



## Medium-term bioenergy market considerations – challenges and opportunities

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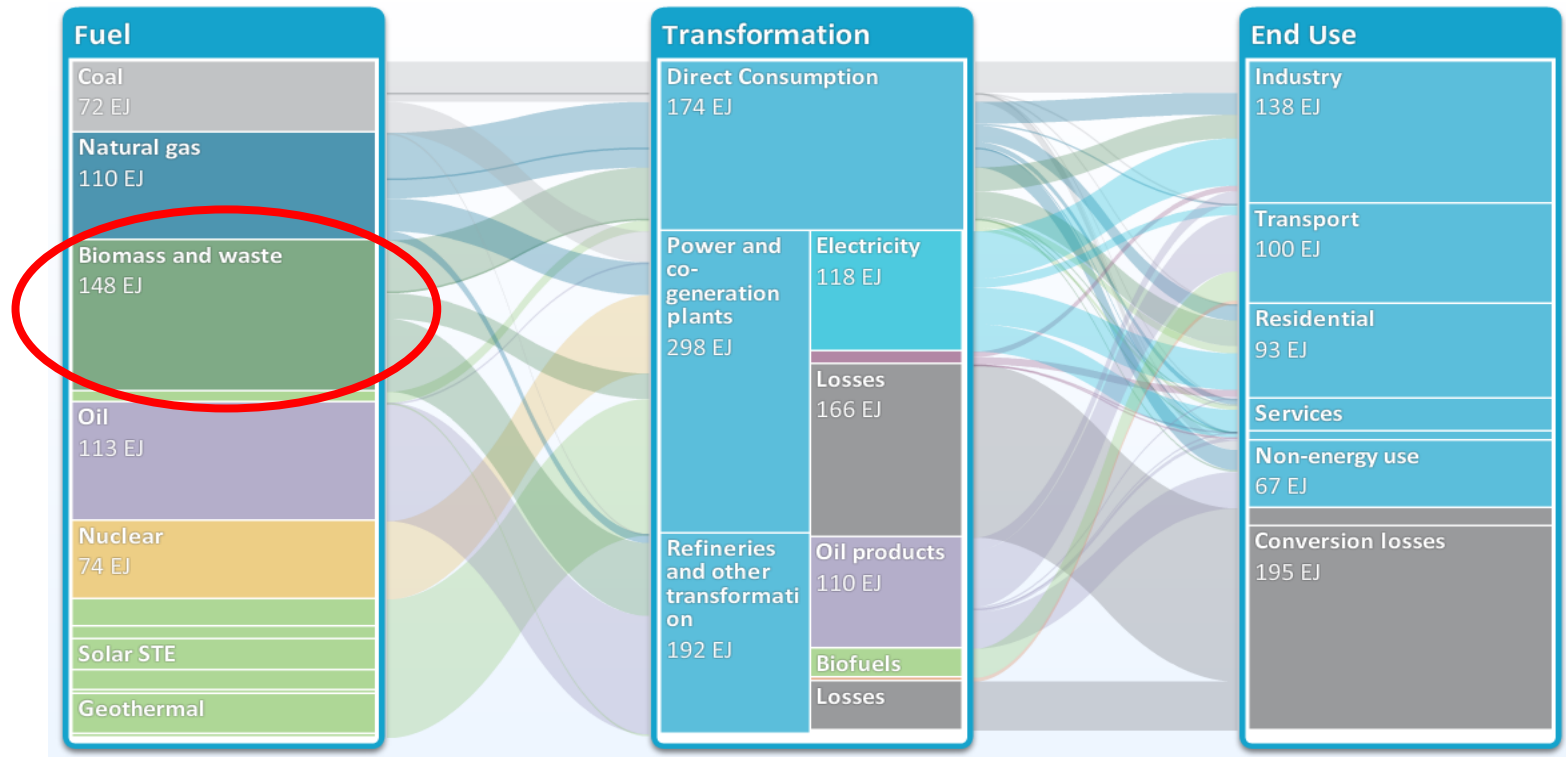


- **Bioenergy for power: capacity additions, generation and costs.**
- **Implications of higher shares of Variable Renewable Energy (VRE) for bioenergy technologies in the power sector:**
  - Deployment and costs.
  - Evaluating the case for flexible bioenergy systems.
- **Established and developing EU heat markets.**
- **Potential implications of low oil prices for residential renewable heat markets.**
- **Advanced biofuel market considerations.**
  - Forecasts, cost reduction prospects and policies.
- **Concluding remarks.**

