The Investment Case for Advanced Plastic Recycling

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Analyst

A chicken-and-egg dilemma

Industry wants a feedstock guarantee

Image source: ExxonMobil

The waste supply chain wants an offtake guarantee

Image source: ExxonMobil

A chicken-and-egg dilemma

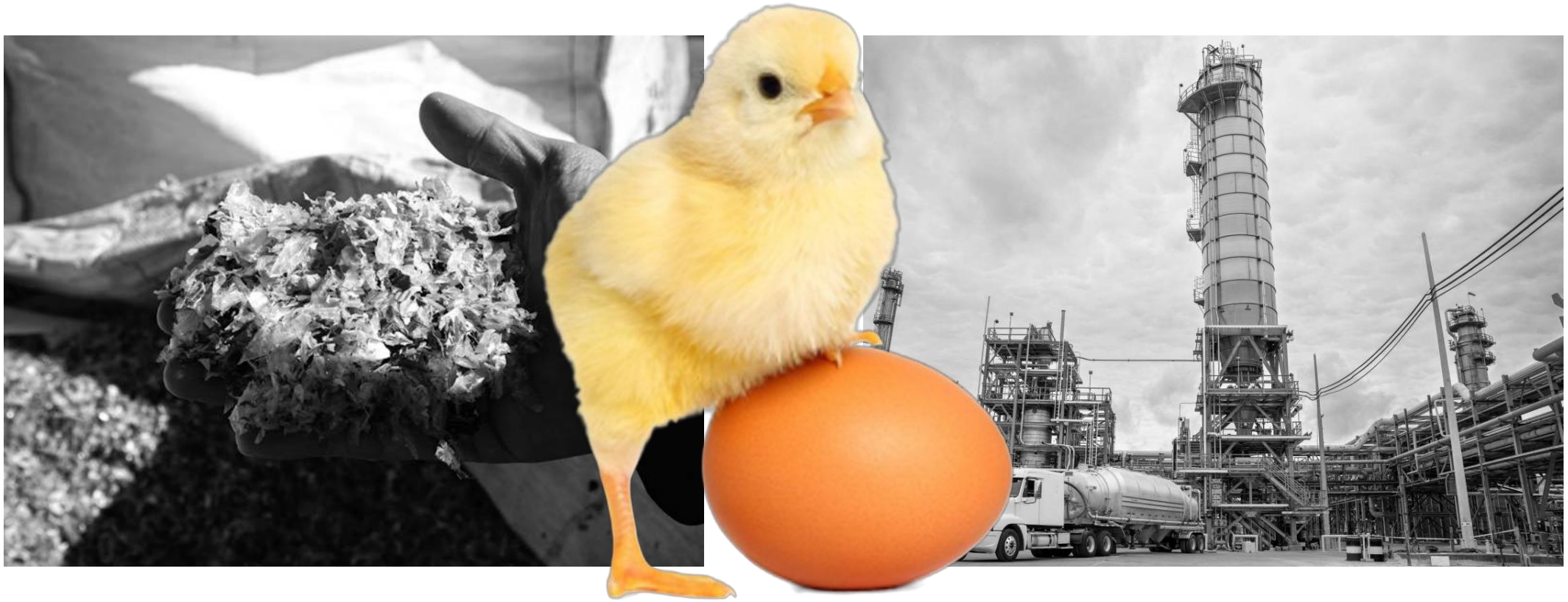
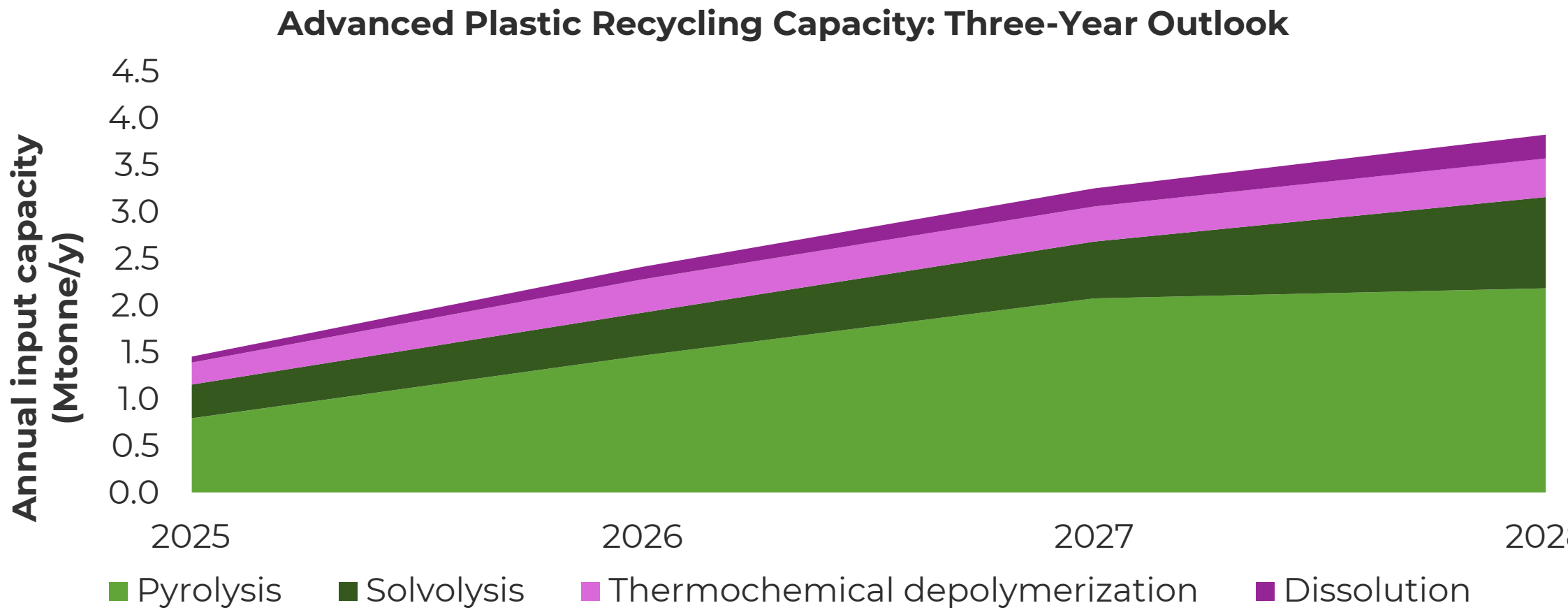


