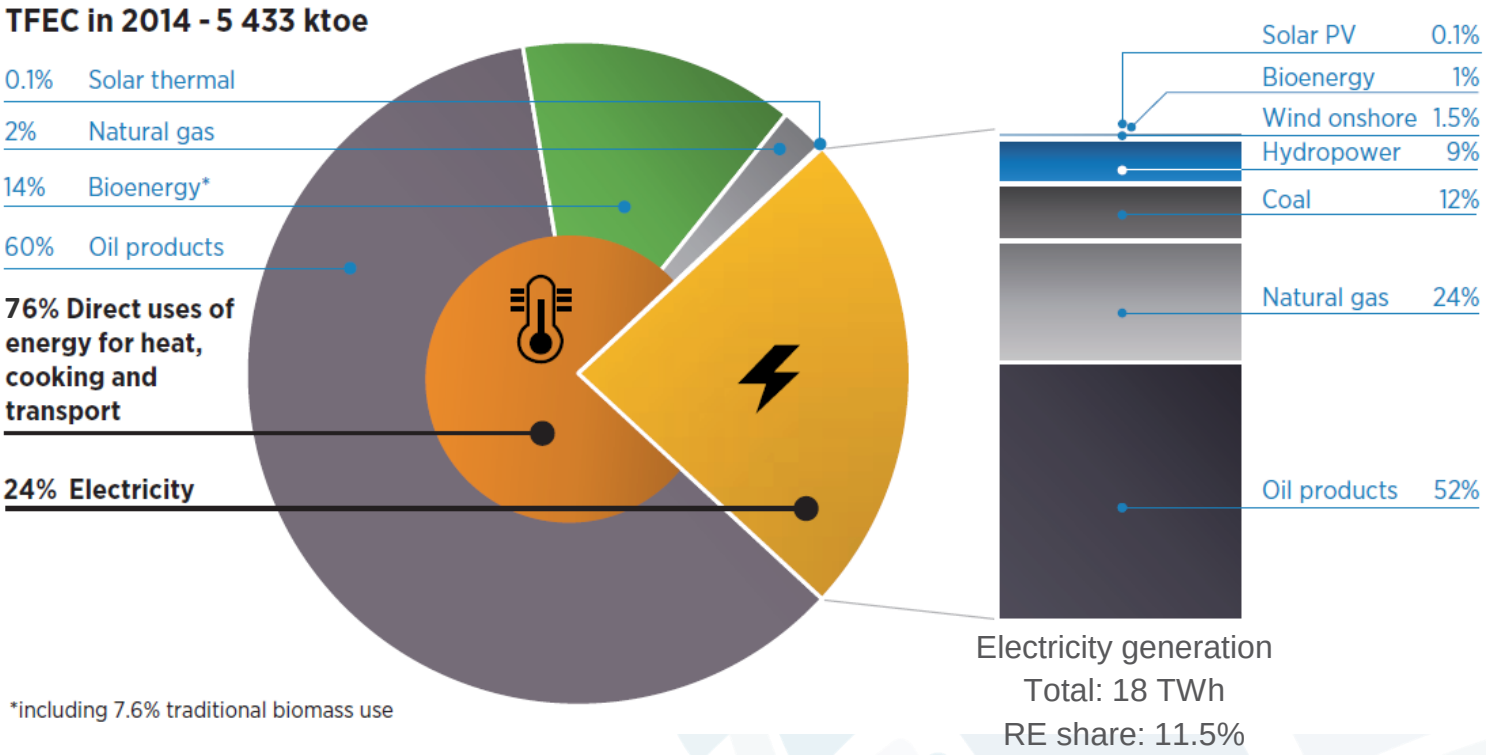
- The Law 57-07 includes provisions for **liquid biofuels**: basis to implement blending mandates; fiscal incentives; reference price setting

Buildings and Industry

- Law 57-07 provides fiscal incentives for bioenergy production and solar thermal installations

Note: Fiscal and financial incentives of Law 57-07 include: exepmtion on income and import taxes; reduced taxes on external financing; low interest loans for community projects.

Total final energy mix in 2014 in the Dominican Republic



In **2014**, the **RE share in total final energy** of the Dominican Republic stood at **16.3%** (8.7% modern renewables and 7.6% traditional bioenergy use)

