
AFRY
ÅF PÖYRY

Introduction – who am I

- M.Sc., Technical Physics (1991)
- 30 years in wind power business
- 1991 – 2007 Pöyry: consultant, project manager, development manager & senior advisor
  - Project assessments, project development services, construction supervision…in 20 countries & 5 continents!
  - Developing Pöyry Group's wind power business on global scale
- 2007 – 2015 wpd Finland Oy: Managing Director & Board member
  - Managing of wpd's business in Finland
  - Developing a project porfolio of > 10 projects
  - Financing and construction of 3 wind farms with total capacity of > 140 MW
- 2016 – 2018 Recognis Consulting: Owner, Senior Advisor
  - Consulting services for renewables in Finland and internationally
- 2019 – Back to Pöyry / AFRY
  - 2019 Business Director, responsible for wind power business in Asia Region, based in Bangkok
  - 2020 Global Sales Director for AFRY's wind power business (currently located in Oxford, UK)

AFRY
ÅF PÖYRY

Content

Part I 7.10.2022

1. Wind resource estimation
2. Wind project development

Part II 14.10.2022

1. Project economy and financing
2. Building of a wind farm
3. Briefly about offshore wind

Main focus on the ONSHORE wind projects

AFRY Introduction

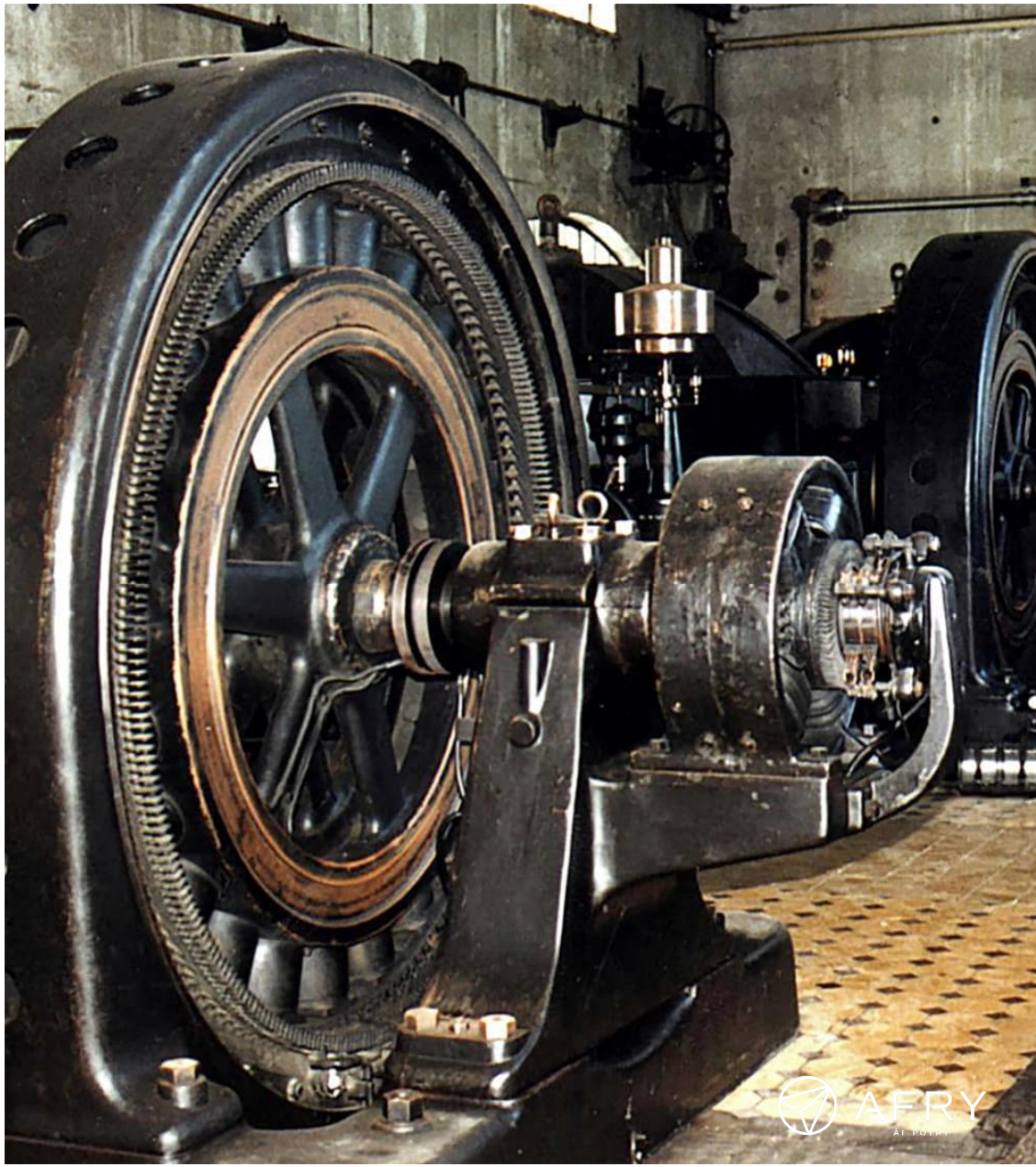
AFRY
ÅF PÖYRY

Locally present and globally connected

— In February 2019 ÅF and Pöyry joined forces in order to become an international engineering, design and advisory company, driving digitalisation and sustainability for the energy, infrastructure and industrial sectors all over the world.

— In November 2019 ÅF Pöyry launched a new common brand, AFRY. The name is a combination of the letters in ÅF and Pöyry: AF+RY [eɪːfɹi]

— With a strong focus on sustainable solutions we bring the best from ÅF and Pöyry into the new brand AFRY.