**N.B. all slides with \* have been updated to remove information to be used in forthcoming publications.**

# Bioenergy is central to the long-term decarbonisation of the energy system

## IEA 2050 2 degree scenario (2DS) energy balance

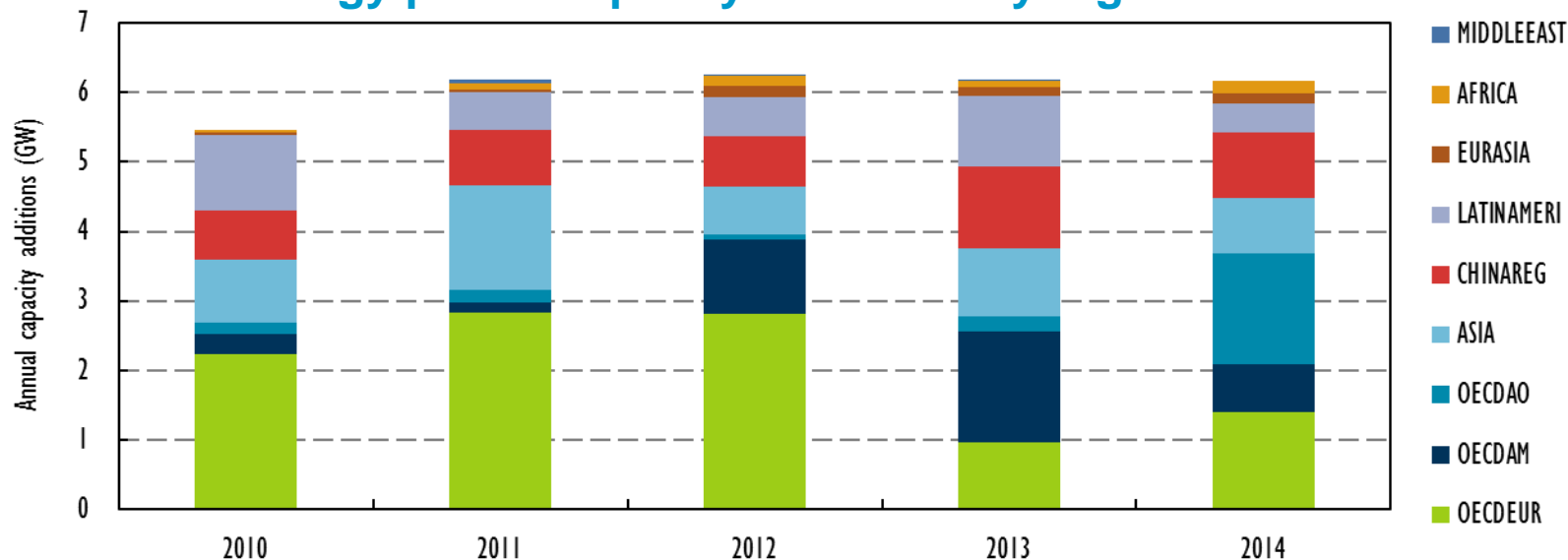


Source: IEA Energy Technology Perspectives (ETP) 2015

***Biomass and waste are key elements of the IEA's long-term decarbonisation scenarios, representing the largest primary energy source in 2050 within the 2DS.***

