THE ECONOMICS OF NUCLEAR POWER

Reinhard HAAS

Vienna University of Technology

CONTENT:

1. Introduction
2. Cost components
3. Technological learning
4. Recent developments of costs
5. Nuclear vs energy conservation
6. Conclusions

1. INTRODUCTION

- **In the past: Nuclear is VERY cheap!**

- **Today: Nuclear is cheaper than the alternatives**

→ Objective of this presentation: …provide some stilized explanations and identify key patterns of the economic dynamics of nuclear power

A history of mistaken forecasts

"It is not too much to expect that our children will enjoy in their homes [nuclear generated] electrical energy ***too cheap to meter***."

Lewis Strauss
Chairman
US Atomic Energy Commission
1954

Source: Rogner IAEA (2006)

Energy Economics Group

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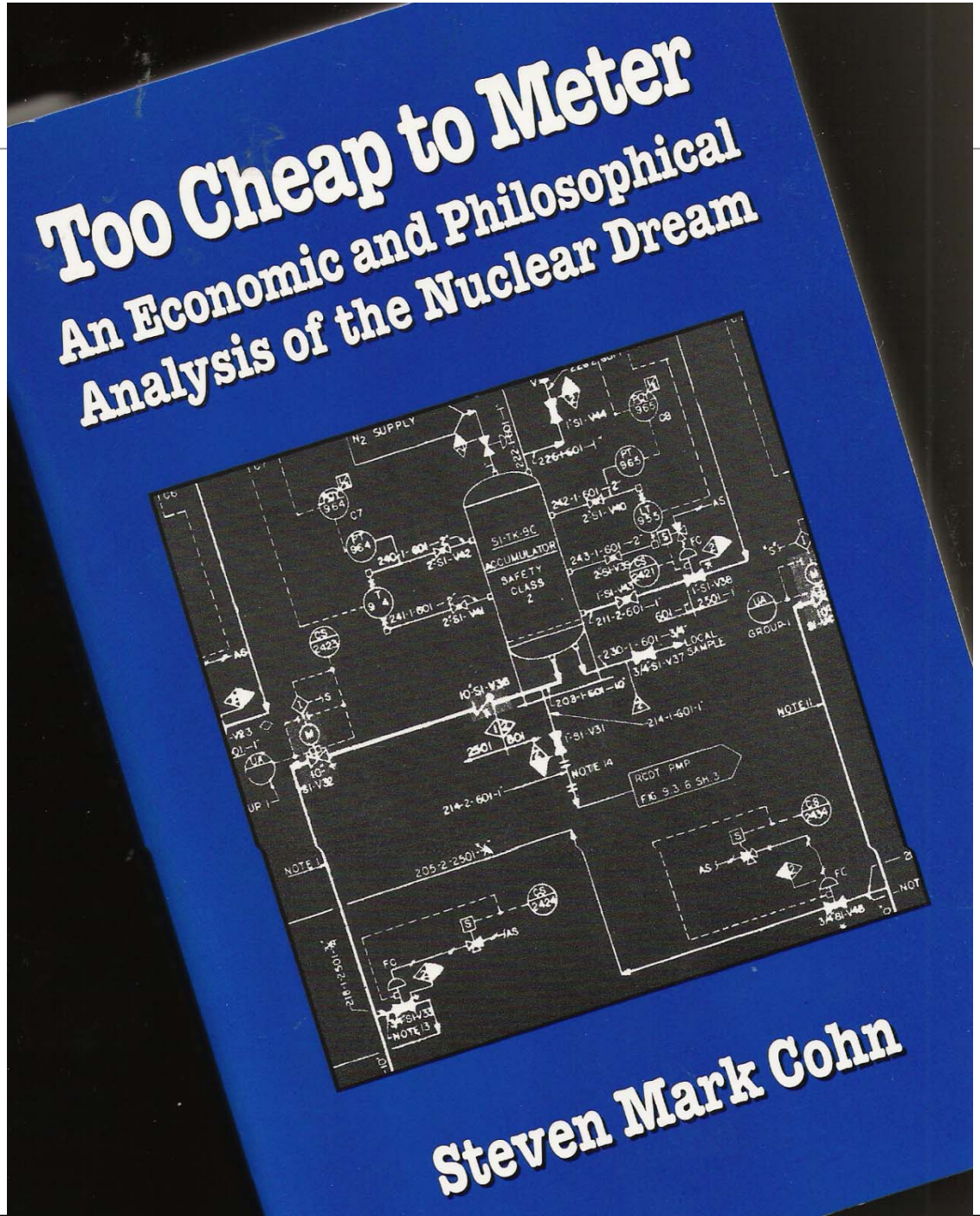


Three take-aways

- **Rising expectations**
- **One size does not fit all**
- **“It’s the economics, stupid”**

Source: Rogner IAEA (2006)

With respect to external/ social costs:

Benefits Privatized, Costs Mutualized

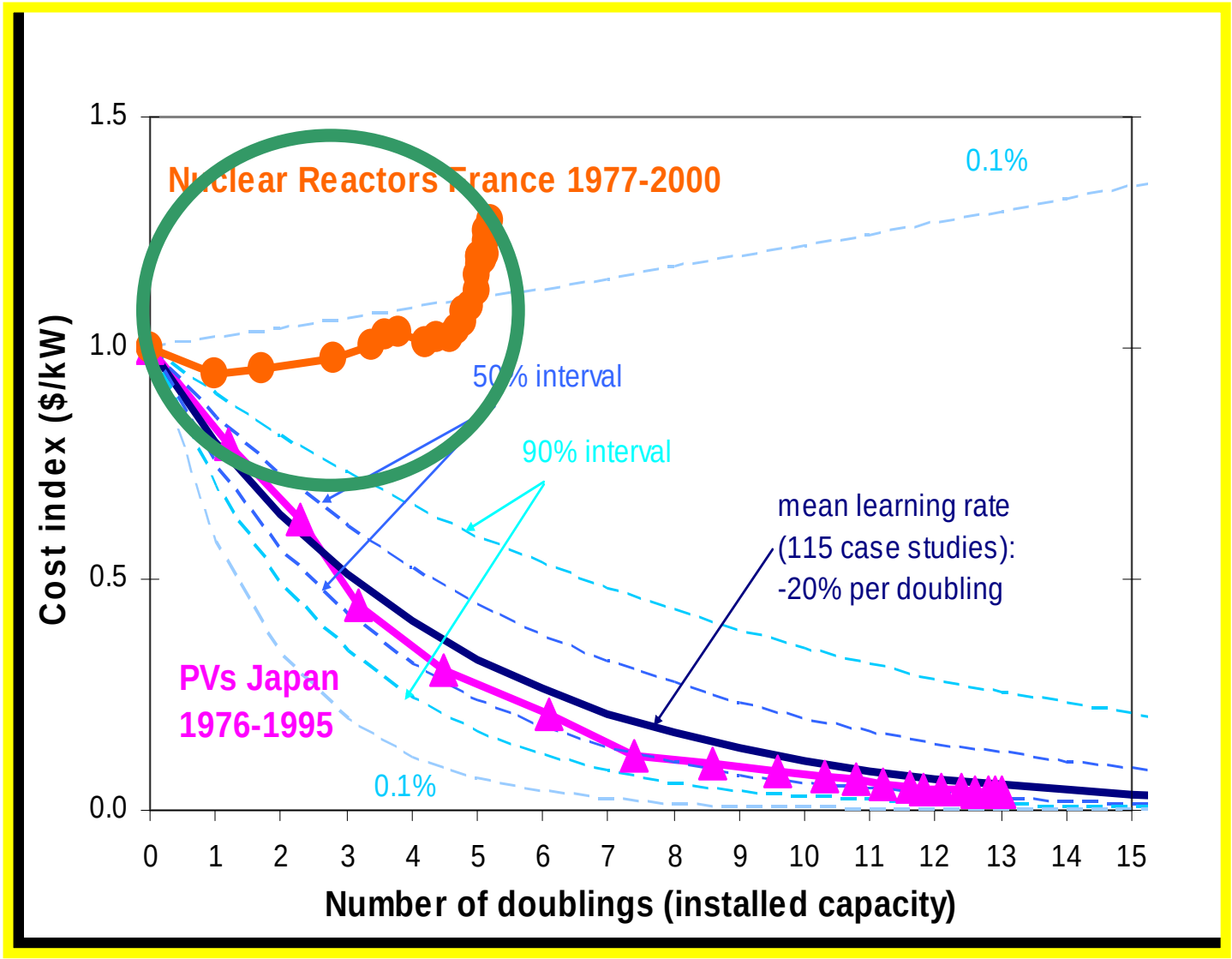
The total cost of a nuclear kWh most likely will never be known. Costs for waste management, decommissioning and clean-up are constantly on the rise and are generally expected to be paid for by the taxpayer, while in many countries beneficial power generation has been privatized. However, according to most international cost assessments, nuclear power generates by far the most expensive delivered energy. For new nuclear power to become competitive it would need substantial State subsidies in particular to provide guarantees against substantial financial and economic risks. [4]