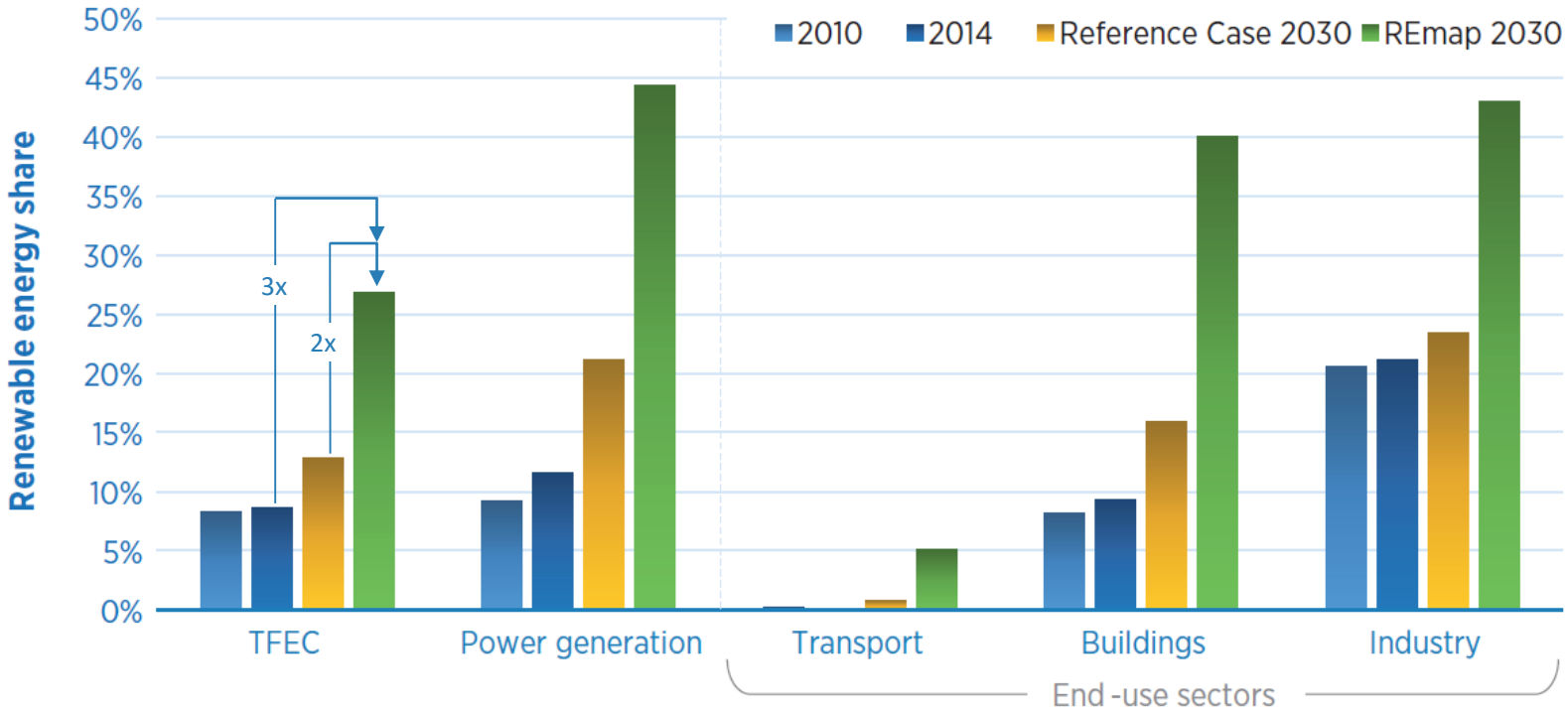
Power generation is predominantly based on hydrocarbons

Source: IRENA estimates based on national energy balances
TFEC: total final energy consumption; ktoe: kilotonne of oil equivalent; PV: photovoltaic

Energy developments to 2030 in the Reference Case (baseline)

- Based on preliminary results of the CNE energy demand projections for 2013-2030 other data for the power sector shared by CNE
- Total energy demand to grow by 41% in 2010-2030 to 7 685 ktoe
- **Share of modern RE in final energy mix reaches 13% in 2030**
- **Power sector**
  - Doubling of annual electricity generation from 18 TWh to 36 TWh
  - Coal generation 10 TWh, oil 12.2 TWh (mainly fuel oil and diesel), natural gas 5.3 TWh by 2030
  - **RE share in the power sector reaches 21%,** compared to 11.5% in 2014: mainly hydropower and wind onshore
- Renewables in **end-use sectors** see limited additions (mainly bioenergy)

What could be achieved based on REmap Options



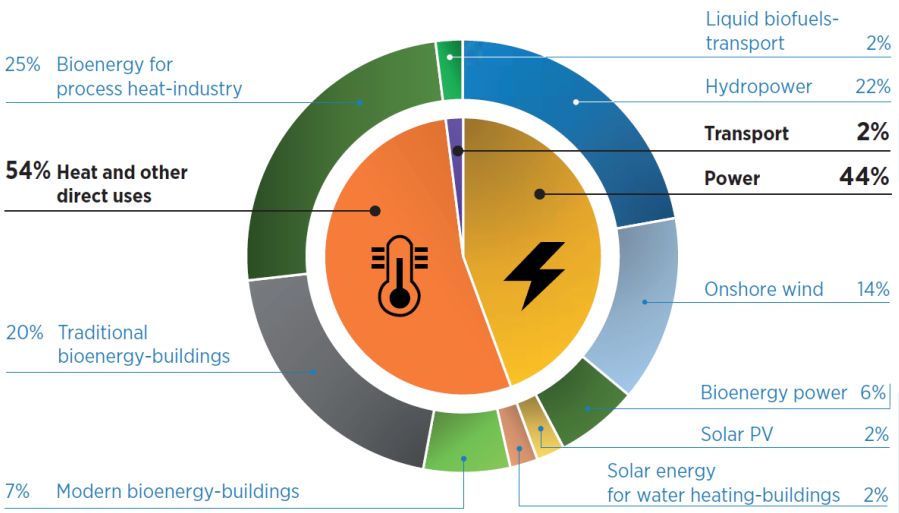
The modern RE share in final energy use in REmap can double in 2030 with respect to the Reference Case (baseline) and triple when compared to 2014

Note: End-use sectors include renewable energy consumption from direct uses and electricity; RE share in Buildings and TFEC excludes traditional uses of bioenergy

What is the mix of renewables in the baseline and what can be realised in REmap by 2030