Image source: ExxonMobil

There’s already 1.5 Mtonne/y of capacity



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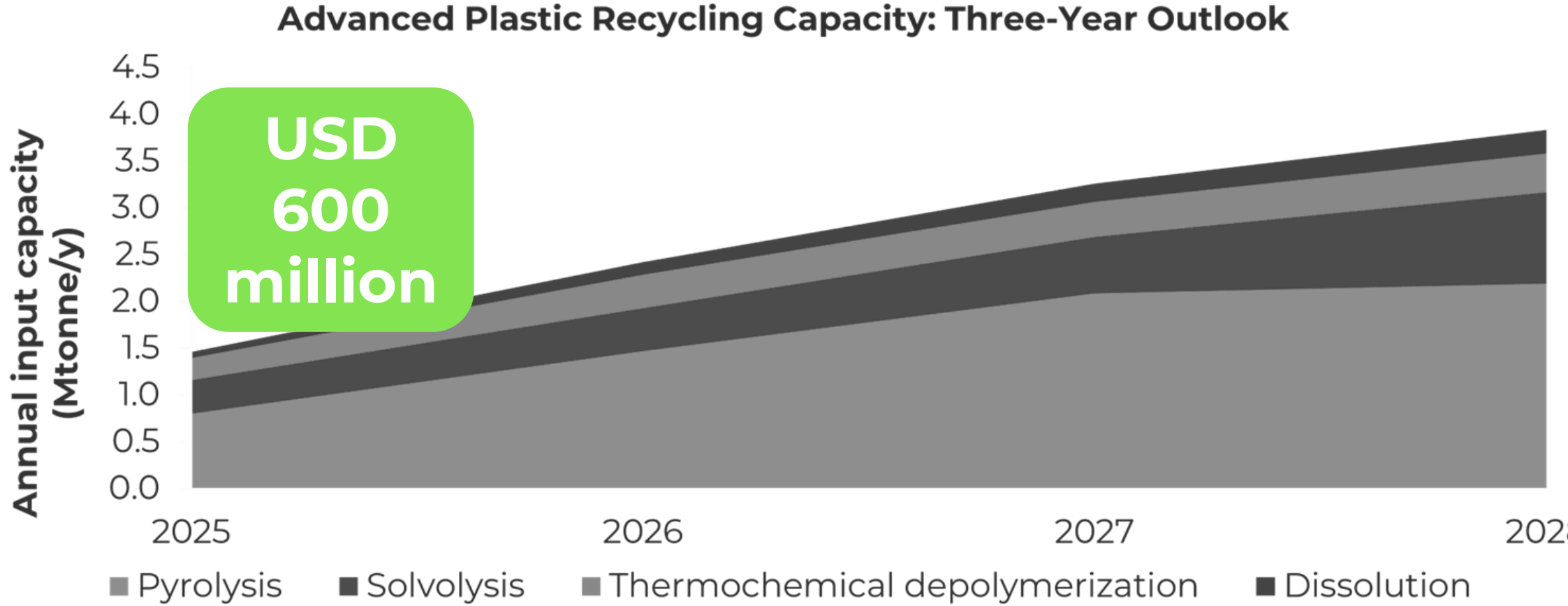


The value chain is starting to move forward

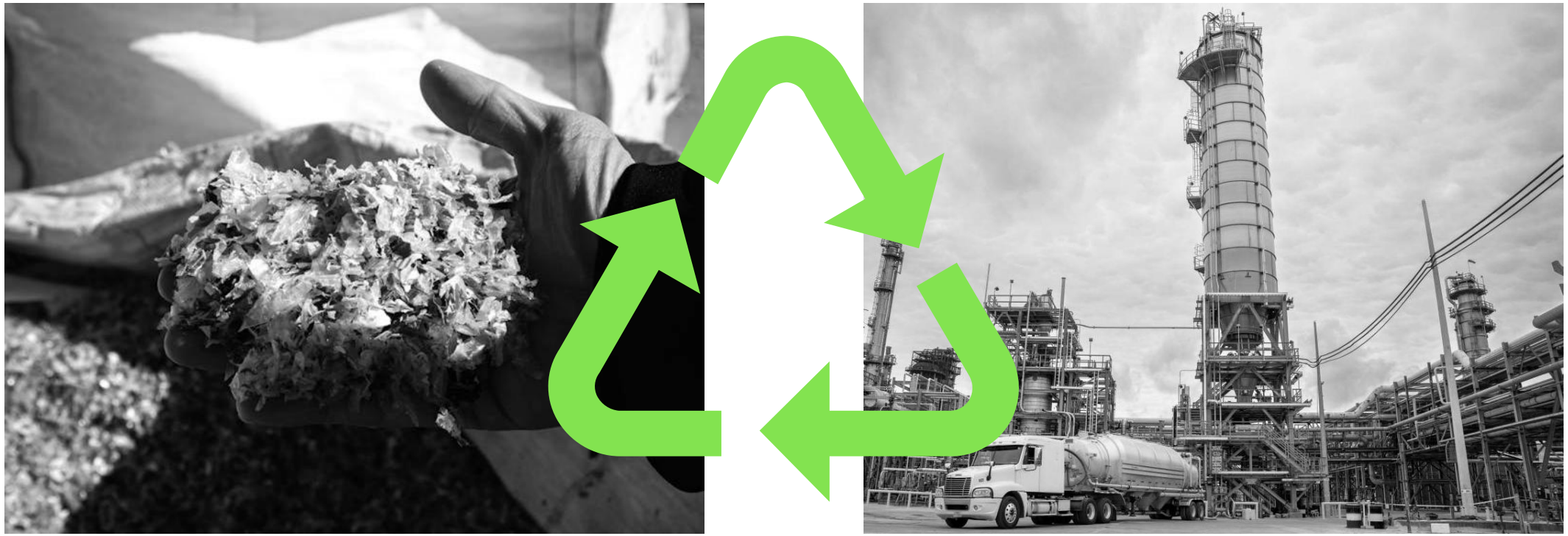


Image source: ExxonMobil

EU recycled content deadlines are approaching

Packaging
Recycled content targets*

Vehicles
Recycled plastics in new vehicles**

	2030	2040
Contact-sensitive PET:	30%	50%
Contact-sensitive non-PET:	10%	25%
Non-contact sensitive:	35%	65%

	~2033 (est.)	~2037 (est.)
Plastics in new vehicles:	15%	25%

*EU Packaging and Packaging Waste Regulation (PPWR), ** End-of-Life Vehicles / Vehicle Circularity Regulation

Is it time to invest in advanced plastic recycling?

