IEA Technology Roadmap: Delivery sustainable bioenergy

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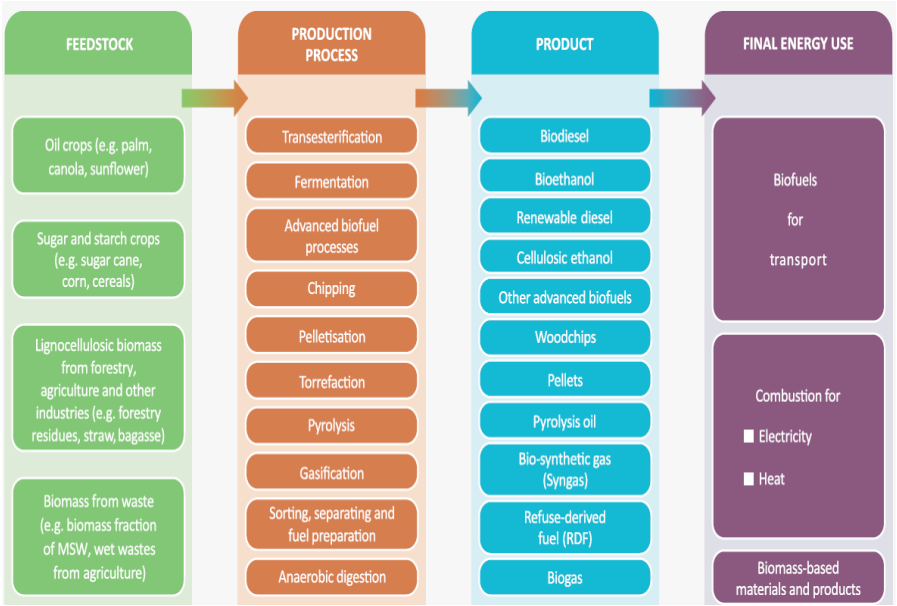
IEA

Sustainable bioenergy

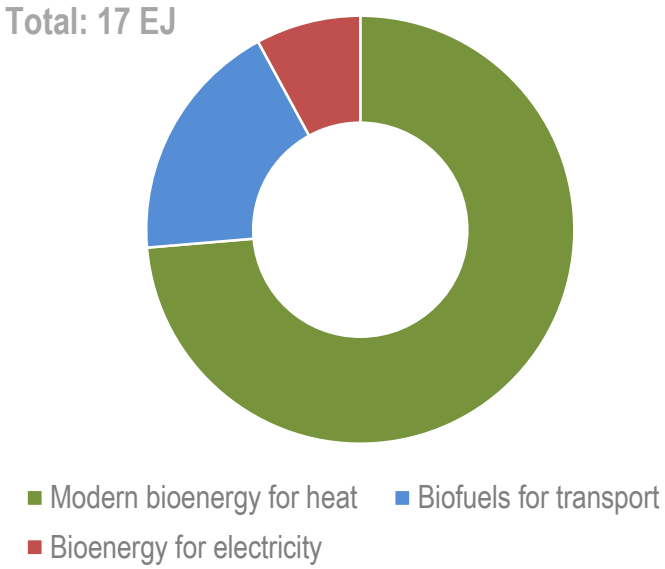
- Bioenergy can be a **major part of a low carbon energy system**, providing low-carbon transport fuels, electricity, and heat as part of a growing bioeconomy.
- To play these roles bioenergy must be deployed **sustainably**.
- But bioenergy is complex and sometimes controversial. **General statements and oversimplification are unhelpful**.
- There is growing consensus on what constitutes sustainable best practice.

