The Delft Skyline Debates
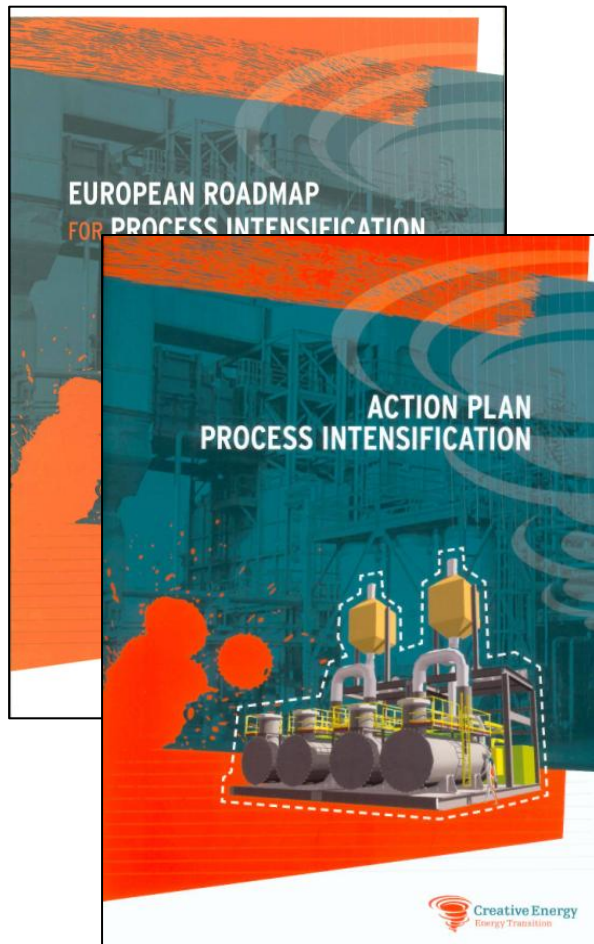
An Overview

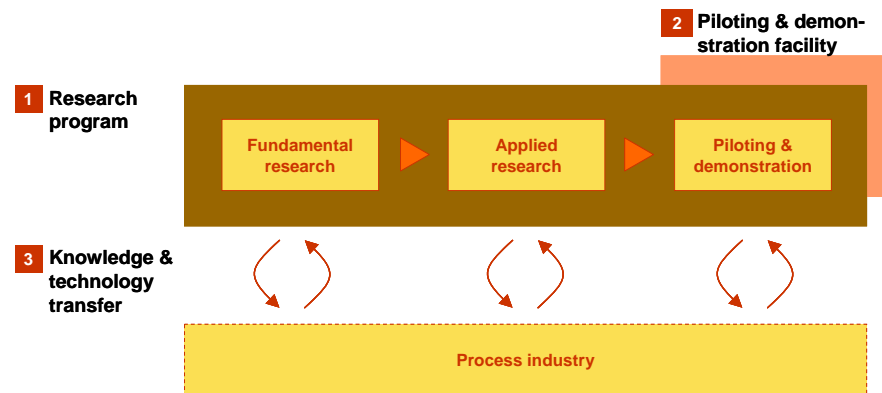Delft, June 4, 2010   Andrzej Stankiewicz