Agenda

01 | **Calculating risk and return for a FOAK plant**

02 | Scenario-building for future developments

03 | Conclusions and outlook

Image source: Plastic Energy

Evaluating the reward and the risk

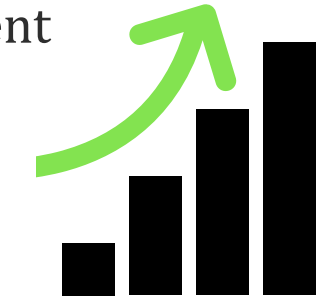
Internal Rate of Return (IRR)

The **rate of return** a project or investment is expected to generate.

$$\text{IRR} = \frac{(\text{Cash flows})}{(1+r)^i} - \text{initial investment}$$

$i = \text{Time period}$

$r = \text{Discount rate}$



Risk

The **uncertainty** that the expected results will happen.

Evaluating the reward and the risk

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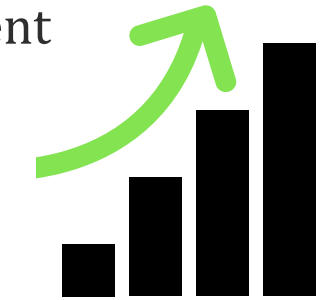


Risk

The **uncertainty** that the expected results will happen.

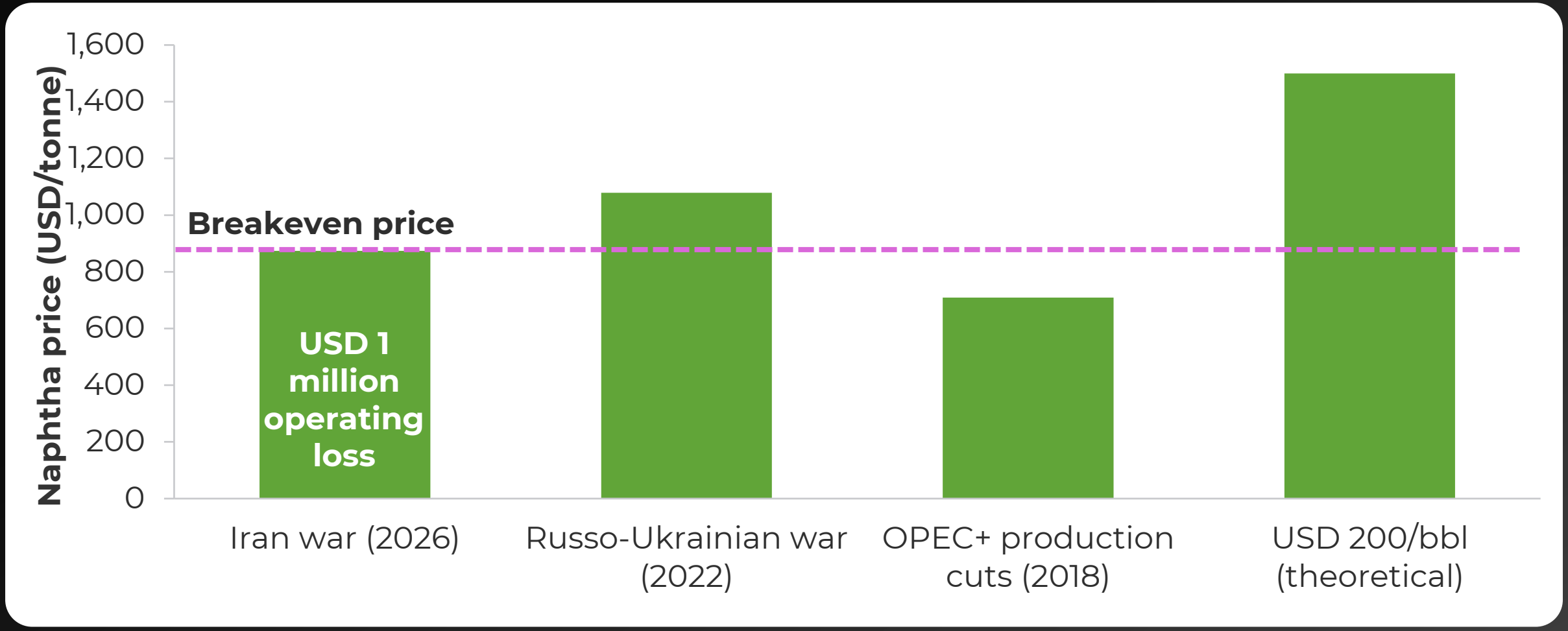
We have actual data on plant economics

Building a FOAK plastic pyrolysis plant

Parameter	Value
Size (input)	25,800 tonne/y
Capex	USD 80.7 million
Opex	USD 850/tonne
Pyrolysis oil price	Unknown

Image source: Plastic Energy

What if we project based on naphtha peaks?



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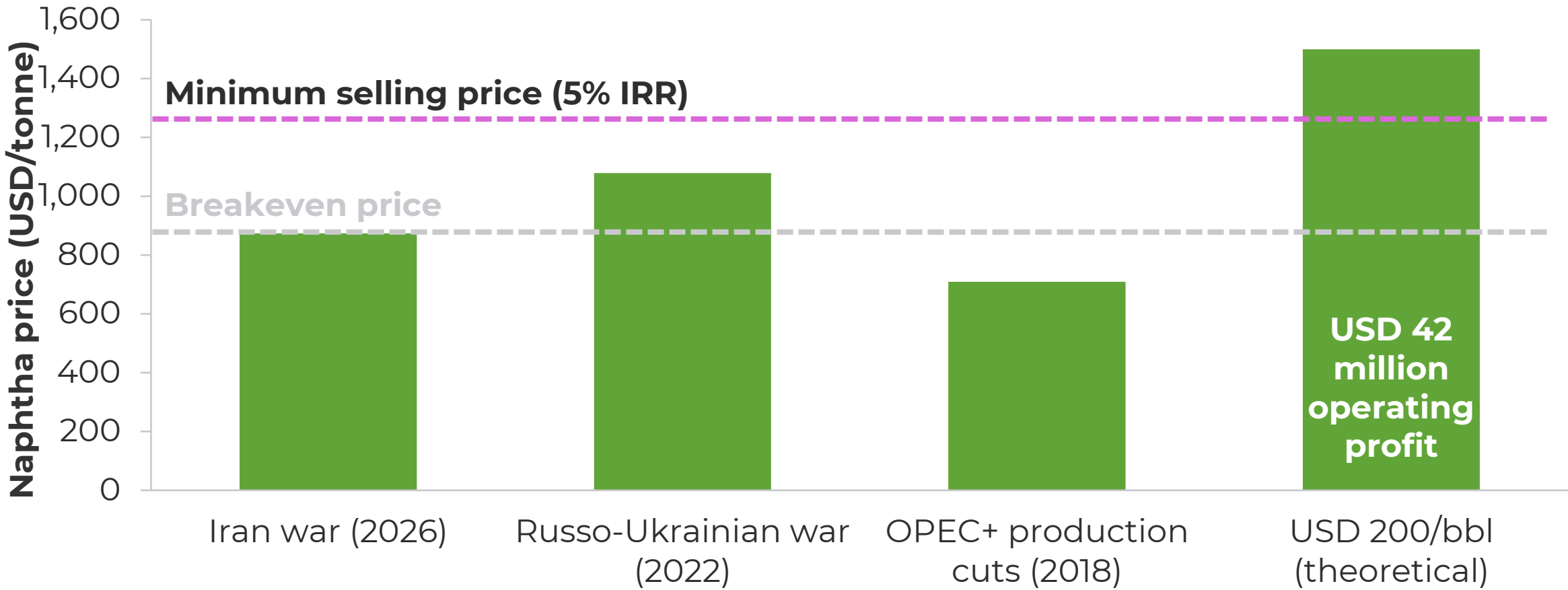