Source: Mycle Schneider: The nuclear end game (2006)

3. TECHNOLOGICAL LEARNING (OR NOT)

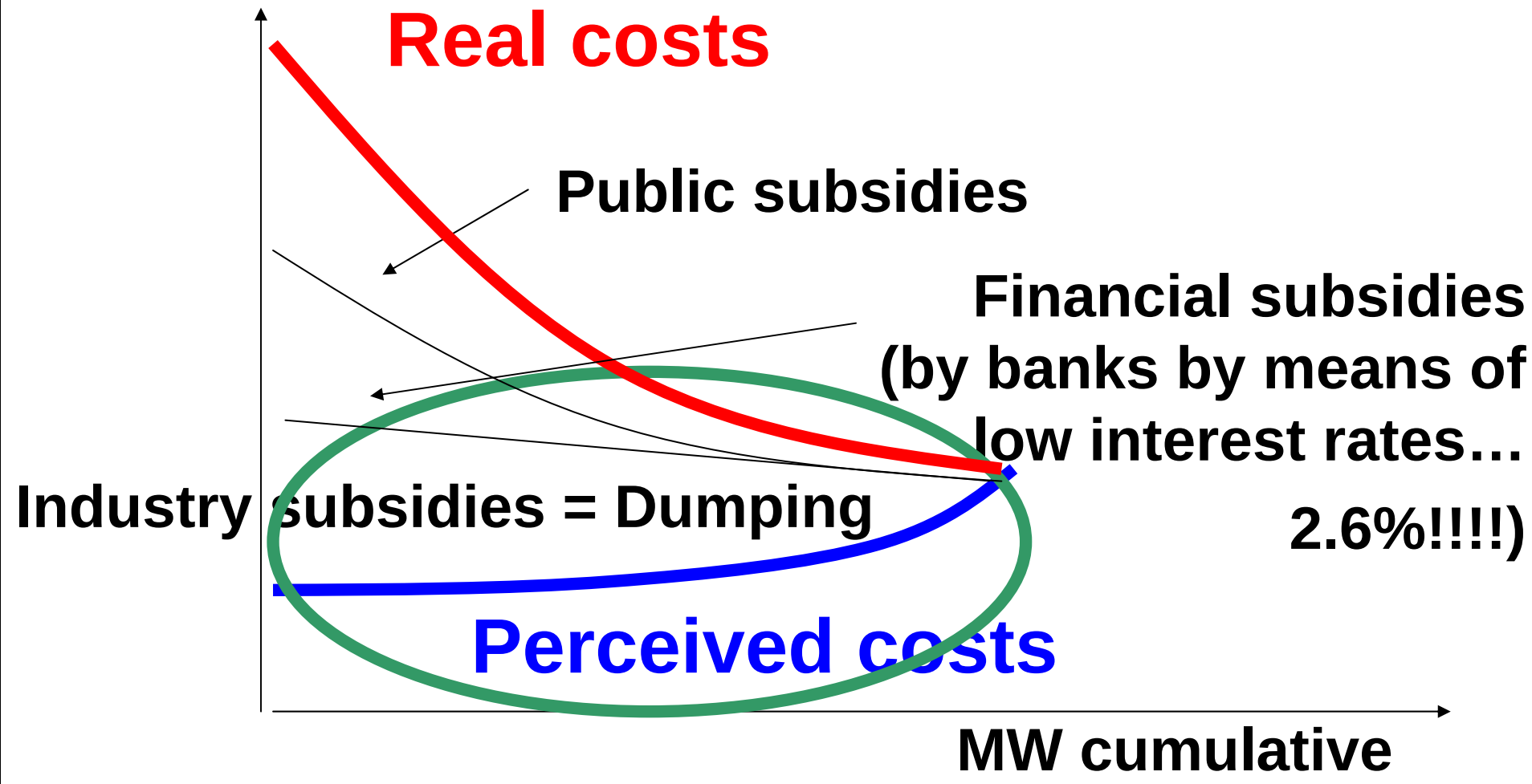
The impact of dumping and indirect subsidies (e.g. export guarantee for AVERA from French government for Olkiluoto, 2.6% nominal interest rate!!!!!!)

Technological Uncertainties: Learning rates (push) and market growth (pull)



Source: Nakicenovic, Schrattenholzer, Grübler various papers

Technological learning: why not for nuclear?

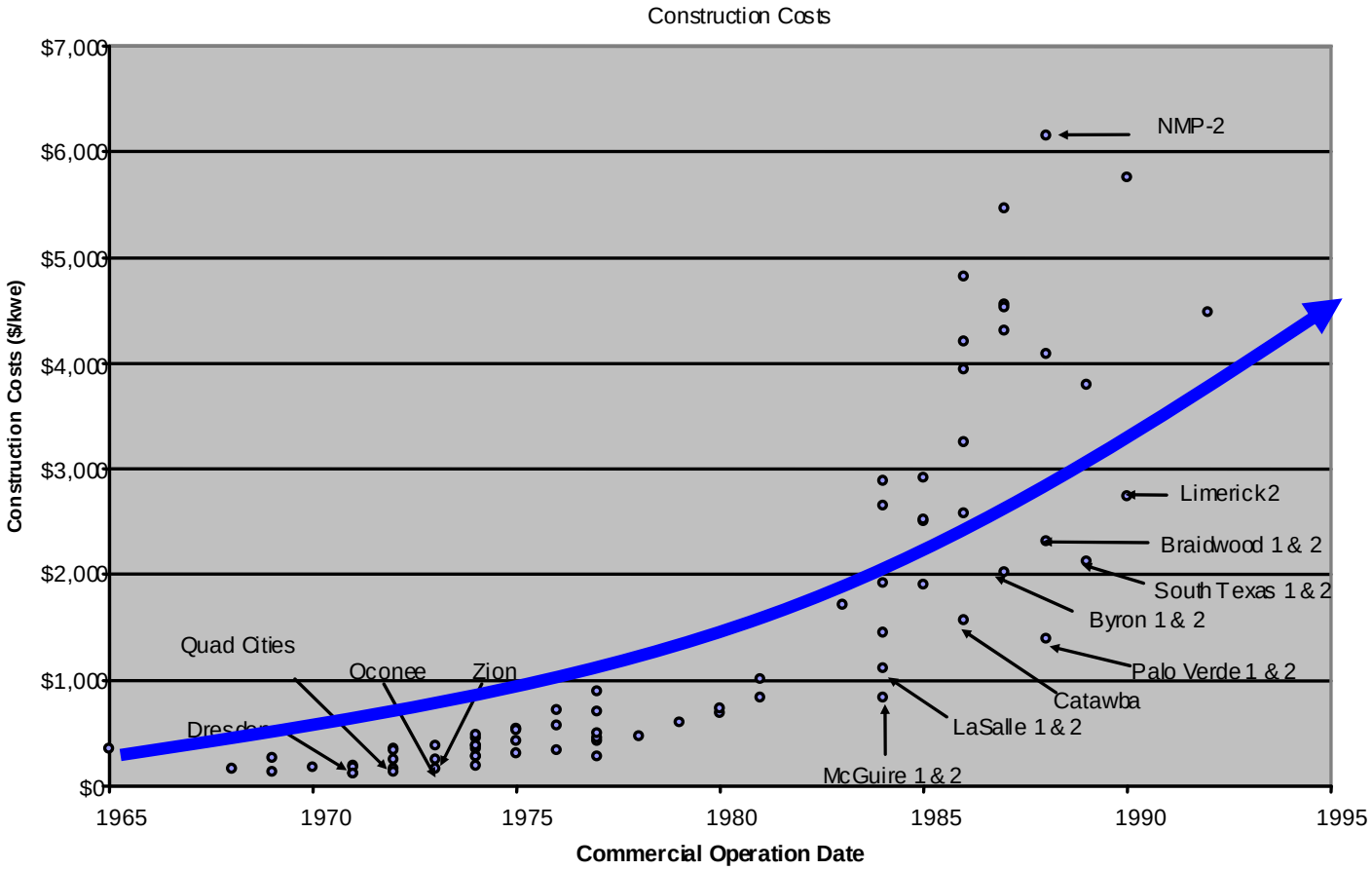


For further discussion of industry subsidies:
Steve Thomas: The economics of nuclear power (2005)