# Annual bioenergy capacity additions relatively stable

## Bioenergy power capacity additions by region 2010-15\*



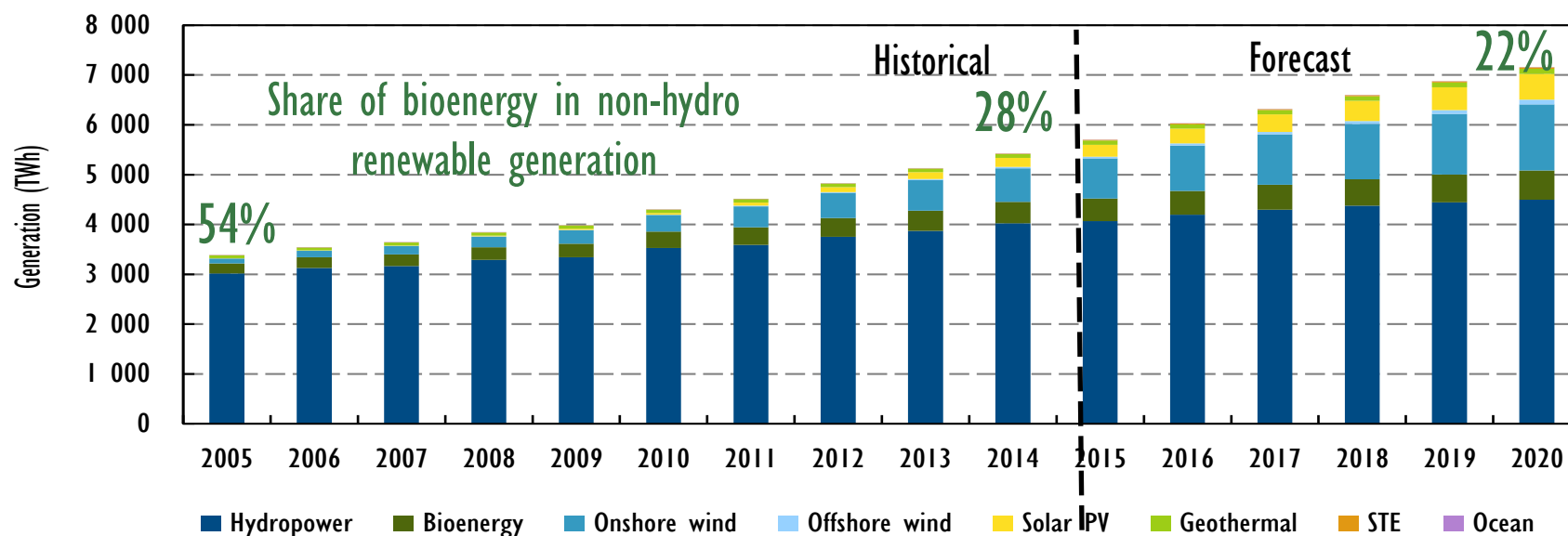
Note: 2015 data is provisional

***Agricultural residues such as straw and sugar cane bagasse make key contributions to bioenergy capacity deployment in markets such as China, Brazil and India.***

# Renewable electricity generation growing steadily



## Renewable generation by technology (2005-20)



***Non-hydro renewable electricity generation is rising, however higher capacity additions for onshore wind and PV cause bioenergy's share to reduce.***

# Bioenergy costs span over a wide range taking account of multiple factors



Global reference LCOE ranges for bioenergy technologies compared with subsidy examples

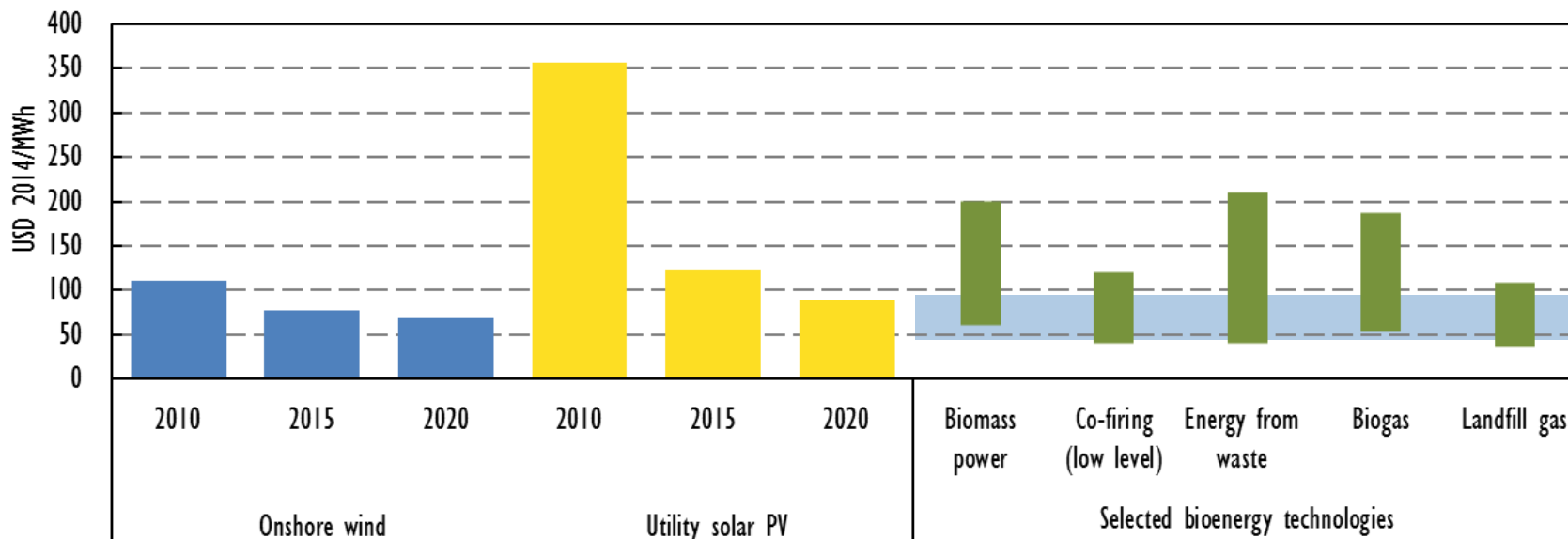
**Graph removed due to use in forthcoming publication.**