Variability in our parameters represents risk

Internal Rate of Return (IRR)

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$$\text{IRR} = \frac{(\text{Cash flows})}{(1+r)^i} - \text{initial investment}$$

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Risk

The **uncertainty** that the expected results will happen.

Two main sources of risk

1

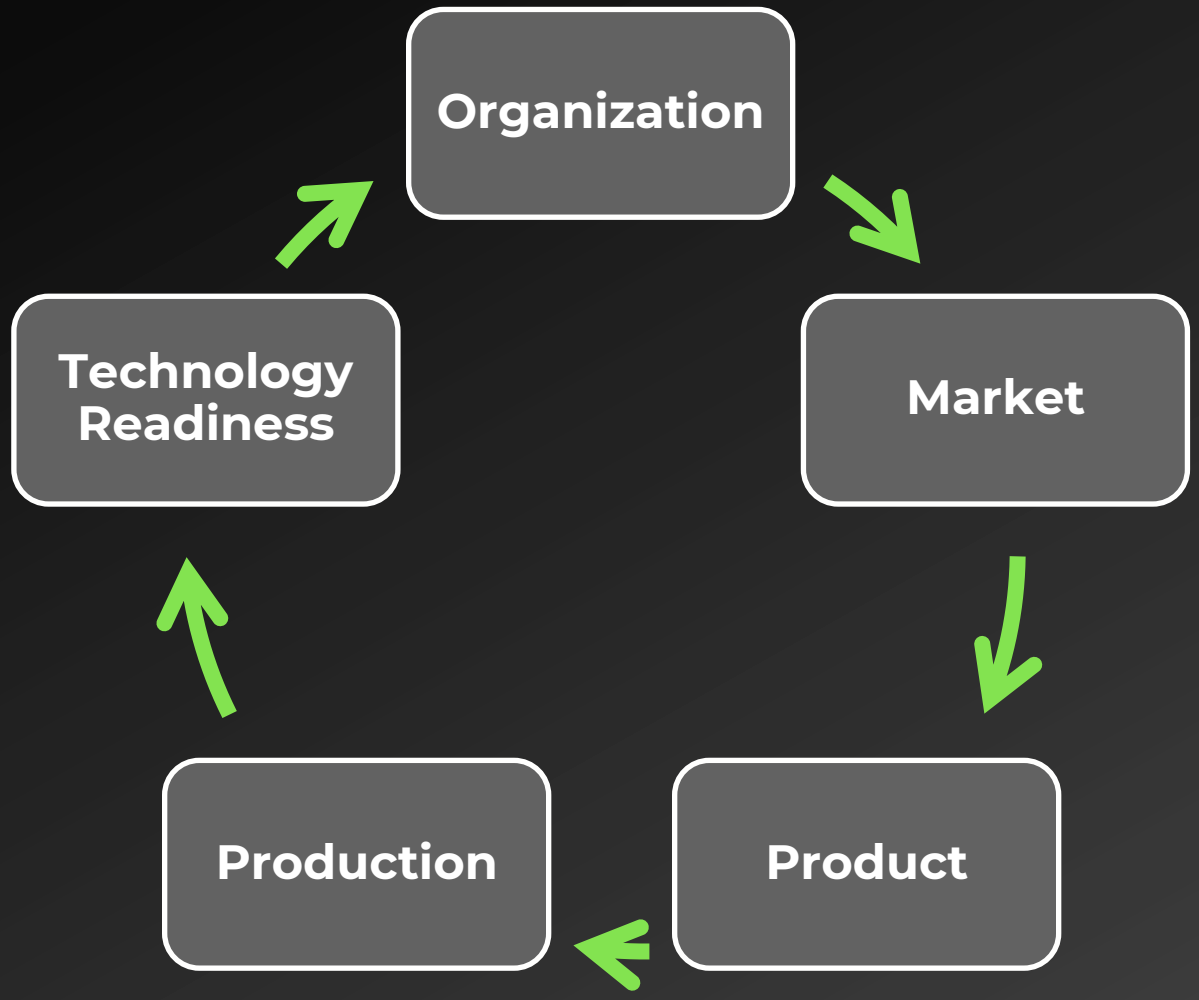
Inherent uncertainty in large capex projects

Parameter	Base Uncertainty
Capex	2%
Opex	20%
Pyrolysis oil price	16%

Two main sources of risk

2

Innovation maturity



Innovation maturity

Adds uncertainty to the base uncertainty

0% (low)

20% (high)

Parameter	Base Uncertainty
Capex	2%
Opex	20%
Pyoil price	16%

Innovation maturity

Organization

Market

Product

Production

Technology Readiness

Image source: Plastic Energy

Regulations uncertain; supply chain nascent

Organization

Low maturity: +20% to opex uncertainty

Image source: Plastic Energy

Addressable market in the triple-digit billions, but it's largely driven by speculation

