

# Renewable Energy in the Present and the Future

*CERN Geneva  
23 October 2013*



# Consequences of fossil energy dependence

- 
- The resources are not evenly distributed worldwide
    - Supply security risk
    - Interest to replace imports with indigenous resources
  - Fossil fuels are costly and prices fluctuate
    - Some countries spend more than 10% of GDP on fossil fuel imports
    - IEA projects that fossil fuel prices will continue to rise
    - Global shale gas prospects outside US are unclear
    - Minigrid and offgrid solutions for electrification of remote communities – diesel based power generation is very expensive
  - Significant local air pollution damages
  - The latest IPCC report stresses the risk of climate change
    - Burning of fossil fuels, especially coal, is a prime source of GHG emissions
  - Renewable energy and energy efficiency are widely accepted as sustainable solutions
    - UN SE4ALL initiative calls for a doubling of RE share and doubling of efficiency gains by 2030
    - IRENA as hub for renewable energy

# About IRENA

International Renewable Energy Agency

Established April 2011

**Mission:** Accelerate deployment of renewable energy

**Scope:** Hub, voice and source of objective information for renewable energy

**Members:** 161 partner countries; 119 ratified members (global scope)

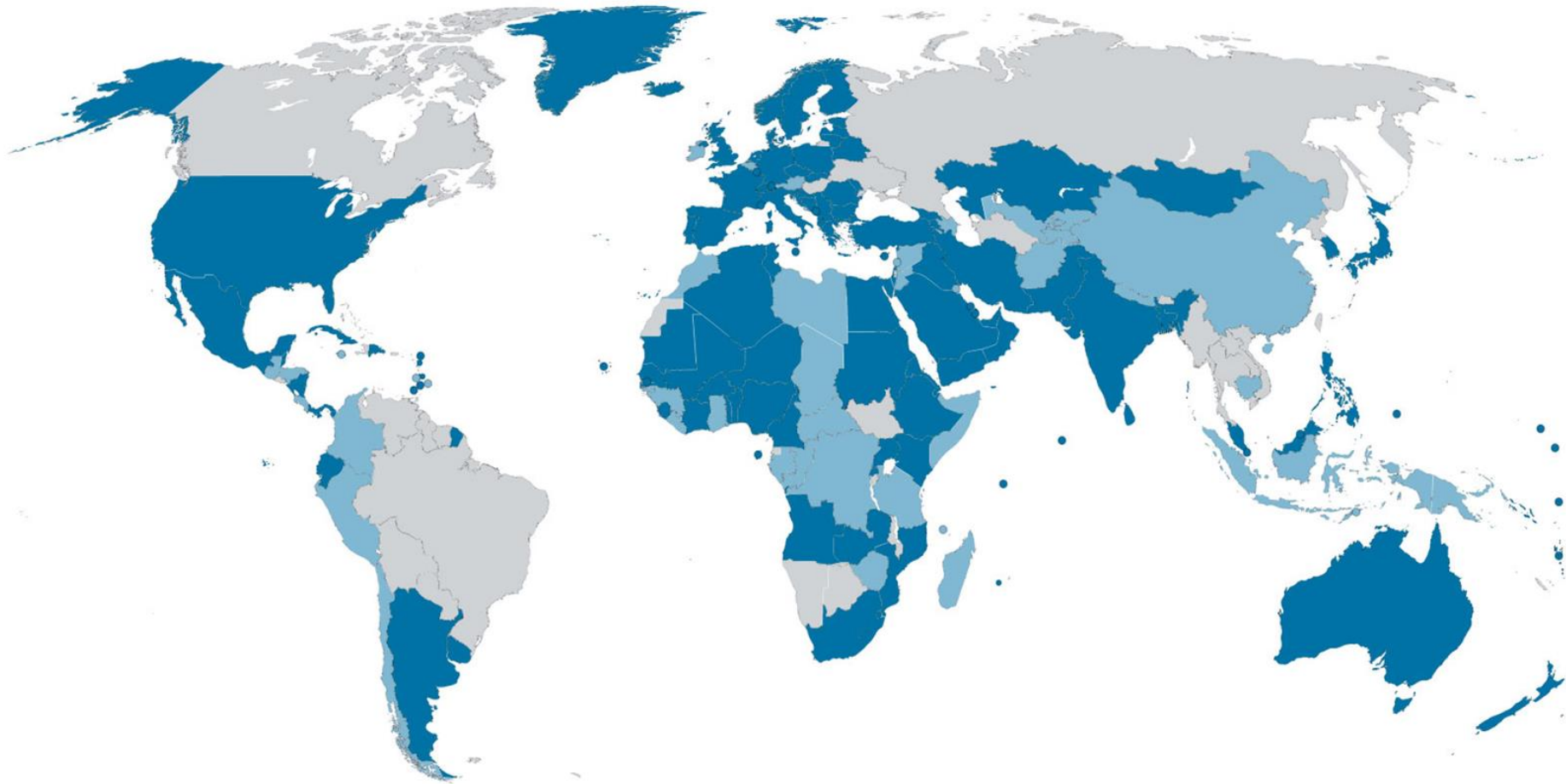
**Mandate:** Sustainable deployment of the six RE resources (Biomass, Geothermal, Hydro, Ocean, Solar, Wind)

**Structure:** Three programmatic divisions CSP, IITC, KPFC

**Location:** Headquarters in Abu Dhabi, United Arab Emirates  
Innovation and Technology Centre IITC, Bonn, Germany

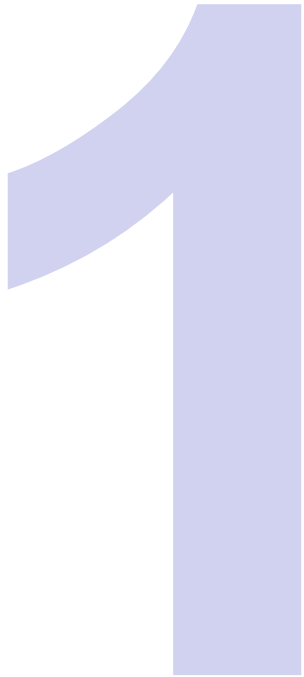
**Director-General:** Adnan Amin

# International Renewable Energy Agency: 119 Member Countries and growing rapidly



- Members of the Agency
- Signatories/States in Accession

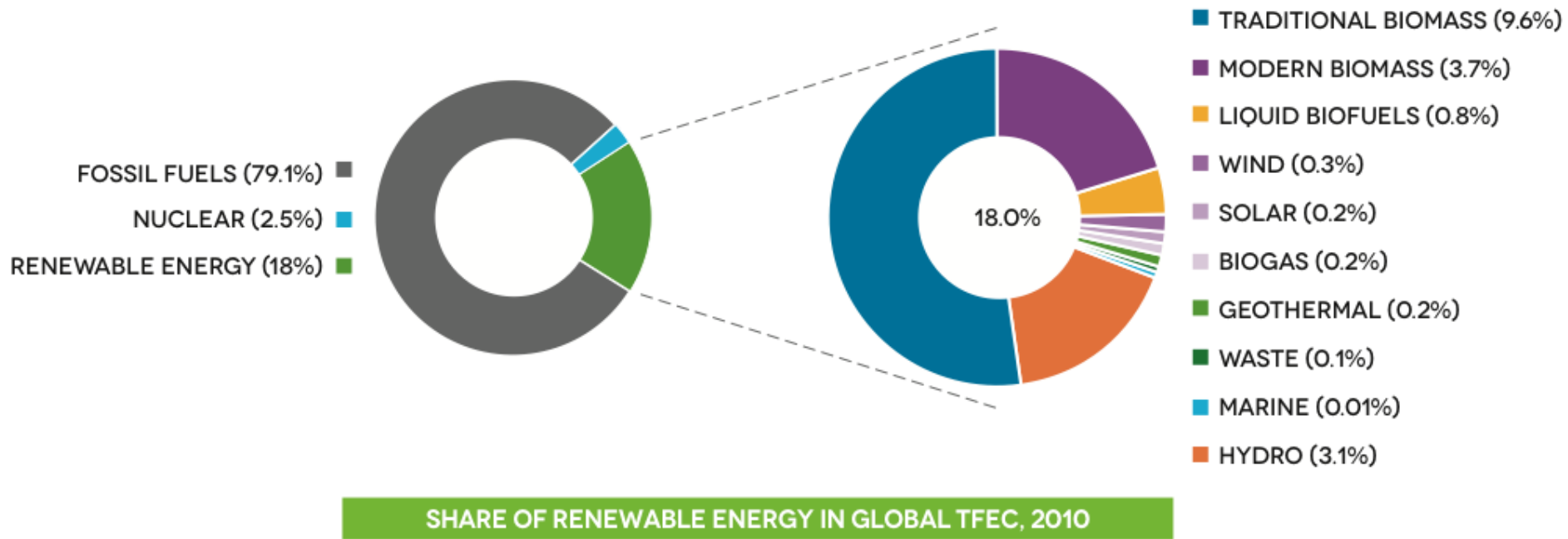
More than 160 partner countries



# **RENEWABLE ENERGY SITUATION AND TRENDS**

# Globally 18% RE in Total Final Energy Consumption in 2010

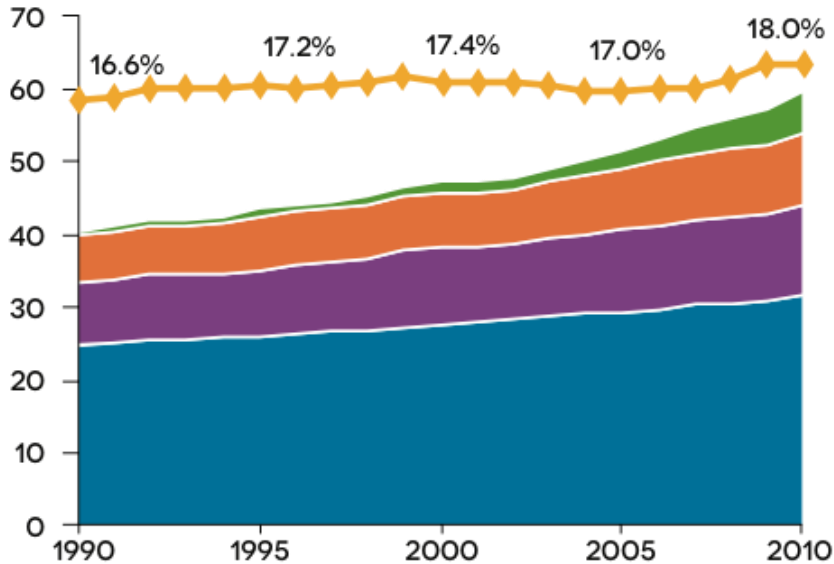
## Half is traditional biomass, 8.4% modern renewables