*Low fuel costs can deliver competitive LCOEs, but factors such as the level of technology sophistication, costs of capital and regulatory requirements also influence costs.*

# Downward cost trends for onshore wind and PV may influence bioenergy prospects



## Historical and forecast global weighted average generation costs for new onshore wind and utility PV plants vs. reference bioenergy LCOE ranges



***High levels of incentives are no longer necessary for onshore wind and solar PV in many markets, which may focus opportunities for biomass power generation on the most promising applications.***

# Flexible bioenergy: challenge or opportunity?

## Challenges

- Low / negative power prices at times of high VRE generation and low demand.
- Reduced full load hours (FLH) e.g. switch from base to residual load, impacting revenue streams.
- More factors to consider in assessing the economic case for operating plant.
- Additional investment may be required to increase plant flexibility.
- Competition with hydro and fossil-fuel technologies in providing flexibility.

## Opportunities

- Need for flexible & controllable plants to provide system services & follow fluctuations in residual load.
- B&W solutions to provide the above may be favoured due to decarbonisation goals & security of supply considerations.
- Strategic generation (high demand & low VRE) to access peak power prices.
- Acting as a bridging technology for renewable back-up and balancing services given high cost of electricity storage technologies and early stage development of demand side management solutions.

***High VRE power systems create opportunities for bioenergy technologies to access new revenue streams. However, they also challenge existing modes of operation and business models for many plants.***

**Note: VRE = Variable Renewable Energy**



# Flexible bioenergy: Technical modifications for greater flexibility



Technology	Means to increase flexibility
<b>Biogas (Anaerobic Digesters)</b>	<ul style="list-style-type: none"><li>• Increased storage capacity for biogas, alongside a higher capacity generator.</li><li>• A larger number of smaller capacity units to increase ramping and turn-down.</li><li>• Upgrading of biogas to bio-methane and injection to the gas grid.</li><li>• Adapted substrate feeding regimes to optimise gas storage capacity and align gas production with demand.</li></ul>
<b>Combustion of solid biomass</b>	<ul style="list-style-type: none"><li>• The turndown ratio of boilers can be used to modulate operation.</li><li>• Emissions equipment e.g. heated precipitators, can improve both part-load operations and start-ups.</li><li>• Gas igniters / liquid biofuel burners for part load operation and start-up.</li><li>• Negative control power through steam bypass to a heat sink.</li></ul>

***Many bioenergy technologies have the potential to increase flexibility, either through technical modifications at the design stage or via investment in adaptations to existing plants.***

# Flexible bioenergy: economic considerations



Example LCOE values for bioenergy technologies at 70% and 35% load factors

**Graph removed due to use in forthcoming publication.**

*Opportunities to provide baseload power will still exist in many markets, but the ability to economically contribute to residual loads will influence bioenergy market prospects in countries with high VRE shares.*

# Significant variation between established and developing renewable heat markets in the EU



## Renewable heating and cooling shares 2014 and % increase 2010-14

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Source: European Commission

*Nordic and Baltic countries with high shares of renewable heating offer valuable lessons to those EU countries under pressure to achieve 2020 targets, who are now boosting markets with policy measures.*