Market

Medium maturity: +10% to pyrolysis oil price uncertainty

Image source: Plastic Energy

Pyrolysis is “known,” but specifications vary

Product

Medium maturity: +10% to pyrolysis oil price uncertainty

Image source: Plastic Energy

100,000-tonne/y plants have been built

Production

High maturity: No change to uncertainty

Image source: Plastic Energy

Pyrolysis is mature and operational

High maturity: No change to uncertainty

Technology Readiness

Image source: Plastic Energy

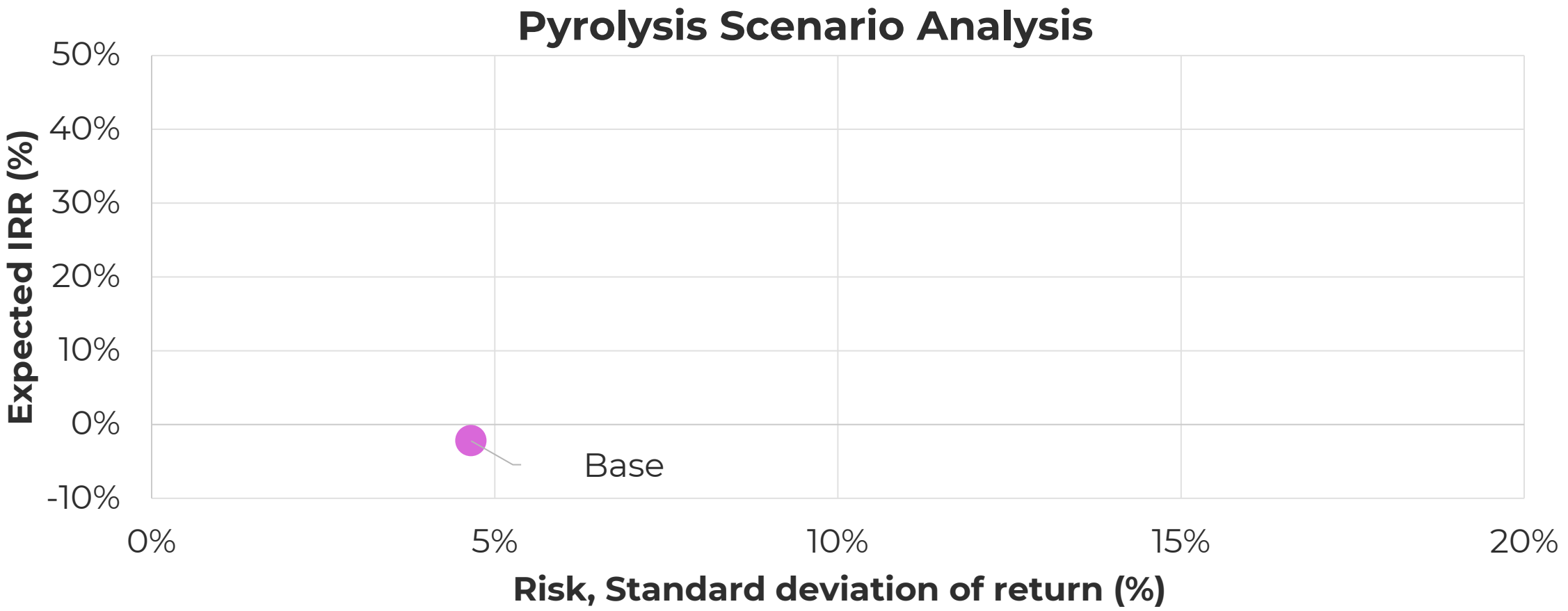
Predicting average IRR and risk

Parameter	Value	Uncertainty Margin
Size (input)	25,800 tonne/y	–
Capex	USD 80.7 million	**2%**
Opex	USD 850/tonne	**21.6%**
Base price	USD 580/tonne	**19.2%**

Monte Carlo simulations

Average IRR and its variability

The base case has a negative expected IRR



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02 | **Scenario-building for future developments**

03 | Conclusions and outlook

Scenario 1:
Feedstock supply infrastructure

Scenario 2:
Recycled content mandates

Scenario 3:
Mass balancing goes into effect

Scenario 1: Feedstock supply infrastructure

Reduce feedstock costs by 25% and opex uncertainty by 10%

Parameter	Value	Uncertainty Margin
Size (input)	25,800 tonne/y	–
Capex	USD 80.7 million	2%
Opex	USD 785/tonne	19.8%
Base product price	USD 580/tonne	19.2%

Feedstock costs have little impact on IRR

Reduce feedstock costs by 25% and opex uncertainty by 10%

Parameter	Value	Uncertainty Margin
Size (input)	25,800 tonne/y	–
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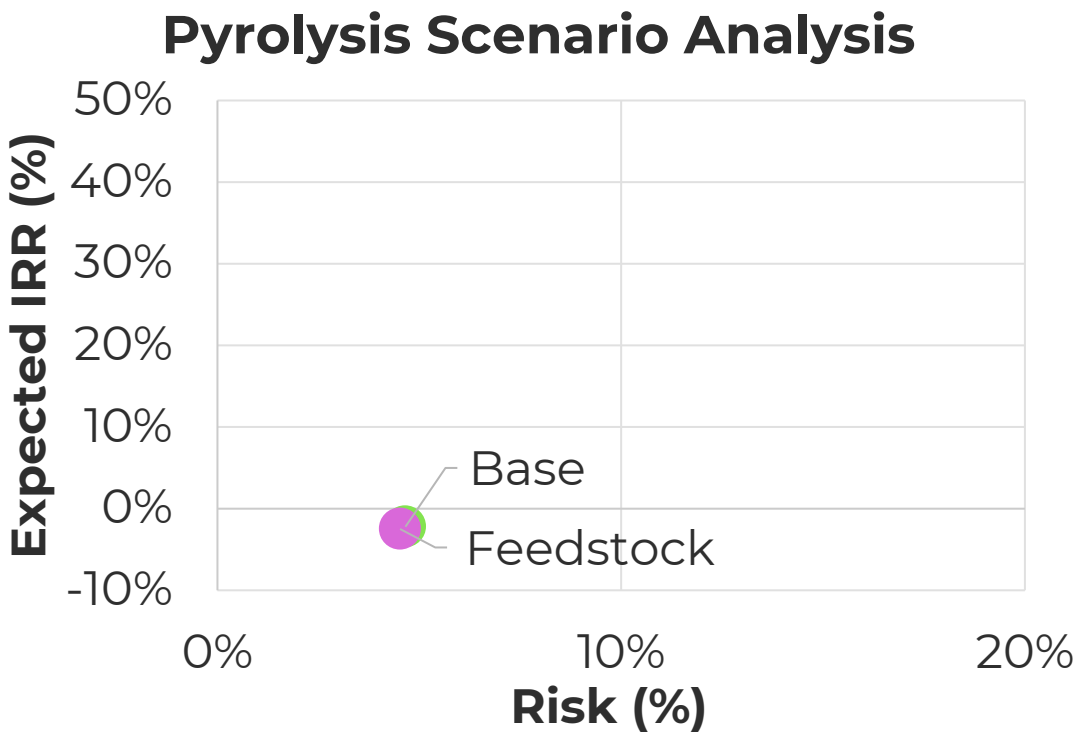

Scenario 1:

Feedstock supply infrastructure

Scenario 2:

Recycled content mandates

Scenario 3:

Mass balancing goes into effect

Scenario 2: Recycled content mandates

Product is 3× base case, and price uncertainty drops by 10%

Parameter	Value	Uncertainty Margin
Size (input)	25,800 tonne/y	–
Capex	USD 80.7 million	2%
Opex	USD 850/tonne	21.6%
Base product price	USD 1,740/tonne	17.6%