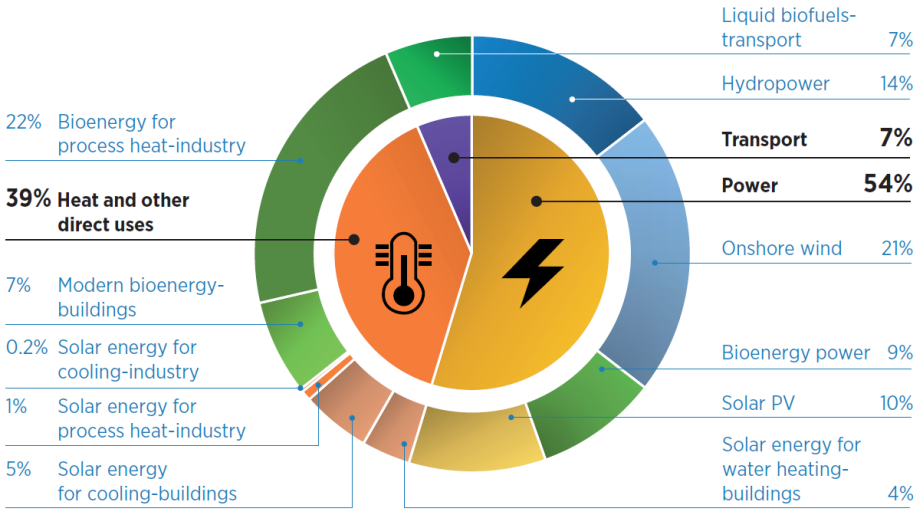
Shares of total RE use in TFEC by technology and sector

RE use in the Reference Case: 1 234 ktoe



Reference Case: 13% modern RE share and 3% traditional bioenergy

RE use in REmap: 2 080 ktoe

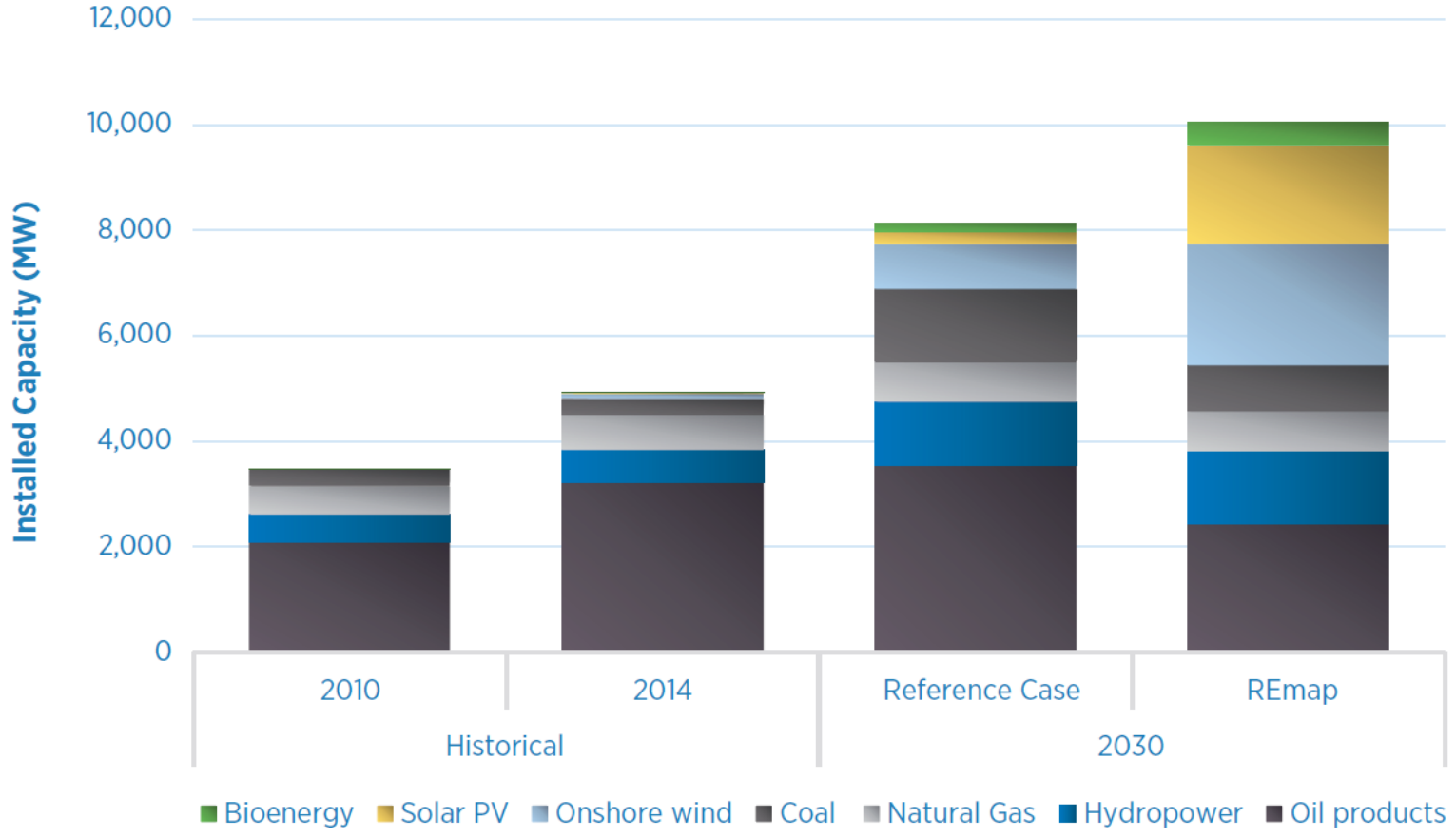


REmap : 27% modern RE share (all traditional uses of biomass substituted)

Total **RE use** attains **2 080 ktoe by 2030 with REmap Options**, half of it is from **modern bioenergy**

