IEA Bioenergy

Bioenergy

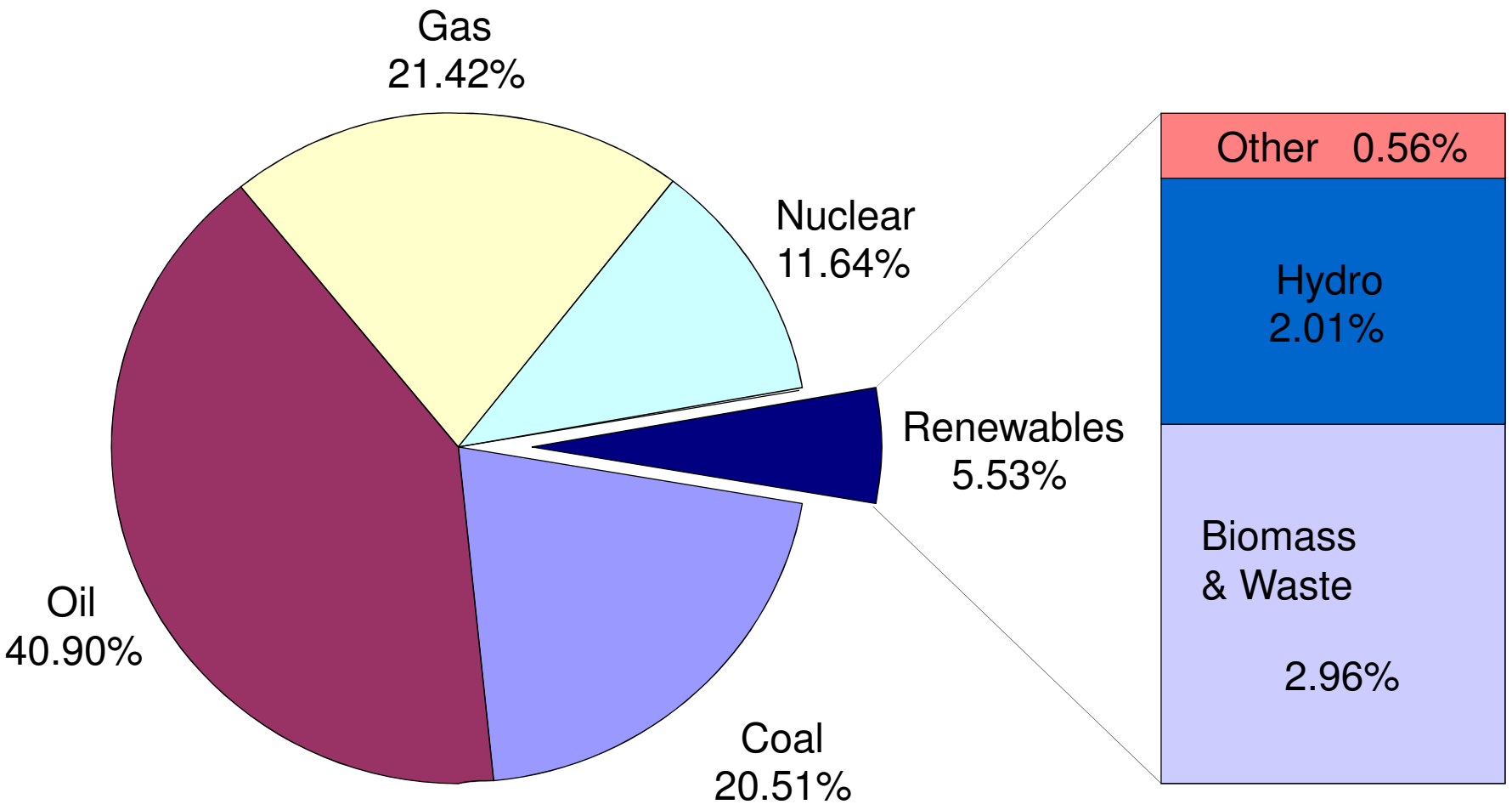
a complex matrix, full of opportunities - and dependent on policy instruments

Björn Telenius

Outline

- Bioenergy
  - current role
  - drivers & barriers
  - many options
- Heat & Electricity
  - end-use sectors
  - conversion technolgy
  - feedstock
- International collaboration