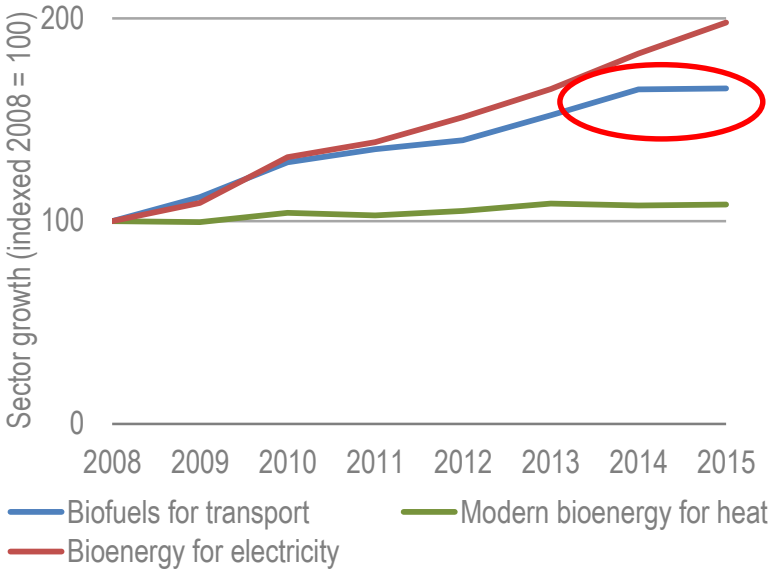


Bioenergy now needs a new impetus based on up to date evidence and experience

Bioenergy is already a significant global energy source

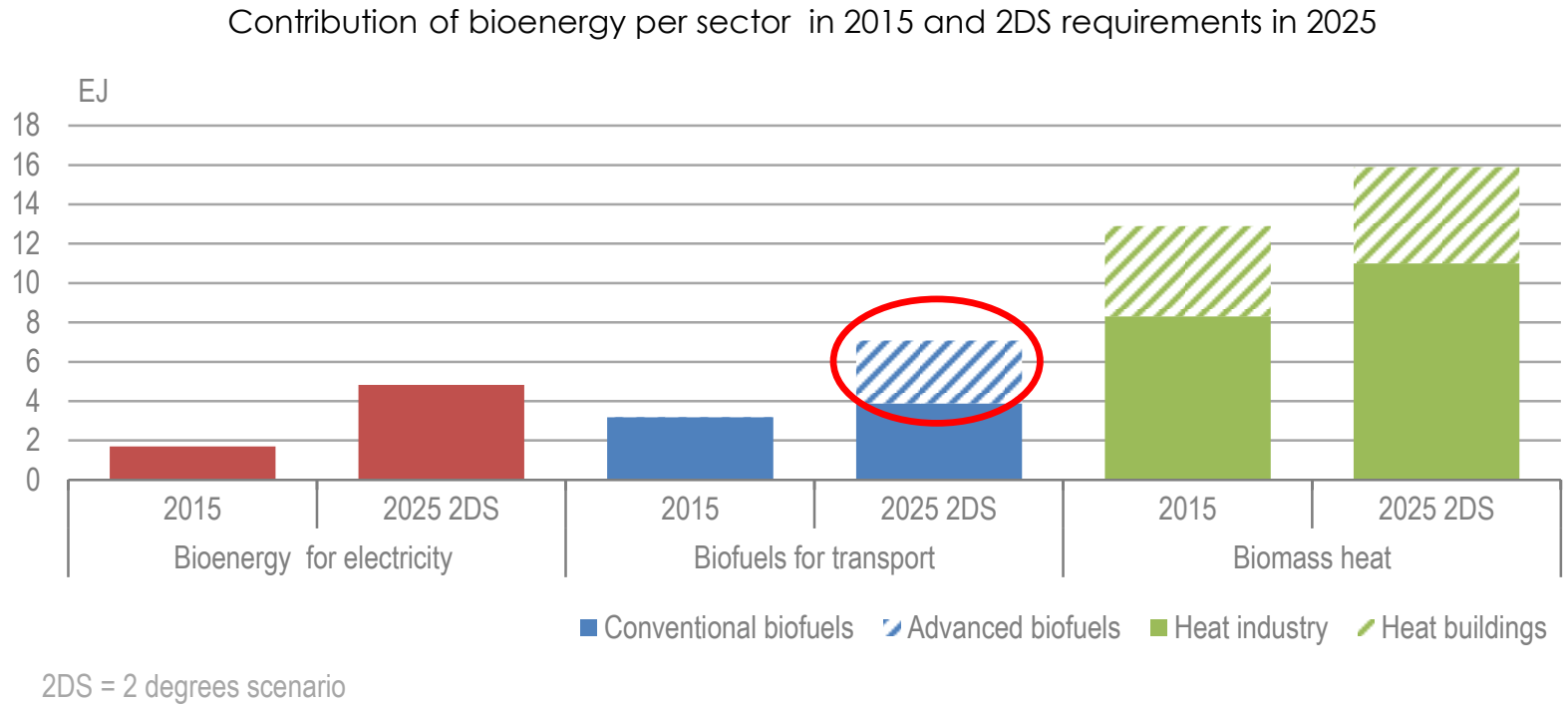
Modern bioenergy in final energy consumption 2015 (left) and growth by sector 2008-15 (right)





Modern bioenergy accounted for around half of renewables in final energy consumption in 2015, a contribution five times greater than wind and solar PV combined. However, growth rates vary by sector.

Accelerated bioenergy deployment needed to keep apace with the 2DS

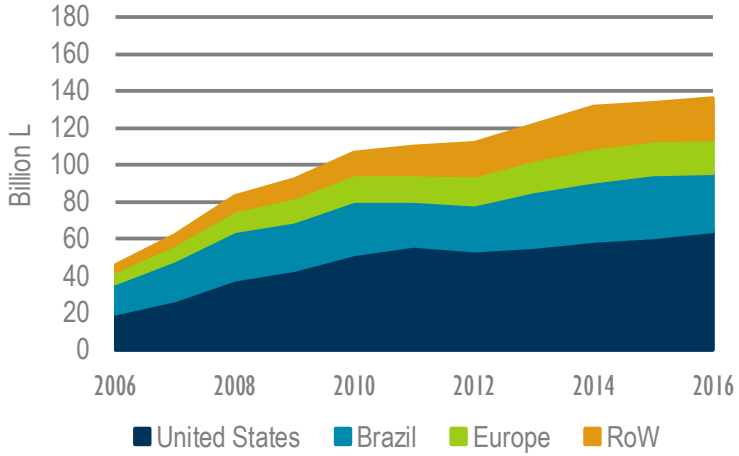


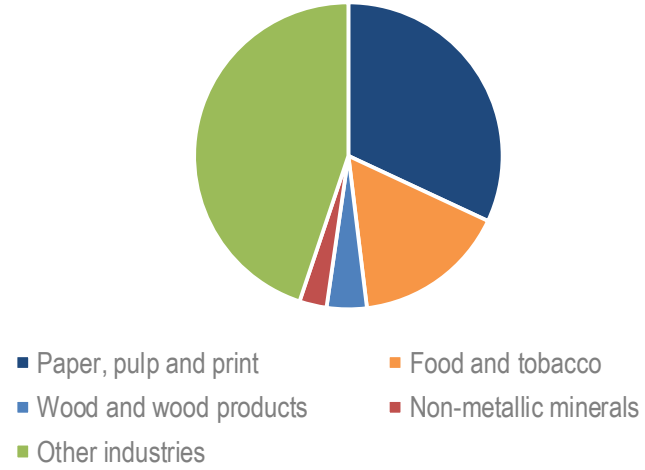
2DS = 2 degrees scenario

There is a disconnect between current market growth in all three sectors and the rate of deployment needed to deliver the roadmap vision.