3. HOW DID INVESTMENT COST DEVELOP OVER TIME?

Constellation Energy — The way energy works.™

Background – Industry Experience "Last Time"



Source: Jim Harding: Seven Myths of the Nuclear Renaissance (2007)

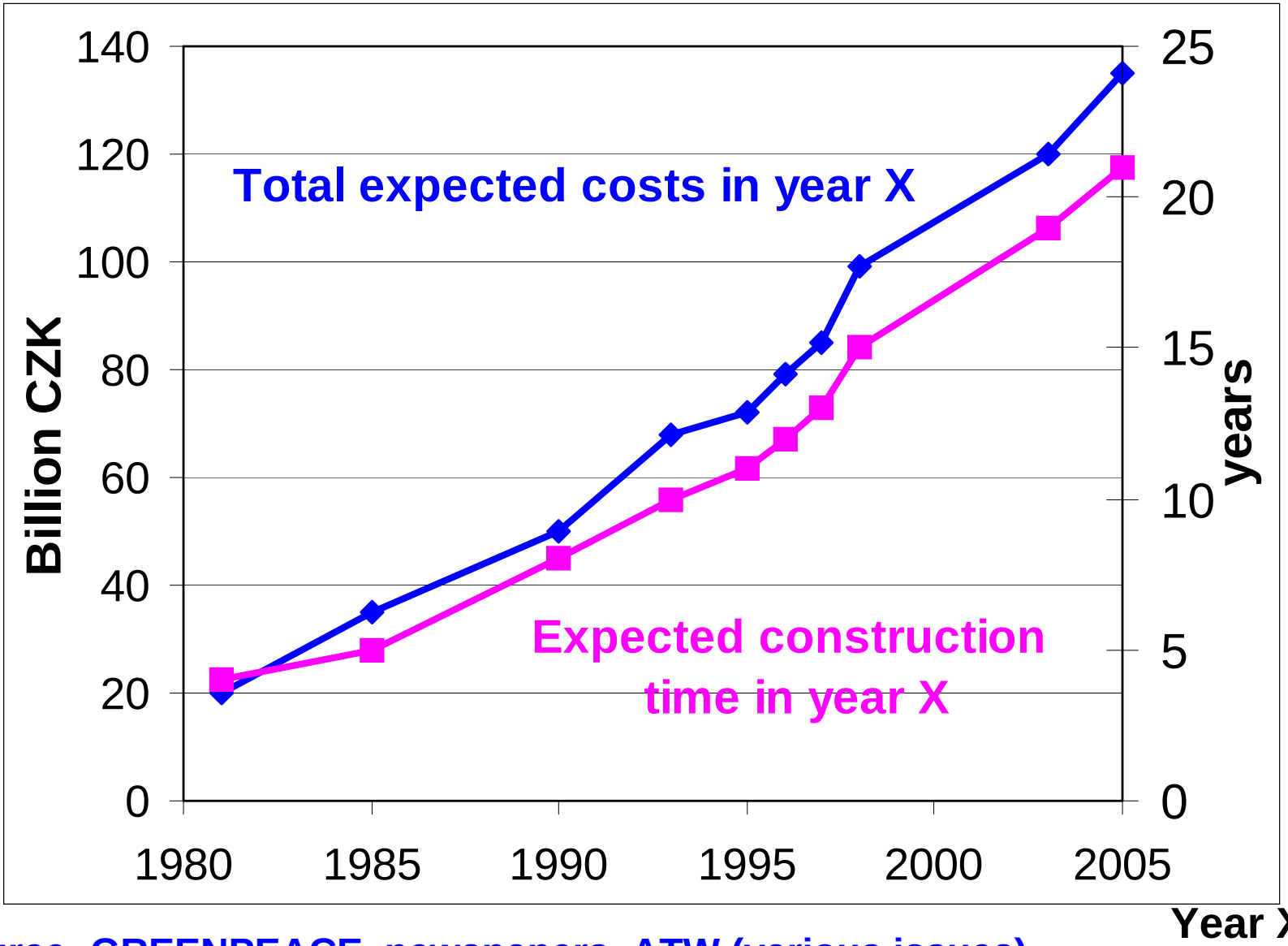
4. RECENT DEVELOPMENT OF NUCLEAR COSTS

SPECIFIC ASSUMPTIONS ON ECONOMIC ANALYSIS

- **Interest rate: 8%, depreciation time 25 years;**
- **fuel costs: 9 EUR/MWh up to 2007, slightly increasing afterwards**
- **other O&M costs: 9 EUR/MWh**
- **decomissioning costs: 1.5 EUR/MWh**

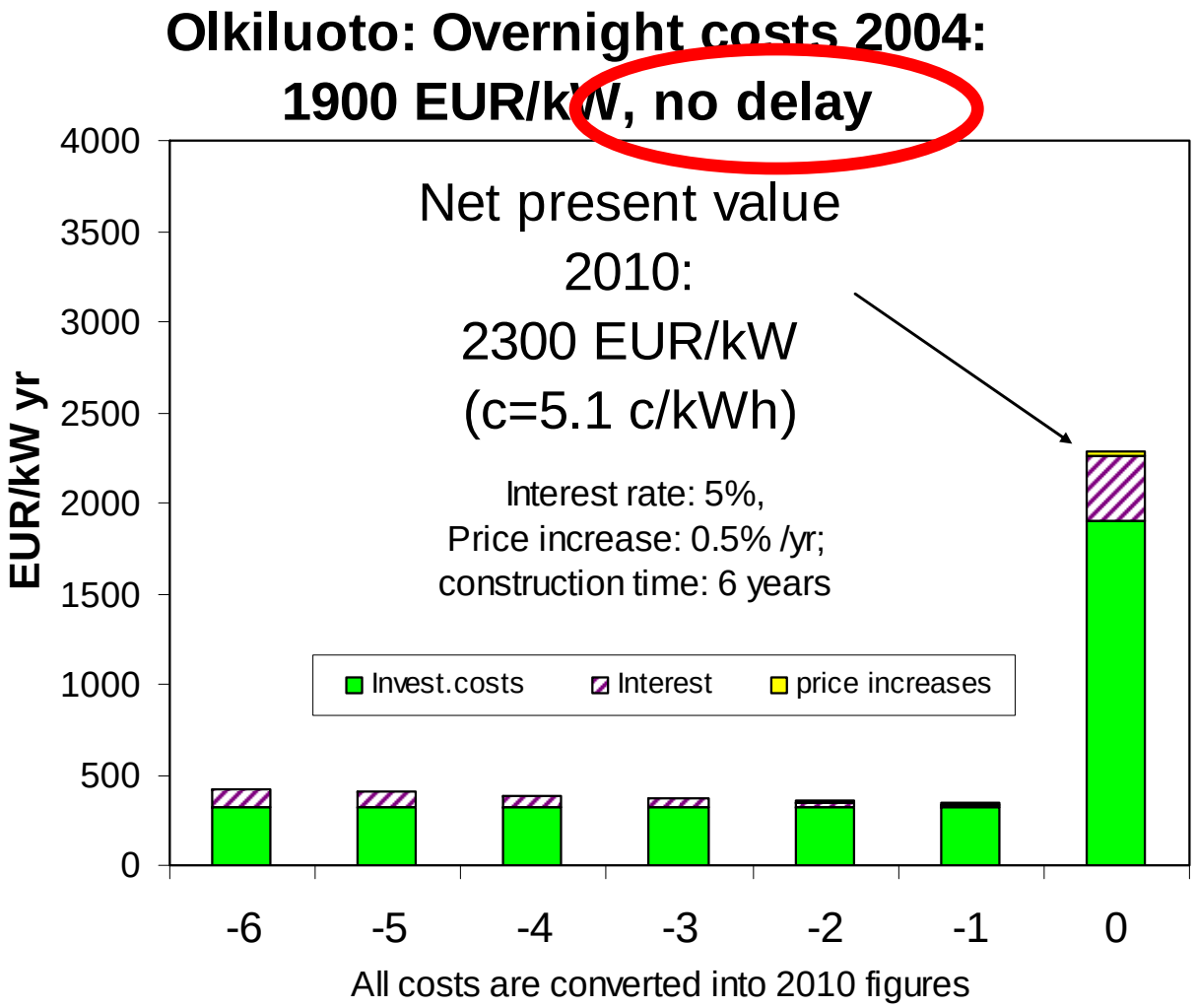
all cost figures are of 2010!

