REmap
A Renewable Energy Roadmap

IRENA
International Renewable Energy Agency

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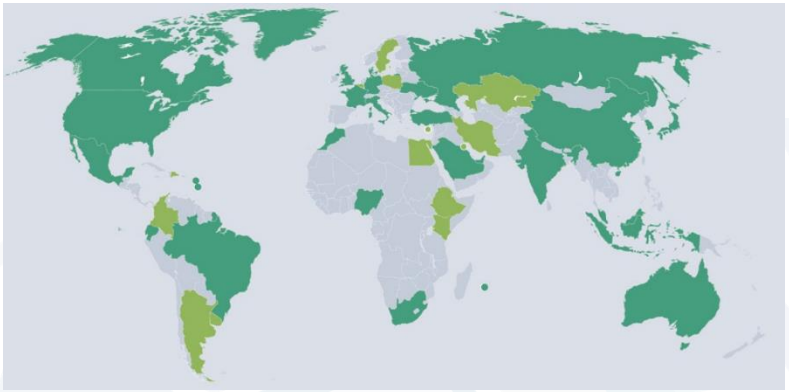
ROADMAP FOR A RENEWABLE ENERGY FUTURE

10 June 2016, Asian Clean Energy Forum - Transport

IRENA's REmap Programme



- IRENA's REmap programme explores **potential, cost and benefits** of accelerating the growth of renewables in global energy mix, key to realize **SDG 7: Affordable and clean energy**
- **Technology Options** in power, district heat, end-uses (industry, **transport**, buildings)
- Unique in that is developed **together with and validated by country experts from 40 countries, representing 80% of global energy demand**

