# THE NEXT BIO-INNOVATION FRONTIER

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# OLD SCHOOL VERSUS NEW SCHOOL BIO-INNOVATION

| UPSTREAM | MIDSTREAM | DOWNSTREAM |
|---|---|---|
| SURPLUS BIOMASS | INCINERATION | POWER |
| SOFT COMMODITIES | FERMENTATION<br>ESTERIFICATION | ETHANOL<br>BIODIESEL |

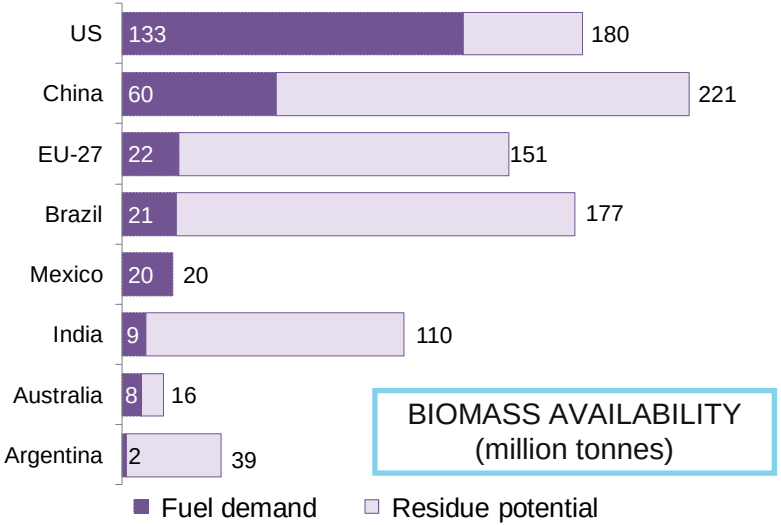
Limited innovation; uses well known processes