SOURCE: IEA

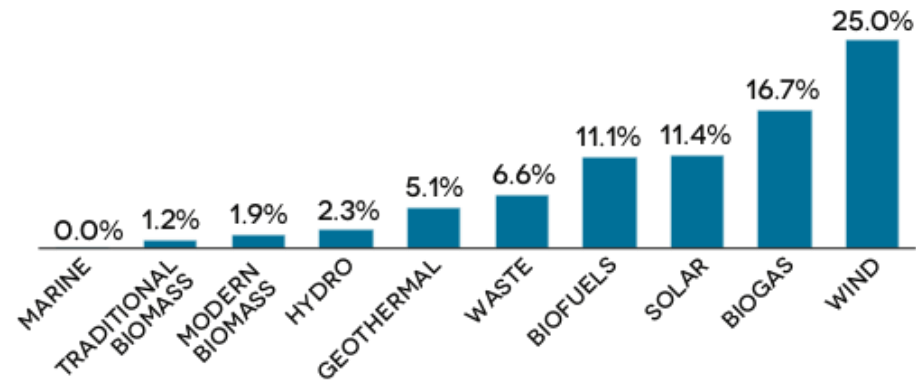
Source: Global Tracking Report, 2013

## Overall share of renewable energy has remained quite flat, albeit some sources grew exponentially from a small base



**WORLD CONSUMPTION OF RENEWABLE ENERGY (EXAJOULES) AND SHARE OF RENEWABLE ENERGY IN TFC (%)**

■ OTHER RE    ■ HYDRO    ■ MODERN BIOMASS  
◆ RE SHARE IN TFC    ■ TRADITIONAL BIOMASS



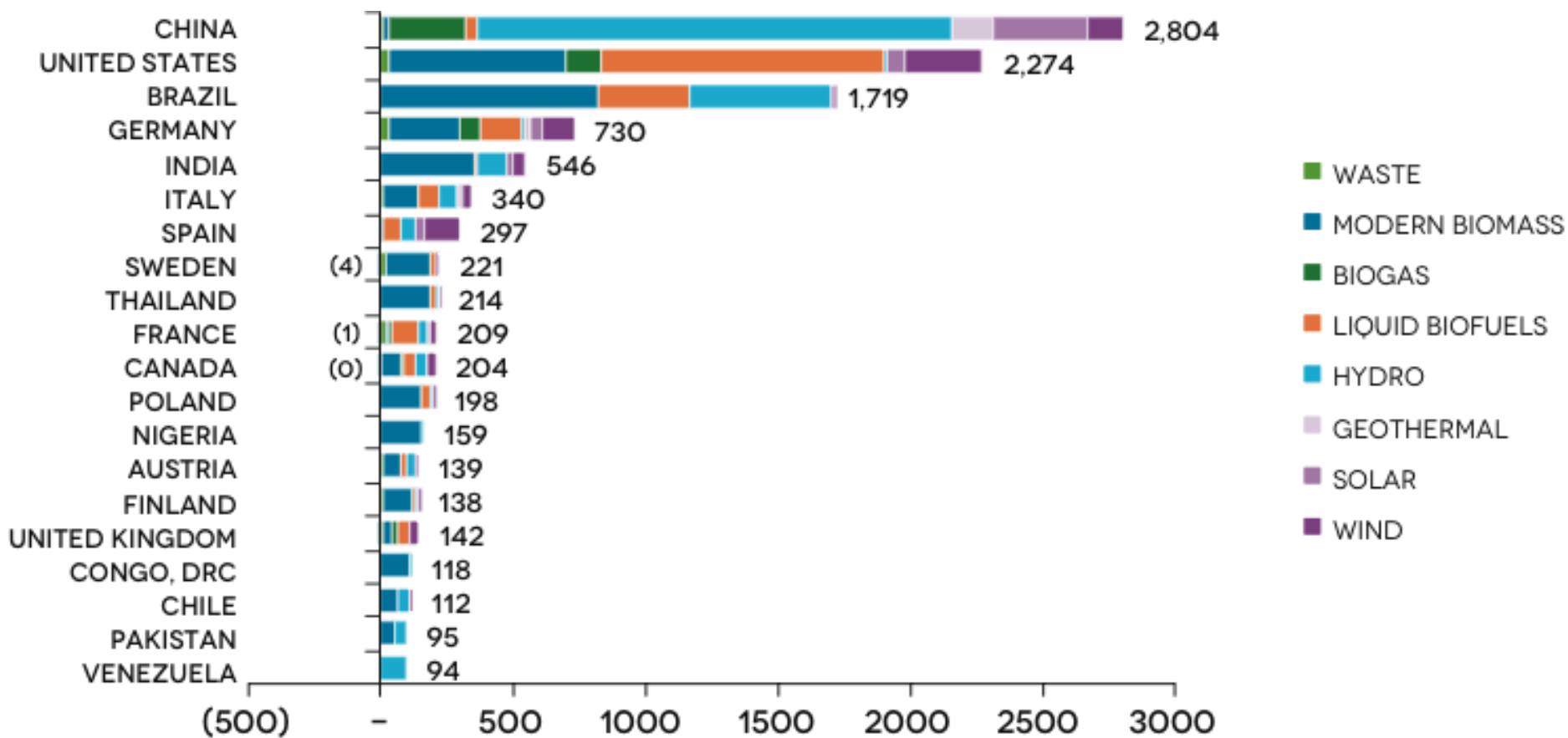
**COMPOUND ANNUAL GROWTH RATES (CAGRS) BY RENEWABLE ENERGY SOURCE, 1990-2010**

SOURCE: IEA 2012A.

SOURCE: IEA 2012A.

NOTE: TFC = TOTAL FINAL ENERGY CONSUMPTION; RE = RENEWABLE ENERGY.

# Growth 1990-2010 by country



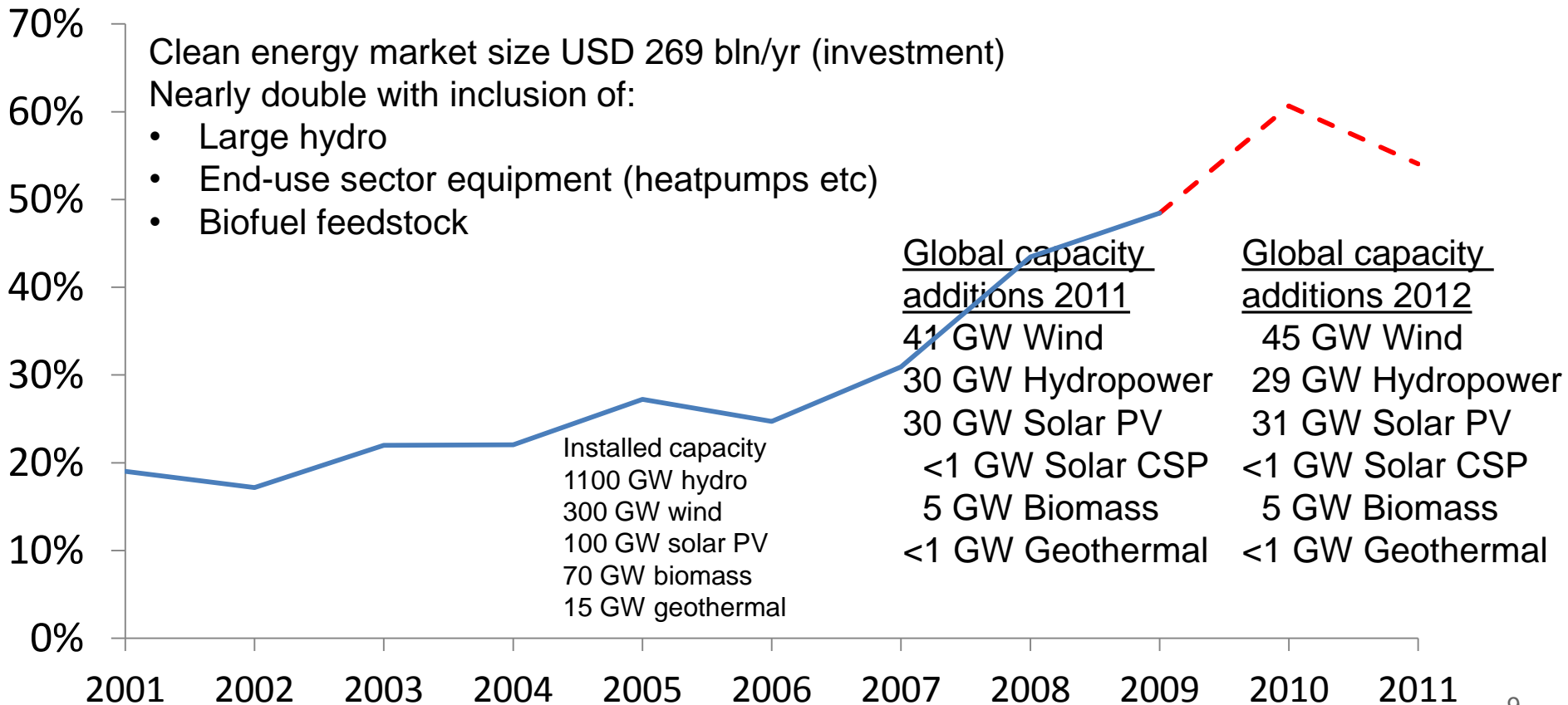
SOURCE: IEA 2012A.