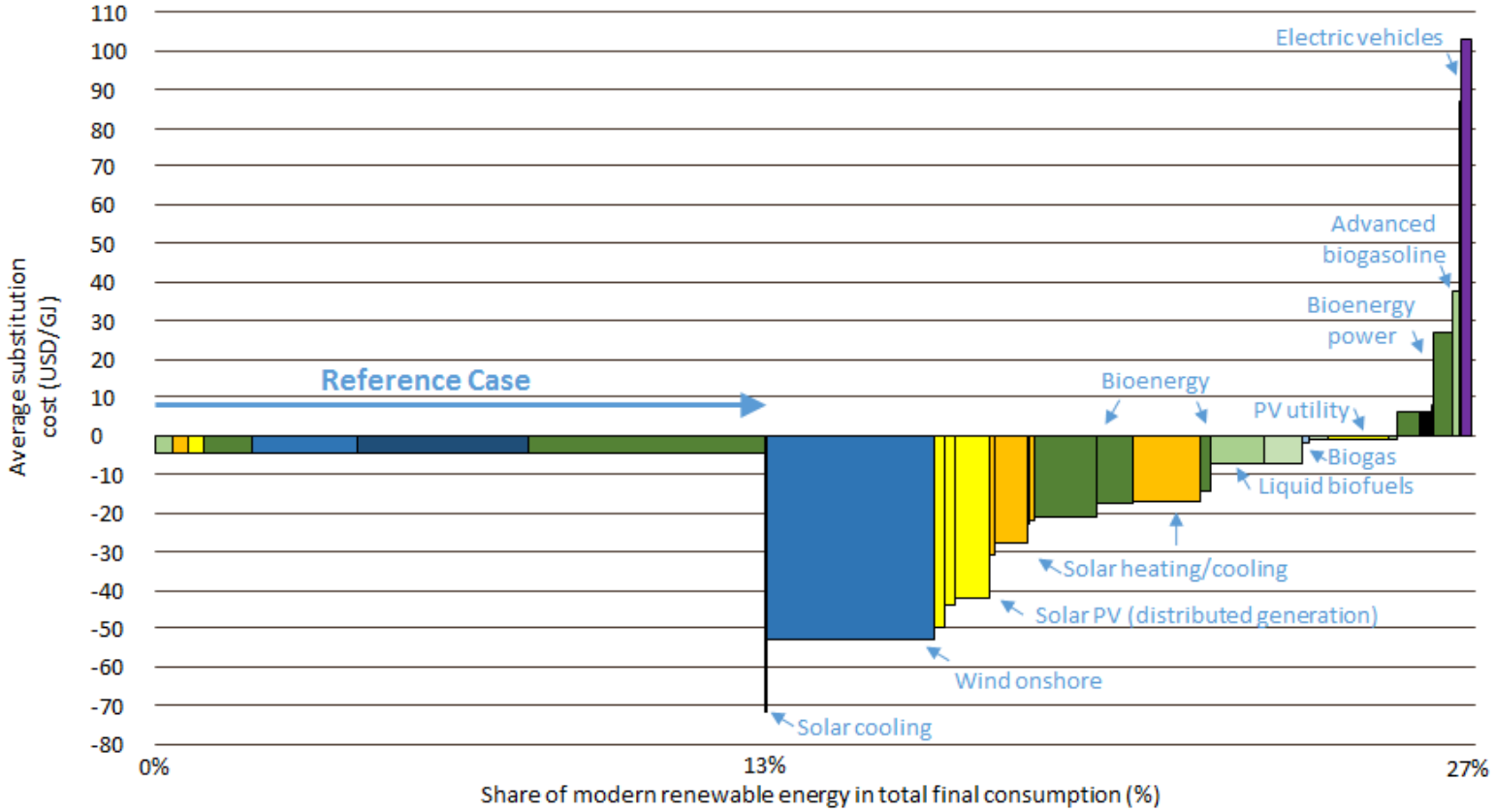
Onshore wind and **solar technologies** also play a major role

Power generation capacity developments



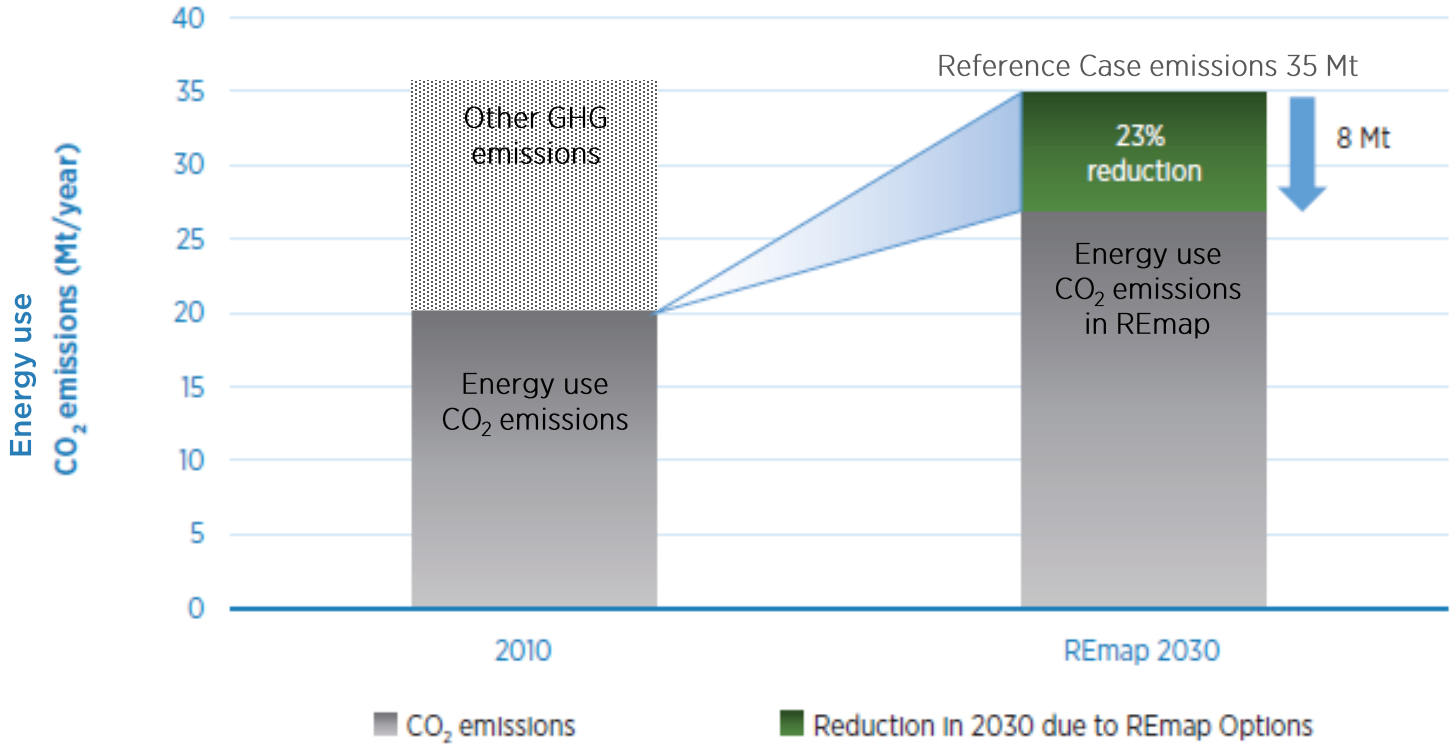
All RE sources for power generation have the potential to grow beyond current plans by 2030