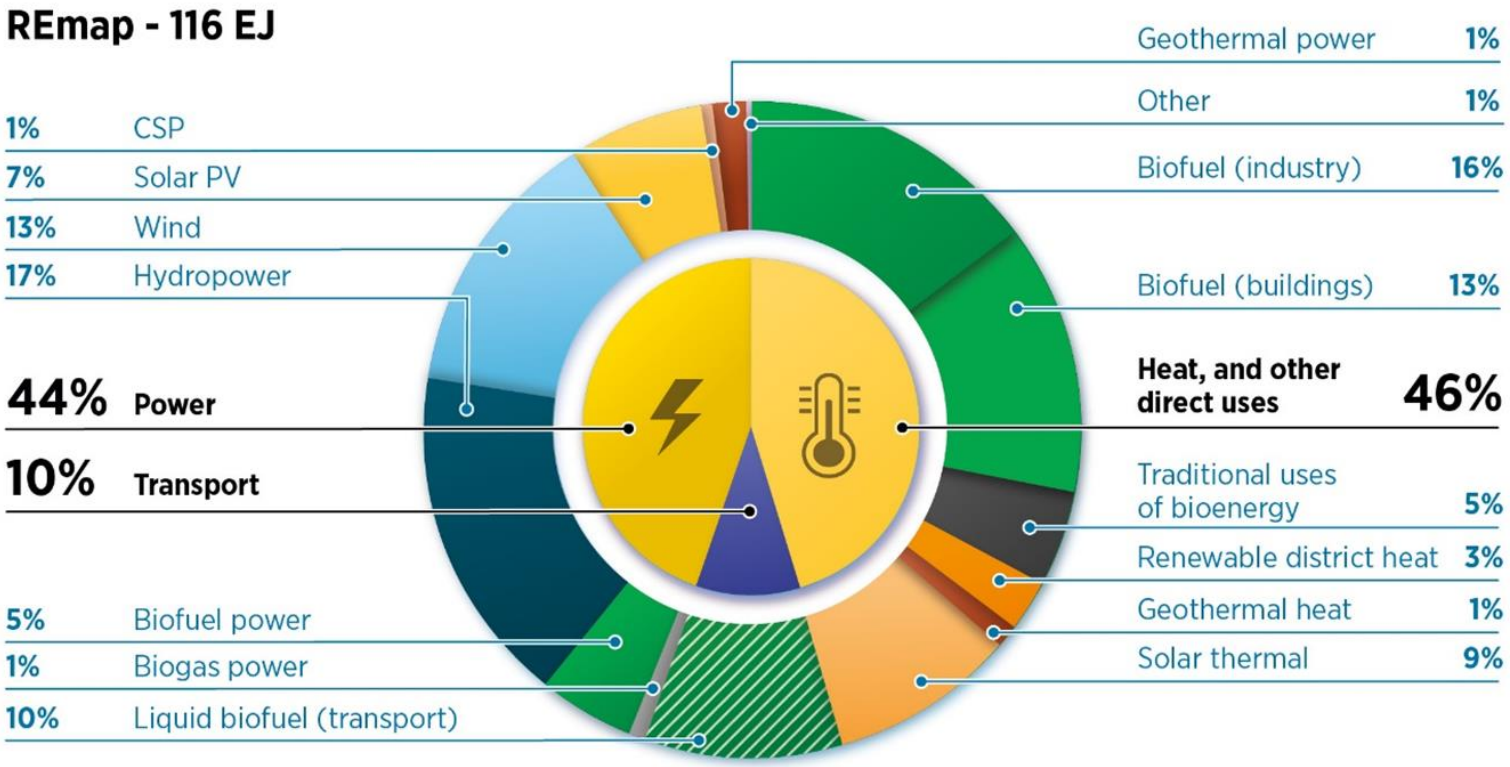
REmap Transport Action Team

- Identifying potential of renewables in transport sector and translating into action on a country level
- Leveraging REmap analytical framework and network of around 200 participants from industry, government, academia and research, NGO

→ **Working paper forthcoming this summer**

More available at: www.irena.org/remap

Expanding renewables in all sectors



- Fuels and other direct uses of renewables account for 60% of modern renewable energy use in REmap
- Transport share of renewable energy use increases from 4% to 10%, in physical terms this is a 400% increase due to demand growth

Significant growth potential in all countries

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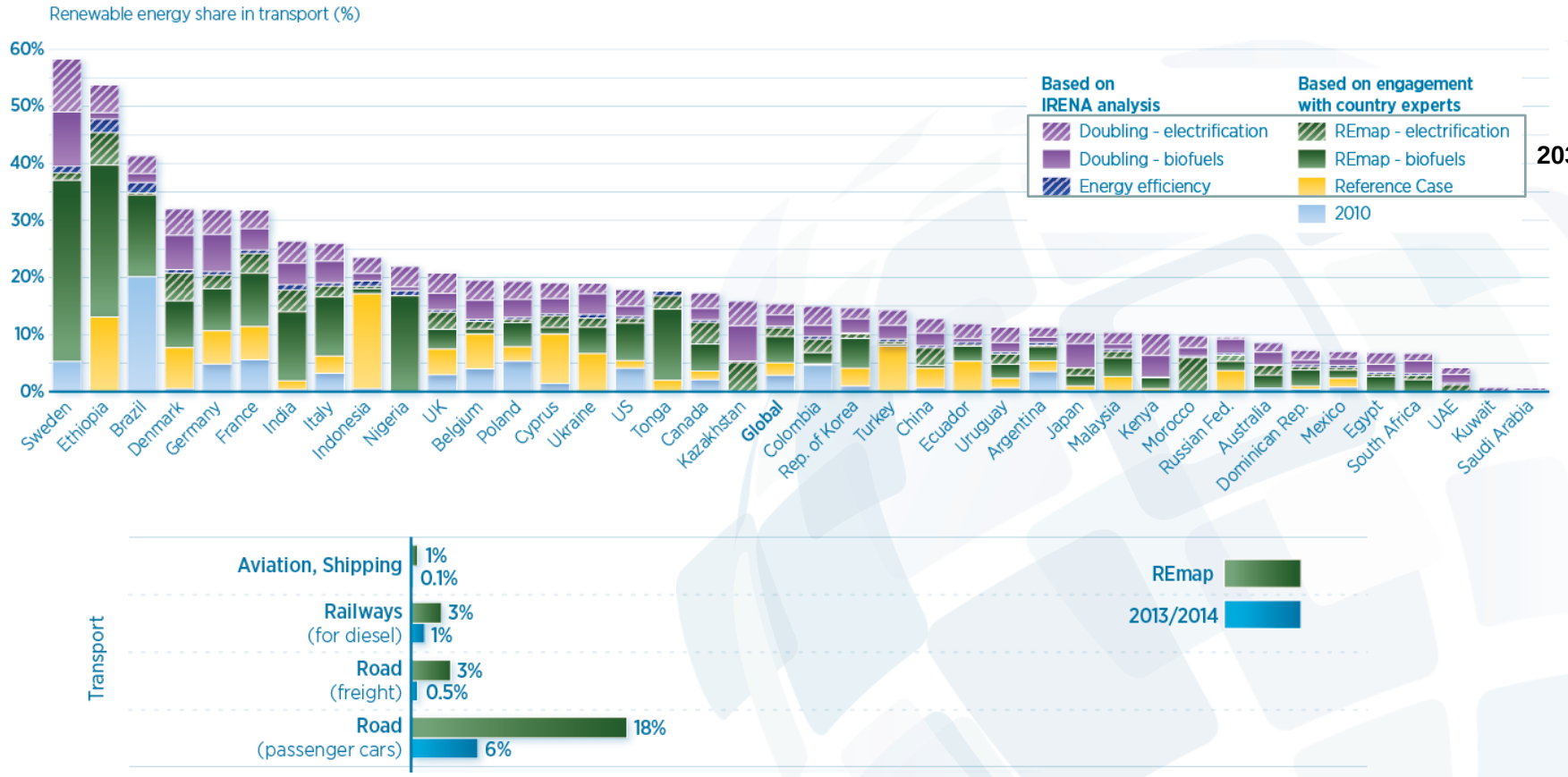