Our first 120 years

1895 Ångpanne-föreningen is founded (ÅF)

1901 ÅF's first environmental consultant

1958 Pöyry is founded

1976 Inspection operations are nationalized in Sweden

1981 ÅF from cooperative associations to limited company

1986 ÅF shares listed on the Stockholm Stock Exchange

1995 Inspection activities resume, ÅF celebrates 100th anniversary

1997–99 Pöyry acquires Electrowatt Engineering AG

2008 Ångpanne-föreningen changes its name to ÅF

2010 Inspection operations are sold to DEKRA Industrial

2012 ÅF merges with Epsilon

2016 Most attractive employer in Sweden among young professionals with M.Sc. Engineer

2017 ÅF launches new strategy "Making Future"

2019 ÅF and Pöyry join forces and become AFRY

AFRY ÅF PÖYRY

Our offerings in six divisions

Infrastructure

Real estate
Rail & Road
Architecture
Environment
Water

Industrial & Digital Solutions

Food & Life Science
Product and Software Design
Automation
Defense

Process Industries

Pulp & paper
Mining & Metals
Steel Industry
Oil & Gas

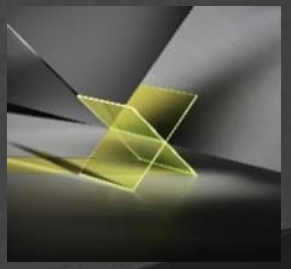
Energy

Hydro
Thermal & Renewables
Nuclear
Transmission & Distribution
Digital and contracting services

Management Consulting

Bioindustry
Energy
Capital
Industry

AFRY X



Digital services and products

AFRY
ÅF PÖYRY

No. of employees: 17,000

Approx. Net sales: 20 bsek

Industry
Infrastructure
Energy

Offices in more than countries: 40

AFRY
ÅF PÖYRY

OUR CONTRIBUTION TO THE SUSTAINABLE DEVELOPMENT GOALS

Clean Energy at AFRY

- Supporting the transition to low carbon, clean energy power sources and energy efficiency since the early 1990s.
- Uniquely positioned to provide a one stop shop for our clients no matter where they are in the energy transition.
- Holistic view of the mix of low carbon technologies available to support shift from largely fossil based world to a clean energy world.
- Backed by market and technical expertise in renewable technologies and advanced clean energy options, such as:
  - storage solutions and carbon capture
  - bioenergy, hydrogen, waste-to-energy, wind, solar, geothermal energy
  - both legacy and modern nuclear assets, from large scale nuclear to new small and advanced modular reactors (SMR/AMR).

AFRY Energy Division

HYDRO

Reservoir Storage Schemes incl. Pump Storage

Run-of-River Schemes

Electro-mechanics

Rehabilitation

Specialist services e.g. hydrology & dam safety

NUCLEAR

New Builds. All reactor types

Decommissioning

Waste management & disposal

Specialist services e.g. nuclear safety cases & PSAR

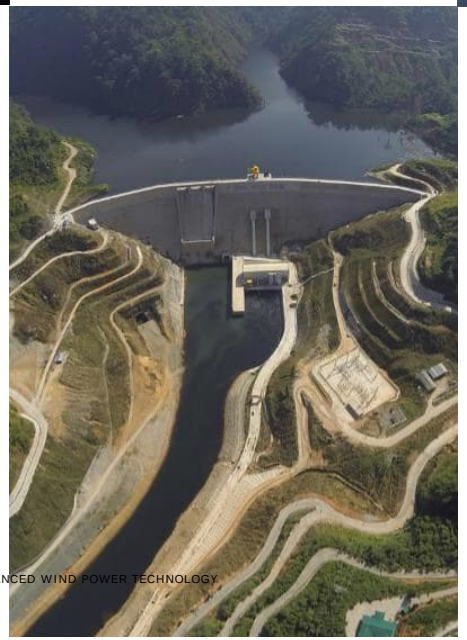
RENEWABLE ENERGY & THERMAL POWER

Waste-to-Energy, Biomass & District Heating / Cooling

Gas (NG / LNG), Cogen and Desalination

CSP, Solar PV and Wind

Specialist Services e.g. Perf measurement



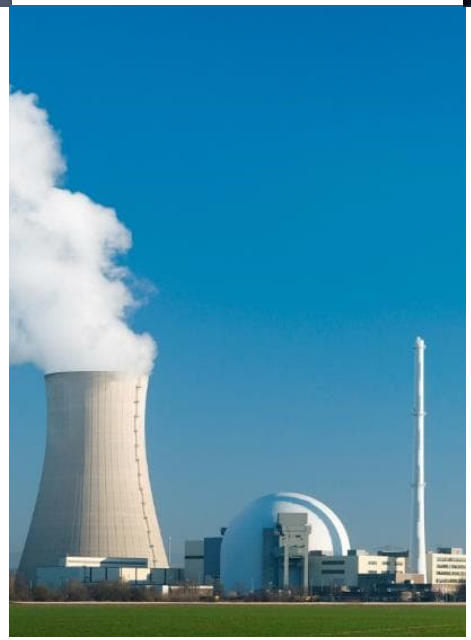
TRANSMISSION & DISTRIBUTION

HV/MV/LV networks

HV/DC Interconnector schemes incl. land & submarine cables

HV/MV Substations

Specialist services e.g. load flows models & smart grids



CONTRACTING

EPC+ System Methodology

- Bioenergy
- Small scale thermal and hydro plants
- Small scale industrial plants
- Renewables

Full O&M services

No. of employees: 1’900

Approx. annual revenue: 2,7 BSEK

Energy Division

Offices in countries: 30

Projects in more than 97 countries

We speak more than 30 languages

AFRY
ÅF PÖYRY

WIND POWER SERVICES

AFRY is dedicated to the Wind Power industry

AFRY is at the forefront of wind power development. For more than 25 years, AFRY has been actively involved in numerous wind power projects around the world. AFRY'S dedicated team of wind experts have cutting-edge engineering and technology expertise to serve clients throughout the entire value chain and project lifecycle.