# Infrastructure and technology factors are key considerations in increasing renewable heat uptake



**Table removed due to use in forthcoming publication.**

*Greater utilisation of district heating and cogeneration are key means of increasing bioenergy's contribution in the heating sector for countries seeking to increase renewable heat deployment.*

# How is consumer decision making impacted by current lower heating oil prices?



Residential heating oil price compared with biomass and heating oil system installations in Germany (2011-15, indexed)

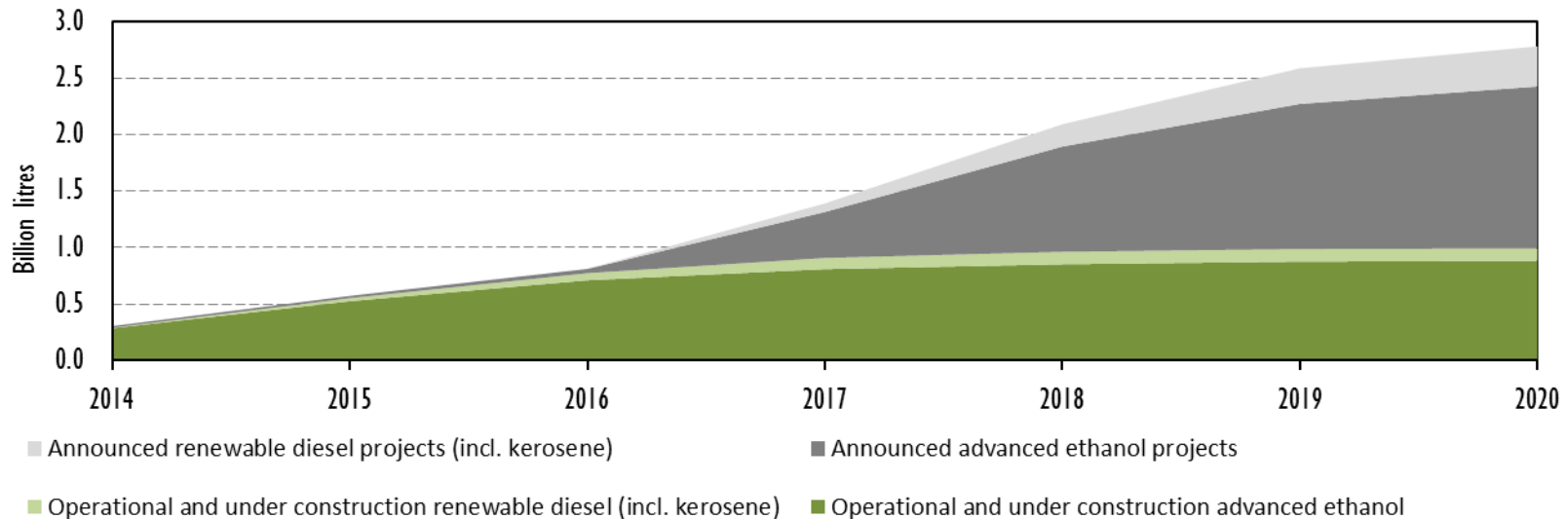
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*Lower heating oil costs appear to stimulate oil system installations, but the long-term price stability of pellets needs to be given due consideration.*

# A crucial time for advanced biofuels as production could scale-up



## Global advanced biofuels forecast 2015-20<sup>\*</sup>



***Scaling-up production can be achieved by “de-bottlenecking” to deliver the rated capacity of current plants, and a suitable investment climate to deliver the visible project pipeline.***

# ...but accelerated growth is required to meet climate change objectives



Global biofuels production and medium-term forecast compared with current IEA 2DS scenario requirements