Cost-supply curve of REmap Options, government perspective



More than 80% of REmap Options are cost-competitive when compared to the non-renewable energy alternative

CO_2 emission reductions from RE would be an important step to achieve the targets in the NDC



Target: 25% GHG emissions reduction by 2030, compared to 3.6 tonnes CO_2-eq per capita in 2010

Lower fossil fuel combustion from renewables in REmap reduces energy related CO_2 emissions to 2.3 tonnes per capita per year by 2030, compared to 2.9 tonnes per capita in the Reference Case

The energy transition is affordable and makes economic sense

Annual energy system costs and savings in 2030 (Government perspective, Remap vs Reference Case)	
(USD million per year in 2030)	
System costs from REmap Options	**-1 020**
Industry	-165
Buildings	-130
Transport	190
Power	-915
Savings from reduced externalities	**1 060 to 4 280**
Reduced human health externalities (indoor and outdoor air pollution)	900 to 3 500
Reduced externalities from climate change	160 to 760
System costs from Remap Options and reduced externalities	**-2 075 to - 5 300**
Incremental subsidy needs	**160**

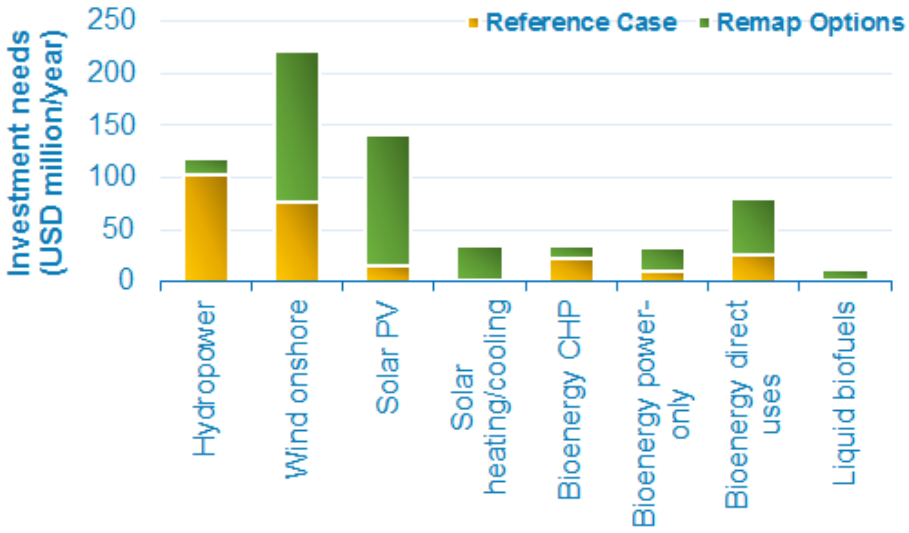
REmap could result in savings of up to USD 5.3 billion per year in 2030

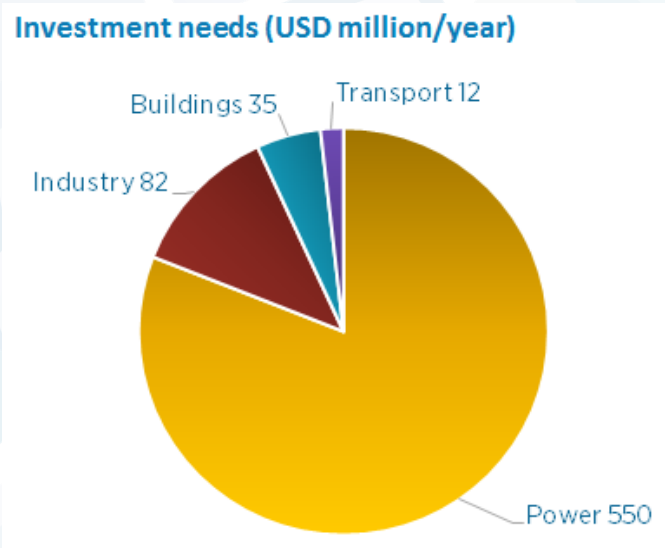
Most of the RE options are cost-effective; most expensive options are found in the transport sector (under government perspective)

Investment needs by RE source

Investments (annual average between today and 2030) (USD million per year in 2030)	
	2015-2030
Total investment needs (REmap Options)	422
Total RE investment needs (REmap Options and Reference Case)	680

Average annual investment needs in REmap by sector RE technology and sector, average 2015-2030