- More than half of all REmap countries can raise the renewable energy share in transport to above 10%, but shares will vary by mode

Cost and Benefits

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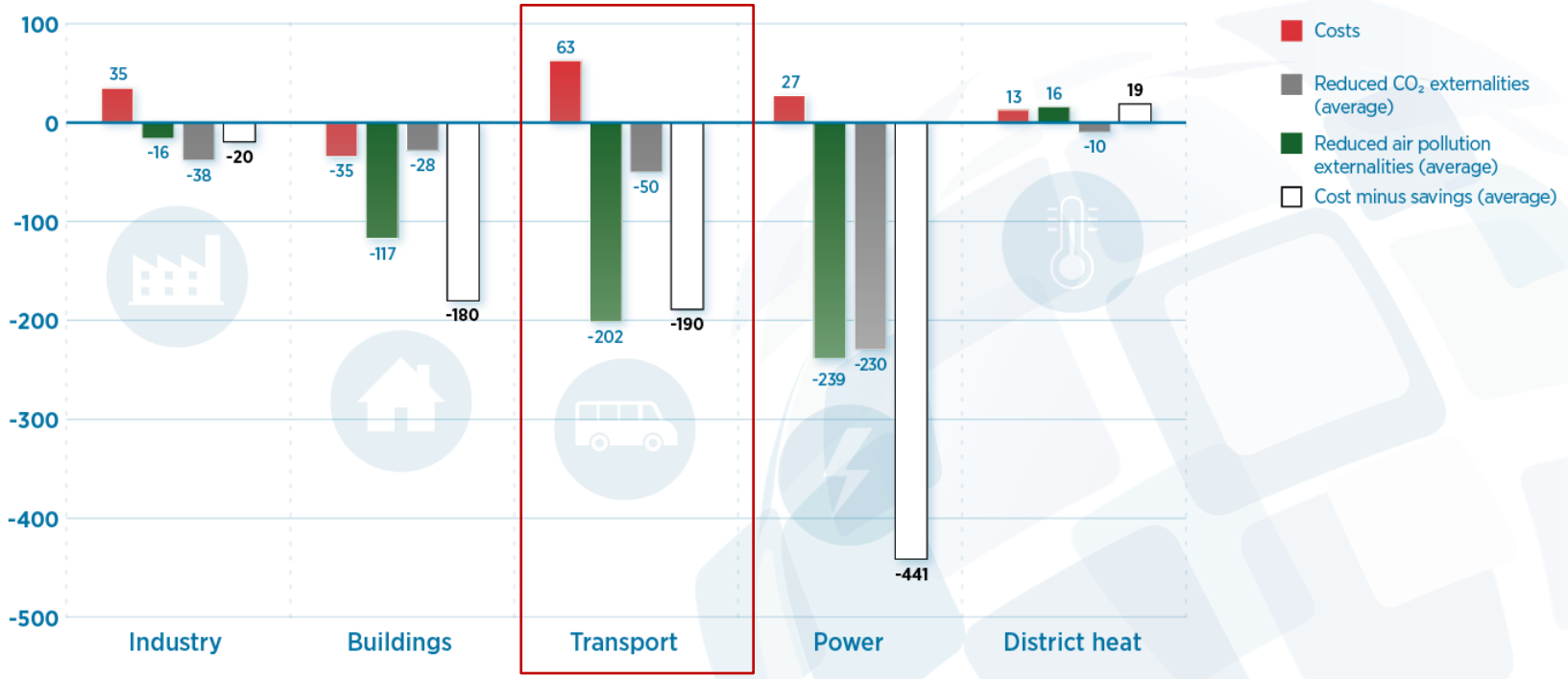
Costs and savings of renewables by sector in2030
(USD bln per year)