AFRY's Wind Power Numbers:

— Involved in more than 30 GW wind projects worldwide as Technical Advisor / Owner's Engineer and more than 80 GW as Commercial / Market Advisor

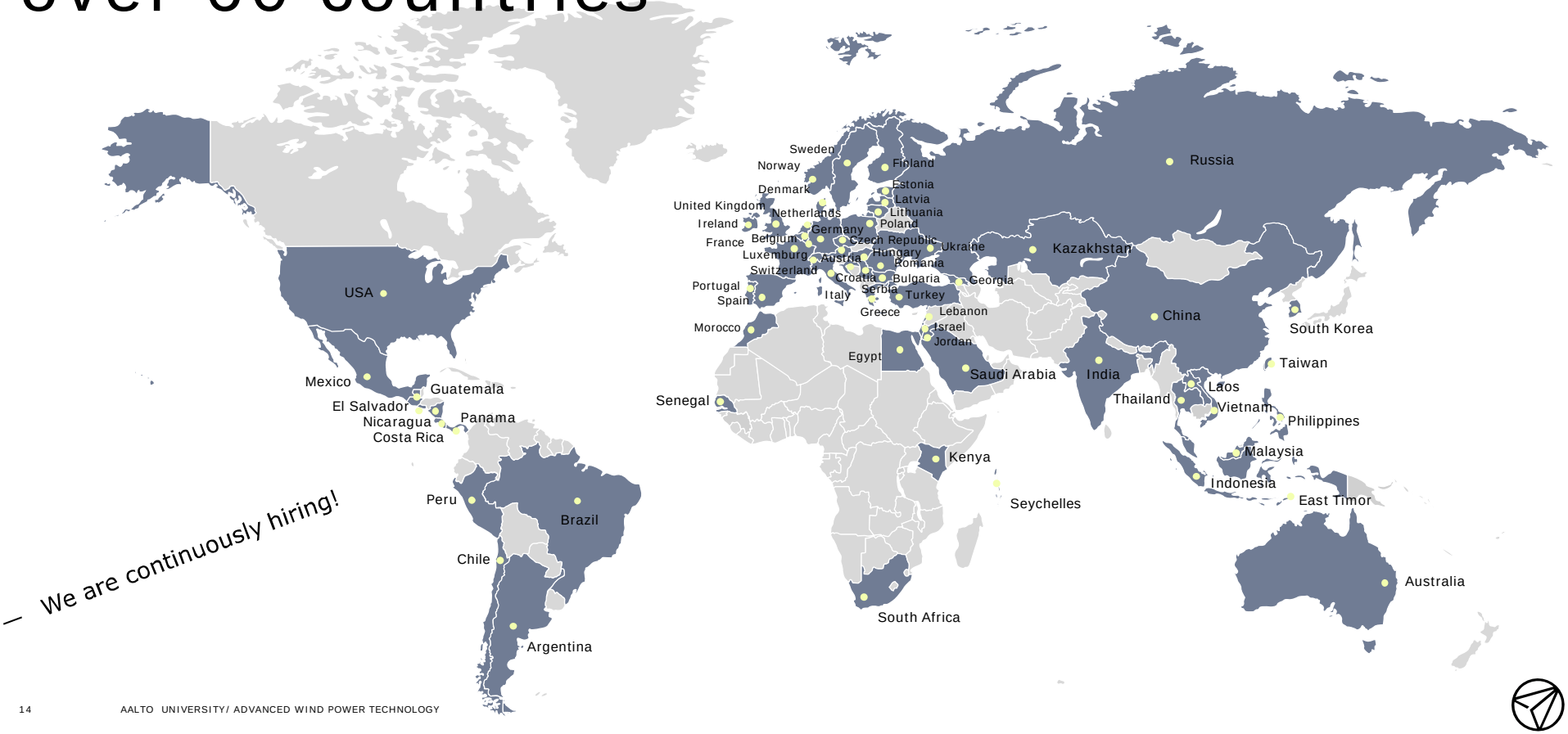
— 250+ Wind projects delivered

— 25+ years of experience in Wind Power

— 150+ Wind Power Experts

GEOGRAPHICAL PROJECT FOOTPRINT

We have delivered wind power projects in over 60 countries



We are continuously hiring!