NOTE: "INCREMENTAL CONSUMPTION" INDICATES ADDITIONAL CONSUMPTION OF RENEWABLE ENERGY OVER AND ABOVE THE LEVEL OF CONSUMPTION IN 1990. DRC = DEMOCRATIC REPUBLIC OF CONGO.



# About half of the new electricity generation capacity worldwide is based on renewable energy

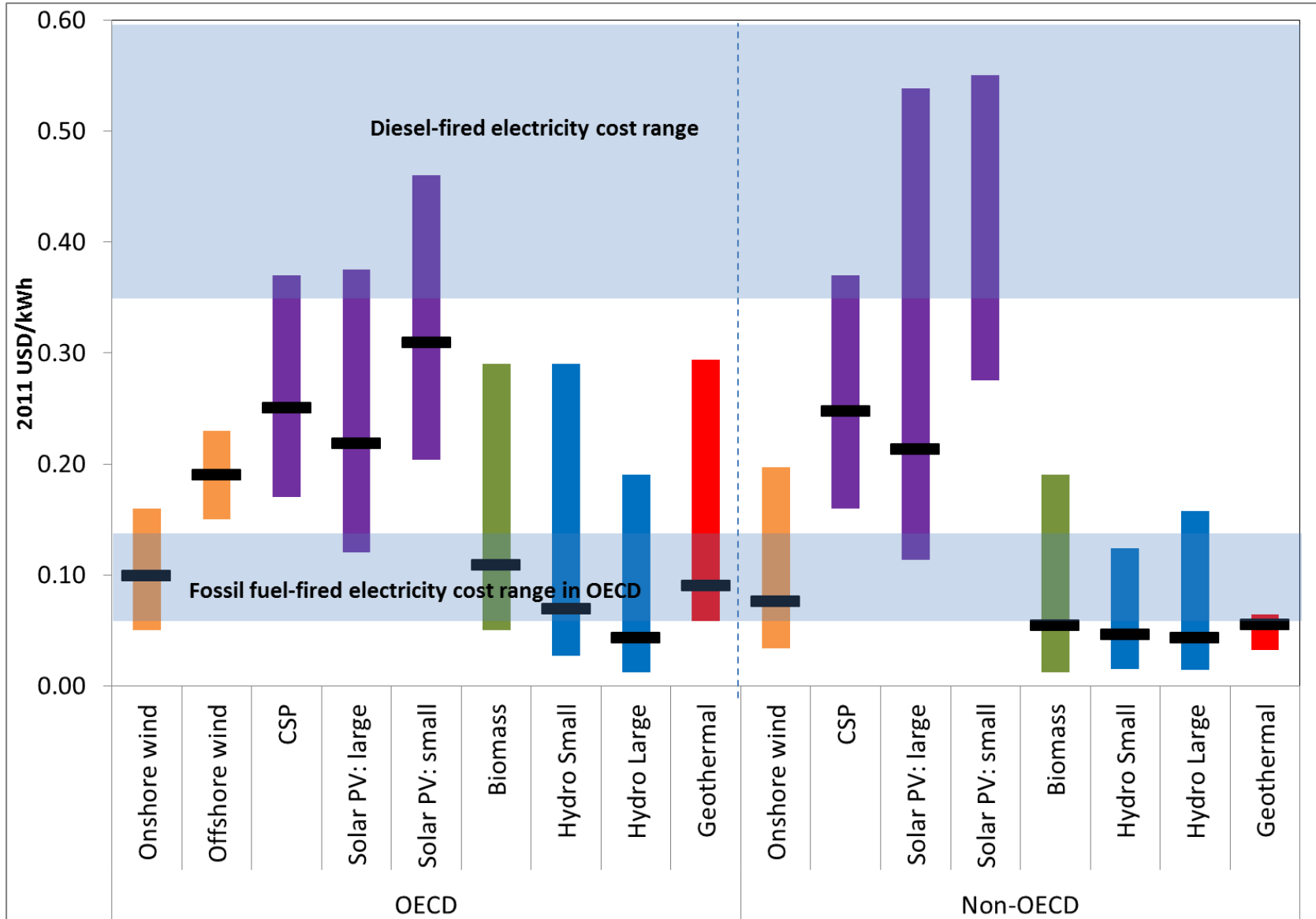
*The share has doubled in recent years*



Source: IRENA

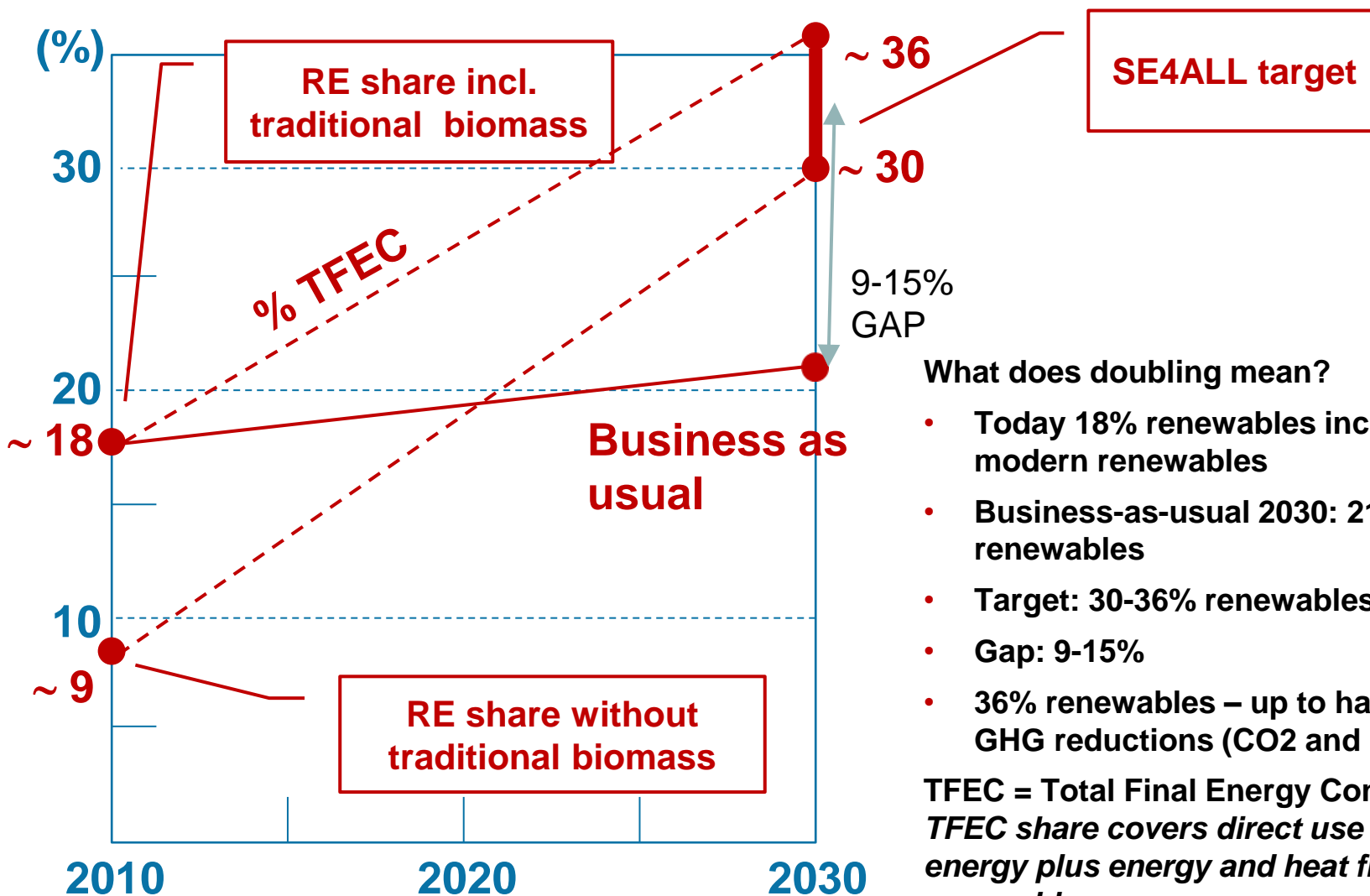
# LCOE ranges and averages

## *RE is cost effective today in many cases*



# 2 RENEWABLE ENERGY PROJECTIONS FOR 2030

# What does it mean to double the RE share?

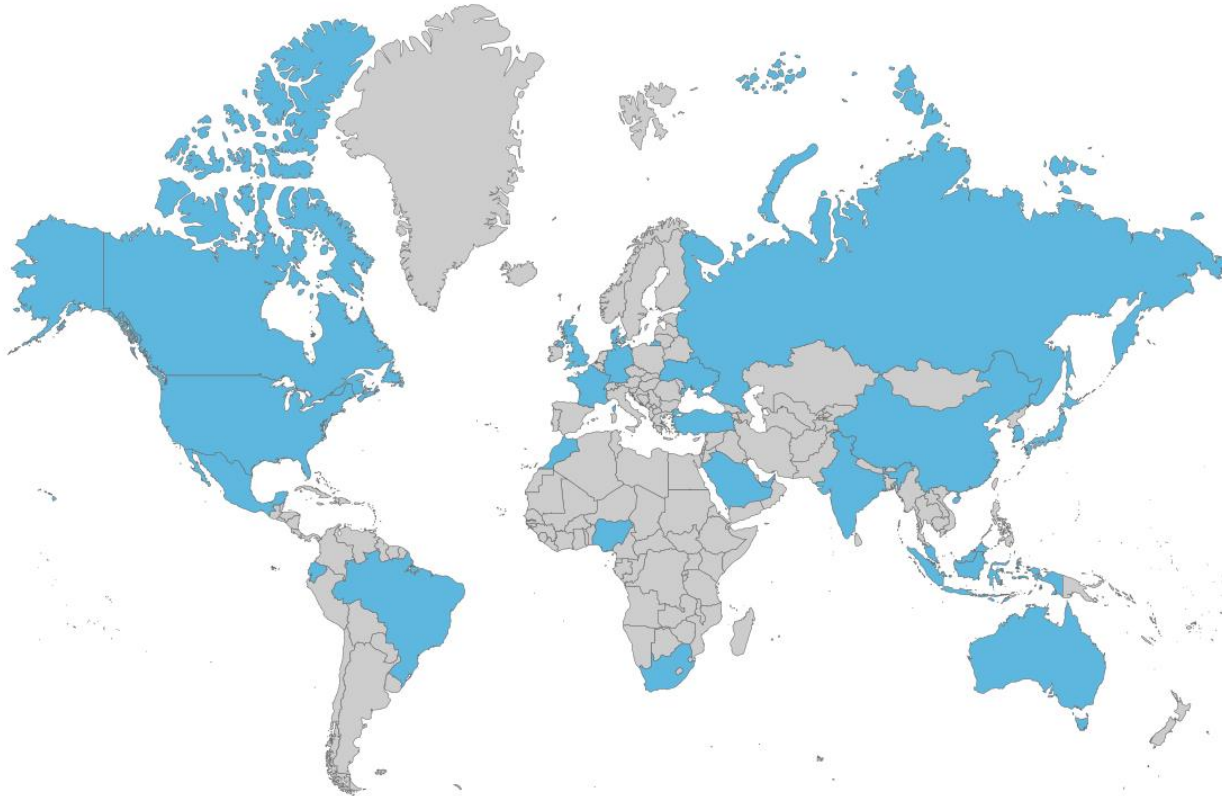


## What does doubling mean?

- Today 18% renewables including 9% modern renewables
- Business-as-usual 2030: 21% renewables