Bioenergy's current role in OECD countries

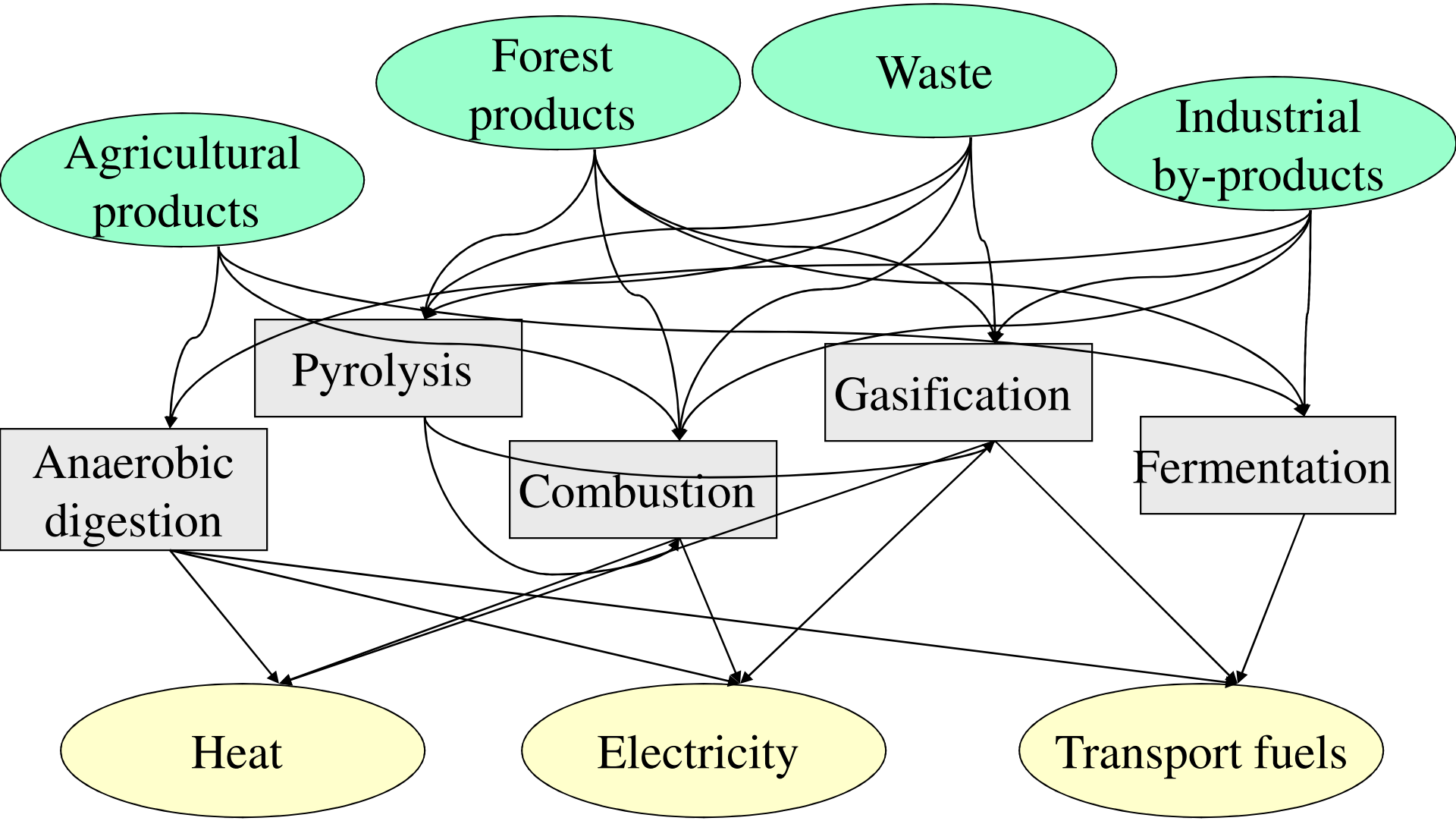


Current use and future potential

- **Current use: 50 EJ/a of 440 EJ/a total world energy consumption (2001)**
- **Future potential (EJ/a)**

	Year		
Scenario	**2025**	**2050**	**2100**
Shell (1996)	85	200 – 220	–
IPCC (1996)	72	280	320
Greenpeace (1993)	114	181	–
Johansson et al. (1993)	145	206	–
WEC (1993)	59	94 – 157	132–215
Dessus et al. (1992)	135	–	–
Lashof and Tirpak (1991)	130	215	–
Fischer and Schrattenholzer (2001)		350 – 450	–