EXAMPLE TEMELIN

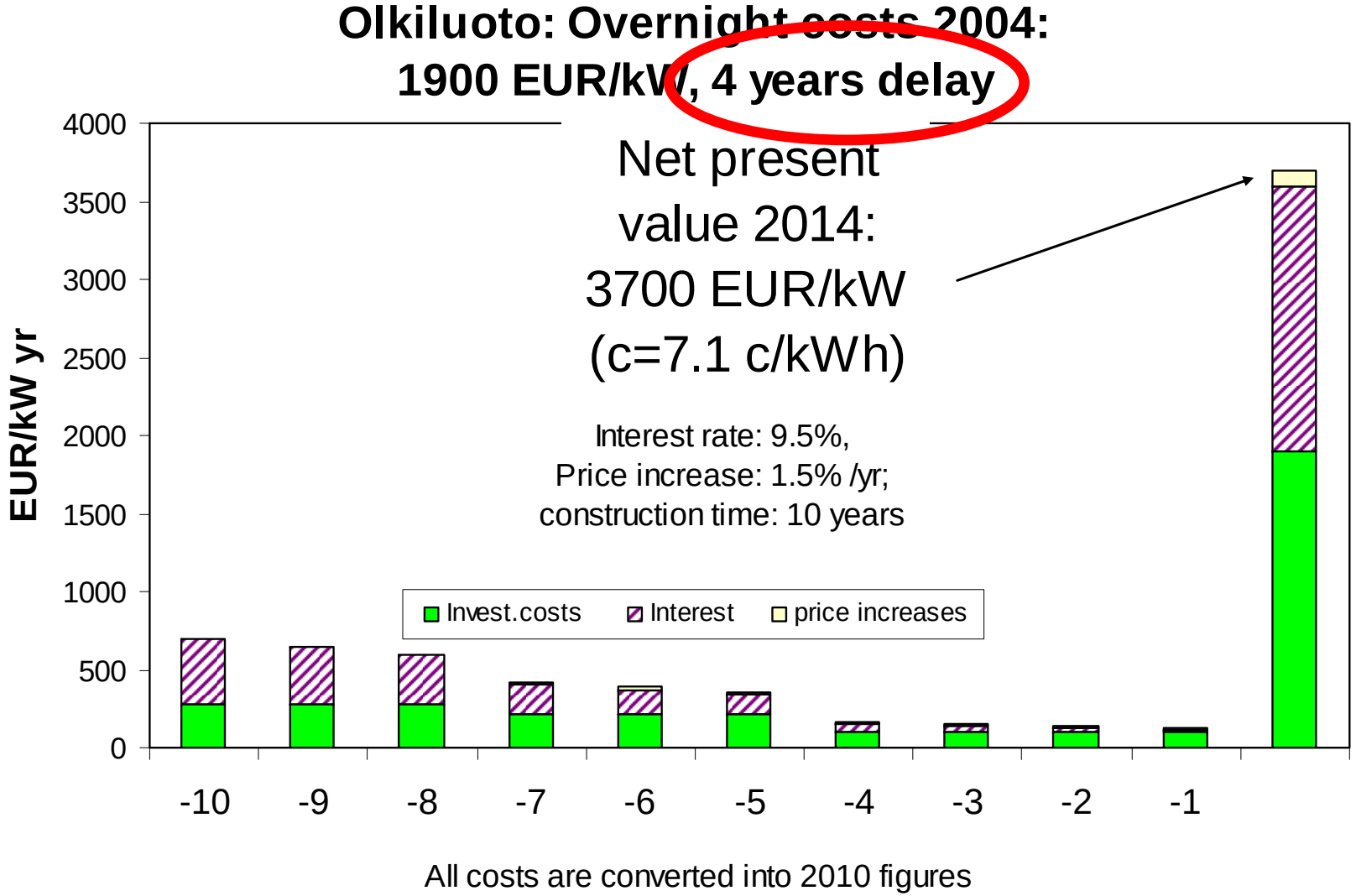


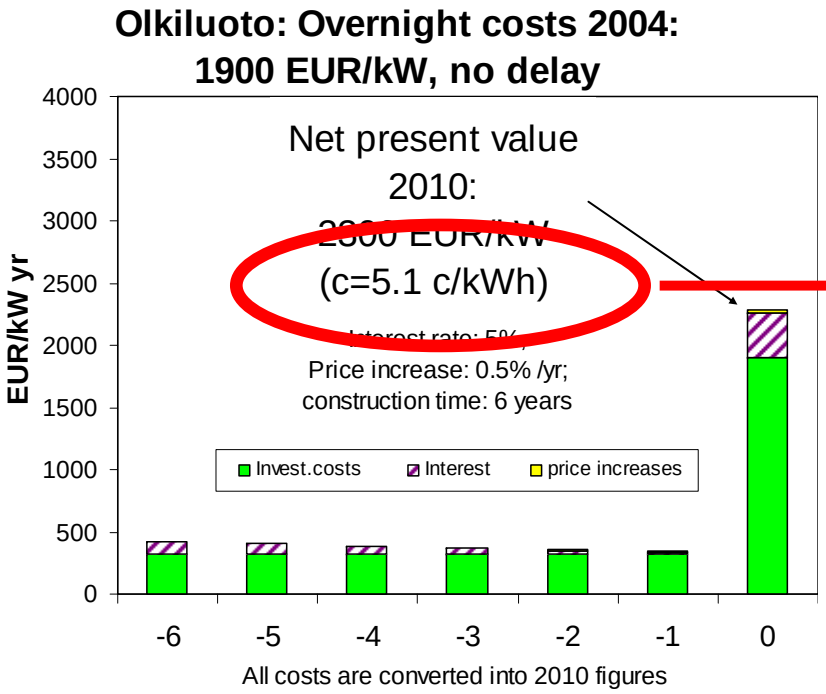
Source: GREENPEACE, newspapers, ATW (various issues)

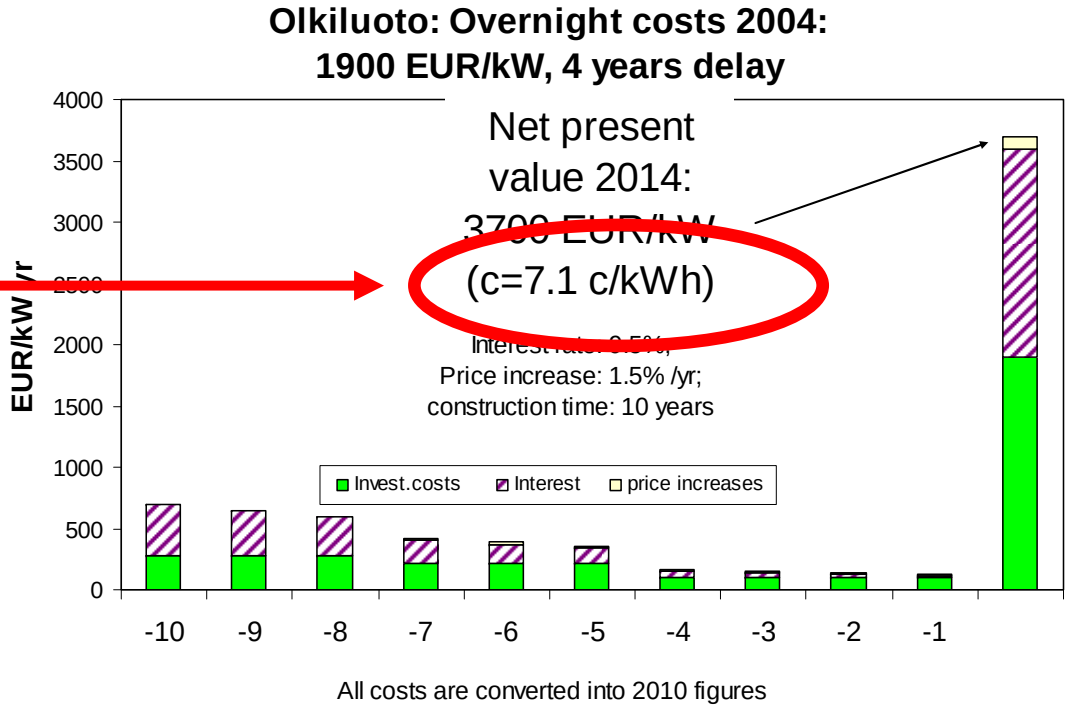
Impact of construction time on investment costs: Example Olkiluoto