- Target: 30-36% renewables
- Gap: 9-15%
- 36% renewables – up to half of global GHG reductions (CO<sub>2</sub> and CH<sub>4</sub>)

TFEC = Total Final Energy Consumption  
*TFEC share covers direct use of renewable energy plus energy and heat from renewable sources*

# REMAP 2030 - Scope



## REMAP Countries:

AUSTRALIA  
BRAZIL  
CANADA  
CHINA  
DENMARK  
ECUADOR  
FRANCE  
GEMANY  
INDIA  
INDONESIA  
ITALY  
JAPAN  
MALAYSIA  
MEXICO  
MOROCCO  
NIGERIA  
RUSSIA  
SAUDIA ARABIA  
SOUTH AFRICA  
SOUTH KOREA  
TONGA  
TURKEY  
UNITED ARAB  
EMIRATES  
UNITED KINGDOM  
UNITED STATES  
UKRAINE

26 countries representing 75% of global energy demand by 2030

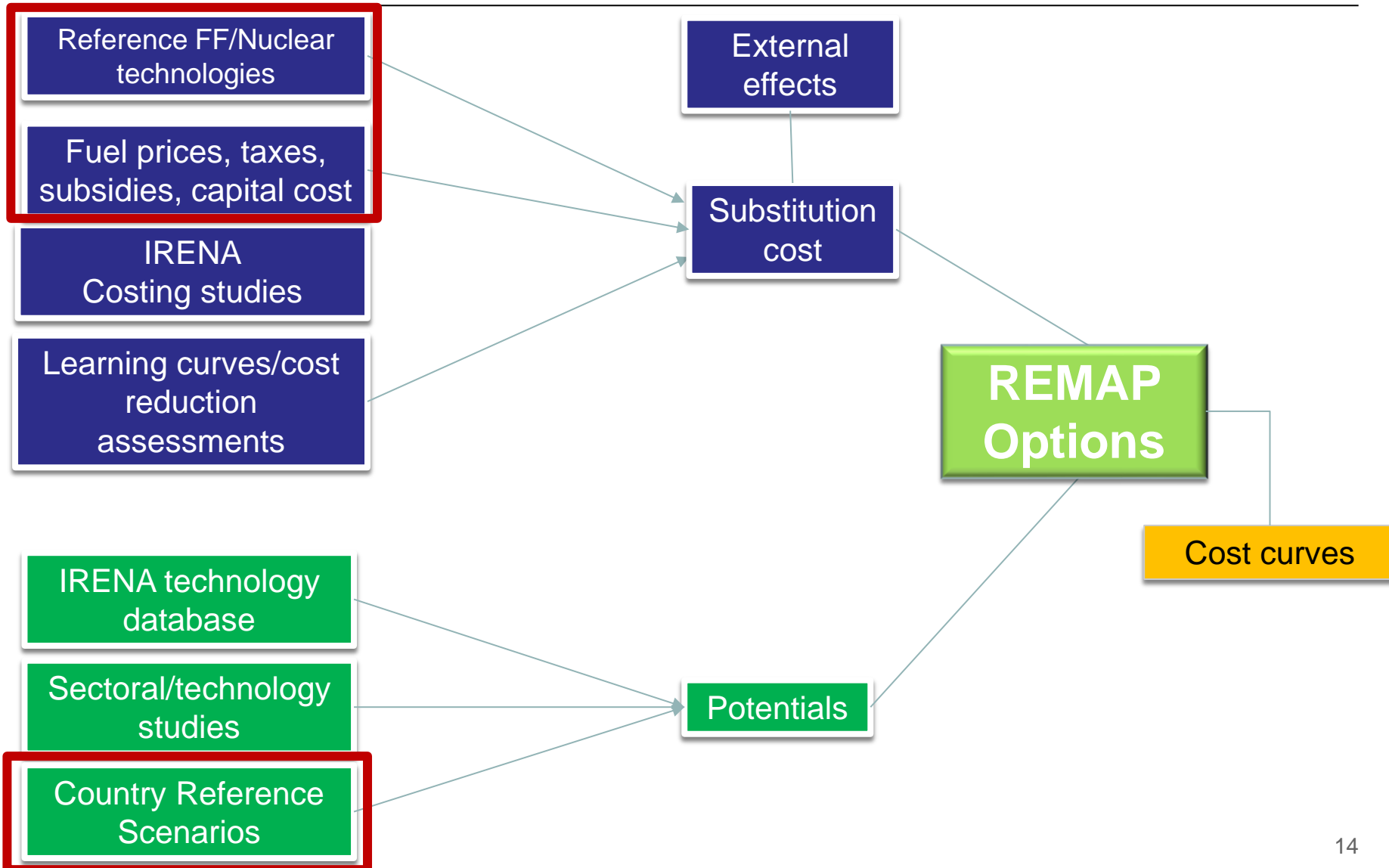
Represents 58% of world population in 2012, 56% in 2030