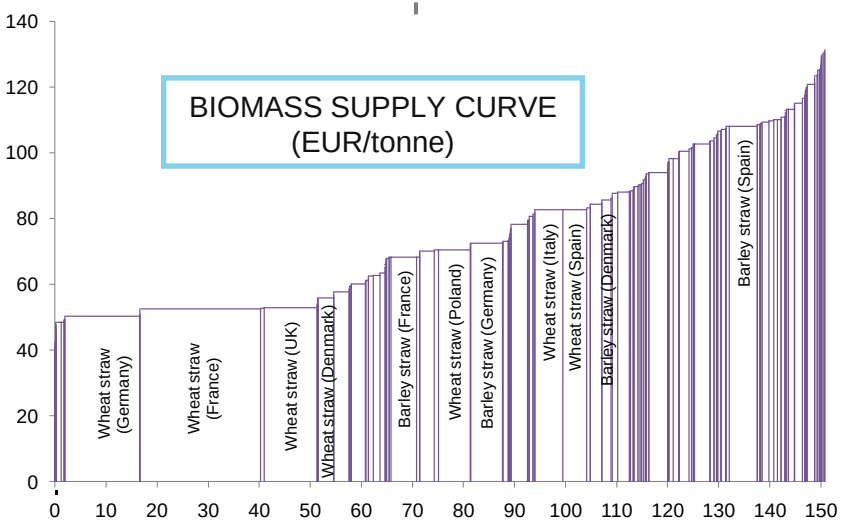
| | | |
|---|---|---|
| ALL BIOMASS | MULTIPLE PATHWAYS | TAILORED PRODUCTS |

# BIOMASS AVAILABILITY, 2012-30

UPSTREAM → MIDSTREAM → DOWNSTREAM

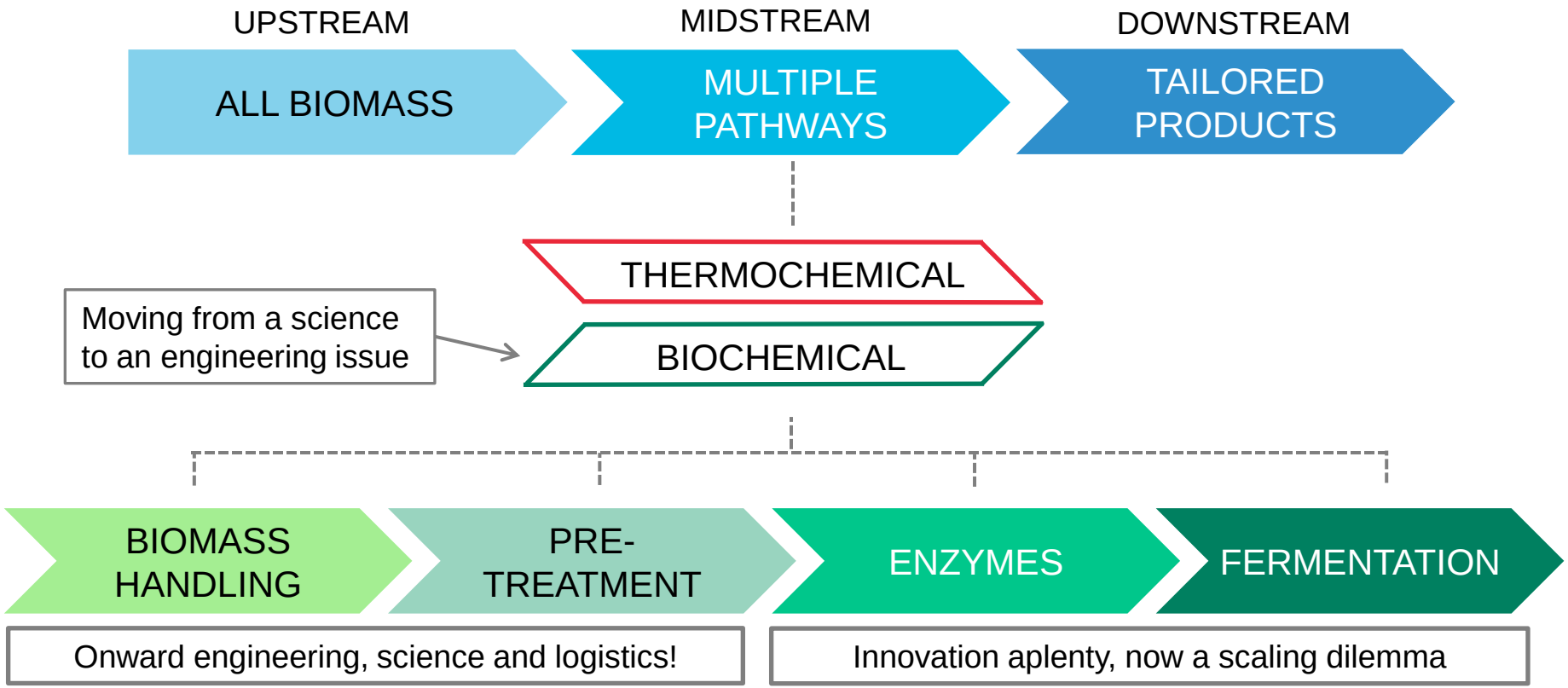
ALL BIOMASS → MULTIPLE PATHWAYS → TAILORED PRODUCTS




Source: Bloomberg New Energy Finance, FAO.

# BIOCHEMICAL PATHWAYS MOVE TO A NEW STAGE



# BIOCHEMICAL PATHWAYS MOVERS AND SHAKERS

MIDSTREAM

| BIOMASS HANDLING | PRE-TREATMENT | ENZYMES | FERMENTATION |
|---|---|---|---|
| COMPANIES | | | |
| POET | CHEMTEX, mbi, IOGEN, SunOpta, Renmatix, virdia | novozymes, DUPONT, DSM, EdeniQ, CODEXIS, DYADIC, VERENIUM | BIOGASOL, ZeaChem, AMYRIS, LS9, solazyme, gevo, MASCOMA |
| Innovation required | Science challenge | Big players present | Innovation gone nuts! |

# LINKING FEEDSTOCK SUPPLY AND VARIOUS PATHWAYS

| UPSTREAM | MIDSTREAM | DOWNSTREAM |
|---|---|---|
| ALL BIOMASS | MULTIPLE PATHWAYS | TAILORED PRODUCTS |

| | |
|---|---|
| Wood pellets | Densify wood residues |
| Mixed biomass pellets | Densify agricultural residue |
| Pyrolysis | Oil proxy |
| Torrefaction | Coal proxy |