The Skyline details the long-term vision of the European Roadmap for Process Intensification
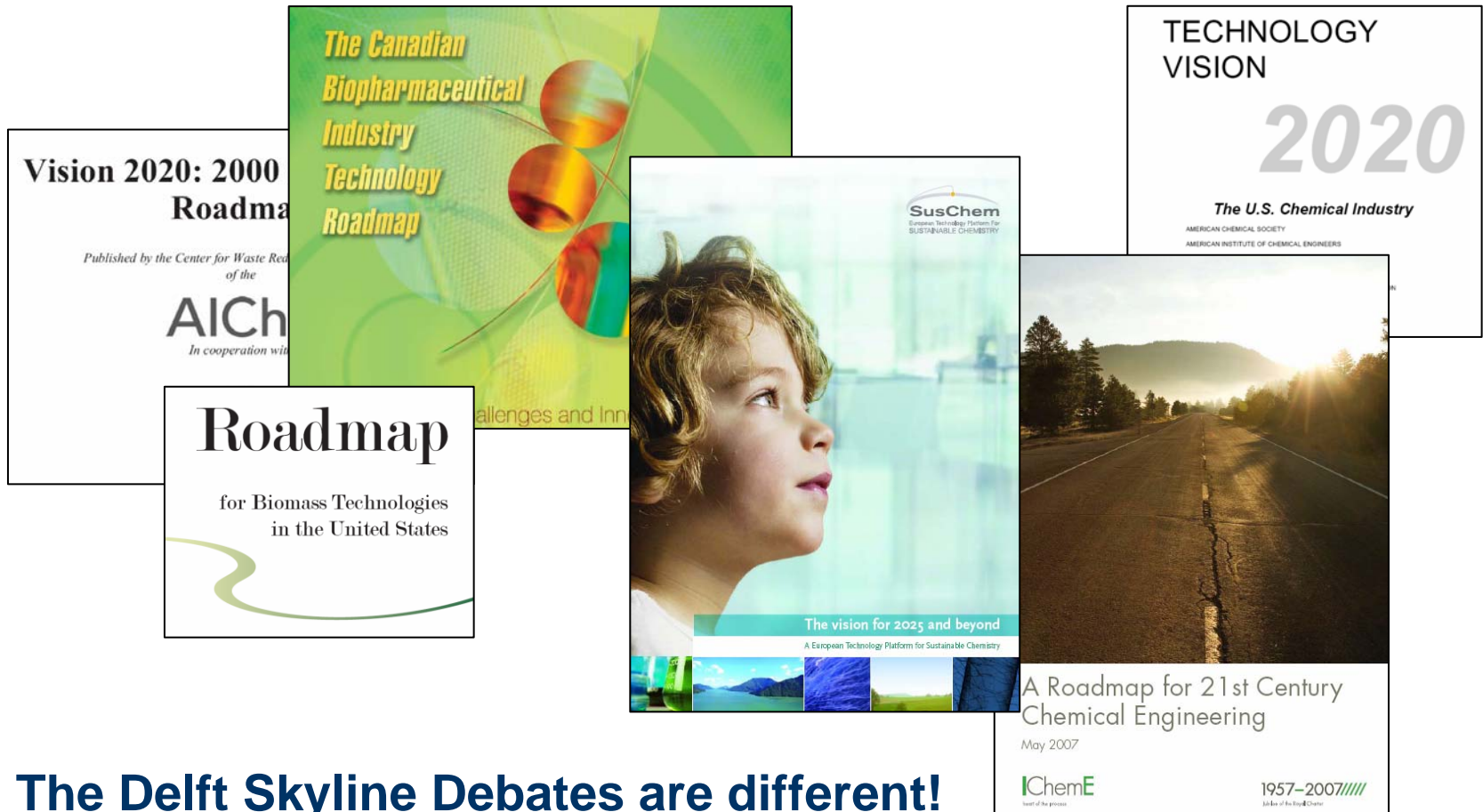
Goal: minimum 20% energy saving by 2030 due to process intensification alone

European Roadmap for Process Intensification:
> Predominantly industrial work
> Necessary follow-up: a scientific vision on 2050 and beyond

# The Delft Skyline Debates – Yet another roadmap?

The Delft Skyline Debates are different!