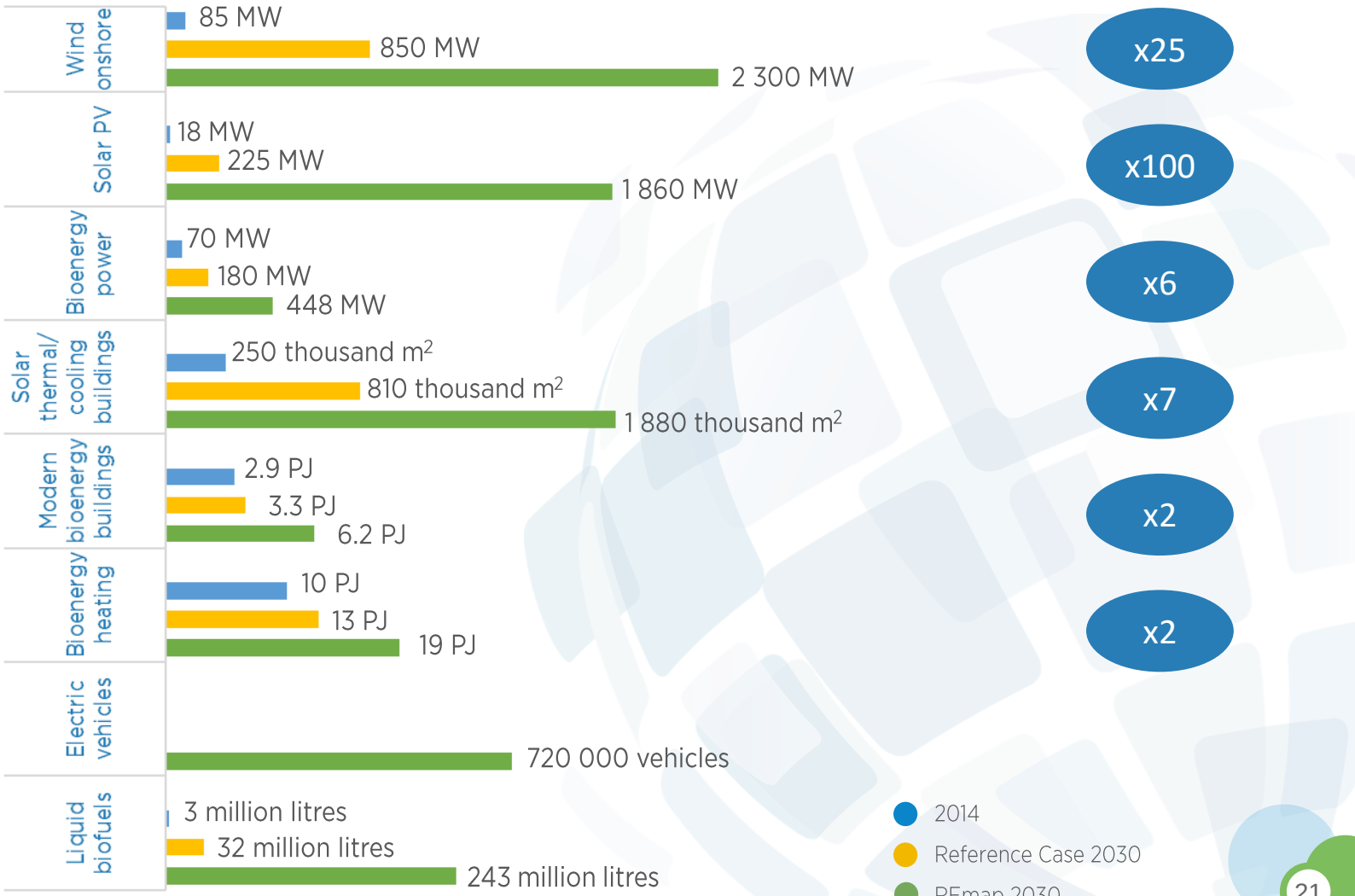


Annual investment needs for REmap at USD 680 million in 2015-2030

Addition of USD 422 million to Reference Case

80% of investments in power sector

Growth in selected technologies



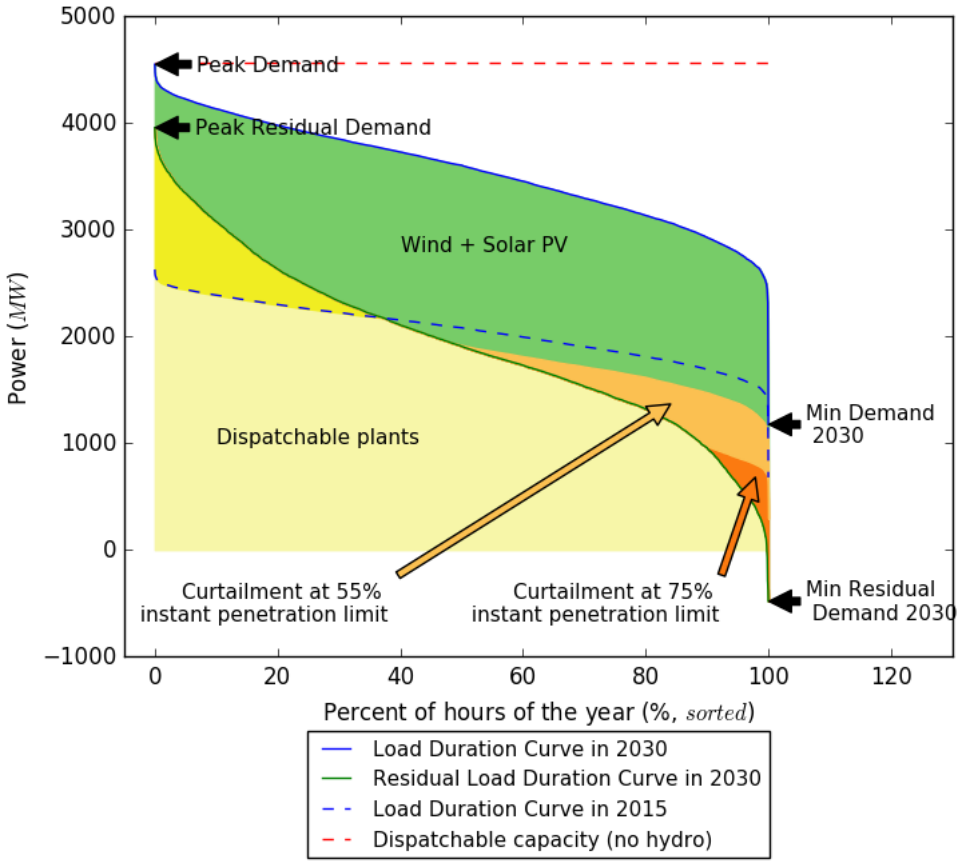
REmap Dominican Republic, challenges and action areas to an accelerated RE growth