60% of global PPP in 2012

**Country Dialogue** is crucial and ongoing

Results are aggregated to produce a global cost curve

# Methodology at a Glance

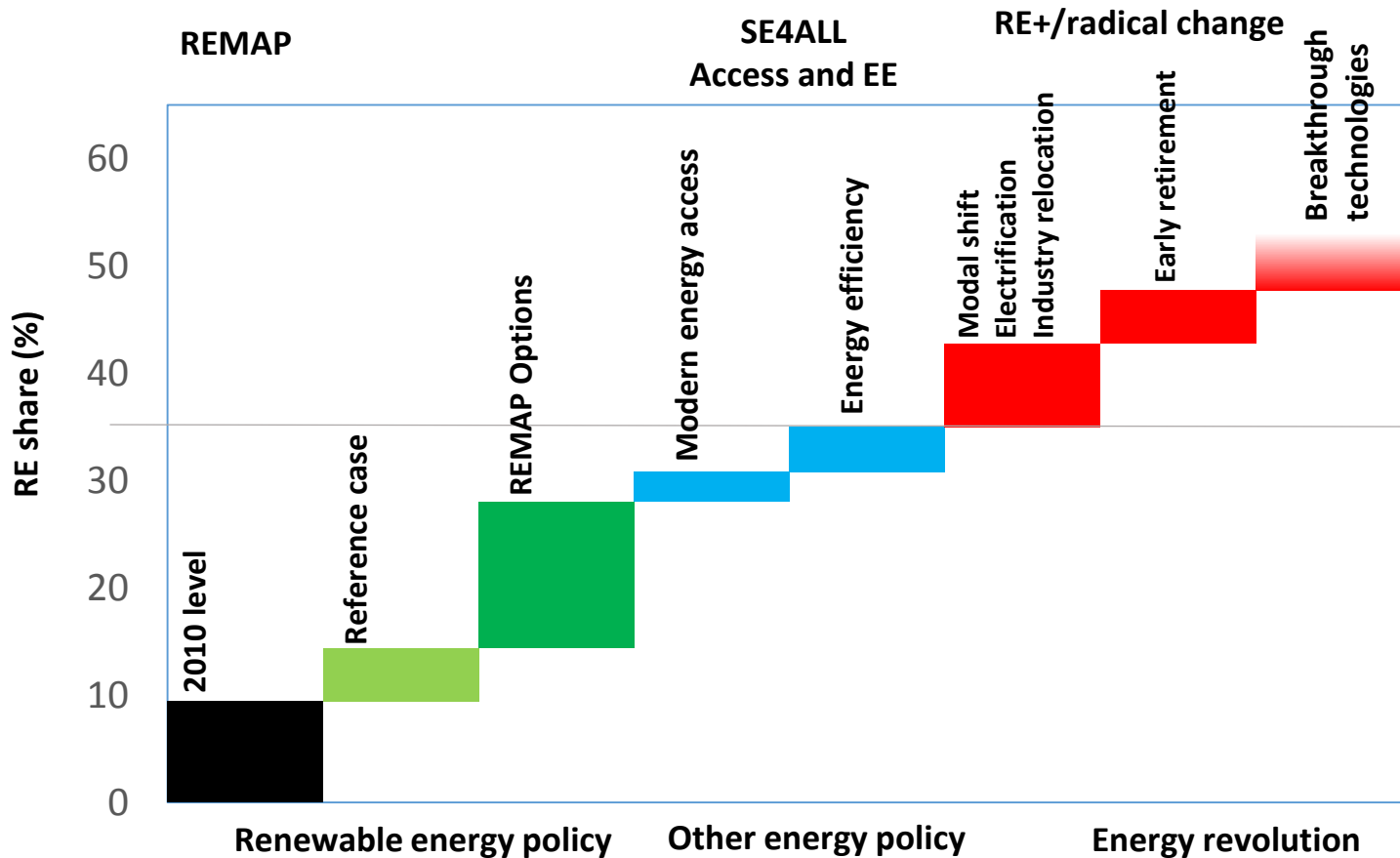


## The Reference Scenario

- Includes all policies in place or likely to be put in place in the coming years
- Some countries have scenarios and objectives for 2030, others not
- Supplemented by IEA WEO 2012 data
- Reference scenario includes efficiency gains
- No cost assessment of the reference scenario
- Planning framework comparison will be part of the analysis

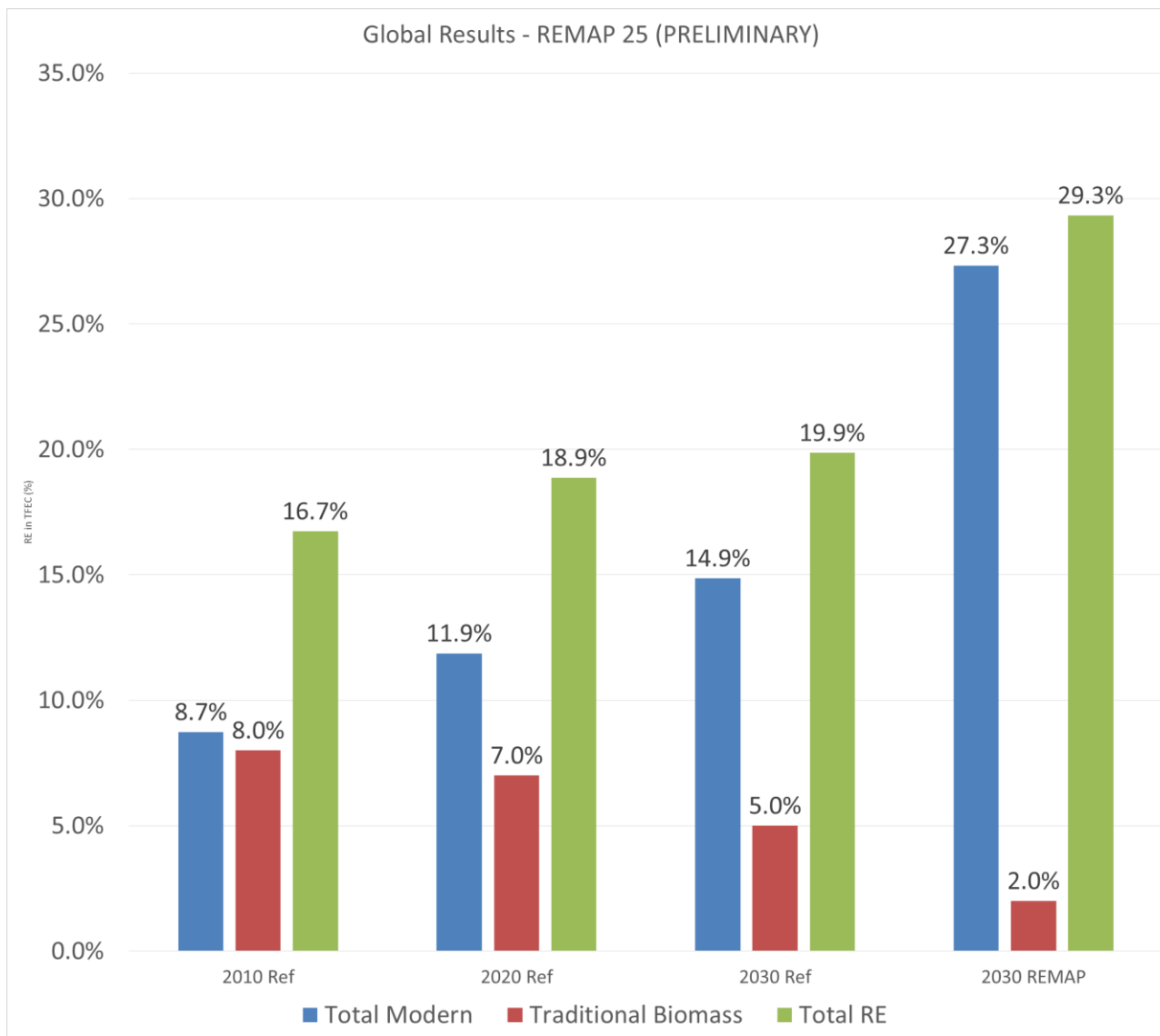
# How to double the RE share

## Access and efficiency can help to double the share





# Impact of all REMAP options Combined DRAFT



Total renewables grow from:

- 20% (Ref. 2030)
- 29.3% (REMAP)

Modern renewables grow from:

- 8.7% (2010)
- 14.9% (Ref. 2030)
- 27.3% (REMAP)

**Traditional biomass declines from 8% to 5% in Ref. 2030 to 2% in REMAP\***

\*assessment imprecise b/c large amount of traditional biomass is consumed outside of REMAP 25 countries