Expansion of bioenergy into new countries and sectors also needed

Global biofuels production 2006-16 (left) and bioenergy within industrial final energy consumption 2015 (right)

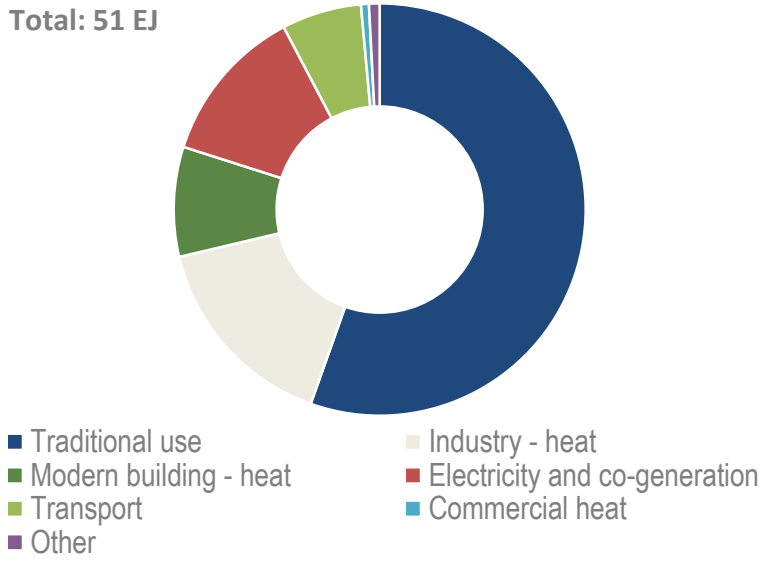


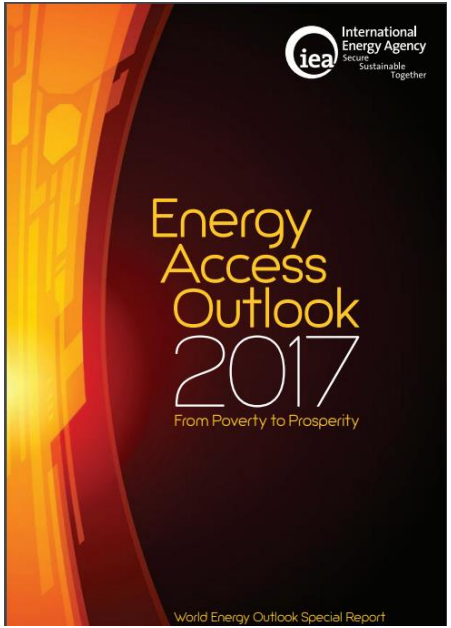


To deliver the roadmap vision bioenergy deployment will need to expand geographically, be utilised in a wider array of industries and move beyond use in road to aviation and marine transport.

The focus of the technology roadmap is modern bioenergy solutions

Consumption of biomass and waste by end use (2015)





It should not be forgotten however that currently over half of biomass and waste resources are still used in a traditional manner for cooking and heating, resulting in health, societal and environmental impacts.

A range of mature bioenergy solutions can scale up immediately

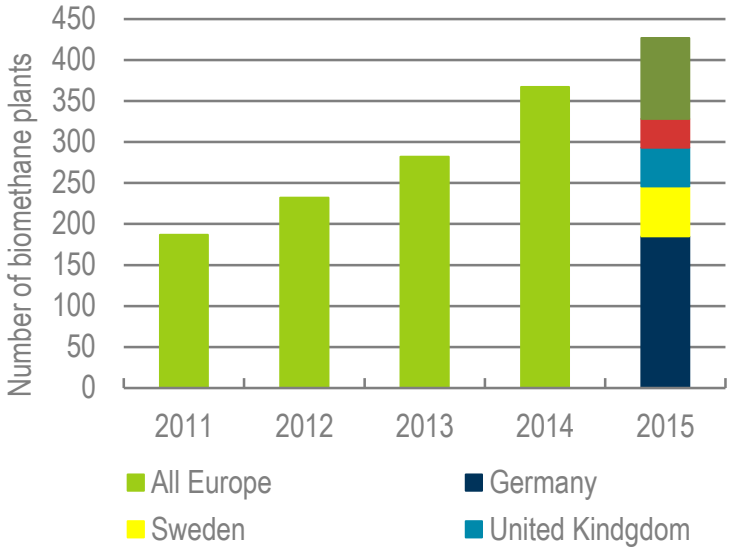
Bioenergy solutions suitable for immediate scale-up

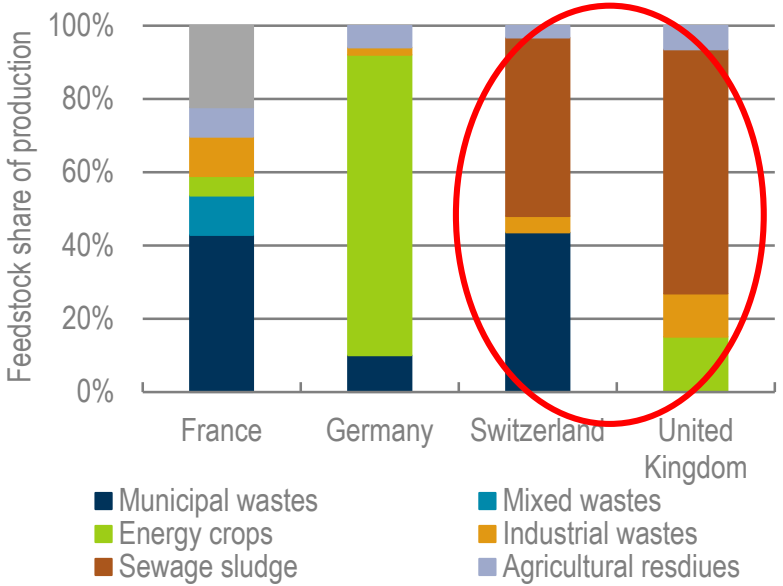
- Biomethane from waste and residues for use as a transport fuel.
- HVO / HEFA from waste and residues for use in heavy-duty road freight and aviation.
- Higher ethanol blends and unblended ethanol in road transport.
- Bioenergy-based district heating networks in urban areas.
- The conversion of existing fossil fuel infrastructure for bioenergy use.
- Energy recovery from municipal waste solutions.
- Maximising the efficiency of sugar cane residue co-generation in the sugar and ethanol industry.
- Medium-scale biomass heating systems in commercial and public buildings.

Accelerating bioenergy deployment up to 2025 will depend on greater utilisation of technically mature solutions which can roll out quickly under supportive policies and market conditions.