Innovation required & coming

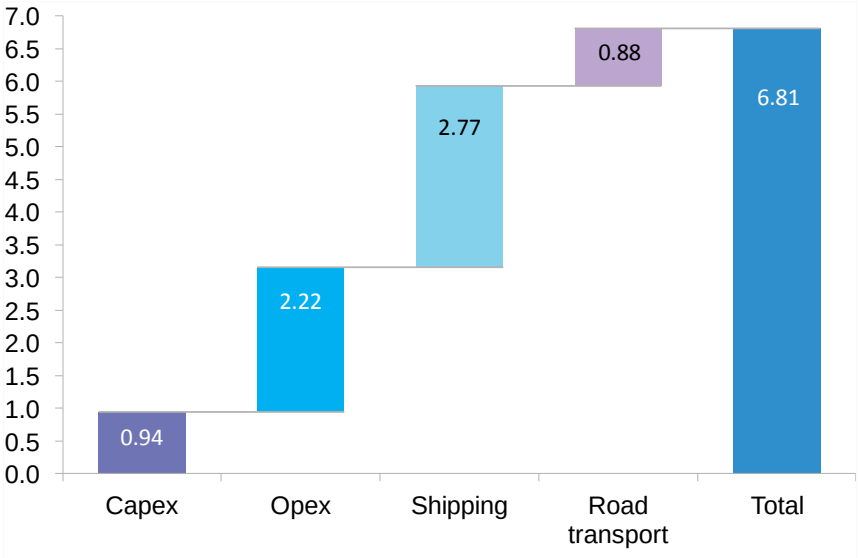
Business models

Engineering

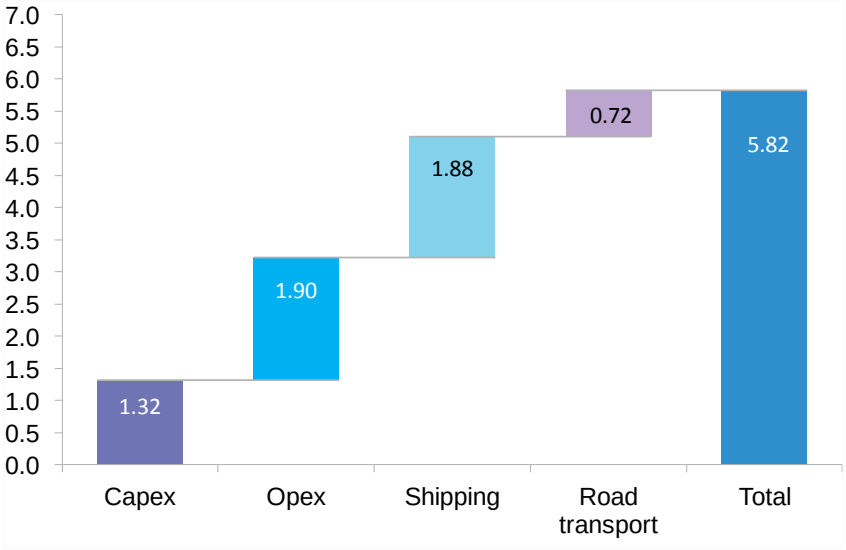
Logistics

# FEEDSTOCK VALUE CHAINS, 2015 ($/GJ)

## WOOD PELLETS




## TORREFIED PELLETS




Notes: Assumes value chain costs from Canada to Rotterdam to a European coal plant. Wood pellet assumptions: 18GJ/tonne, 10GJ/m$^3$ and 650kg/m$^3$; plant capital costs are $170m, returning 10% IRR. Torrefied pellets assumptions: 22GJ/tonne, 18GJ/m$^3$ and 800kg/m$^3$; plant capital costs are $300m, returning 15% IRR. Canadian road transport leg represents 100km, likewise the European leg, includes all handling and storage costs.

Source: Bloomberg New Energy Finance

# FINAL REMARKS

- Technologies and pathways to utilize sugar platform to produce tailored products almost there; midstream advances evident
- Matching biomass potential with tailored products now key
- Next innovation wave will hit energy densification (engineering), biomass handling (logistics) and pretreatment (science)

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# SUMMIT 2012

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19-21 MARCH

INNOVATE > GENERATE >> INTEGRATE >>>