The bioenergy matrix



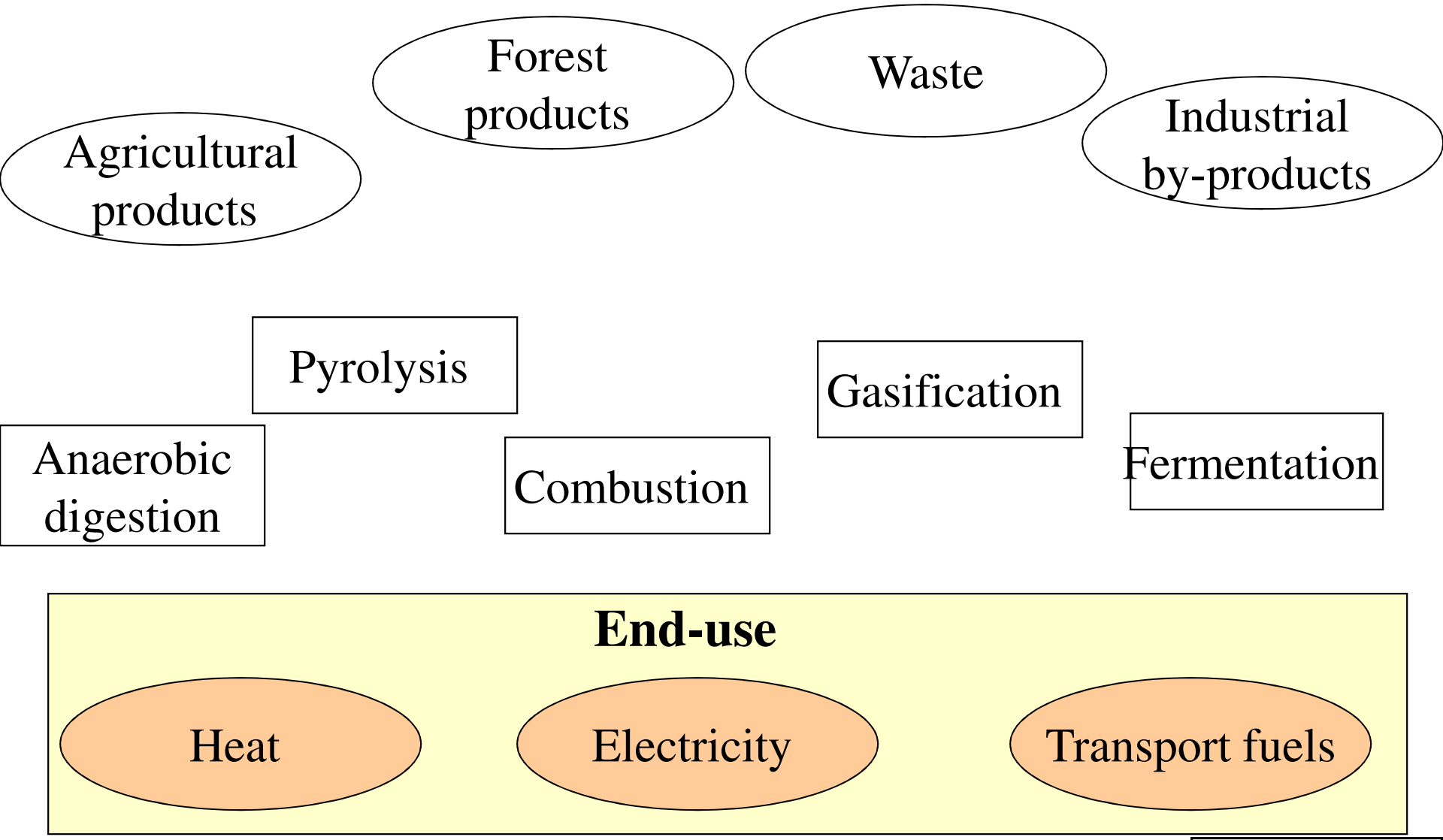
Driving forces

- Energy and environmental policy objectives
  - Security of energy supply
  - Reduction of GHG emissions
  - Reduced environmental impact from waste treatment
- Other policy areas
  - Agricultural policy objectives
  - Rural development objectives
  - Industry and economic growth objectives