# REMAP 25 Cost Curve

## DRAFT

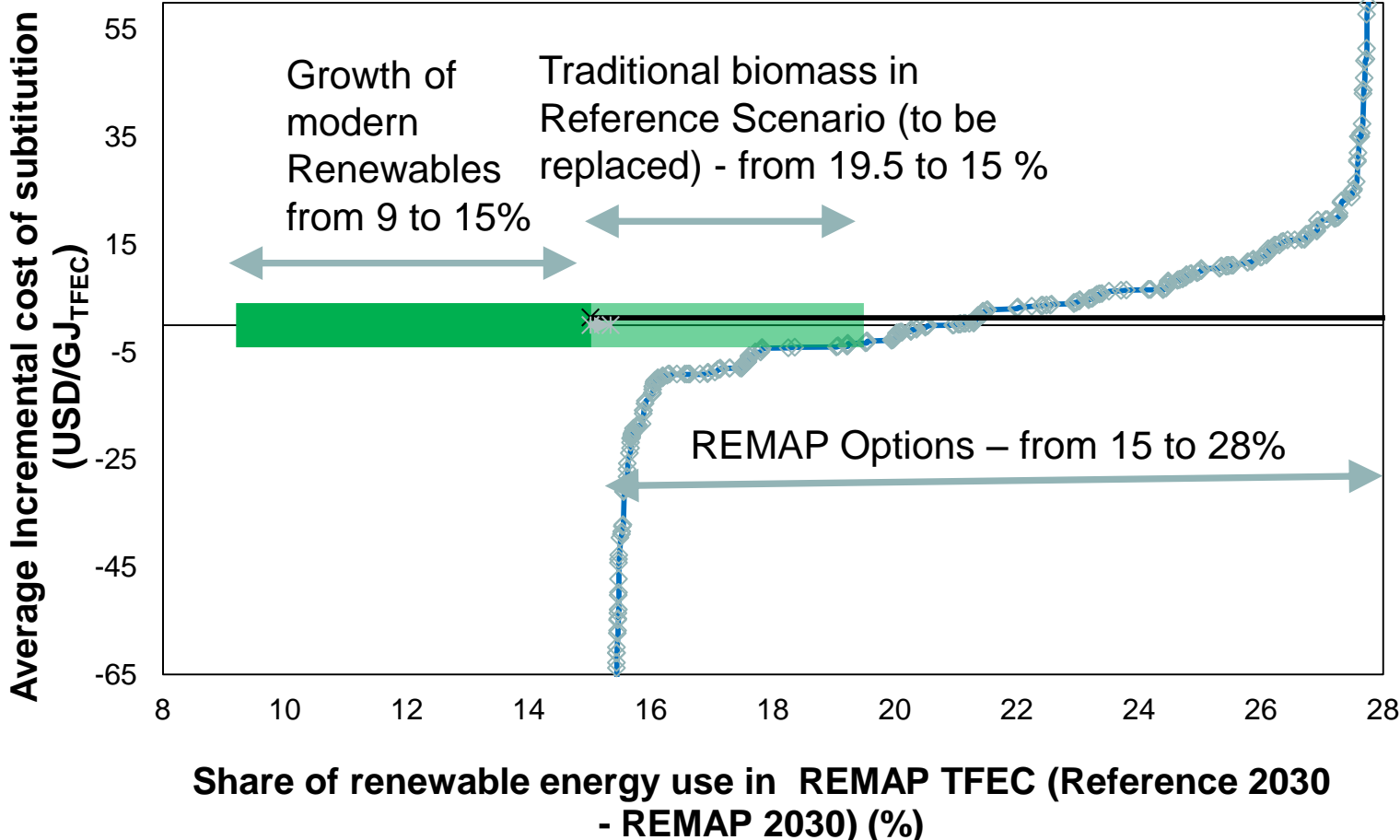
### TOTAL - REMAP 25 (N) REMAP Options

353 REMAP Options

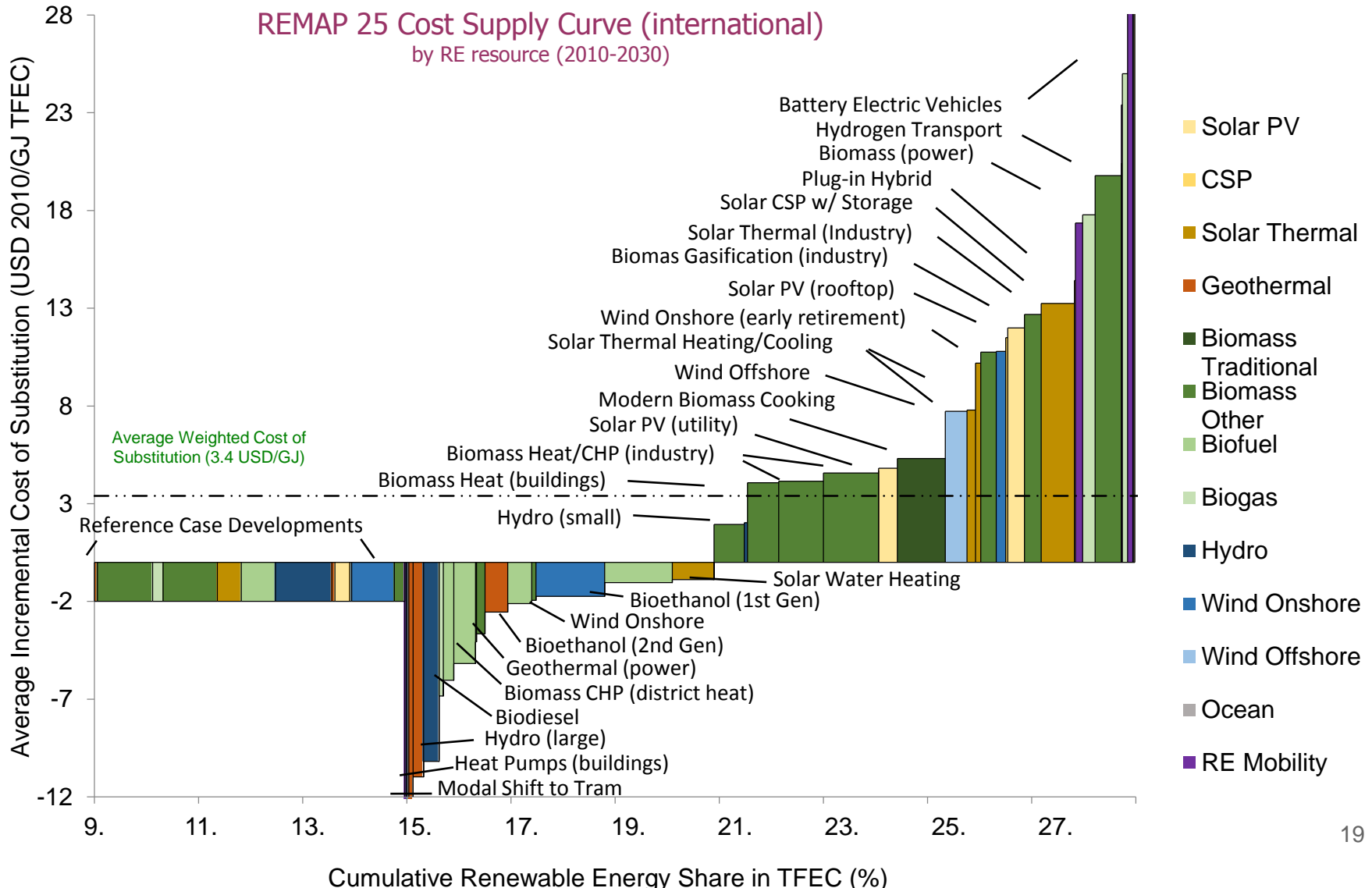
Weighted Average  
Substitution Cost=  
+1.37 USD/GJ TFEFC

Additional RE  
Consumption  
REMAP:  
41 EJ/yr

Total Annualized  
Substitution  
Cost/year  
57 Bln (USD 2010)  
( $<1\%$  of 4 trillion total  
annualized cost for  
350 options)

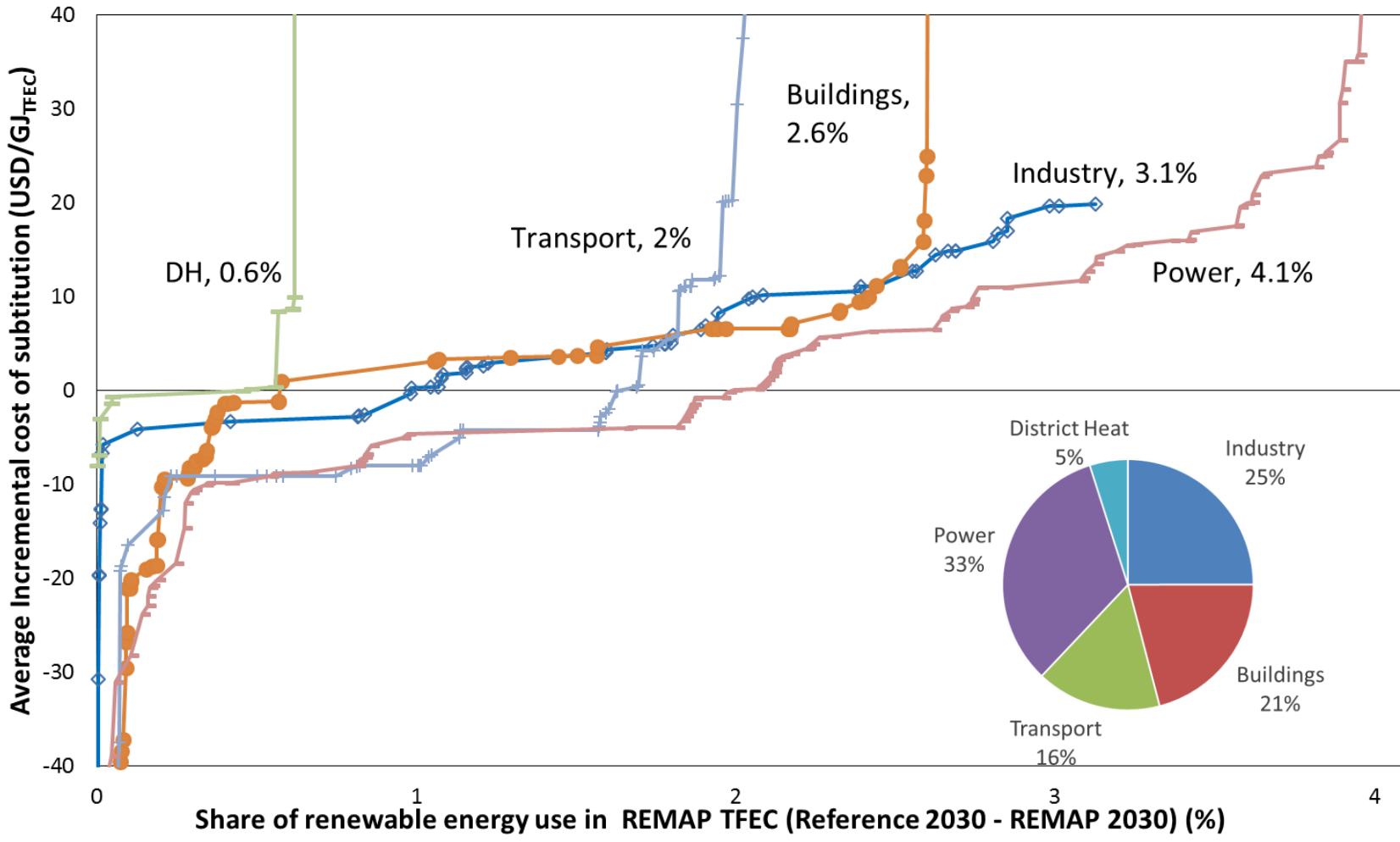


# REMAP Options Cost Curve with Tech/Resource Breakdown DRAFT



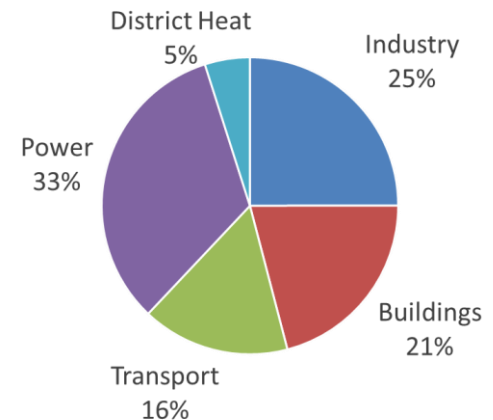
# REMAP options - sectoral Power sector represents only one third of total potential DRAFT

