

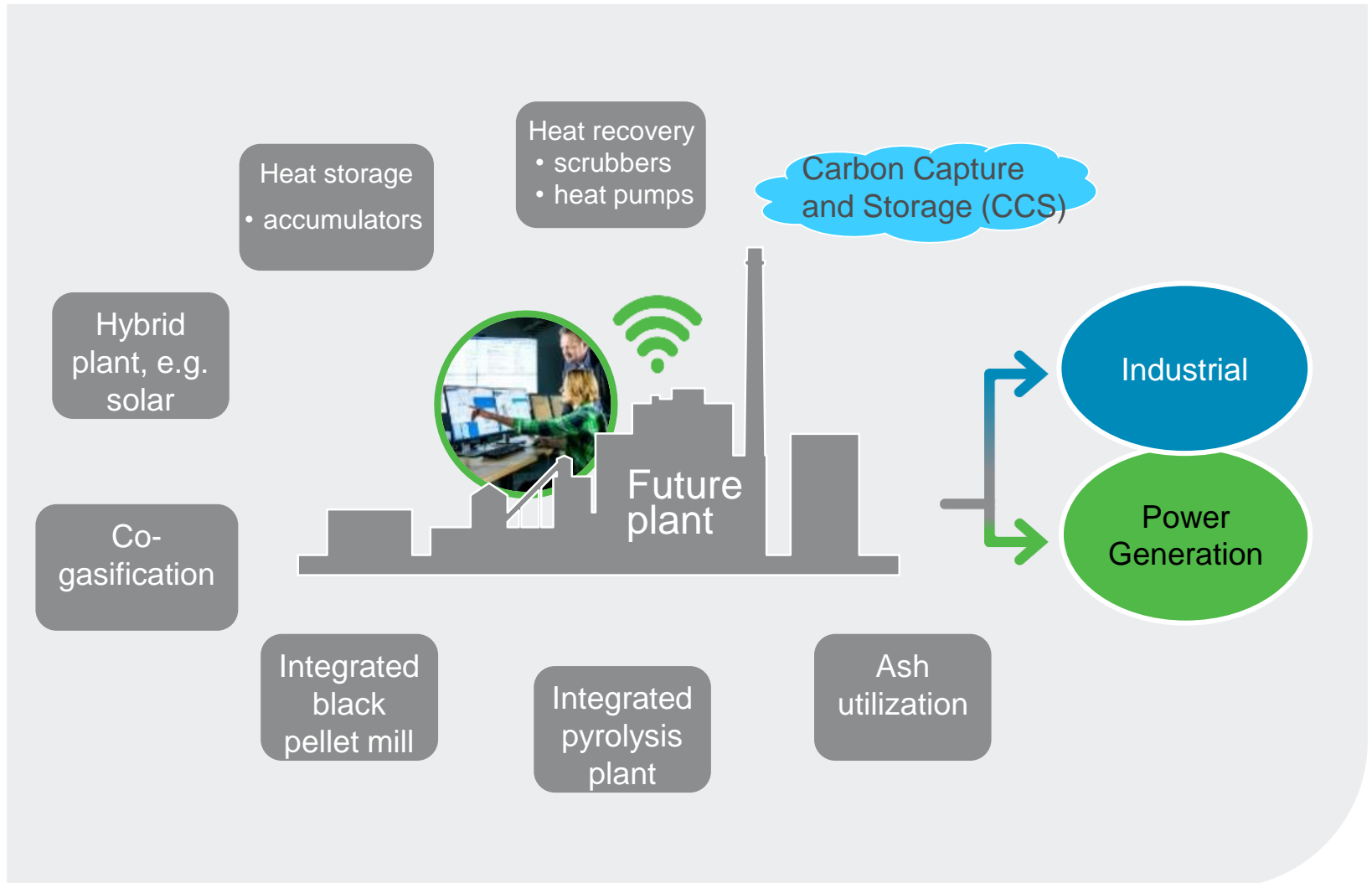
Innovations in advanced biofuels

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Increasing flexibility of plants