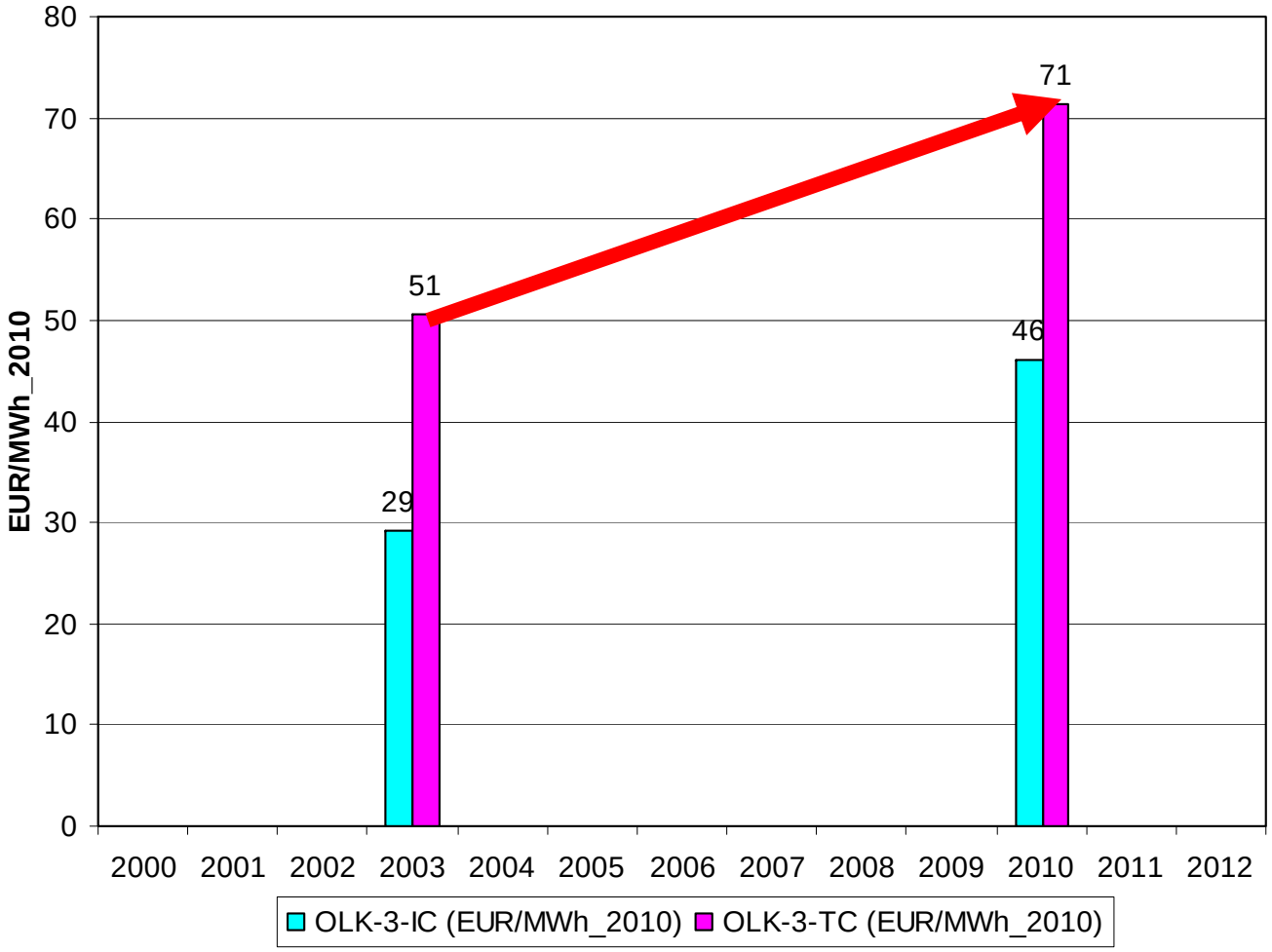
Impact of construction time on investment costs: Example Olkiluoto



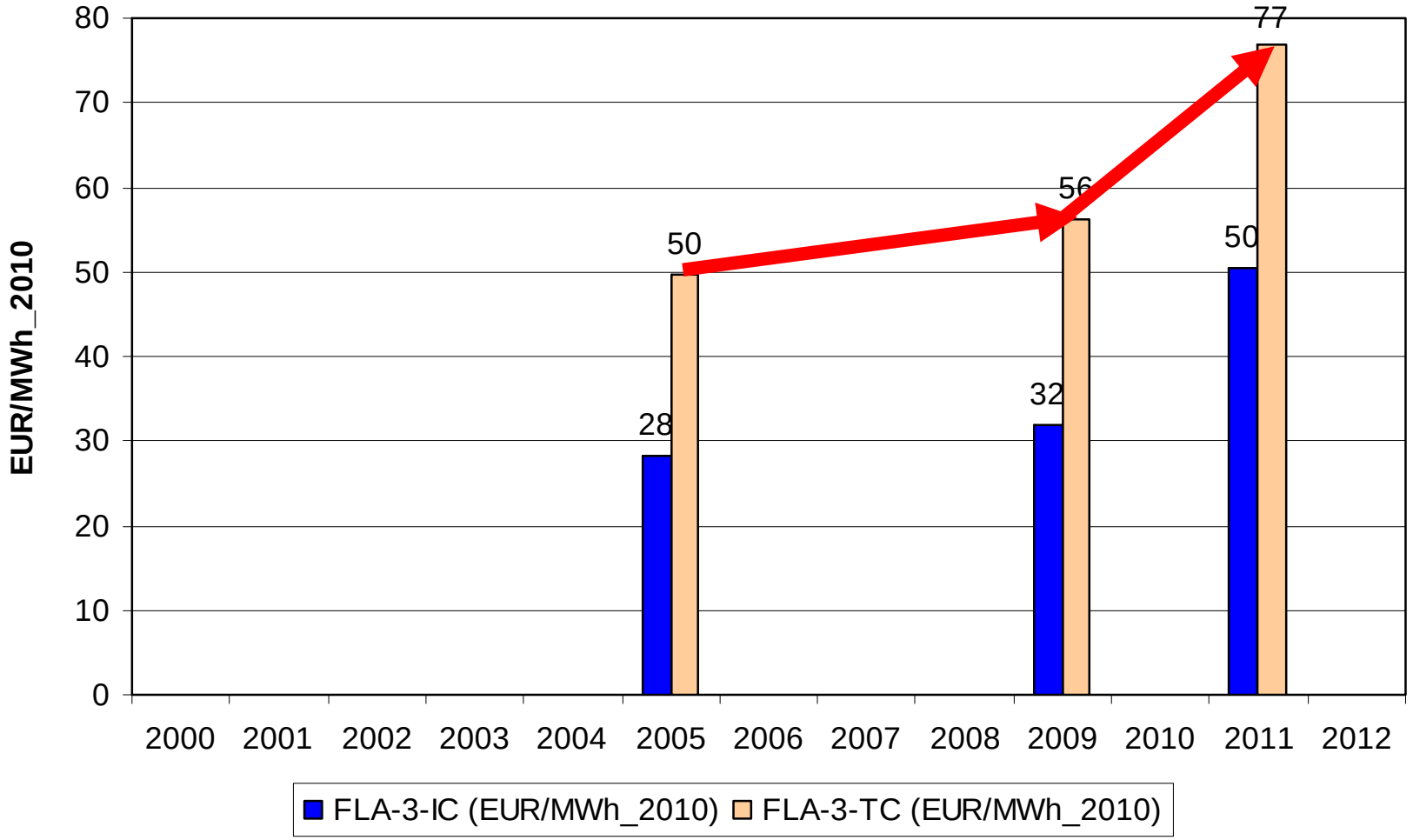

Olkiluoto: Overnight costs 2004:
1900 EUR/kW, no delay
EUR/kW yr
4000
3500
3000
2500
2000
1500
1000
500
0
Net present value 2010:
(c=5.1 c/kWh)
Price increase: 0.5% /yr;
construction time: 6 years
Invest.costs
Interest
price increases
-6
-5
-4
-3
-2
-1
0
All costs are converted into 2010 figures