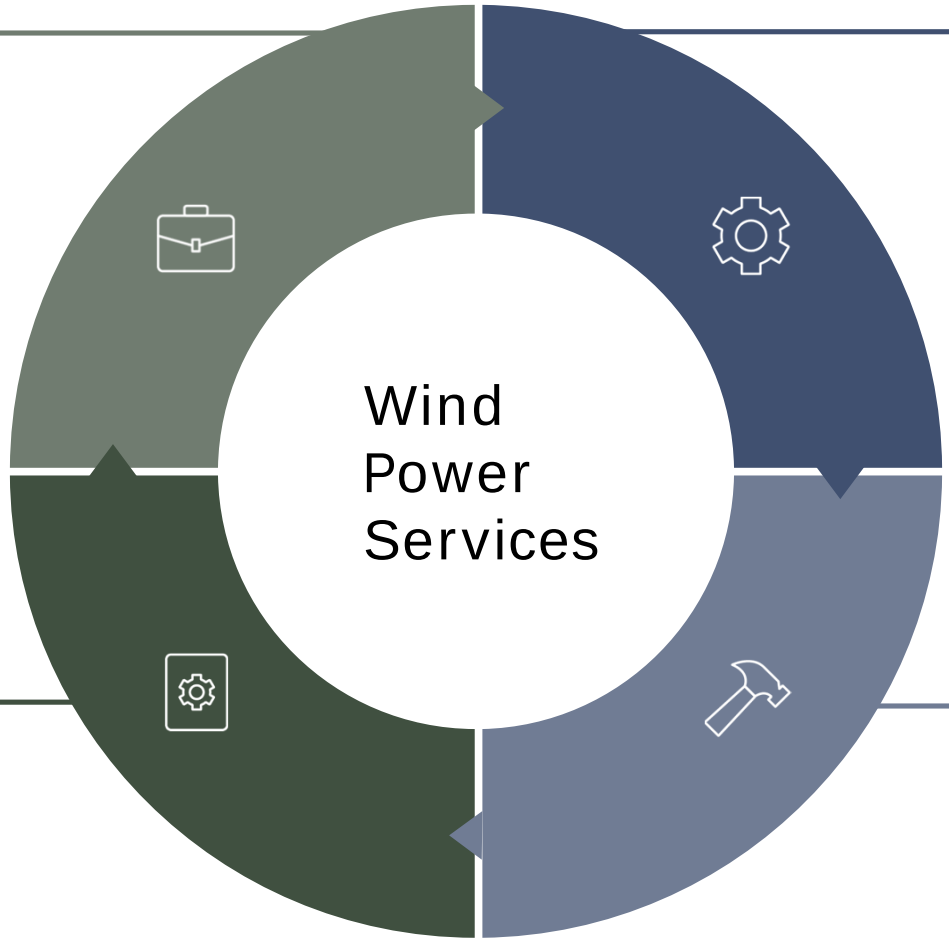
AFRY
ÅF PÖYRY

MARKET ADVISORY

- Market reports and price projections
- Policy and regulation studies
- Wind and renewable energy strategies
- Market entry strategies
- PPA advisory

DEVELOPMENT

- Development support
- M&A support
- Project management
- Wind measurements and energy yield Assessment
- Feasibility
- Basic design
- Permitting
- Environmental studies
- Grid Studies and Power system integration
- Technical specifications
- Tendering
- Contracting
- Financing support



O&M

- Asset management
- Operational excellence
- Production analysis
- Maintenance
- HSE plans
- Energy sales

CONSTRUCTION

- Design review
- Site supervision
- Testing
- Commissioning
- Connection to transmission network
- Contracts and loan management

AFRY
ÅF PÖYRY

Content

Part I 7.10.2022

1. Wind resource estimation
2. Wind project development

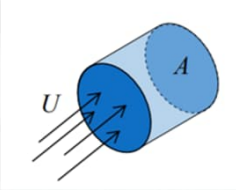
Part II 14.10.2022

1. Project economy and financing
2. Building of a wind farm
3. Briefly about offshore wind

Main focus on the ONSHORE wind projects

Wind as ”Fuel Source”

POWER CONTENT OF MOVING AIR MASS:



$$P = \frac{1}{2} \cdot \boldsymbol{\rho} \cdot \boldsymbol{A} \cdot \boldsymbol{U^3}$$

Cube of the wind speed

Air density

2 x higher wind speed

⇔

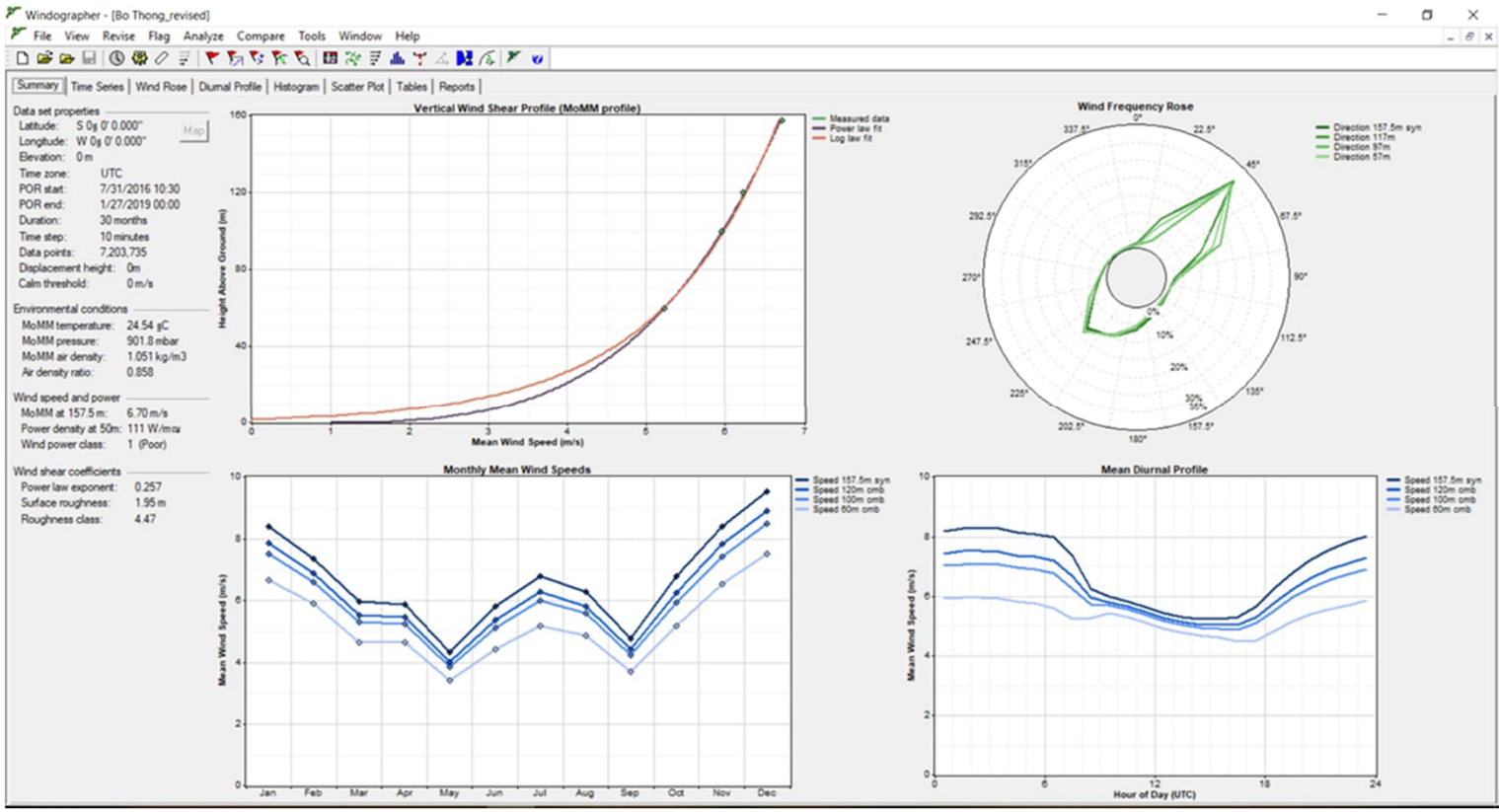
8 x more power in wind!