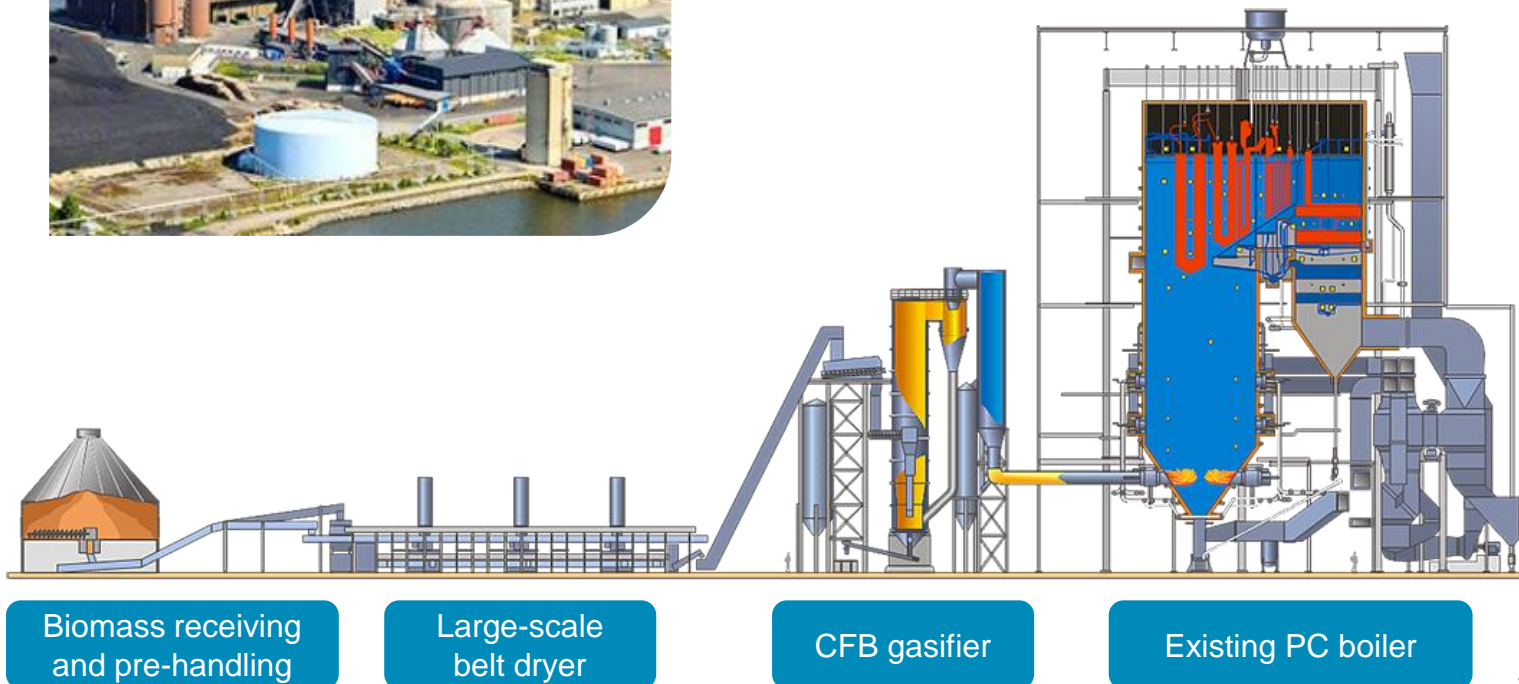


Co-gasification – Biogas to coal fired boiler

Gasification plant
Vaskiluodon Voima Oy
Vaasa, Finland




- Coal replacement in PC (pulverized coal) boiler
- Many types of biomasses, for example wood, bark, forest residues, crushed stumps, sawdust, and canary grass



Steam exploded black pellets (bio coal)

New opportunity for supply of sustainable fuel for heat and power generation

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- Steam exploded black pellets, i.e. bio coal, can be produced from many types of biomasses, for example forest residues and bark
 - Can be used as a renewable fuel in many types of boilers, for example to replace coal in pulverized coal boilers
 - Transportable: high energy density and hydrophobic



Bio-oil – Integrated pyrolysis

- Through integrated pyrolysis technology, a fluidized bed boiler at a power plant is a potential biorefinery
- Future possibilities include upgrading the bio-oil quality for example through catalytic processes to make bio-oil suitable for further refining to transportation fuels

Pyrolysis oil production integrated into Combined Heat and Power plant Fortum, Joensuu, Finland

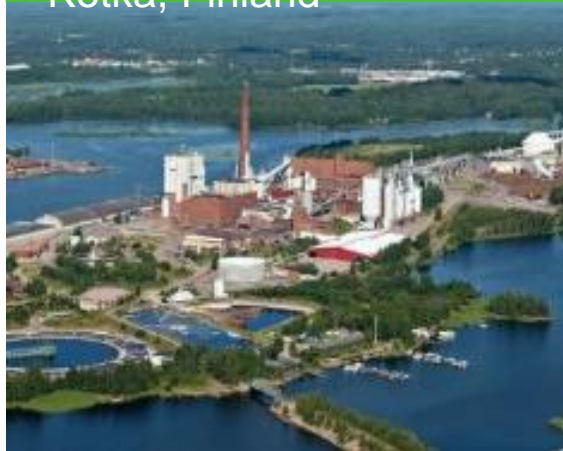


LignoBoost lignin separation technology

LignoBoost separates lignin from kraft black liquor in pulp making

- Fossil fuels can be replaced with lignin to produce energy
- Lignin can be further upgraded to transportation fuels or other bio-based products

LignoBoost plant
Stora Enso Sunila
Kotka, Finland



LignoBoost plant
Domtar Plymouth
North Carolina, USA