Olkiluoto: Overnight costs 2004:
1900 EUR/kW, 4 years delay
EUR/kW yr
4000
3500
3000
2500
2000
1500
1000
500
0
Net present value 2014:
(c=7.1 c/kWh)
Price increase: 1.5% /yr;
construction time: 10 years
Invest.costs
Interest
price increases
-10
-9
-8
-7
-6
-5
-4
-3
-2
-1
All costs are converted into 2010 figures

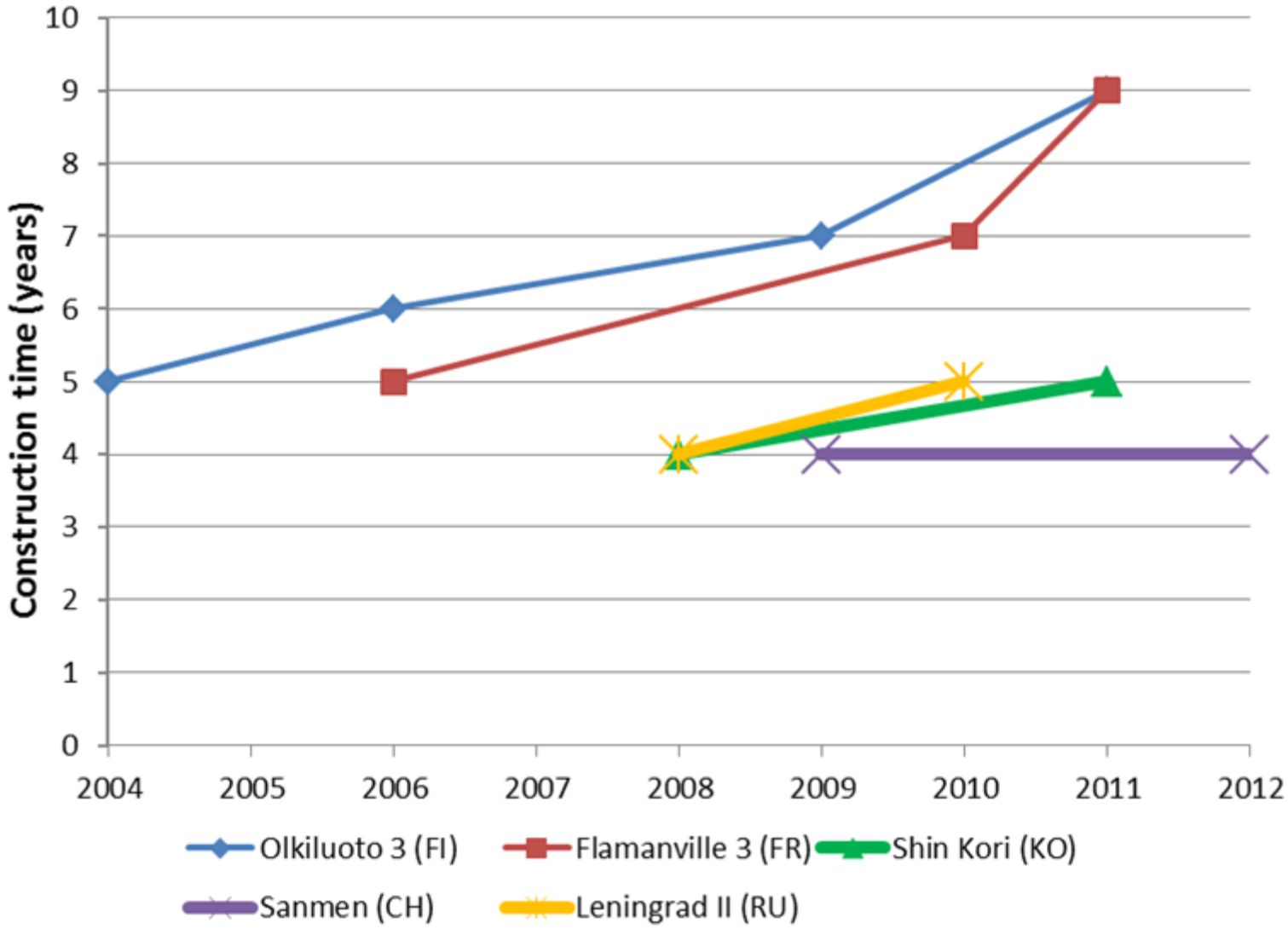
Cost development Olkiluoto



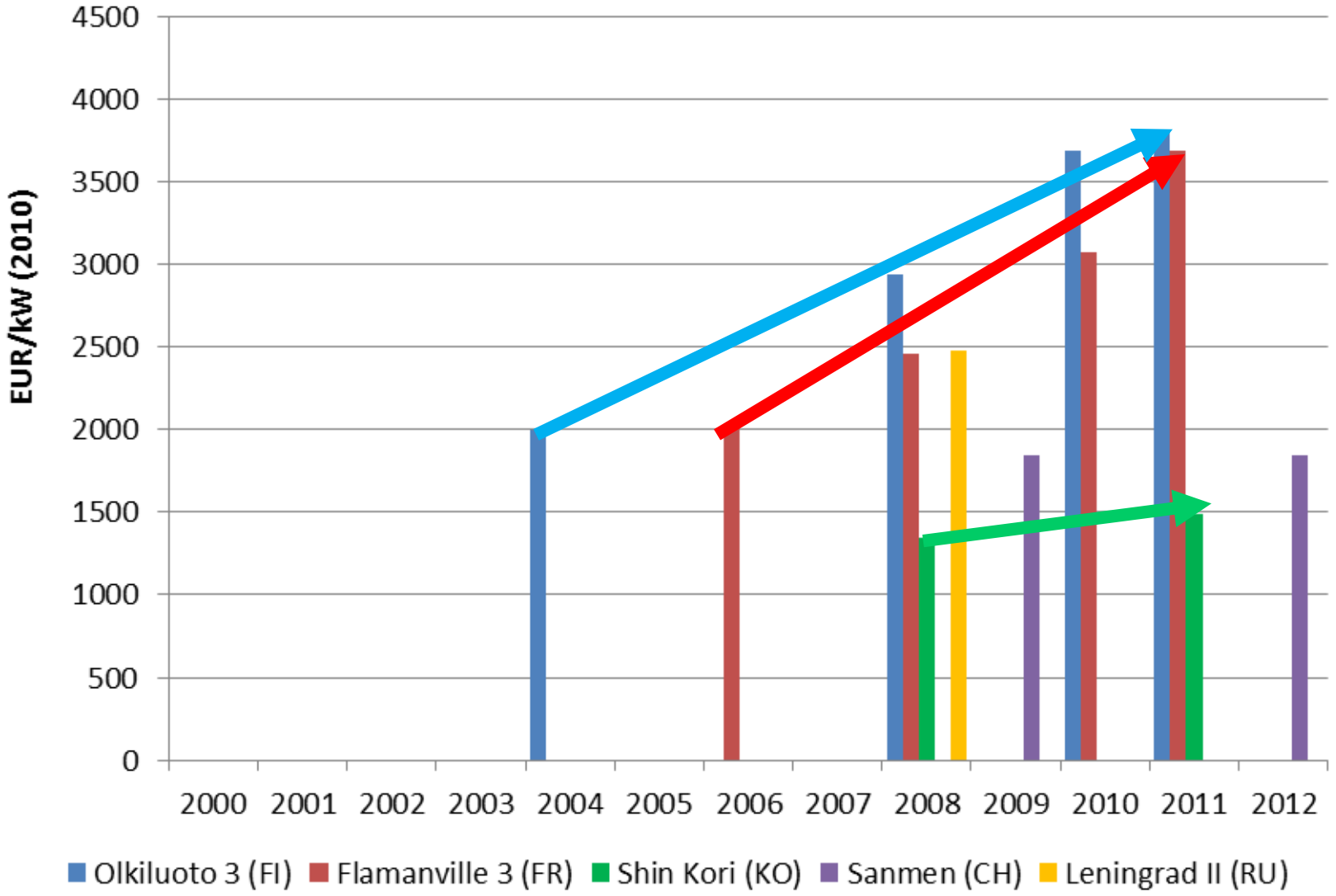
Cost development Flamanville-3



Construction times

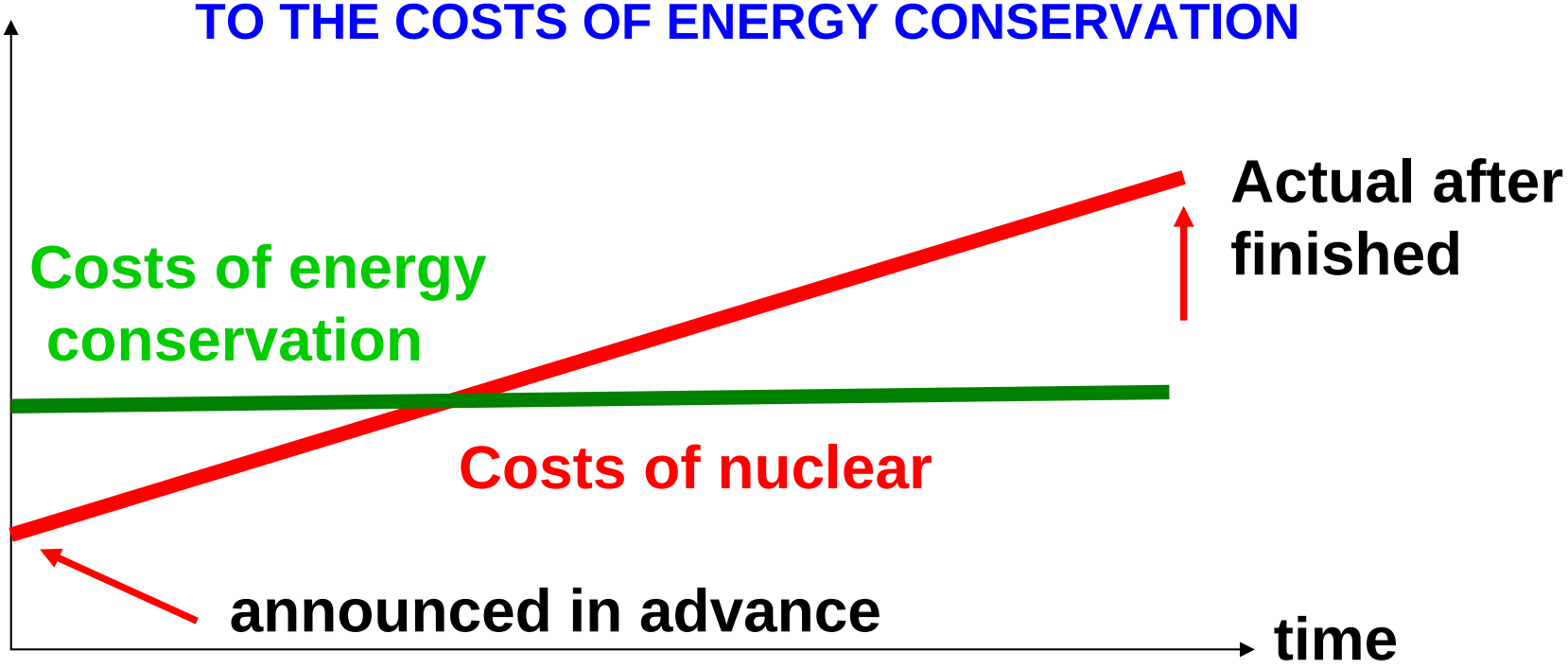


Investment cost development



5. NUCLEAR VS ENERGY CONSERVATION

THE DYNAMICS OF THE COSTS OF NUCLEAR IN COMPARISON TO THE COSTS OF ENERGY CONSERVATION