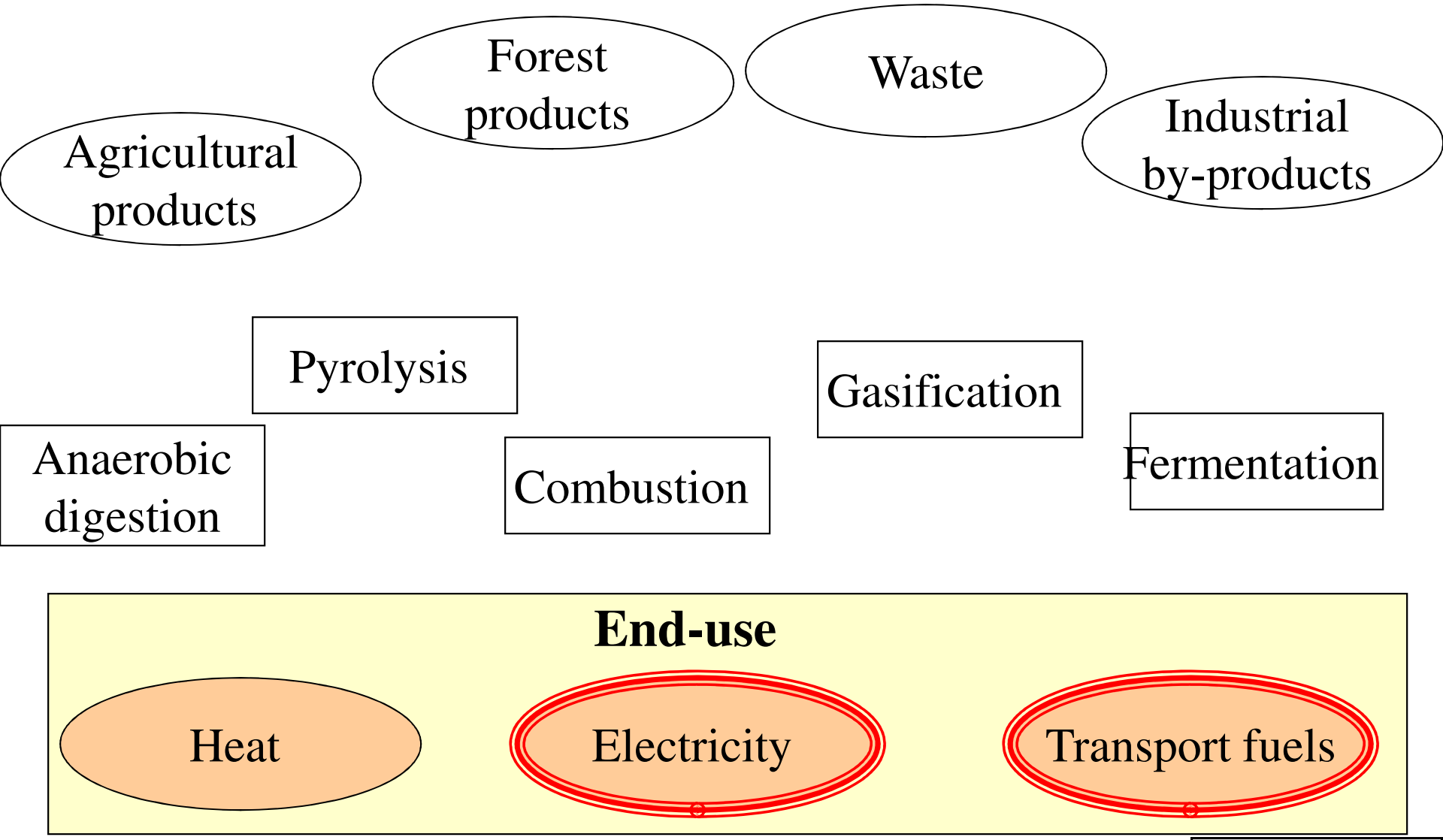
Barriers

- Bioenergy is and will be more expensive than fossil energy sources, i.e.:
  - Market penetration will be determined by political decisions, aiming for security of supply, environmental objectives, etc.
  - Legal instruments influencing the demand side, GHG emissions, or enabling international mechanisms, will be the most powerful instruments – driving R&D investments and cost reduction
  - R&D success will provide new options and cost reductions, but not introduce bioenergy on the markets