- There are incremental cost associated with higher deployment of renewables in transport but the technologies result in far more external cost related savings
- External benefits relating to reduce air pollution are 2nd highest in transport sector due to heavy use of fuels in urban areas

Technology deployment

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Technology focus areas for REmap Transport Roadmap:

- Electric mobility and systems thinking
- Advanced biofuels
- Emerging sectors and technologies

	Units	2013/ 2014	2030 Reference Case	2030 REmap	2030 Doubling
TRANSPORT					
Electric Vehicles	million vehicles	0.8	60	160	173
- Passenger vehicles	million vehicles	*0.8*	*59*	*158*	*158*
- Buses	million vehicles	*0.01*	*0.5*	*1.4*	*11*
- Light duty vehicles	million vehicles	*0.004*	*0.3*	*0.9*	*5*
2/3 wheelers	million vehicles	200	500	900	900
Bioliquids	billion litres	129	250	500	520
- Conventional biogasoline	billion litres	*93*	*185*	*283*	*283*
- Advanced biogasoline	billion litres	*1.0*	*10*	*94*	*94*
- Conventional biodiesel	billion litres	*35*	*55*	*93*	*103*
- Advanced biodiesel (incl. bio jet kerosene, drop-in)	billion litres	*0.01*	*0.3*	*30*	*42*
Biomethane	billion m^3	0.01	0.3	0.9	24