**TOTAL - REMAP 25 by Sector Overlay (N) REMAP Options**



# How to double the global RE share?

- Up to a third RE is possible at approximately zero cost by 2030
- However policies in place yield only 20% RE in 2030
  - RE potential is not yet fully reflected in the policy plans and scenarios
- Power sector accounts for around 40% of total potential
  - The role of end use sectors is critical to meet the doubling objective
- Sustainable biomass plays a key role, around 60% of total potential
  - Residues, energy crops, more efficient use of resources
- Electrification can increase RE deployment
  - For example electric vehicles
- Technology innovation can push the envelope
  - More affordable technology
  - Increase of the RE potential  
(offshore wind, advanced biofuels, grid integration technology, etc)



# 3 RE TECHNOLOGY INNOVATION

# Innovation matches new energy market needs with technological solutions

## *Most innovation is gradual, not disruptive*

### Bio-refineries



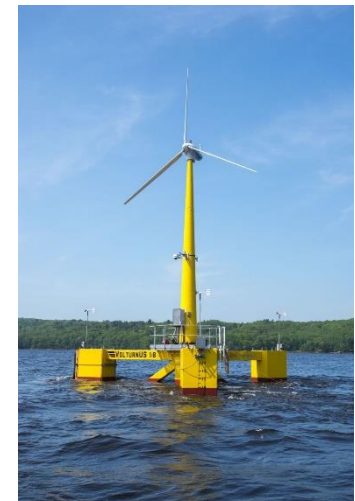
### Wave Energy Technology



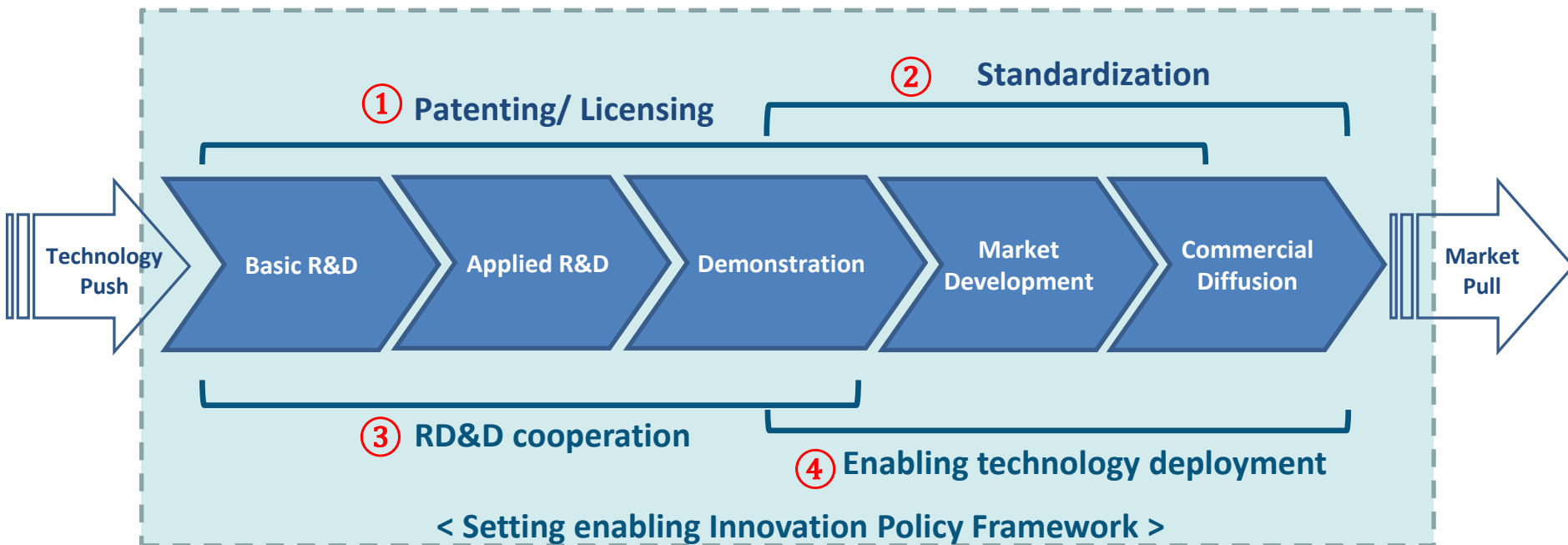
### Floating Turbines

### Fully Integrated Residential Solar Technologies

<http://images.nrel.gov/>

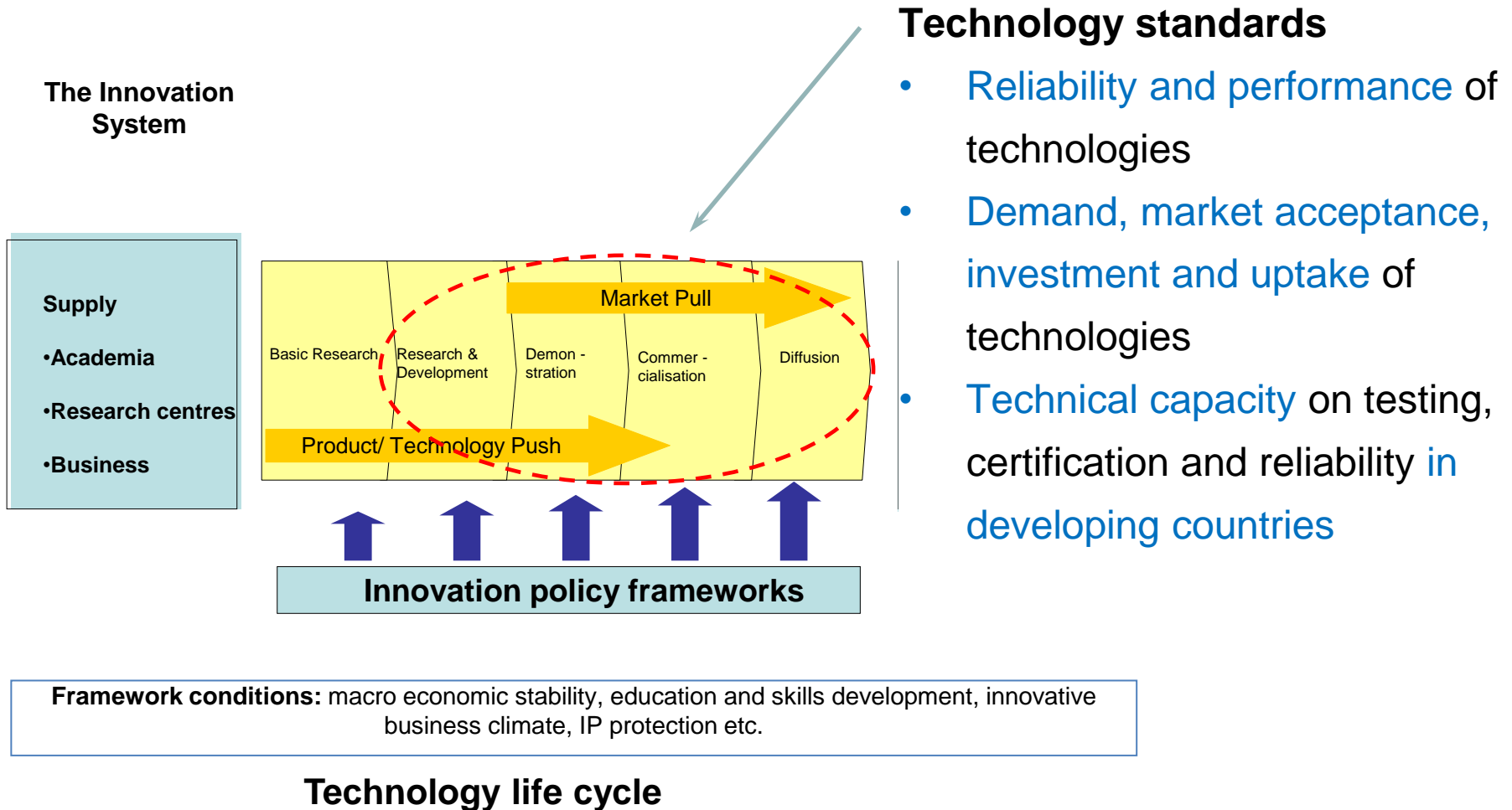


# Innovation supports whole technology life cycle



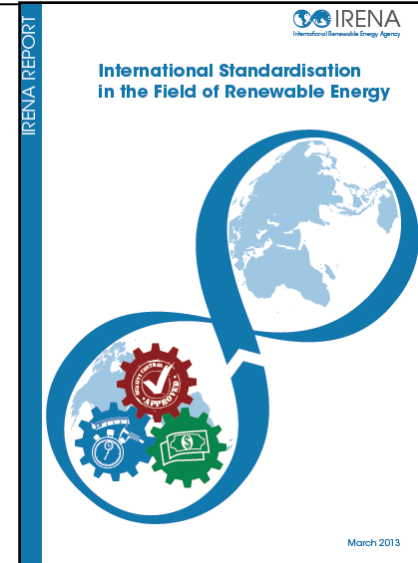


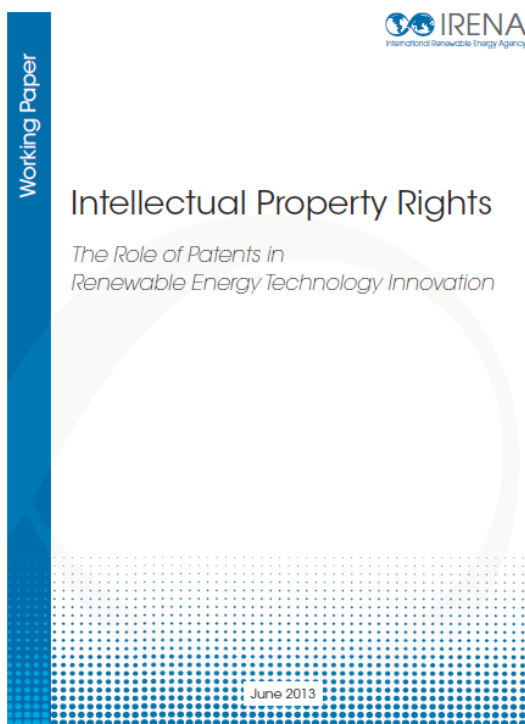
# Standardization across the technology life cycle



# Standardization – Benefits for countries

- 714 international standards were identified
- These are not widely known or deployed
- International standards are lacking in some areas
- Standards can
  - Provide a detailed technical basis for laws and regulations
  - Support public and private tendering processes
  - Provide insights regarding latest technology developments and best practices