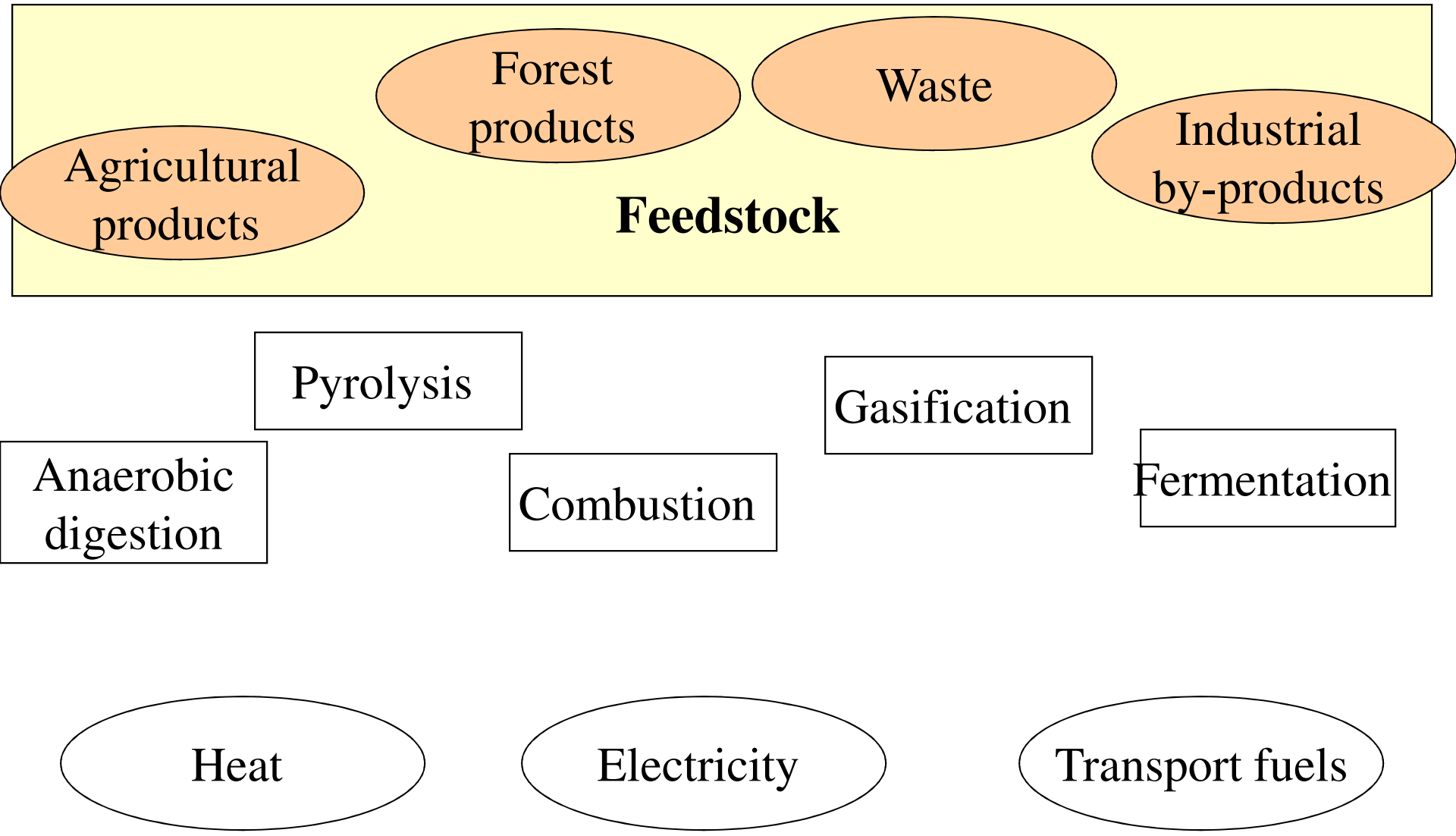
Drivers & Policy instruments



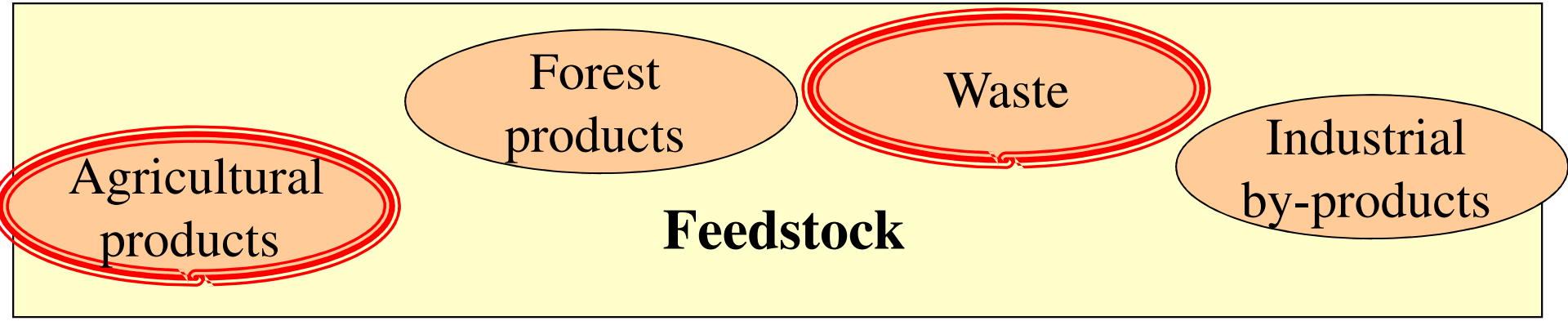
Drivers & Policy instruments