AFRY

Wind as ”Fuel Source”

WE NEED TO ANALYSE:

- Vertical wind speed profile
- Wind direction probability distribution (”Wind rose”)
- Seasonal variations
- Diurnal variations



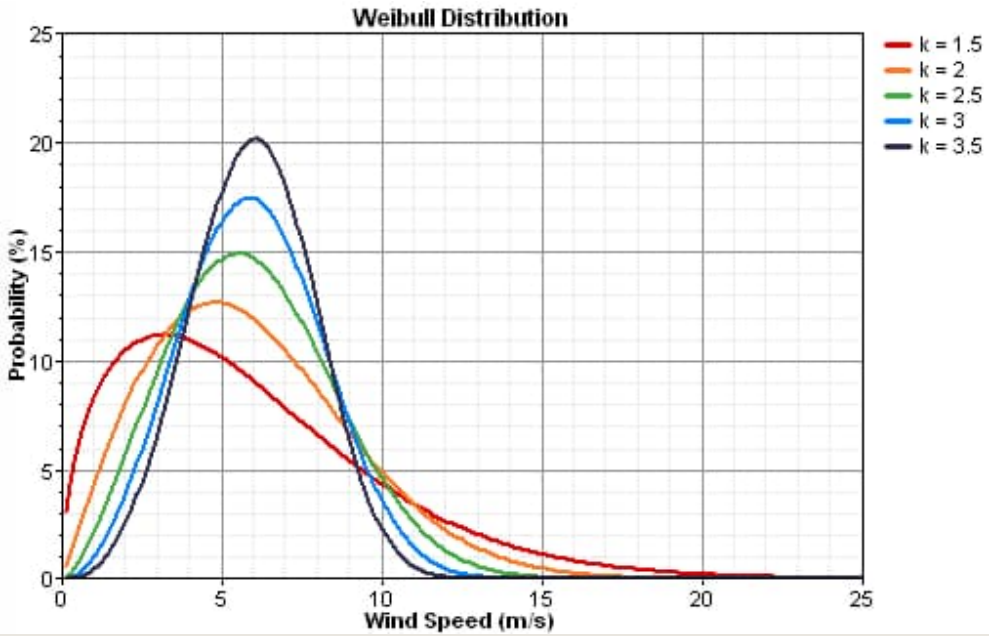
AFRY

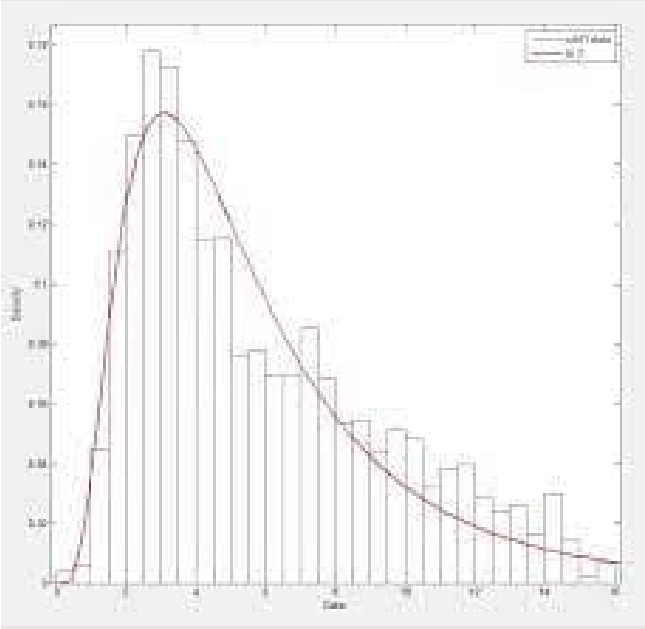
Wind as ”Fuel Source”

- Wind speed probability distribution
- Usually approximated by ”Weibull distribution”:

$$f(v) = \frac{k}{A}\left(\frac{v}{A}\right)^{k-1} \exp\left(-\left(\frac{v}{A}\right)^{k}\right)$$

- In real life, the fit is never perfect
  - Seasonal variations
  - Diurnal variations
  - Directional variations
- Weibull fit is one source of error in estimating the energy production of wind turbines