Recycled content mandates can push IRR into the double-digits

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Parameter	Value	Uncertainty Margin
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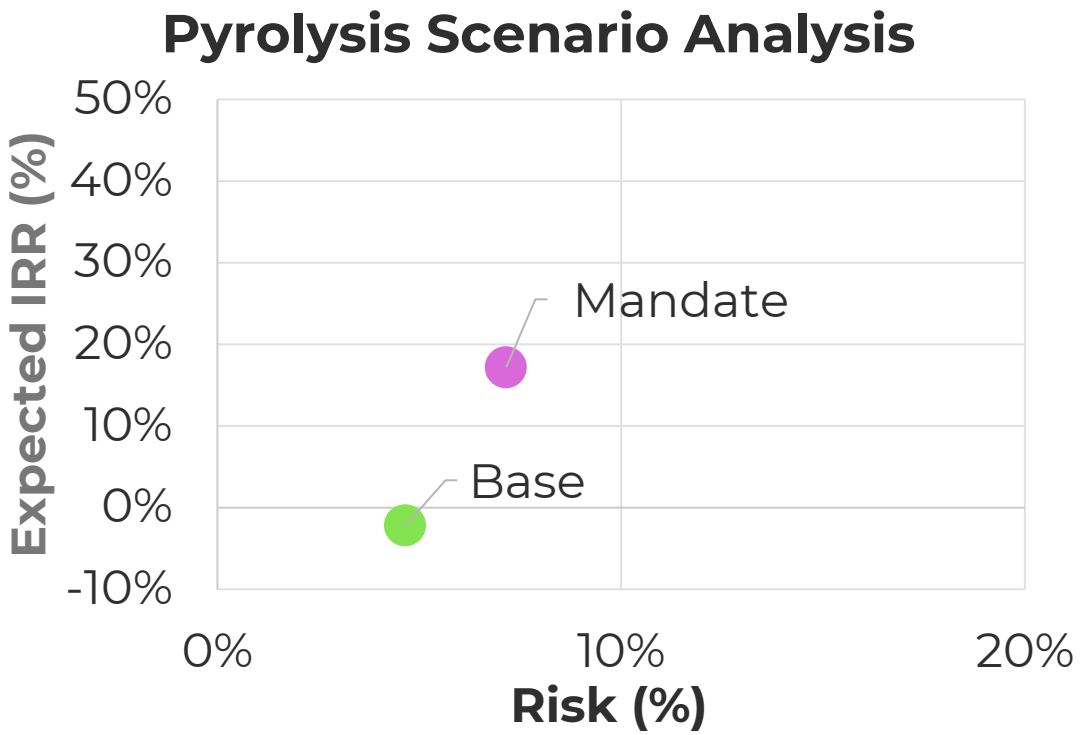

Scenario 1:

Feedstock supply infrastructure

Scenario 2:

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Scenario 3:

Mass balancing goes into effect

Scenario 3: Mass balancing goes into effect

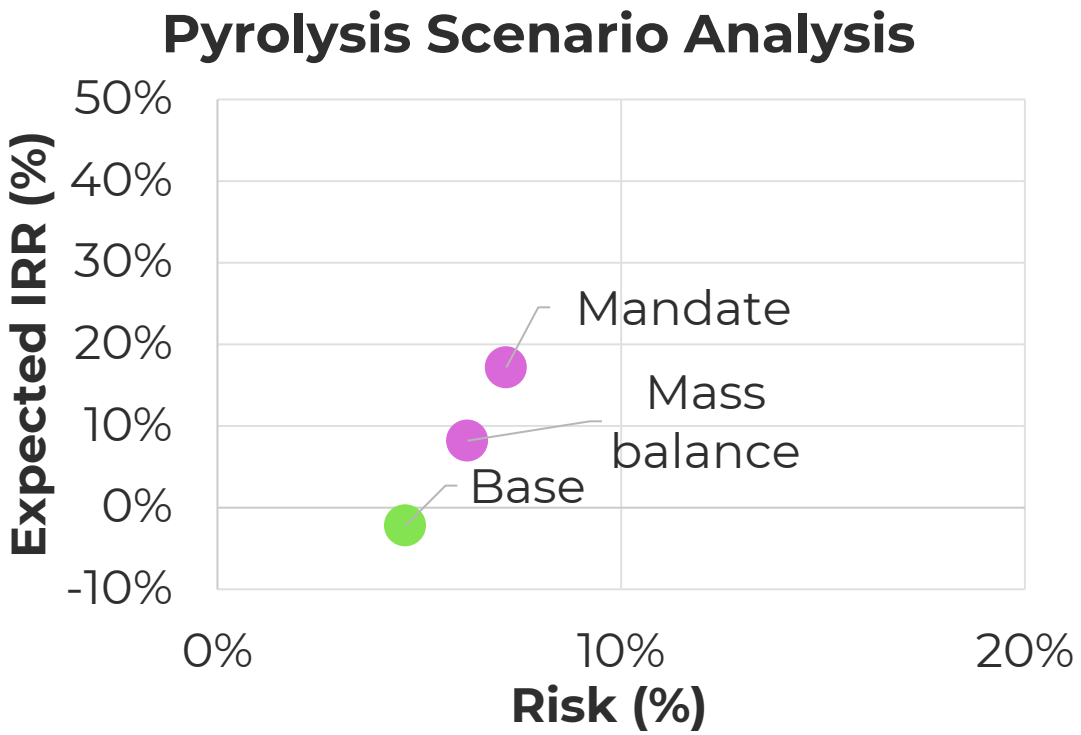
Recycled content premiums halve and price uncertainty drops by 10%

Parameter	Value	Uncertainty Margin
Size (input)	25,800 tonne/y	–
Capex	USD 80.7 million	2%
Opex	USD 850/tonne	21.6%
Base product price	USD 1,247/tonne	17.6%