Waste and residue biomethane consumption in the transport sector

European biomethane plants 2011-15 (left) and production by feedstock source for selected countries (right)

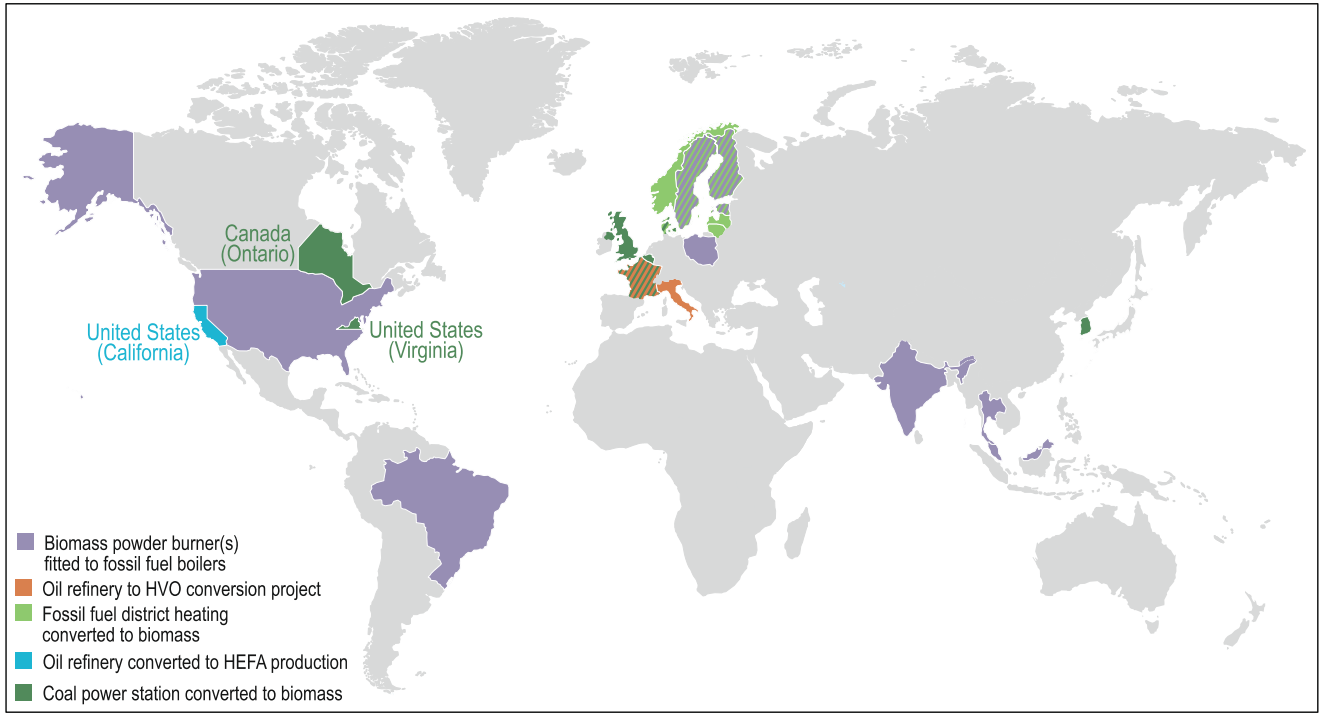




With OECD countries 1.5% of biogas produced was for transport, most notably in Germany, Norway and Sweden, while in the United States consumption grew five-fold between 2014-16.

Conversion of existing fossil fuel infrastructure to bioenergy

Global examples of fossil fuel to bioenergy conversion projects



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.

The conversion of fossil fuel assets to biomass offers reduced investment costs and quicker delivery than new build projects, as well as direct substitution of fossil fuels and potential to conserve jobs in stranded assets.

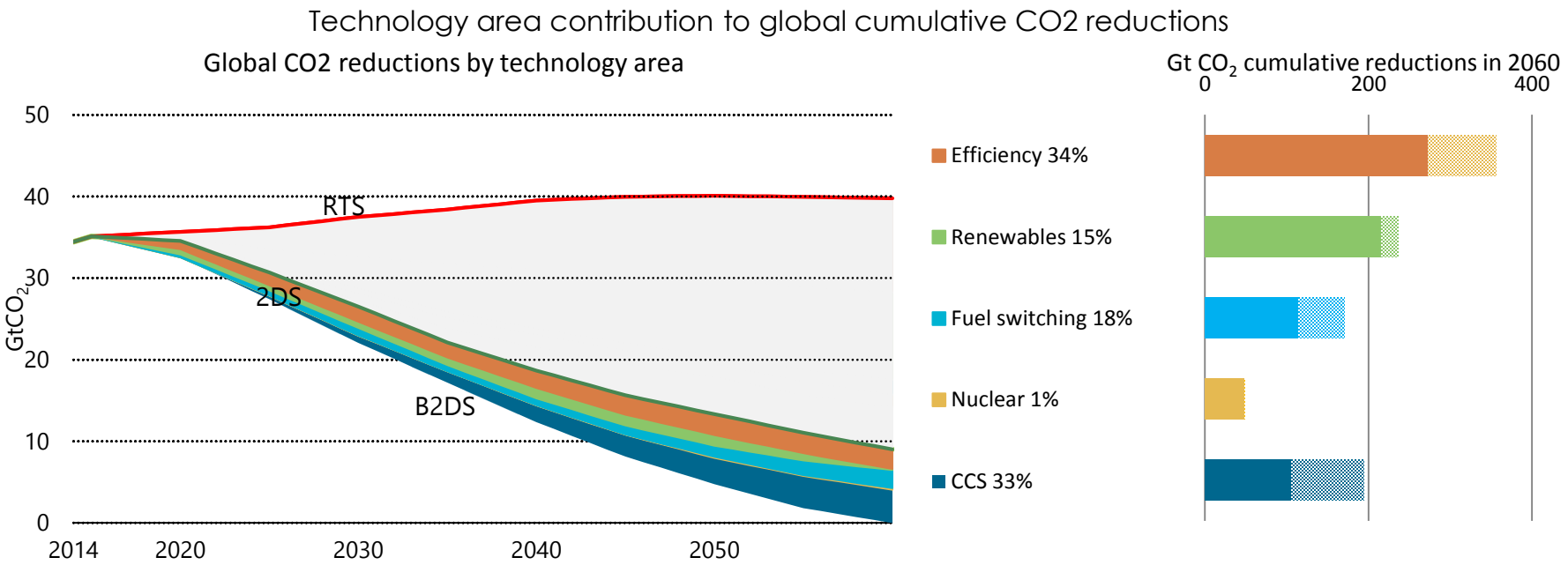
Key policies to enable a scale-up in short term opportunities