  - Support technology markets based on sound quality and health & safety (H&S) requirements
  - Also energy management standards eg ISO 50 001

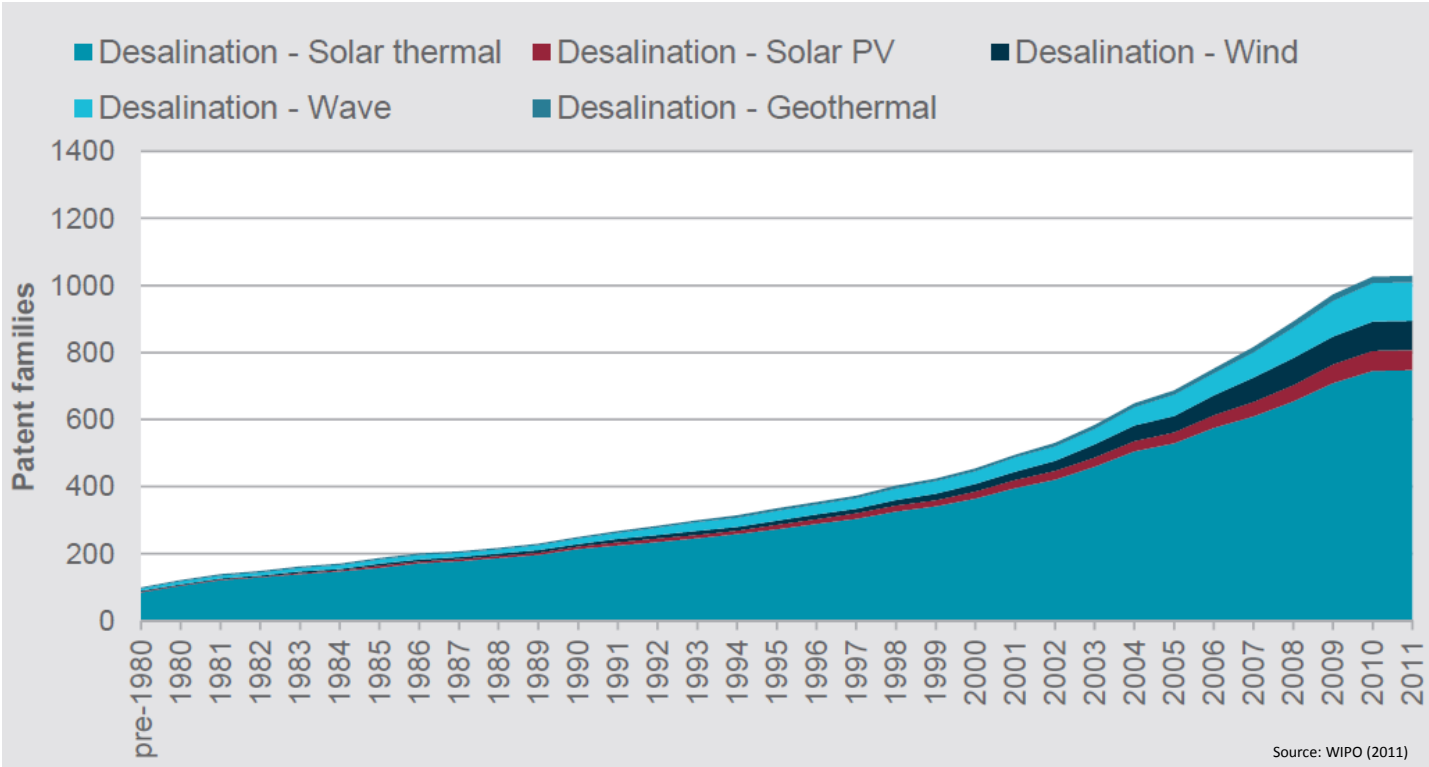




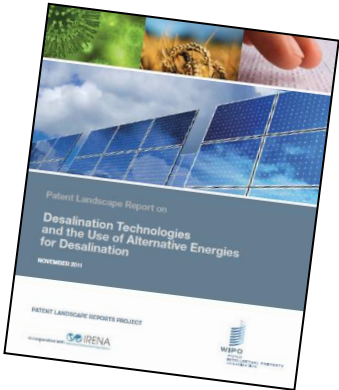
## IRENA's Working Paper

- The role of patents in RET innovation still needs to be better understood.
  - Different views – Incentivize / Restrain
- Patents seen as an engine for innovation in R&D intensive sectors. Further analysis is still required for RET sector.
- Patenting in most renewable energy areas has increased more than five-fold in the last two decades – more than 200 000 patents in place
- Few renewable energy patents have been filed outside OECD countries and China

# Patents can provide additional information on innovation trends



Cumulative patent families in desalination and renewable energy



# Key remarks on RE Patents

Ranking (overall desalination)	Assignee	Overall	Solar thermal	Solar PV	Wind	Wave	Geo-thermal
1	mitsubishi heavy industries ltd	119	8				
2	hitachi ltd	118	10	1			
3	japan organo co ltd	99					
4	kurita water ind ltd	87					
5	ebara corp	75	6				
6	toshiba corp	49	6				
7	toray industries inc	42					
8	hitachi zosen corp	37	7			1	
9	chen ming	33	2				
10	ishikawajima harima heavy ind co ltd	31					

Source: WIPO (2011)

## RET patent information can provide:

- Which countries and innovators are active
- Which countries are potential markets
- Trends of technology developments
- International research and co-operation as indicated by co-invention

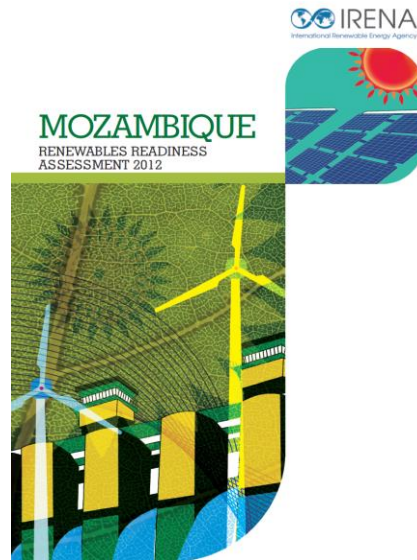
Governments, through their patent offices, must be stewards of patent quality

# THANK YOU !

## WWW.IRENA.ORG



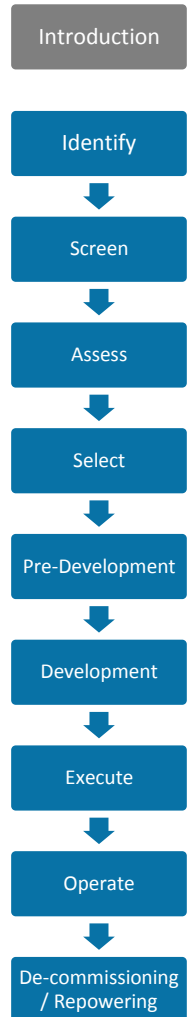
Technology Briefs



RRA



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Project navigator