Fuel-exempt mass balancing kills the investment case

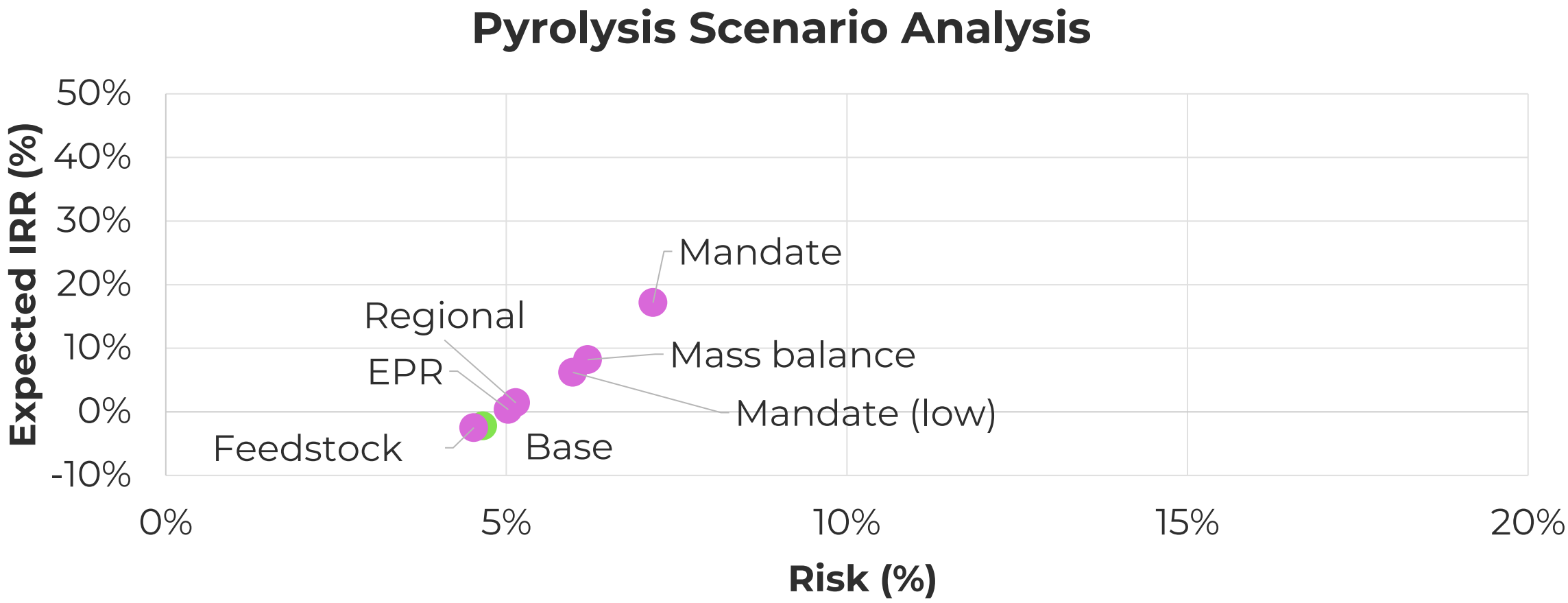
Recycled content premiums halve and price uncertainty reduces by 10%

Parameter	Value	Uncertainty Margin
Size (input)	25,800 tonne/y	-
Capex	USD 80.7 million	2%
Opex	USD 850/tonne	21.6%
Base product price	USD 1,247/tonne	17.6%