- For transport solutions life-cycle carbon intensity based policy frameworks.
- Where high levels of investment is required (e.g. greenfield refinery, sugar mill efficiency improvement or district heating) financial de-risking measures.
- Active municipal government support e.g. planning, waste management, public procurement, heat mapping.
- Robust sustainability governance arrangements to provide confidence to policy makers and the general public.

In addition, other enabling factors such as the availability of infrastructure, technical specification development and enhancing workforce skills play a key role.

The Vision

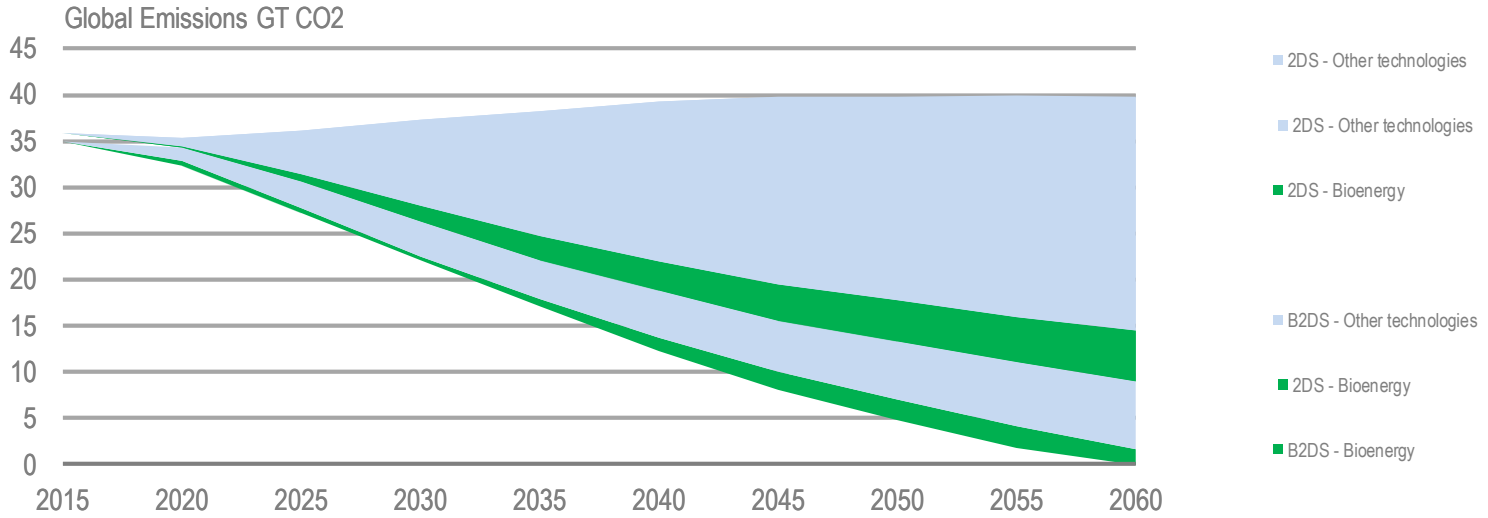
The full portfolio of technologies is needed for decarbonisation



Delivering deep carbon emission reductions will require an unprecedented effort in technology innovation and diversification worldwide

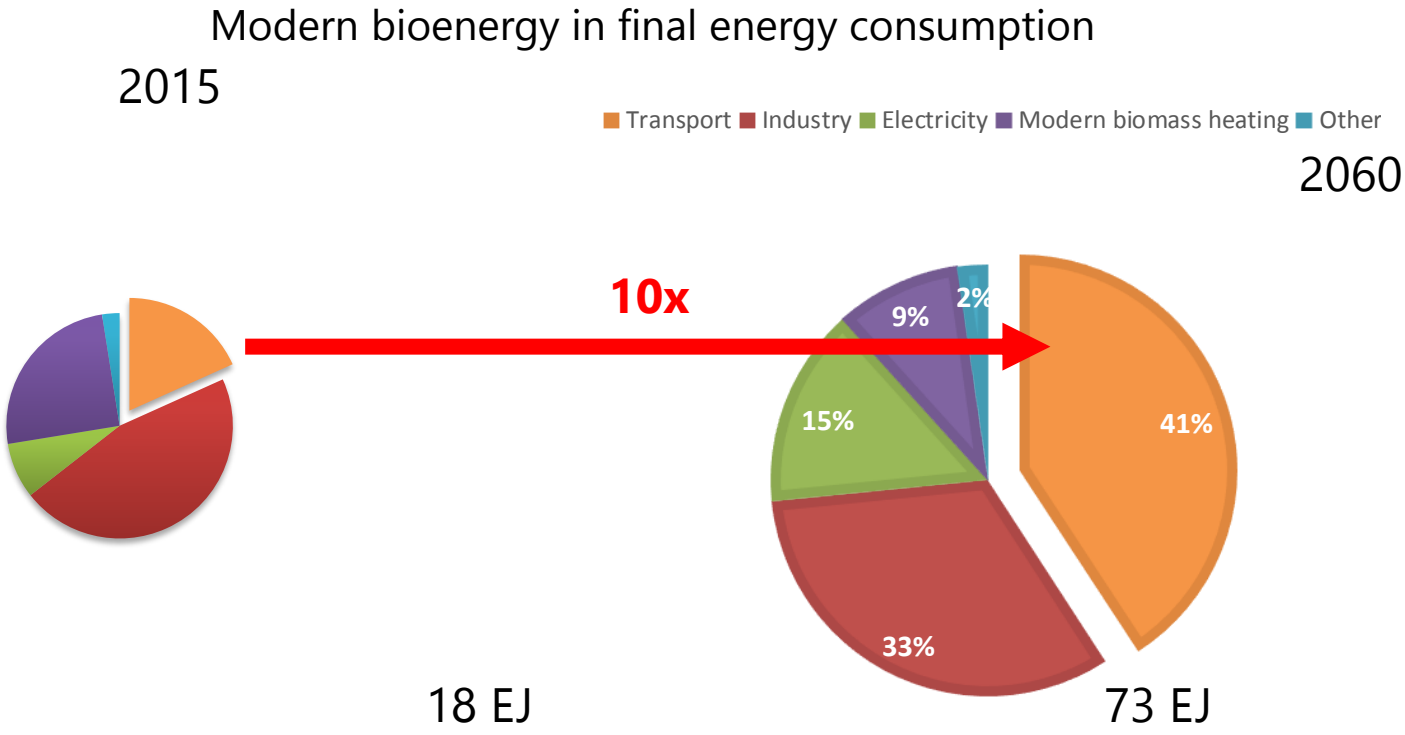
Bioenergy an essential component of IEA Low Carbon Scenarios