→ Announcement in advance: Nuclear leads to cheaper electricity making energy conservation economically unattractive;

→ After completion: Nuclear leads to higher electricity prices which in the aftermath would have made made energy conservation economically attractive;

6. CONCLUSIONS (1)

Does the characterisation of a cheap technology with respect to investment costs fit?

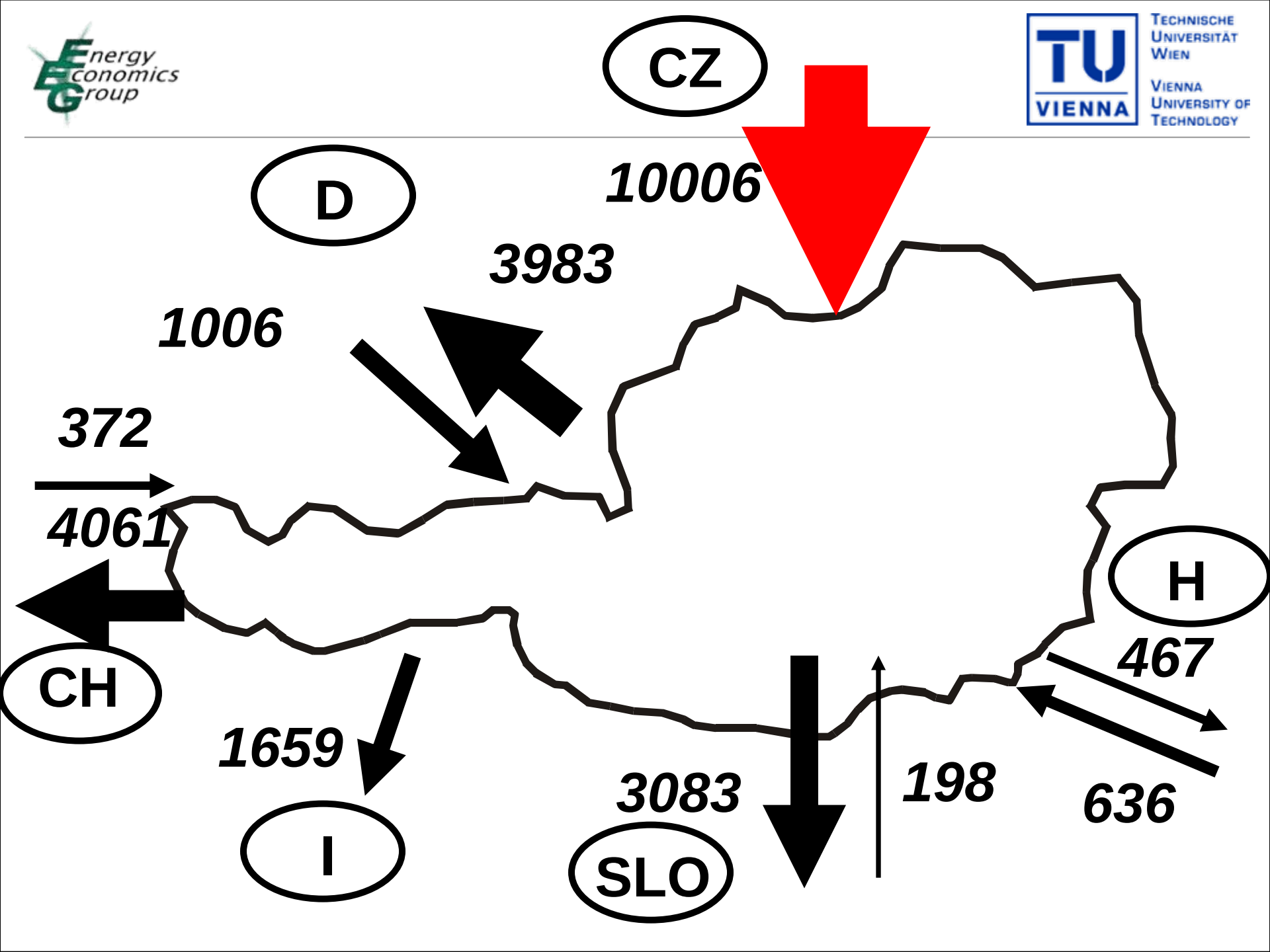
- Significant learning rates? No, vice versa.
- Maturity of technology from overall technical concept? No, see Olkiluoto problems
- Reliability of construction times? By far NO!
- No cross-subsidizations? No, see Olkiluoto dumping offer by AVERA
- No distortions in the market? Interest rates of 2.6% for Olkiluoto?