The Delft Skyline Debates are different for the multidisciplinary, scientific basis

> **Distant** horizon
> **Scientific** contents and final result
> **Multidisciplinary** team of leading visionary European scientists supported by **creative** young scientists-to-be
> **Mind-challenging** workshops and debates in the informal atmosphere of the city of Delft
> **Professionally** facilitated process

Resulting in multidisciplinary Research Agenda based on solid scientific foundation

Delft Skyline 2010 -TU Delft Library

Delft Skyline ca. 1660 (J. Vermeer)/
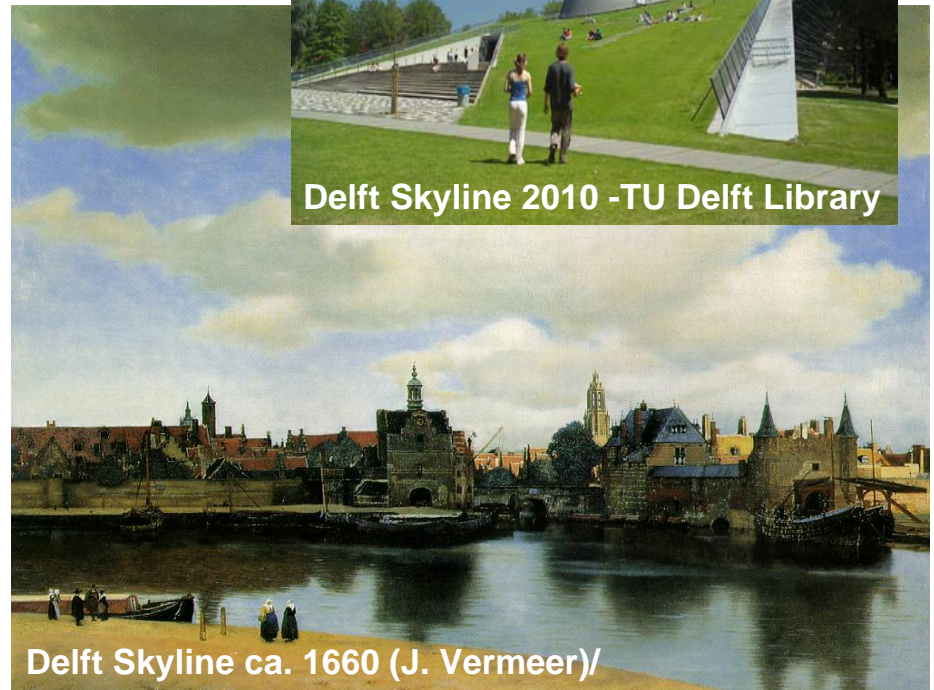
Our point of departure: the world of today (or yesterday?)

⬆ **Chemical Process Industry, 2009**

⬅ **G. Agricola, *De Re Metallica*, 1556**

What will be the future world?