Role of Bioenergy



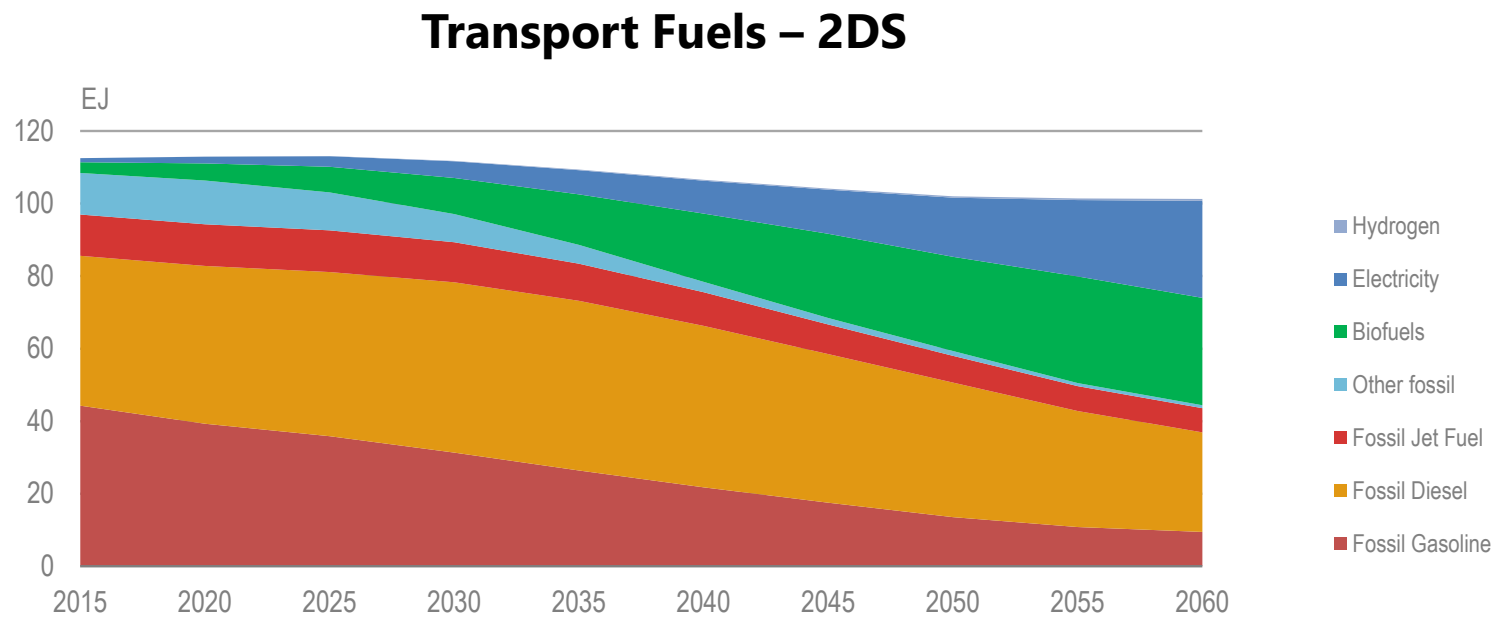
Bioenergy to provide some 17% of cumulative carbon savings to 2060 in the 2DS and around 22% of additional cumulative reductions in the B2DS, including an important contribution from BECCS

Bioenergy serves many energy uses in IEA 2DS scenario



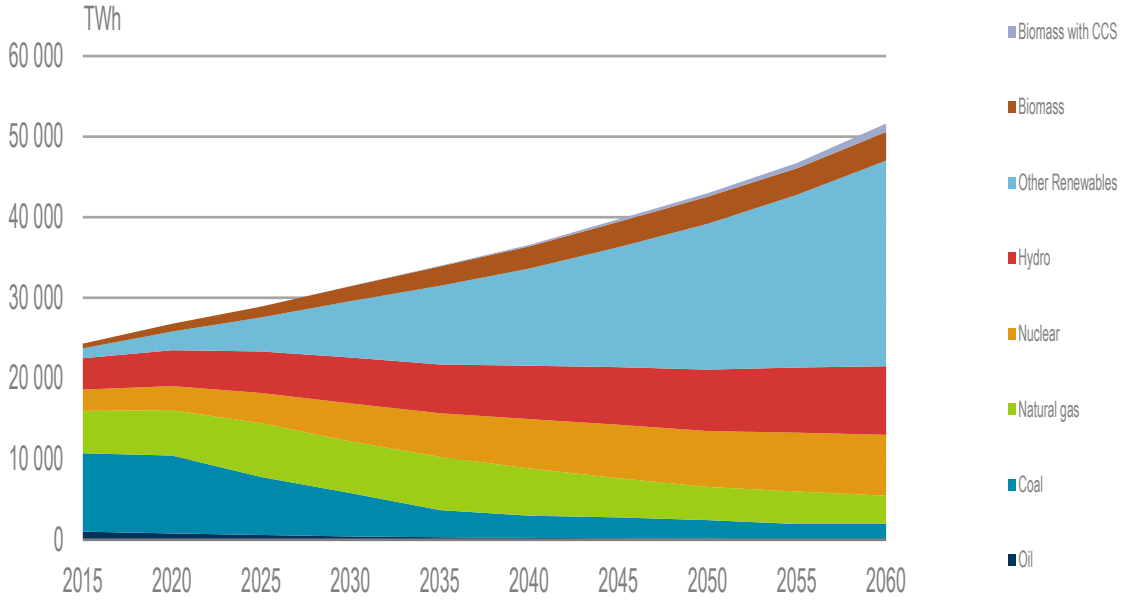
Total final energy consumption of sustainable bioenergy increases four times by 2060 in the 2DS. Use of sustainable biofuels for transport increases tenfold, with a large majority of advanced biofuels