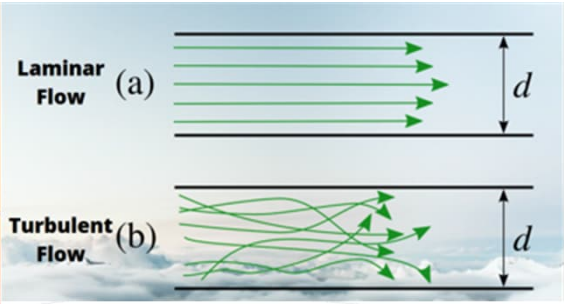


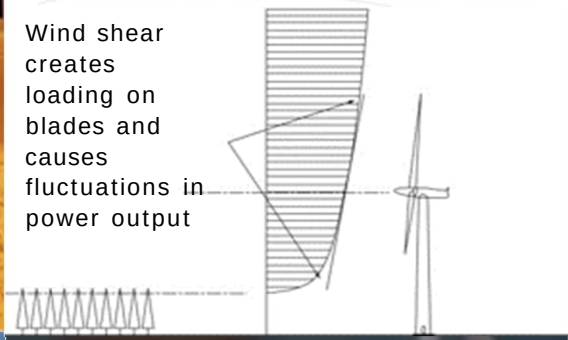
AFRY

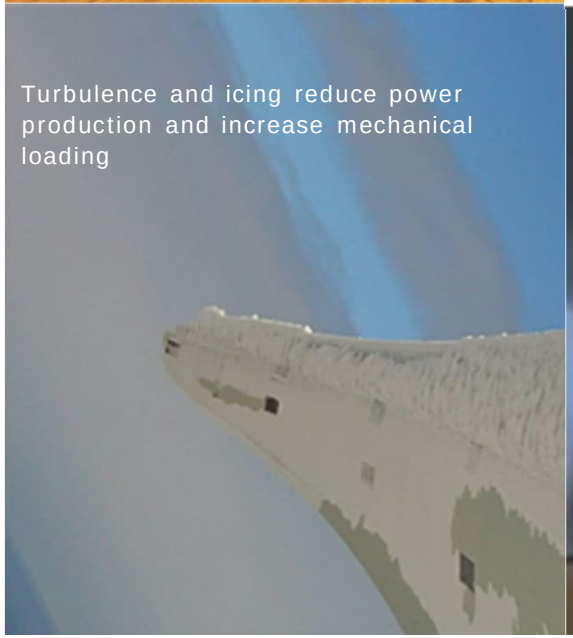
Wind as ”Fuel Source”

OTHER THINGS TO ANALYSE:

- Temperature and air pressure
  - Impact on air density: $P = \frac{1}{2} \cdot \rho \cdot A \cdot U^3$
- Correlation between wind speed and temperature
- Turbulence
- ”Wind shear” (wind speed variation across the rotor diameter)
- Icing conditions
- Extreme wind speeds
- Extreme temperatures
- Etc etc.