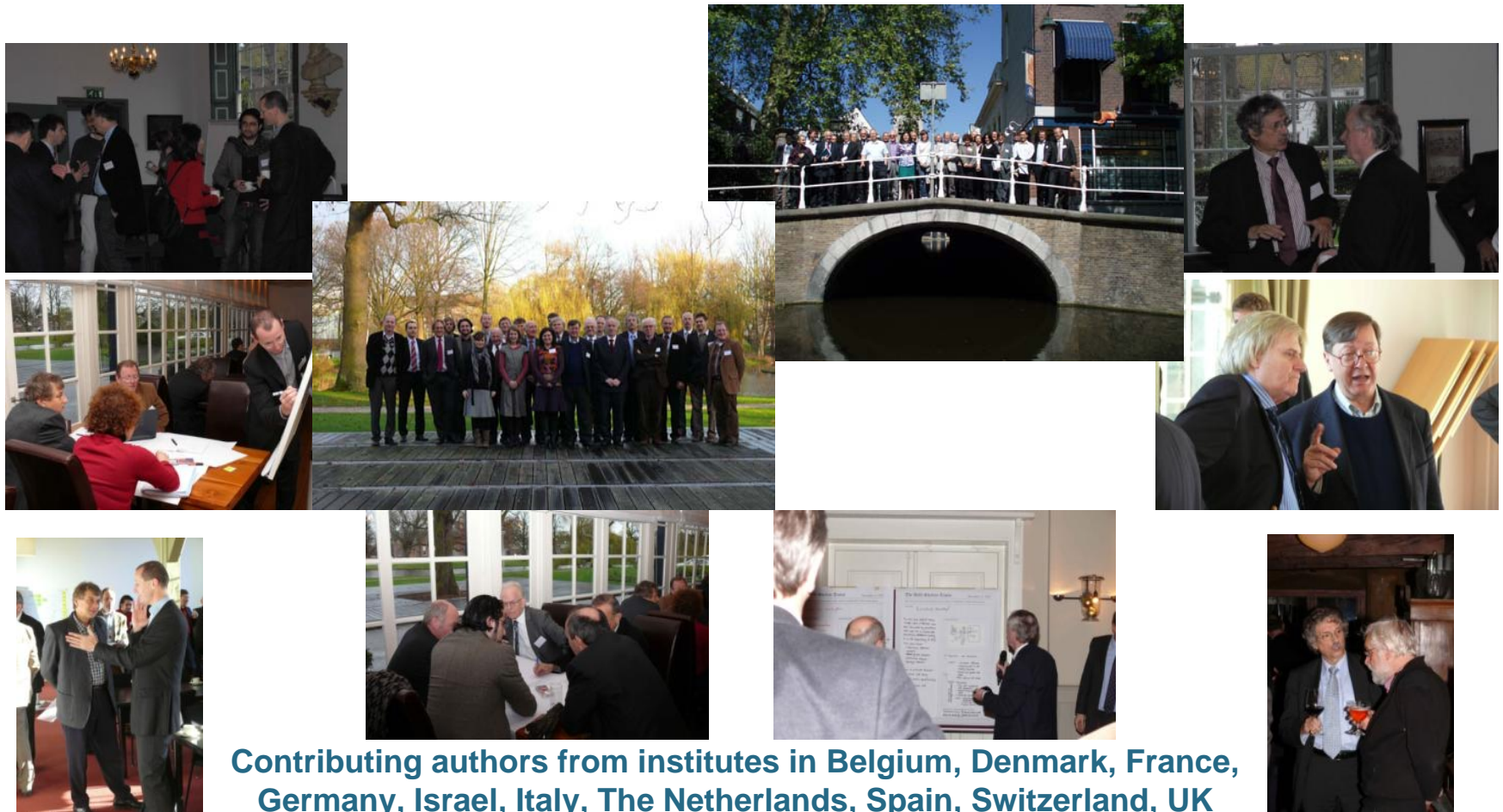**12 EIA World Conventional Oil Production Scenarios**
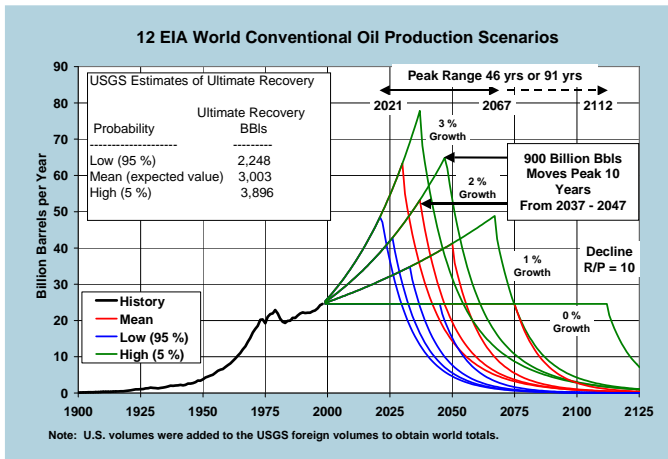
An extinct species in 50 years?