Electric Vehicles and the electrification of transport

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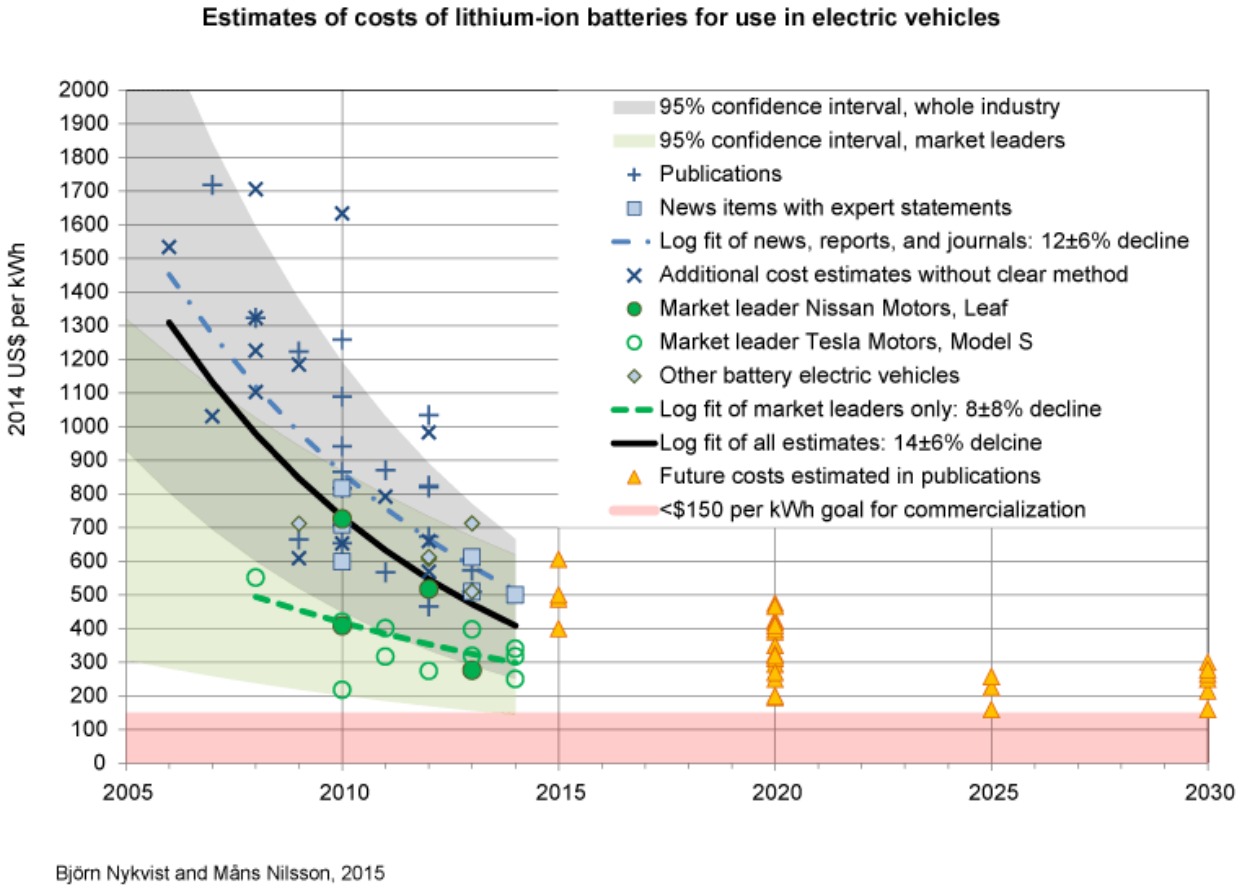
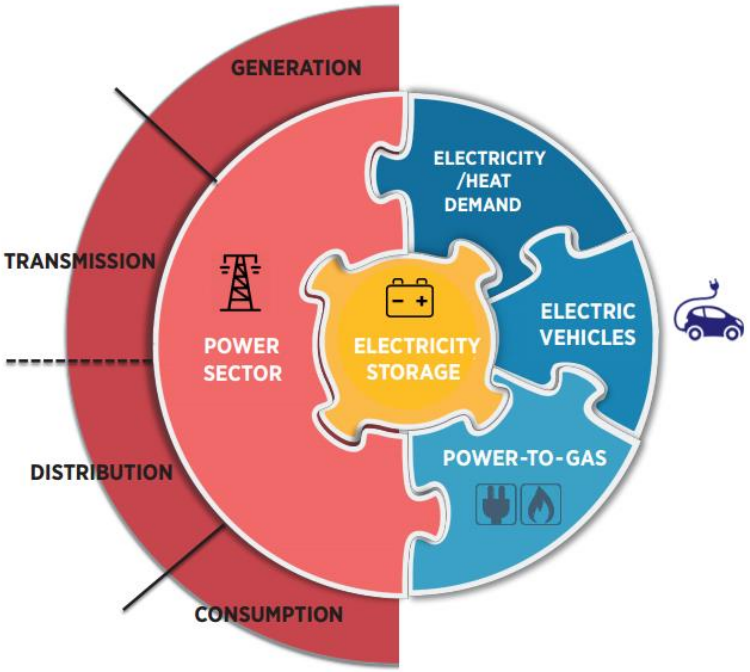
- Vehicle cost is key, and price of battery packs still need significant cost decline
- Yearly sales of passenger vehicles will need to increase from under 1 million today to an average of 10 million per year to 2030