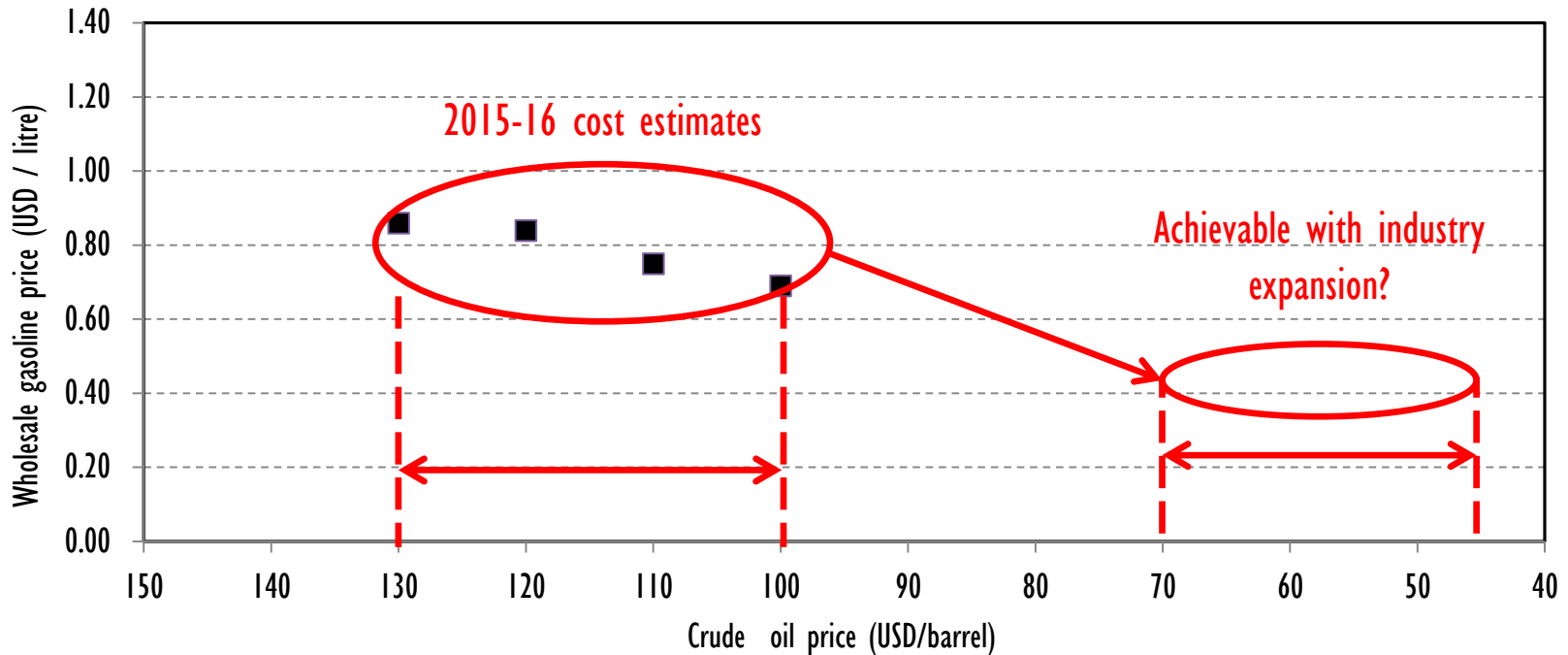
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*A significant advanced biofuels contribution, alongside improved fuel economy and EV roll-out, is central to decarbonisation of the transport sector.*

# Achieving cost-reduction potential essential to underpin industry expansion



## Cellulosic ethanol breakeven crude oil price for competitiveness with gasoline



Note: Equivalent wholesale gasoline prices are based on a USD 10/barrel margin on crude oil price, adjusted for energy content.

***Current production cost estimates suggest breakeven with gasoline at USD 100-130/barrel crude oil prices, but realising significant scope for cost reduction could change this picture.***



# Given current oil prices advanced biofuels policy support necessary to scale-up



Comparison of global conventional biofuels production and oil prices  
2007-20 (indexed)

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*Considering the current investment climate and early stage of the advanced biofuels industry, stable and long-term policies are needed to facilitate expansion.*

# Concluding remarks



- Bioenergy has a valuable role to play in the long-term transformation of the energy system.
- Annual bioenergy power capacity additions are steady but it's share of renewable generation is reducing.
- Downward onshore wind and PV cost trends may influence bioenergy project deployment, but create opportunities for flexible plants.
- However these opportunities depend of both technical and economic considerations.
- There's a wide variation in EU heat markets, and countries with high renewable shares in heating provide valuable success factor examples.
- Low oil prices appear create additional competition for bioenergy heating solutions, but the stability of pellet prices is a key asset.
- Additional policy support and industry cost reductions could provide the impetus to scale-up advanced biofuels production.

For further insights and analysis...



# RENEWABLE ENERGY

## Medium-Term Market Report 2015



Market Analysis and Forecasts to 2020

- The *Medium-Term Renewable Energy Market Report 2015* can be purchased online at:

[www.iea.org](http://www.iea.org)

- Thank you for your attention!