We should look into the future…

Instead of a crystal ball - challenging debates with European top scientists and talented scientists-to-be

Contributing authors from institutes in Belgium, Denmark, France, Germany, Israel, Italy, The Netherlands, Spain, Switzerland, UK

The Delft Skyline Debates' objective is to give direction to PI research from 2010 onwards

Objectives and timetable

Objective

The Skyline Theme will **inspire a vision of new developments in process technology** that can be translated into scientific projects.

Participants

Leading European experts in process intensification – and some of their **PhD-students**

Timeline

Scope of the Delft Skyline Debates

Define research topics **(in 2 workshops)** → **Research topics** → Select and detail topics to obtain funding → **Funded research proposals** → Conduct national & international research → **First technological achievements on the road to 2050**

Summer 2010

Summer 2015
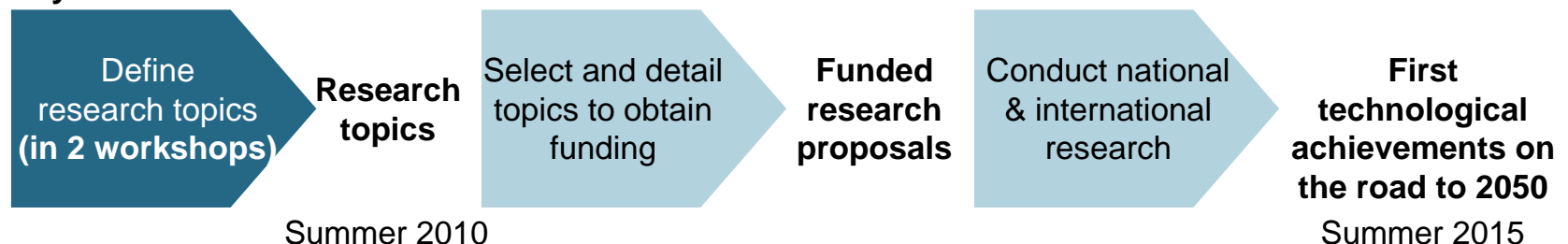
Three main steps lead us from a view of the world in 2050 to research topics for upcoming years

Methodology: three steps

RESEARCH TOPICS 2015 **3**	KEY PI MILESTONES 2030 **2**	BEACONS 2050 **1**
For each key milestone a **paper** is written, leading to **PI objectives** that should be achieved by 2015	KEY PI MILESTONE: a **technological achievement** in process intensification that should be accomplished by 2030 in order to reach more than one of the beacons of 2050 and that is particularly challenging to achieve	BEACON: an **aspired state of the world in 2050** within a specific theme for a specific group of people

Research agenda as input for international PI research programs

Scope of offline work and workshop 2: 3-5 June 2010

Scope of workshop 1: 10-12 December 2009

The process delivers three results: the Skyline Times of 2050…

Deliverables

Beacons 2050:
DELFT SKYLINE TIMES

> **Popular description of "beacons" for PI research**

Available today!

The Delft Skyline Times of June 4, 2050

The articles were inspired by the Beacons developed during the first workshop in December

His father's son

String of arrests as police roll up ring of identity thieves

Gang stole millions of genetic codes to reproduce finger and iris prints

John Retina
London

More than 60 people were arrested today in seven different European countries on suspicions of being involved in large scale identity theft. The operation was jointly coordinated by the European Agency for Privacy

protection systems. Some identities were used to gain access to a victims' home, car or bank account or conduct transactions online. Others were sold as cover identities to criminals and terrorists. As part of the operation, police raided a suspected headquarter in Albania where they

tics that are uniquely individual and impossible to fake. The authentication device scans your finger or e... compares it agai... its files. You ca... machine. But if person's DNA, y... regenerate a fing... stem cells into w...

genome is only two terabytes of data and that is easily stored, shared and stolen. But

The police agree. Sir John McAfee called for better public education and advised

Life expectancy exceeds 100

From our correspondent
Geneva

The World Health Organization

retirement age in deve... countries at the turn o... century."