Björn Nykvist and Måns Nilsson, 2015

The electrification of transport, sector coupling and systems thinking

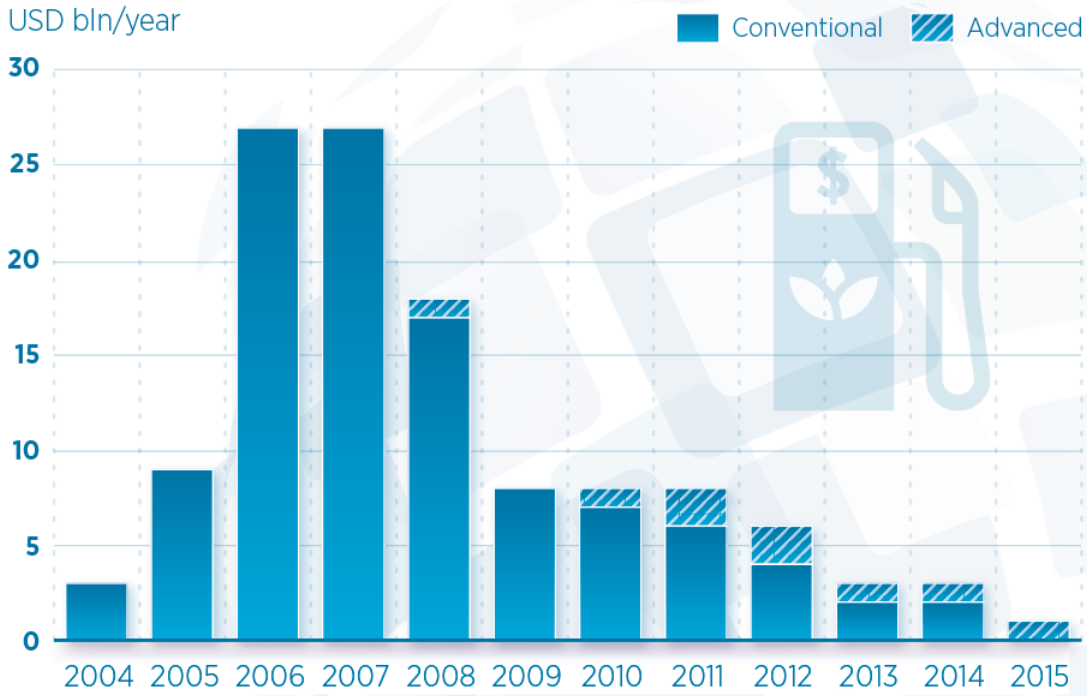
- Dual policy focus on both accelerating uptake of vehicles and infrastructure
- EVs offer a solution to growing urban environments and cities and their energy needs
- Sector coupling will increasingly play a role, i.e. linking power, heating and transport sectors
- Storage and ability to enable higher shares of variable renewable power into the grid will be key driver. Systems thinking is required, including looking at materials constraints



Advanced biofuels

- Investment in advanced biofuel plants will need to be significantly accelerated and reverse recent trends
- Production must be substantially increased, mainly for advanced biofuels

Global investments in liquid biofuels, by technology



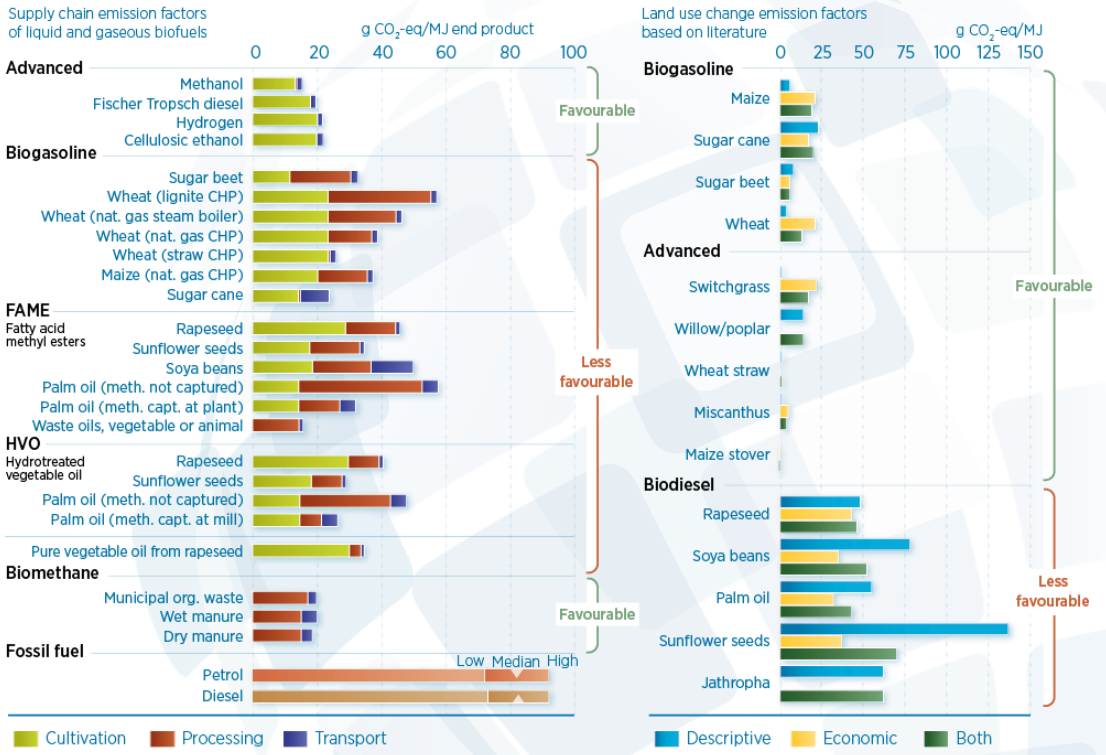
Source: IRENA analysis based on BNEF

Advanced biofuels

- Over an entire life cycle advanced biofuels can cut GHG emissions between 60% and 90% compared with fossil fuels