6. CONCLUSIONS

Europe:

- **No reliabilty regarding construction times.**
- **With respect to economics nuclear has NEVER in history in Western countries fullfilled its promises**
- **Actual investment costs were always higher than costs announced**

- **Are Korea, China, Russia different ?**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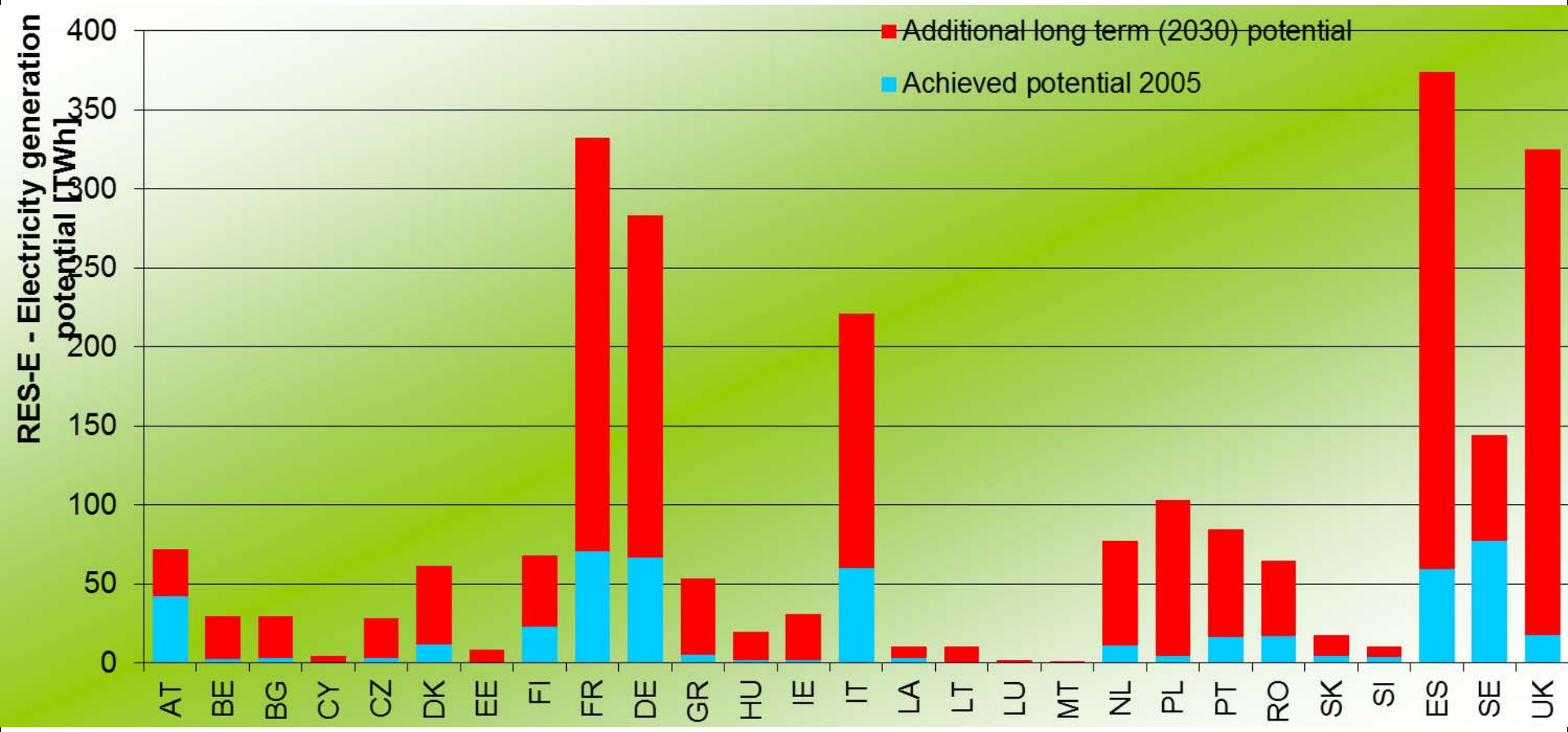
Additional long term (2030) potential
Achieved potential 2005
RES-E - Electricity generation potential [TWh]
400
350
300
250
200
150
100
50
0
AT
BE
BG
CY
CZ
DK
EE
FI
FR
DE
GR
HU
IE
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LA
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LU
MT
NL
PL
PT
RO
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SE
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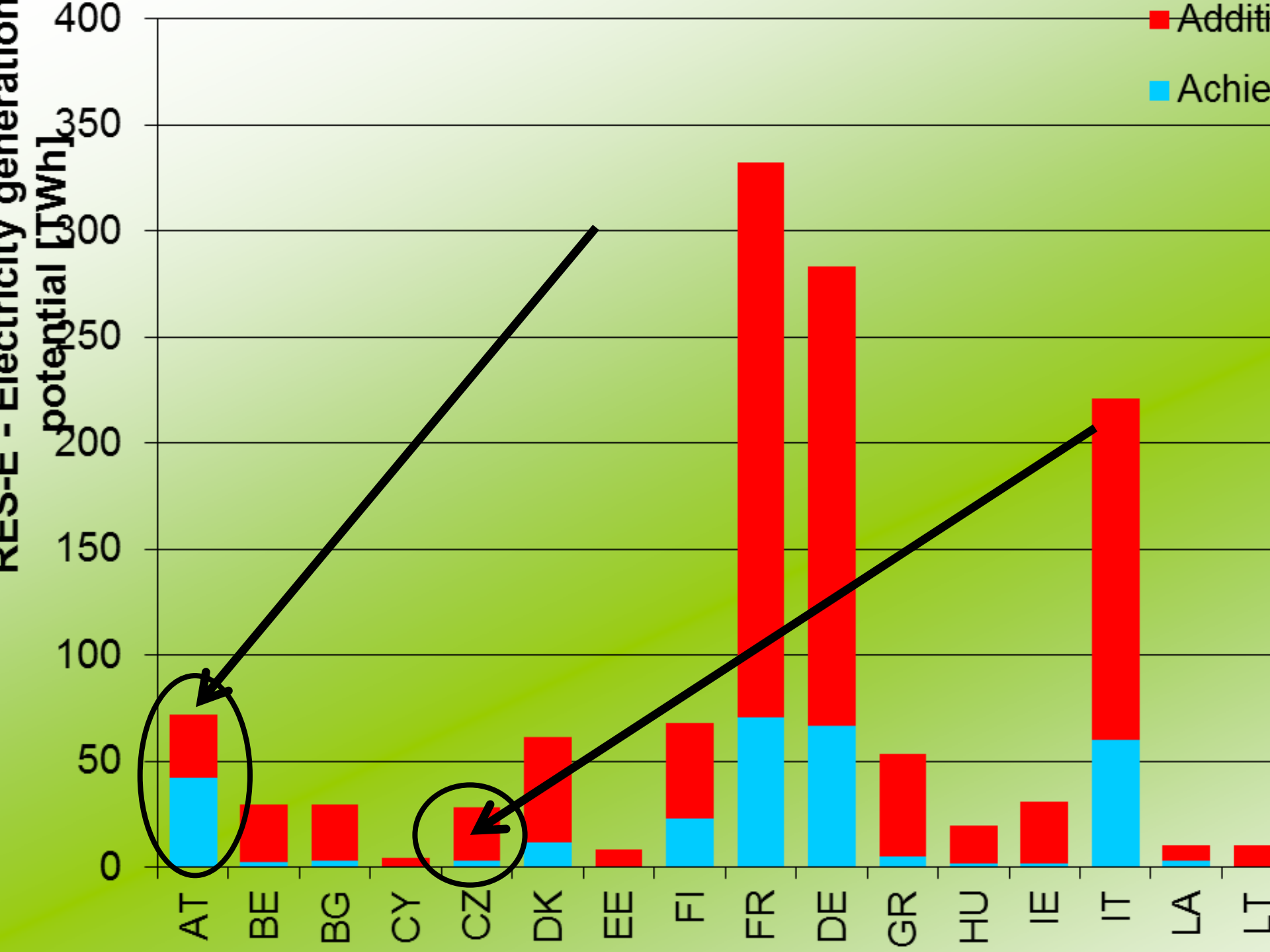
RES-E - Electricity generation potential [TWh]
400
350
300
250
200
150
100
50
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