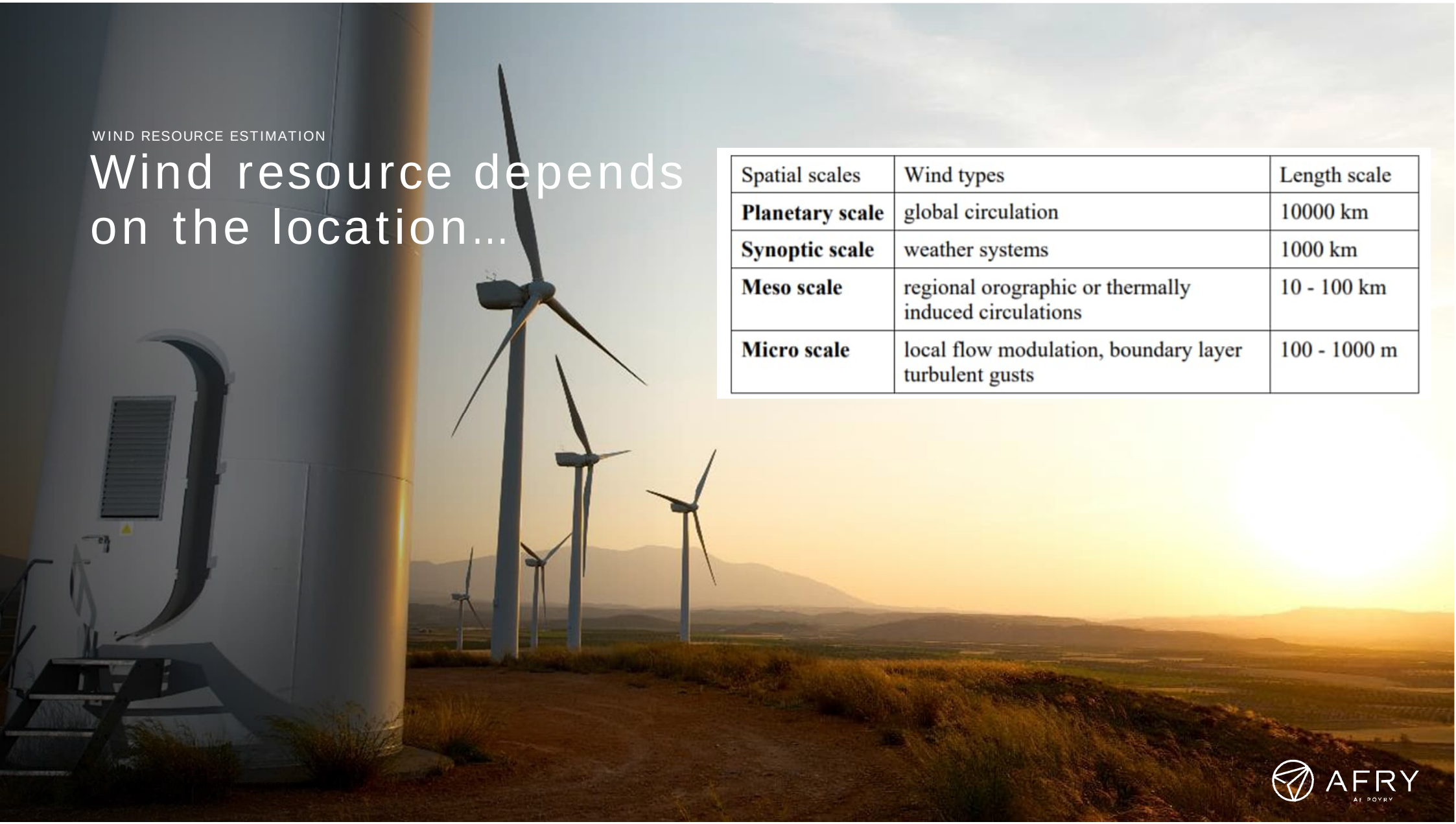




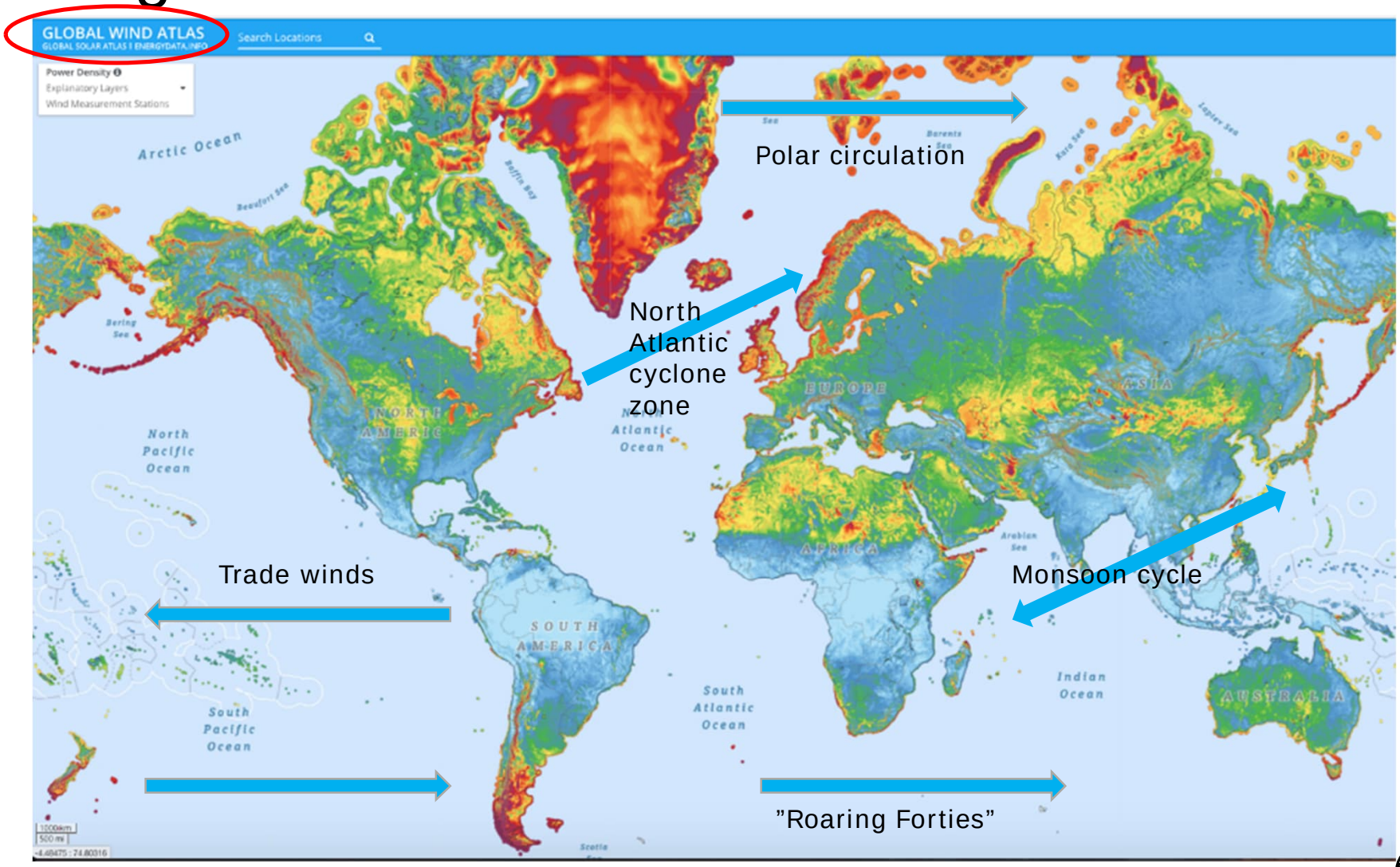
WIND RESOURCE ESTIMATION

Wind resource depends on the location…

Spatial scales	Wind types	Length scale
Planetary scale	global circulation	10000 km
Synoptic scale	weather systems	1000 km
Meso scale	regional orographic or thermally induced circulations	10 - 100 km
Micro scale	local flow modulation, boundary layer turbulent gusts	100 - 1000 m