- Advanced biofuels for freight, aviation and shipping need to be developed to realize climate targets, which are turning attention to transport

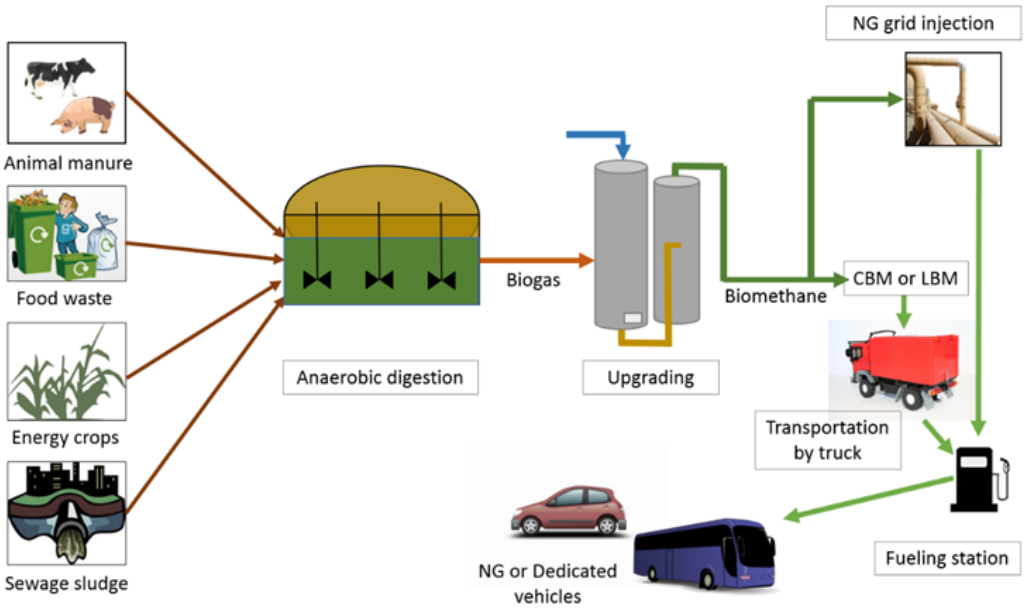
Supply chain for liquid biofuel production and resulting emissions due to land-use change



Source: Based on the European Commission and PBL

Emerging sectors and technologies – hidden Potential of biogas

- Biogas for transportation just 0.42% of the total global production & 1% in EU
- Depending on feedstock type between 50-80% GHG emission reductions
- 2030 biogas supply 3-6 EJ can be available for transport, 2-5% of global transport energy demand



Emerging sectors and technologies – aviation/shipping

- Demand for energy in both shipping and aviation increasing 3% per year, and make up 20% of transport sector demand
- Barriers for renewables include low cost of fuel in shipping, and high-spec requirements of fuels in aviation
- Biojet today meet just 0.05% of jet fuel demand, but REmap shows it would reach 1.5% by 2030. Advanced biofuels are the only option but currently 2-4 times higher cost
- Shipping can use biofuels, but also novel applications, i.e. forms of electrification, wind engines, kite systems, hybrid technologies, modern sails, green hydrogen and methanol are all potentials
- The industries have numerous voluntary initiatives with energy and climate goals. Governments lag behind in supporting these efforts

→ *Innovation and R&D will be key in the coming years to advance technologies in these sectors*

Three action areas

- Increase electric mobility in combination with renewable electricity generation and apply a system strategies approach
- Develop sustainable and affordable advanced biofuel pathways also with focus on non-car modes
- Explore emerging technology solutions and innovation for emerging transport modes

Policies should focus on

Elec. & Systems	▪ Accelerating EV uptake in cities ▪ Enabling investment in charging infrastructure
Adv. Biofuels	▪ Leverage the synergies between EVs and VRE power generation ▪ Ensure availability of affordable and sustainable bioenergy feedstocks ▪ Develop biofuel targets considering life-cycle GHG
Emerging Sectors	▪ Level the playing field for biofuels by considering GHG emission benefits ▪ Support cross-border bioenergy trade of sustainable feedstocks

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For more information about joining the REmap Transport Action Team please email nwagner@irena.org