Biofuels: an important option in a portfolio of transport solutions



While demand of transport services more than doubles , biofuels complement end-use efficiency and strong growth in electricity, providing almost 30% of transport final energy demand in 2060

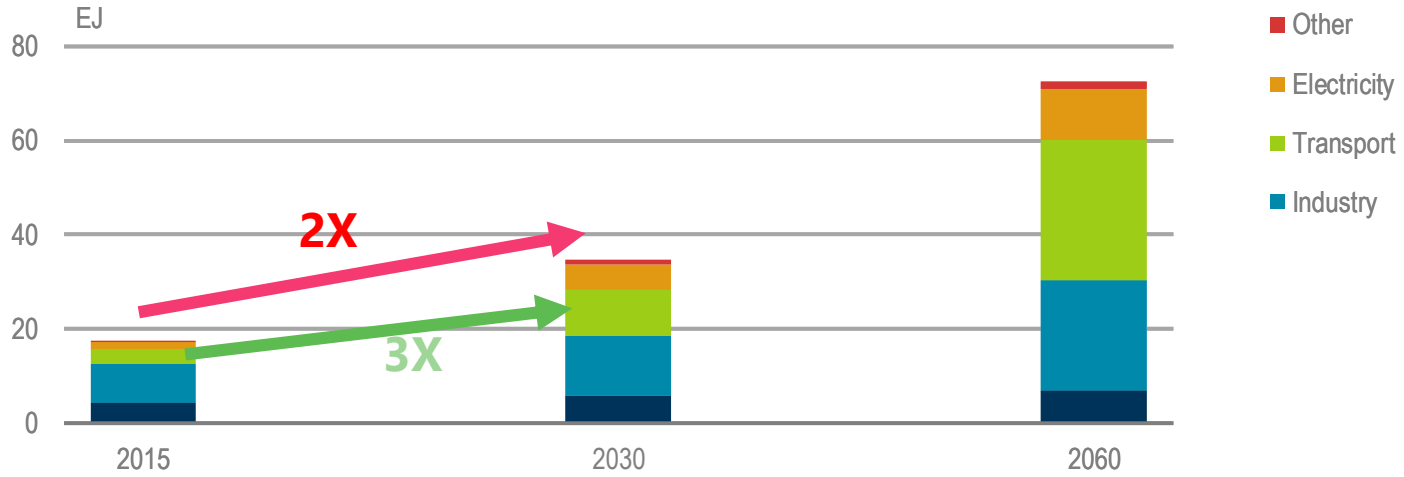
Electricity generation in 2DS



Bio-electricity grows 7X and goes from 2 to 7% of electricity generation

Strong acceleration needed between now and 2030

Modern bioenergy in final energy consumption in 2DS



Bioenergy in final energy consumption needs to double by 2030, and biofuels in transport treble. Advanced biofuels will need a massive scale up

Four key actions

1. Promote short term deployment of **mature options**

2. Stimulate the development and deployment of **new technologies**

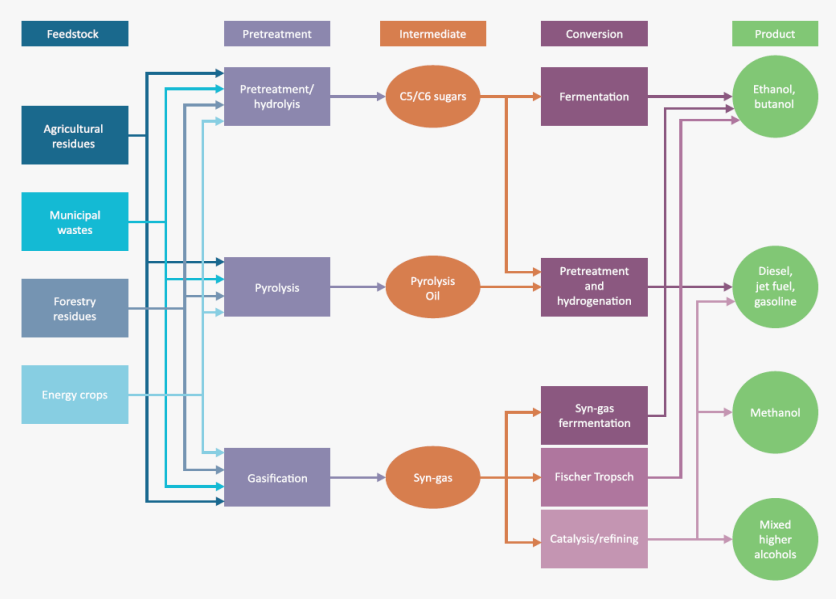
3. Deliver the necessary feedstock **sustainably**, backed by a supportive sustainability governance system