There are other scenarios we can consider

Recycled content mandates still have the single greatest impact on the plant IRR



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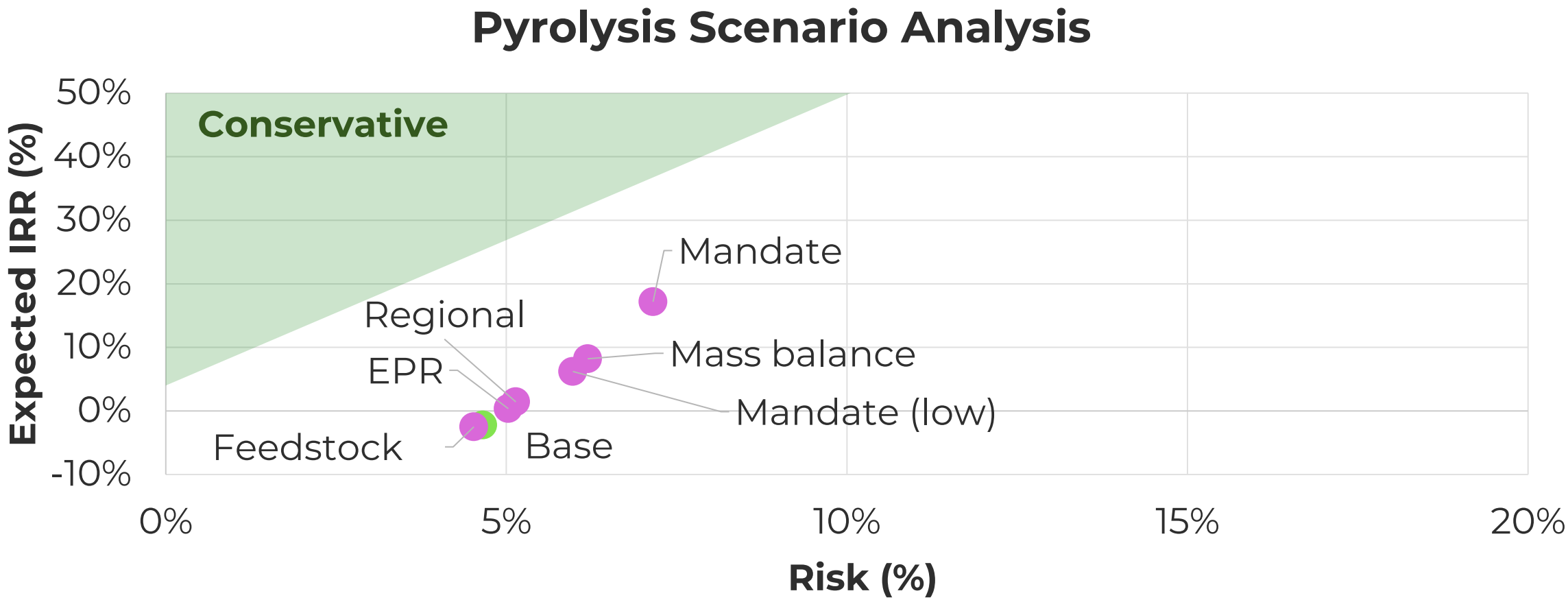
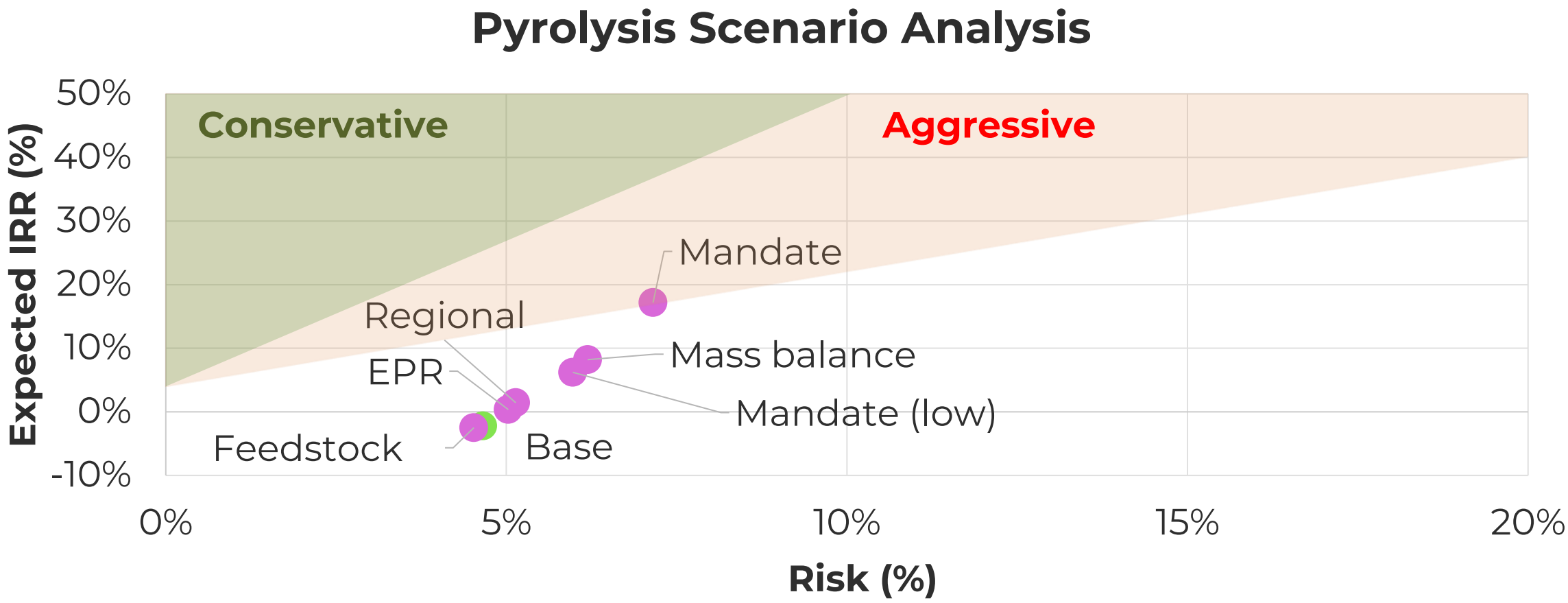
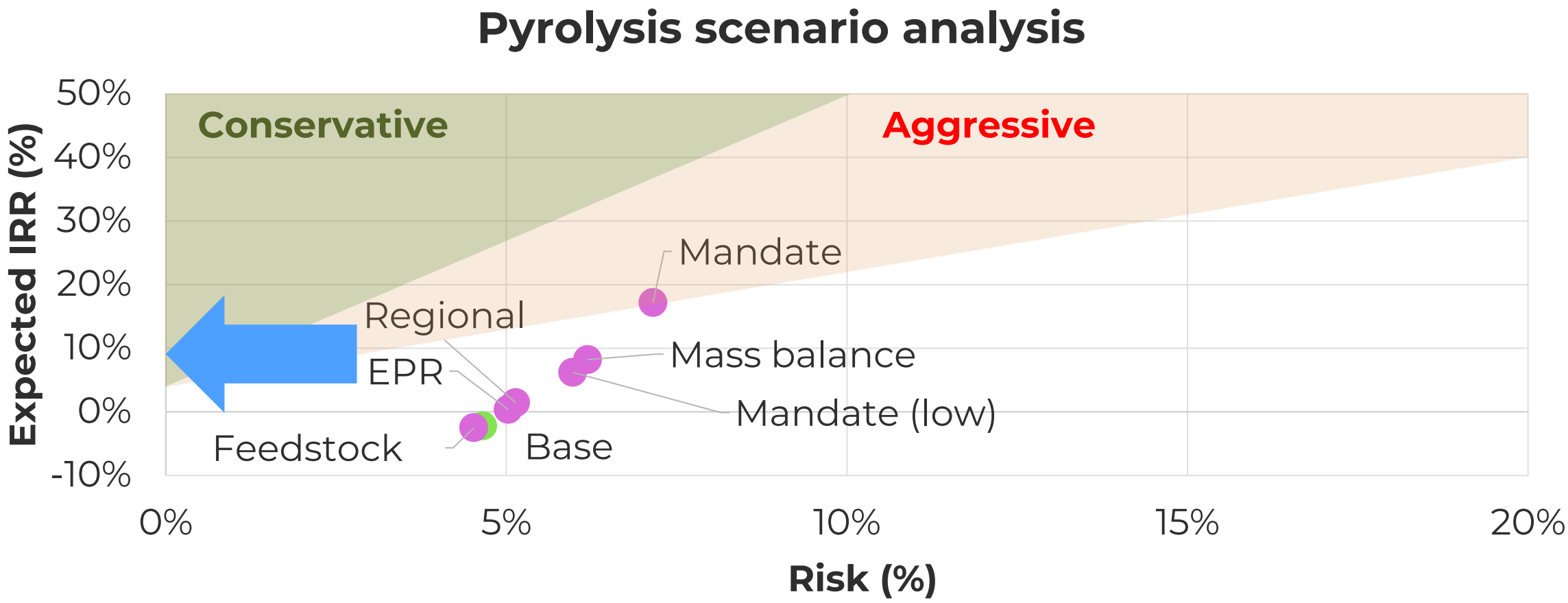
Plastic pyrolysis is not attractive for the conservative investor



It may start making sense for a risk taker, but with some caveats



We can also take steps to derisk and sweeten the investment case



In all likelihood, investing in plastic pyrolysis today is not worth the risk.

Key levers for making the investment case

Feedstock availability is more important than cost.

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Lower technology costs is almost a nice-to-have.

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Lower technology costs is almost a nice-to-have.

Product price is the biggest lever to pull.

There could be more than pure financial returns

REUTERS

Asian refineries, petchem firms cut runs as Iran war disrupts supplies

cna

Philippines declares energy emergency over Middle East conflict risks

ALJAZEERA

Southeast Asia shuts offices, limits travel as oil crisis deepens

A chicken-and-egg dilemma no more

We’ve broken out of the chicken-and-egg cycle

Key Takeaways

1

Be precise about how the technology is deployed.

The target applications and markets determine the risk-reward tradeoff.

2

Prioritize technologies that deliver high yields of valuable recycled outputs rather than those that offer only marginal cost reductions.

The investment case usually crumbles without a significant premium.

3

Look beyond the dollars and cents.

Costs that appear significant for day-to-day profitability may negligibly affect long-term IRR, and there could be more to value than pure financial returns.

Thank You

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