Drivers & Policy instruments



Drivers & Policy instruments



Pyrolysis

Gasification

Anaerobic digestion

Combustion

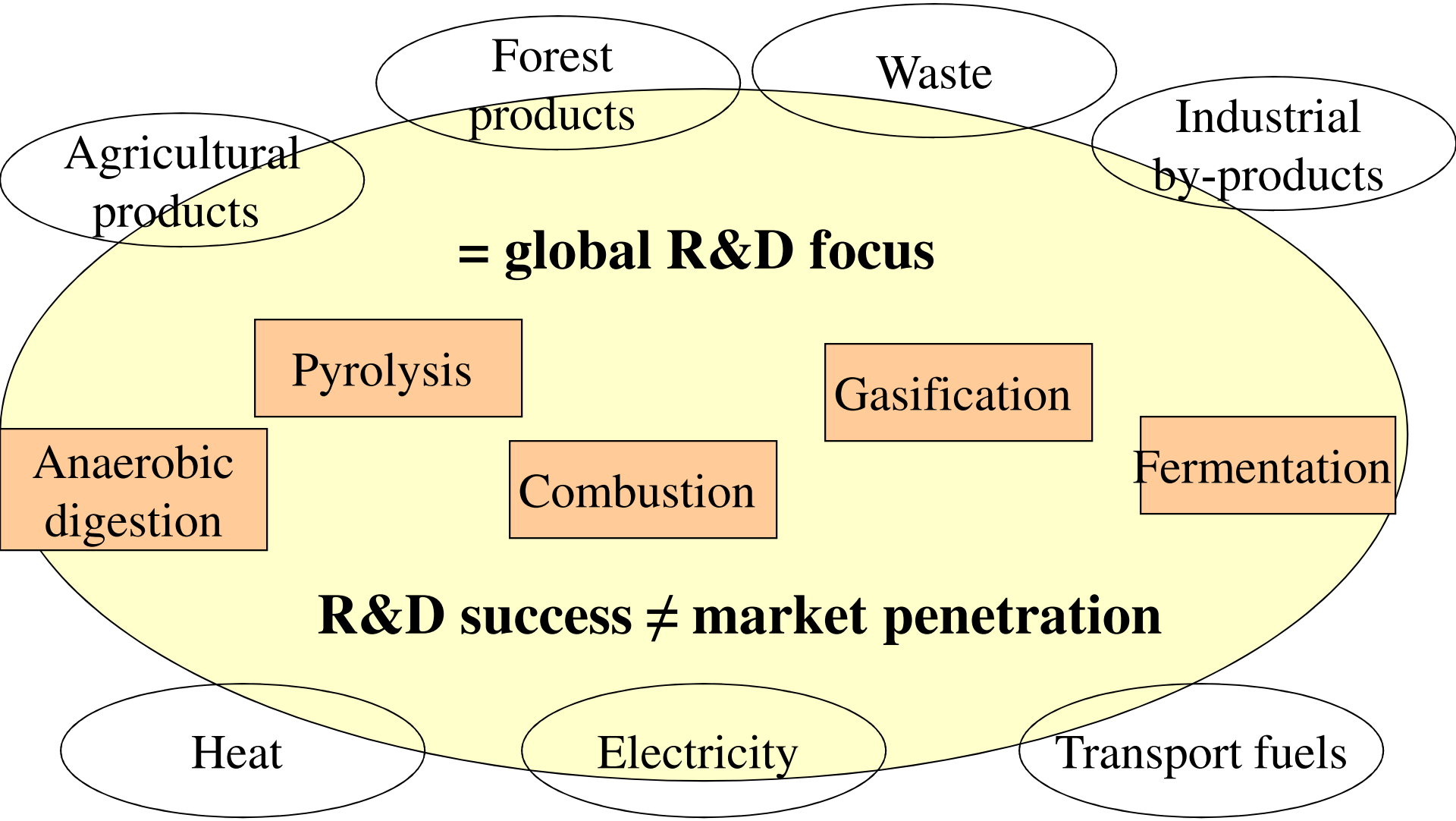