4. Develop capacity and catalyse investment via a coordinated **international collaboration** effort

Need for appropriate policy frameworks

2. Stimulate development and deployment of new technologies

Some routes to new biofuels



- **New technologies needed with good carbon performance and adapted to market roles in 2DS.**
- Continued R,D and D to reduce costs and **improve GHG performance** of existing biofuels technologies
- Demonstrate **reliable performance** from existing “novel biofuels” plants
- Develop and demonstrate routes to diesel and biojet with **improved costs, better C balances and GHG performance** (link to RE H_2 production)
- Identify potential and development paths for **cost reduction**

3. Deliver the necessary feedstock sustainably

- **Deployment will need wastes, residues, forestry and energy crops**
  - Produced in line with sustainable resource management, forestry and agricultural practice
  - Produced with minimized impacts on land use change emissions by co-production with food, use of under-productive land, improved production
  - Supported by general effort to improve agricultural productivity and efficiency

……, backed by a supportive sustainability governance system

Goals

Ensure C savings
Avoid other significant negative sustainability impacts

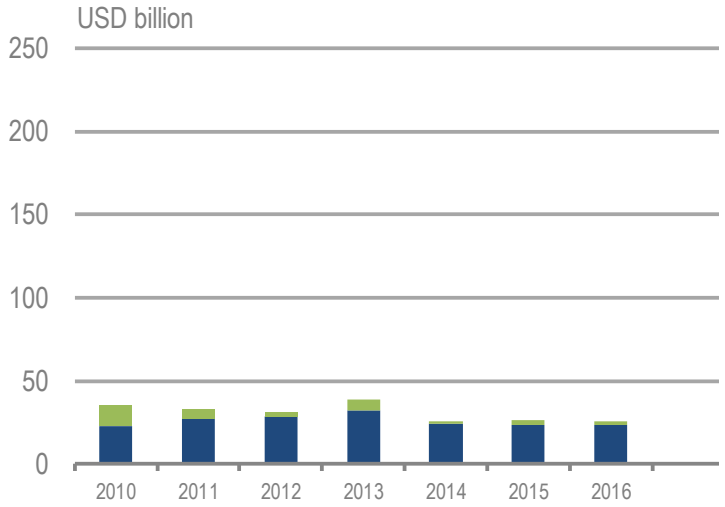
Promote best practice and provide stable regulatory regime

Encourage best practice and stimulate innovation

Principles

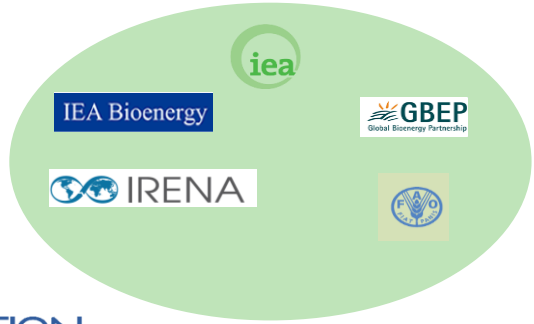
- GHG performance based rather than feedstock or technology specific
- Builds on and integrated with wider efforts to manage sustainability of the bioeconomy
- Recognises regional and sectoral differences
  - opportunities
  - risks
  - governance
- Increasingly based on real life data and feedback into best practice and regulation

Investment needs to rise sharply



Need to catalyse finance: from $30 Billion now to $58 Billion and eventually over $200 Billion/year

4. Develop capacity via a coordinated international collaboration effort



MISSION INNOVATION
Accelerating the Clean Energy Revolution

biofuture platform
Kickstarting a global, advanced bioeconomy

Development Agencies

Funding Institutions

- Identify regional and local opportunities
- Build technical and regulatory capacity
- Build up finance pipeline

The ideal policy landscape…..

Level the playing field	Provide low risk investment climate	Catalyse and support innovation
• Balance subsidies • Price in carbon externalities • Remove other barriers to low carbon technologies	• Market access • Long term goal and clear and specific targets • Long term offtake arrangements • Clear regulatory framework	• Obligations for new products • Risk mitigation (e.g. loan guarantees) • R,D and D Support

Fair, stringent and stable sustainability regime

What next?

- Influencing
  - Strategy for IEA Bioenergy
  - Biofuture Platform
  - MI Sustainable Bioenergy Challenge

- Follow up of key deployment indicators via IEA Clean Energy Progress Report…….

- Continued cooperation/coordination of international organisations
  - Potential for cost reduction for advanced biofuels
  - Potential for bioenergy in industry (along with other renewables)
  - Role of international aid agencies and lenders in bioenergy
  - Expanded work on synergies between bioenergy and wider bioeconomy
  - Identification of policy best practice for stimulation of sustainable bioenergy including novel biofuels
  - Effective application of sustainability criteria for bioenergy, including for forestry based biomass.

Conclusions

- Sustainable bioenergy is an essential element in the portfolio of measures needed for a low carbon scenario.

- Biofuels can play a particularly important role in the transport sector, complementing energy efficiency measures and electrification, and with a special role in aviation, shipping and other long haul transport, but also grows in industry, electricity and buildings.

- Progress is much slower than necessary so we need to
  - Expand deployment of existing technologies
  - Commercialise the new technologies
  - Develop sustainable supply chains and appropriate sustainability governance systems
  - Build technical and regulatory capacity in a much wider range of countries and regions

- Putting in place suitable policy frameworks is a vital step in accelerating deployment

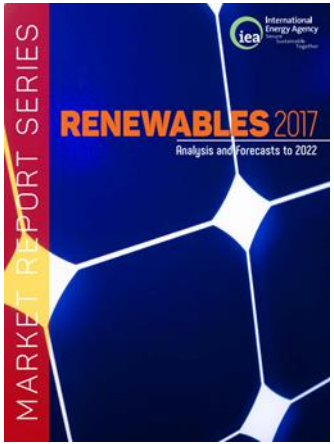
For further insights and analysis…

- Technology Roadmap - delivering sustainable bioenergy
  - Available from the following link:

www.iea.org/publications/freepublications/publication/technology-roadmap-on-bioenergy.html.

- Energy Technology Perspectives 2017
- Renewables 2017 Market Report
- How2Guide for Bioenergy
- Energy Access Outlook 2017

For more information see: www.iea.org/publications/



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