Trawling its way to the top

Recycling giant surpasses Shell in market capitalization

Achmed El Alawi
Honolulu

Who in their right minds would call their company PirateFish? A dot.com era, garage-dwelling Silicon Valley entrepreneur, maybe, or a revolutionary online community of hackers. In fact, neither. PirateFish collects plastic waste from two "rubbish patches" in the Pacific Ocean, recycles it and sells it to car makers, packaging companies and plastics compounders. Sales last year came to EUR 63.4 billion and in the first quarter of this year its market value exceeded EUR 200 billion. "That makes us bigger than Shell or any of the other oil majors", says CEO Peter Moore. "Not bad for a company that started with an old trawler and second-hand

thought of it as a problem and nobody wanted any part of it. The garbage collected outside territorial waters, meaning nobody owned the garbage patch and nobody felt responsible. But we saw an opportunity." It also explains the name. "We were fishing for plastic and we considered ourselves freebooters. So we called ourselves PirateFish. We were thumbing our nose at the establishment that didn't act."

The company developed rapidly, as did its business model. The original funding of the venture was, well... original. "We set up a crowd-funding website where eco-enthusiasts could sponsor us. Visitors could see the rubbish patch grow with GoogleEarth. We included extrapolations and expert blogs to

tourism trade. The Hawaiian Tourism Board was the first to invest. PirateFish now built the first of its twelve recycling rigs, where rubbish was collected and processed to be shipped out in pellets. "It simply was not economical to collect the rubbish and take it ashore for recycling. That is one reason why nobody ever tried it before us. But we relied on other funding to get started and gradually transitioned to a business model that was sustainable in itself. And when electric cars and biofuels eroded petroleum demand, plastic prices rose making us instantly competitive."

Mr Moore proudly shows us around the newly commissioned Blackbeard platform ("we have named all our installations after famous buccaneers"). The plastic that is
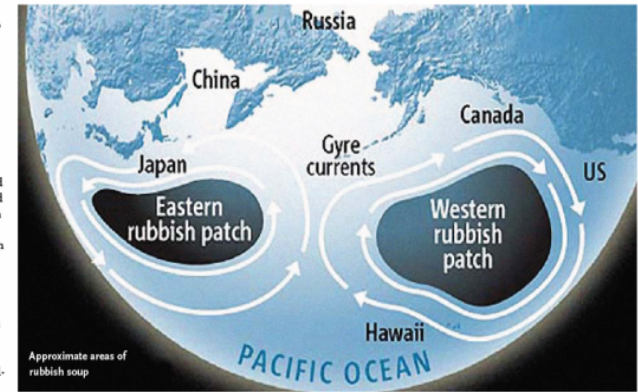
Herman Koch, a famous Dutch novelist, wrote a column for the Delft Skyline Times

The first workshop resulted in Beacons for the year 2050 and Technology Milestones for 2030

MILESTONES (2030)

1	BODY FUNCTION PROCESS CONTROL
2A	DILUTED SYSTEMS
2B	CLEAN WATER SUPPLY
3	POWER GENERATION AND STORAGE
4	LOW-COST SMALL SCALE PROCESSING
5	RECYCLABLE COMPOSITE MATERIALS
6	FUEL CELL SYSTEMS
7	SNOOKER GAME WITH MOLECULES
8	SCARCE ELEMENT BIO-RECOVERY
9.10	PERSONAL. MEDICINE / ARTIFICIAL ORGANS
11	LOW ENERGY FOOD
12	CHEMICALS FROM BIOMASS
13	SOLAR FUELS

BEACONS (2050)

HEALTH
- Everybody healthy!
- Better health by personalized food!
- When I'm ninety four….