Fermentation

Heat

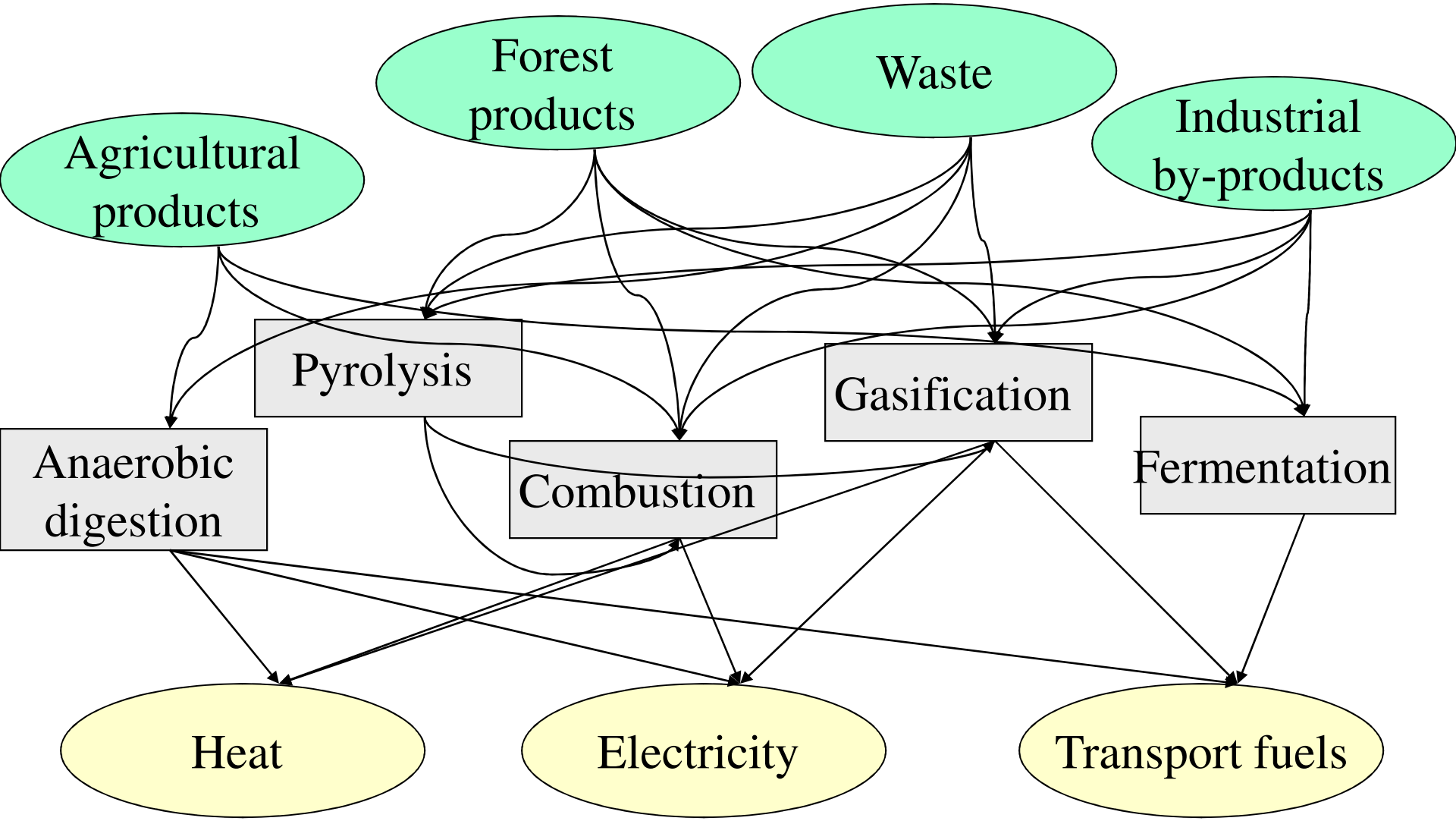
Electricity

Transport fuels

Potential for technical improvement



Where is bioenergy attractive?