Institutional and economic challenges in the power sector

- **Long-term vision** needs to emerge with intermediate **renewable energy targets** and necessary **incentives** to realise the RE potential
- Maintain **consistency** between the national **energy plan** and national **development strategies**
- Provide a **stable and attractive environment for investment**, based on **strong institutional and regulatory frameworks**
- Regulatory framework that allows the implementation of the **changes** required **in the planning and operational procedures of the power sector**, to integrate **large shares of VRE**

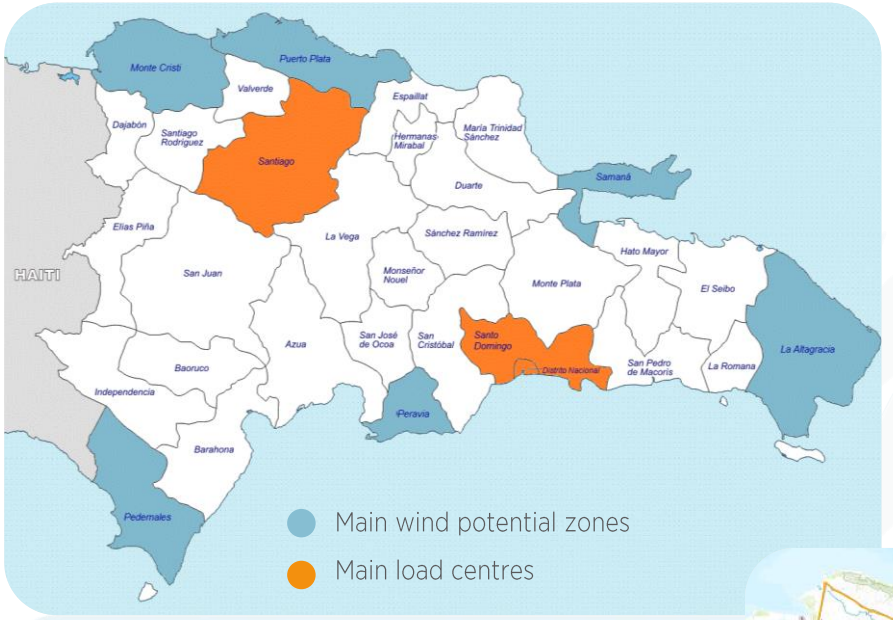
Generation adequacy and flexibility needs

- At least 4 GW of dispatchable generation (both renewable and non-renewable) required
  - To cover peak power demand with low VRE generation
- Incorporating flexibility needs into long-term generation expansion plans with corresponding intermediate targets is essential
- Appropriate financial mechanisms are required in order to guarantee that the firm capacity, alongside flexibility services are available.
  - Financial mechanisms should consider the new reduced utilisation of dispatchable plants



Conventional generation would be used less amount of time, but still required; incentives should ensure that this type of generation is available

Transmission system needs

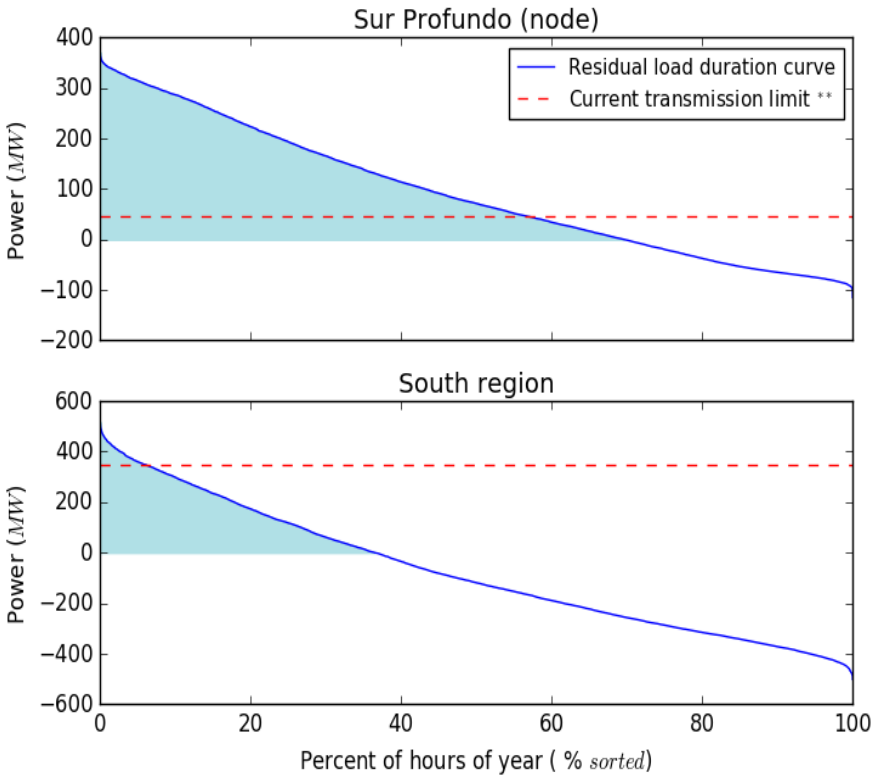


- **Wind**: location based on assessment by the Worldwatch Insitute
- **Solar PV**: installed close to the main load centres
  - this includes distributed generation and utility scale projects in Santiago and Santo Domingo areas