TRANSPORT
- Transport – it's electric
- Cars from waste
- Transport – we're going virtual

LIVING
- Produce where you consume!
- Power House

FOOD & AGRICULTURE
- Plants replace mineral mines
- Good food for all!
- Food with less energy input

ENERGY — RESOURCES — ZERO WASTE

BOUNDARIES

The second deliverable is a published collection of scientific position papers that detail Milestones
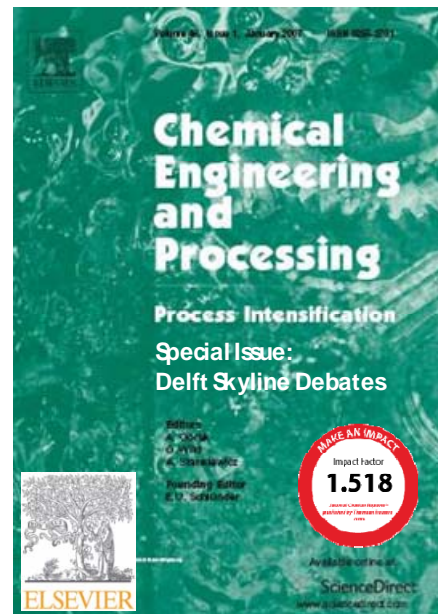
Deliverables

Beacons 2050:
DELFT SKYLINE TIMES

> **Popular description of "beacons" for PI research**

Technology milestones:
SPECIAL ISSUE

> **Collection of scientific position papers**

Teams detailed Milestones in position papers to give the Skyline Debates a scientific basis

Submitted position papers – More will follow

Number	Title of Position Paper	Coordinator	Team members
2B	Efficient technologies for worldwide clean water supply	Drioli	Gusev, Bardow, Macedonio, Semiat
3	High-efficient decentralized electricity generation and high capacity energy storage	Hemmes	Guerrero, Azapagic
5	Design, engineering and intensified production technologies for recyclable (composite) materials	Yang	Kuiper, Van Heerden, R. Boom, De Wit
6	Intensified fuel cell based systems (including biomasses)	Drioli	Grievink, De Wit, Hemmes, Barbieri
7	Gaining full control of chemical and biochemical transformations at molecular level	Stankiewicz	Backx, Ozkan, Van Gerven
8	Sustainable recovery of scarce elements	Clark	Dodson, Parker, Hunt
9	Production systems for personalized medicine	Mothes	tbd
11	Low energy food production and processing in the whole chain (incl. energy and materials generation, transport)	Boom	Harmsen, Sanders, Rossier, Azapagic
12	Chemicals from biomass – integrated solution on chemistry and processing	Sanders	Harmsen, Clark, Van Swaaij, Moulijn, Heeres, Heijnen
13	Functioning devices for fuels directly from sunlight	Mul	Van Swaaij, Stankiewicz, Schacht, Moulijn

Finally, the Skyline Debates deliver a research agenda with research topics for each Milestone
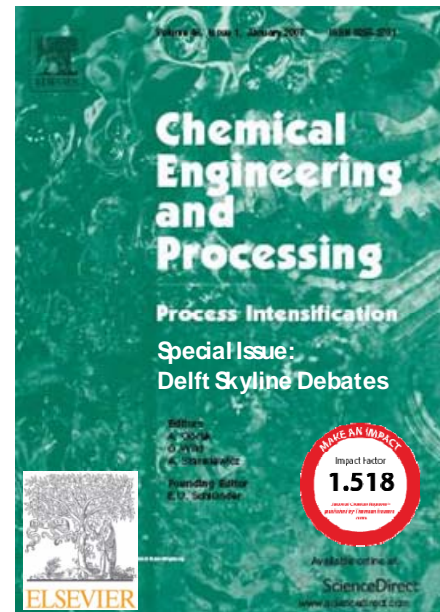
Deliverables

Beacons 2050:
DELFT SKYLINE TIMES

> **Popular description of "beacons" for PI research**

Technology milestones:
SPECIAL ISSUE

> **Collection of scientific position papers**

Research topics:
RESEARCH AGENDA

> **Proposed research topics based on position papers**

Research agenda for process intensification