Bioenergy is not a local issue

Forest products

Waste

Agricultural products

Industrial by-products

Heat

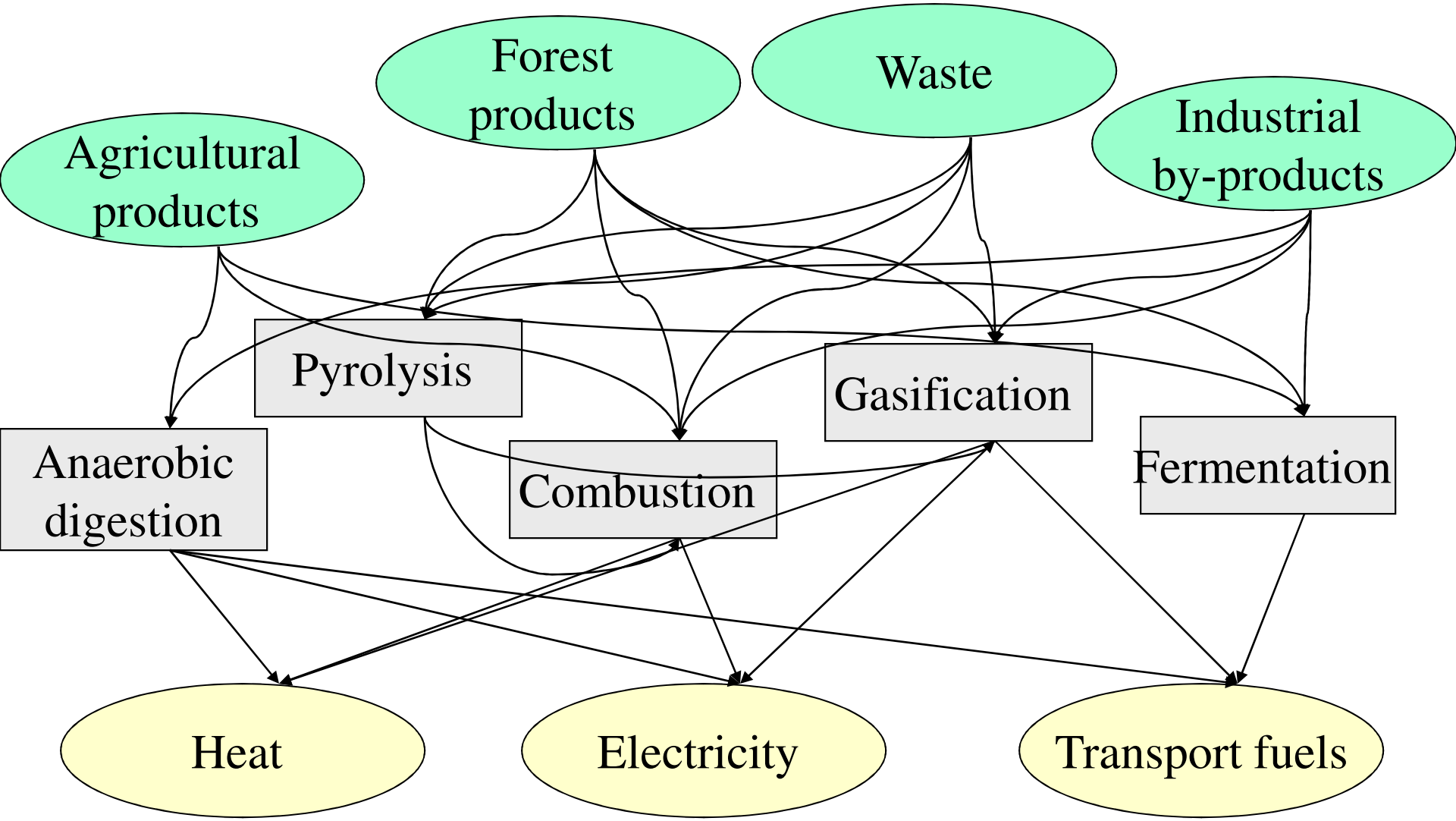
Electricity

Transport fuels

General conclusions

- After hydro power bioenergy is the dominating RES. It is one of the most cost efficient RES alternatives
- (As all other RES) The degree of market deployment is determined by political decisions and driven by policy instruments. The strongest instruments are:
  - Demand side regulations, e.g. fuel mandates and taxation-based instruments
  - Instruments overcoming geographical barriers, i.e. stimulating international trade, certificates, CDM etc.
- The bioenergy matrix' complexity offers most regions excellent opportunities to develop cost efficient options meeting varying policy objectives

Heat & Electricity



End-use sector: Heat

- The most important end-use sector in countries/regions where bioenergy has played a significant role
- The most cost efficient end-use sector to introduce bioenergy in
- The end-use sector where one unit of bioenergy substitutes most fossil fuels, i.e. of importance where energy policy is driven by environmental objectives
- Often heat demand defines bio-electricity production
- Strategically important factors & opportunities:
  - Industrial biomass by-products and industry's need for steam
  - District heating networks
  - Small scale domestic heaters

End-use sector: Electricity

- Often produced as CHP in either process industry or dedicated CHP plants
- In several ways electricity from cheap and readily available biomass takes an intermediary position between heat and transportation fuels
- In many countries co-utilization with fossil fuels is the quickest and easiest strategy to increase electricity from RES. Very strong driver for feedstock supply development. Public perception may be an issue

Conversion technologies: Combustion

- Direct combustion of solid fuels and, if electricity is produced, a rankine cycle dominate. Efficiency and cost vary with type of fuel, scale, product and degree of process integration
- Leading hardware producers have excellent commercial technology available for most “conventional” fuels, e.g. waste, wood chips or pellets, straw, etc. No emission problems with modern technology
- Co-utilization with fossil fuels is more cost and energy efficient than stand-alone units
- Process integration and polygeneration are more cost and energy efficient than stand-alone or one product systems
- Wood pellet market has introduced a revolution in both large and small scale bioenergy conversion systems

Conversion technologies: Gasification

- A shift from combustion to gasification will be a major technology leap, influencing both feedstock and products.
- High priority in public R&D; but technologies are not yet enough competitive (compared to combustion and distillery based systems) to mobilise industry for large scale development
- First commercial large scale opportunities may be in e.g.:
  - Integrated processes where production of energy products are combined with production of high value products, e.g. black liquor gasification
  - Integrated processes which build on existing infrastructure, e.g. co-utilisation with coal

Feedstock

- An increase in production of (bio) heat and electricity is not limited by feedstock availability. Most regions have access to cheap and readily available biomass
- A future, policy driven, substantial increase in bioenergy demand will:
  - Increase current feedstock supply capacity
  - Support development of regional and international trade
  - Create feedstock competition among bioenergy end-use sectors
  - Mobilise more expensive production systems, e.g. agriculture
- The strongest policy instrument for feedstock supply are instruments creating an end-use sector

IEA Bioenergy

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- **Our objective**
  Support member countries' objectives and efforts. New and added values are created by linking the national programmes and expertise
- **Values and deliverables**
  Information exchange and syntheses based on R&D results and policy experiences;
  Platform for collaborative projects and informal contacts;
- **Participation**
  21 countries participate in 12 Tasks with an overall budget of 1.4 million USD

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The Tasks of IEA Bioenergy

- **Feedstock**
  Forest and agricultural products, municipal solid waste and recovered fuels
- **Conversion**
  Combustion, gasification, pyrolysis, anaerobic digestion, fermentation
- **Integrating research themes**
  Greenhouse gas balances,
  Socio-economic impact,
  International trade,
  System analysis

Summary

- **For long, and regardless of public R&D, all forms of renewable energy will be dependent on policy instruments**
- **Substitution of fossil fuels with bioenergy for heat and electricity production is a cost and energy efficient strategy to support security of supply and environmental objectives**
- **In most regions the bioenergy matrix offers opportunities with significant volume potential and which are competitive to most renewable energy sources**