Overview diagram of existing transmission system and power generation plants

Source: CNE maps, http://mapas.cne.gob.do/

Transmission system adequacy

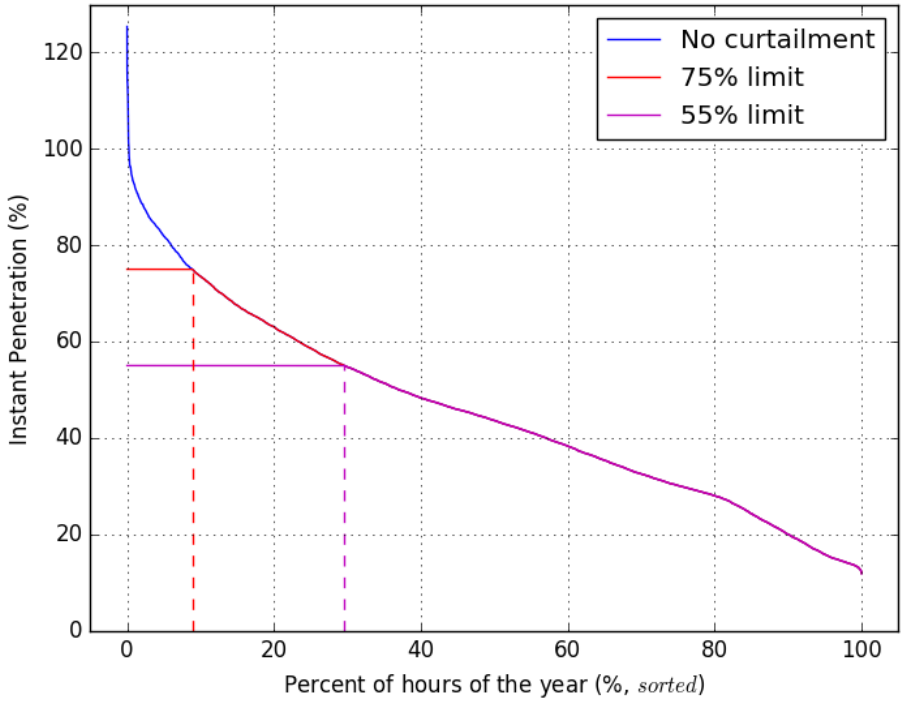


** Source: Transmission system restrictions study for 2016-2019, OC-SENI 2015

Transmission network analysis:

- Production of wind power and demand for power was calculated for each subzone
  - Net load (power demand minus VRE generation) can be negative
- This means that there would be a need to export power from these, to other subzones
- Transmission system must be expanded so that Wind power can be transmitted to the bigger load centres
  - Otherwise curtailments due to transmission congestions are likely
- Transmission system planning must be coordinated with VRE projects
- Strategies for financing the required network upgrades must be investigated

Instantaneous penetration of VRE



- Up-to 10% of total electricity that could be generated by renewables by 2030 may need to be curtailed to guarantee system security (55% limit)
- The use of the most up-to-date technologies and operational practices in the future may help reduce curtailment to less than 2% (75% limit)

- **System must be carefully analysed to identify penetration limits**
- **Reasons for the constraints must be identified and solved**
- **Required and acceptable levels of curtailment have to be evaluated**
- **Forward looking grid codes and operational practices could help to allow higher instantaneous penetration of VRE**

Key policy recommendations

Power sector

- RE targets consistent with national strategies and a stable institutional and regulatory framework with the right economic incentives
- Enough dispatchable generation to provide firm capacity and flexibility
- Transmission planning in line with RE targets and different balancing measures to manage grid congestion
- Generation and transmission capacity measures that enable economic levels of curtailment of renewable energy
- Appropriate incentives and market mechanisms for flexibility

End-use sectors

- Codes and standards for buildings and urban planning that consider RE
- Strategy for RE use in industry considering techno-economic factors
- Create a market for liquid biofuels and promote electric mobility
- Targets for bioenergy use in applications lacking other RE alternatives

Next steps, how to support the Dominican Republic on its energy transition

Further power system studies

- Achieving the REmap case requires further detailed technical and economic studies focusing on operating and planning the interconnected systems with high shares of variable renewable energy
- IRENA could support the Dominican Republic during the realization of these in-depth studies particularly in the next areas:
  - Long-term planning models adapted to account for high shares of VRE
  - Dispatch optimization of a power mix with high VRE, to shed light on operating costs, reliability constraints, etc.
  - Power system studies to identify VRE limits and transmission constraints

Project Navigator

Online tool for the development of bankable projects:

technology information, tools, templates, case studies and examples

- **Technology coverage:**
  - Onshore wind
  - Utility and residential PV
  - Mini-grids
  - Small hydro
  - Bioenergy
  - Geothermal
- Finance opportunities
- 2 000 active users

Visit us: **www.irena.org/navigator**

The Sustainable Energy Marketplace

Objective: to support **initiation, development** and **financing** of sustainable energy projects by:

- Improving the transparency of the market
- Offering IRENA's tools and databases for market players
- Supporting projects at the development stage

IRENA
International Renewable Energy Agency

Thank you!

REmap

ROADMAP FOR A RENEWABLE ENERGY FUTURE

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