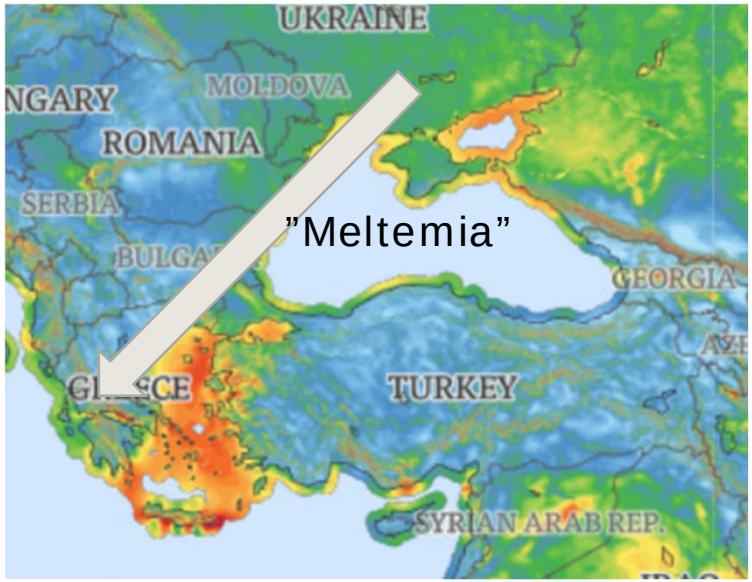


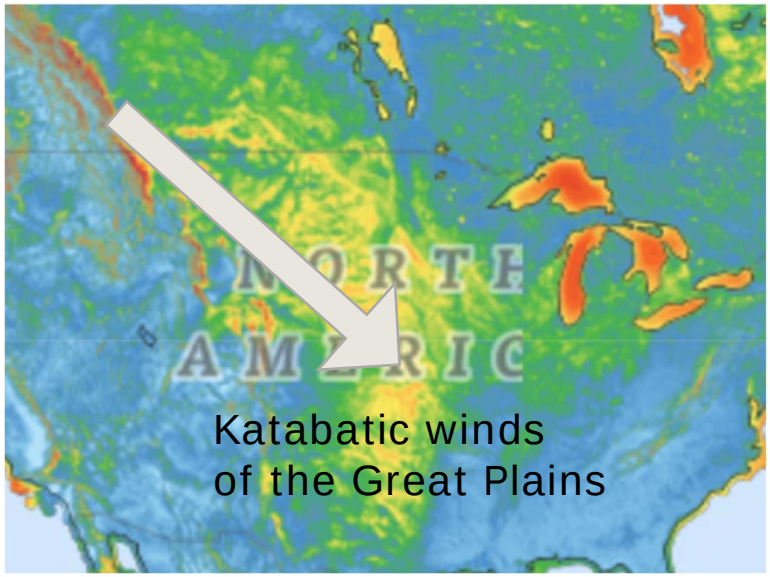
On a global scale…

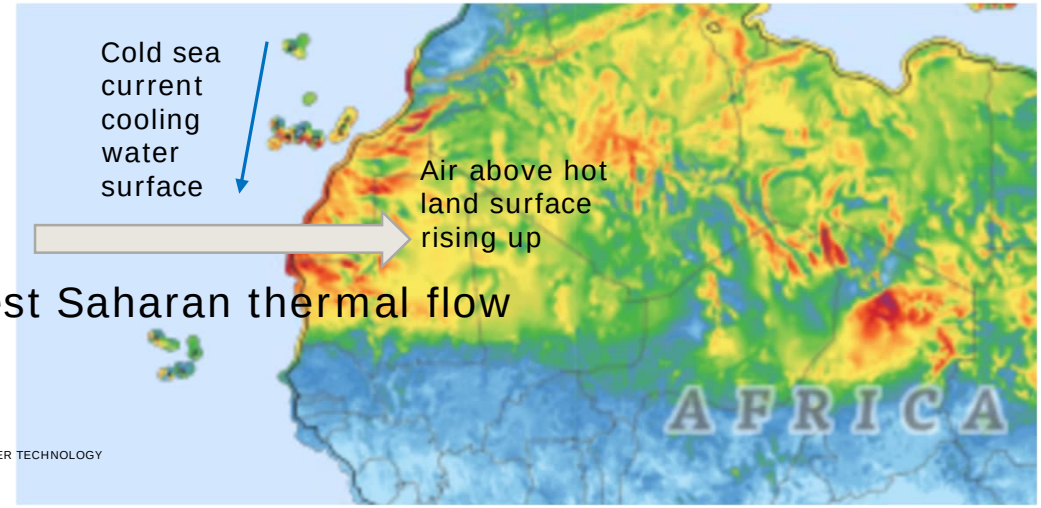


AFRY
ÅF PÖYRY

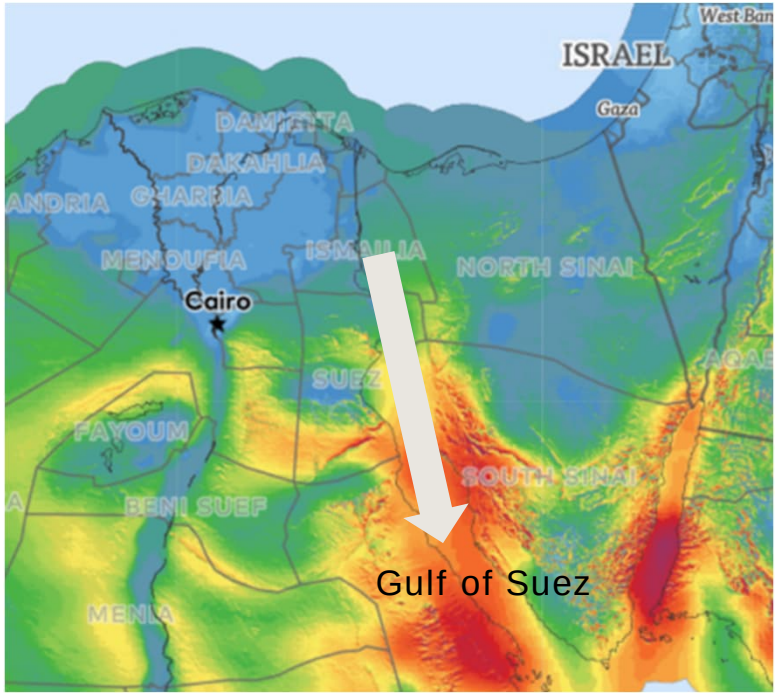
On a continental scale…

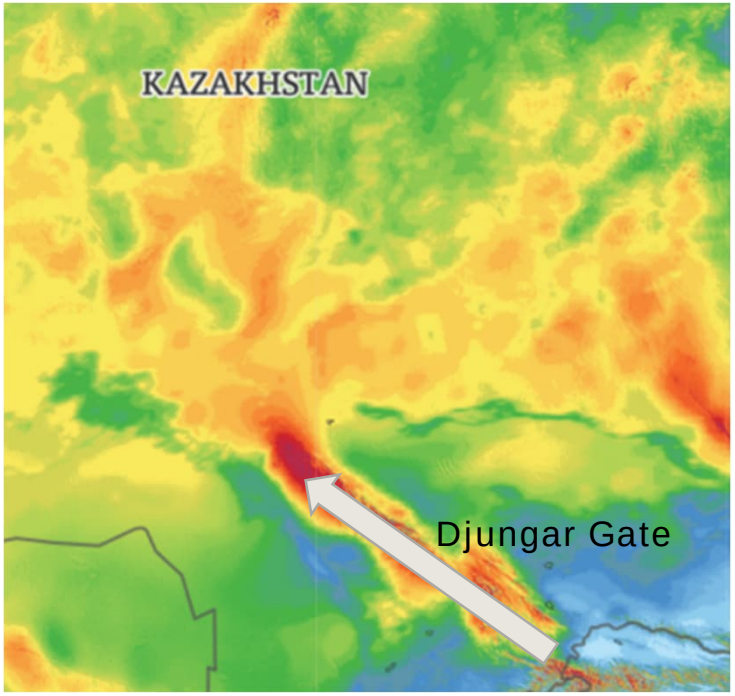






On a regional / mesoscale…



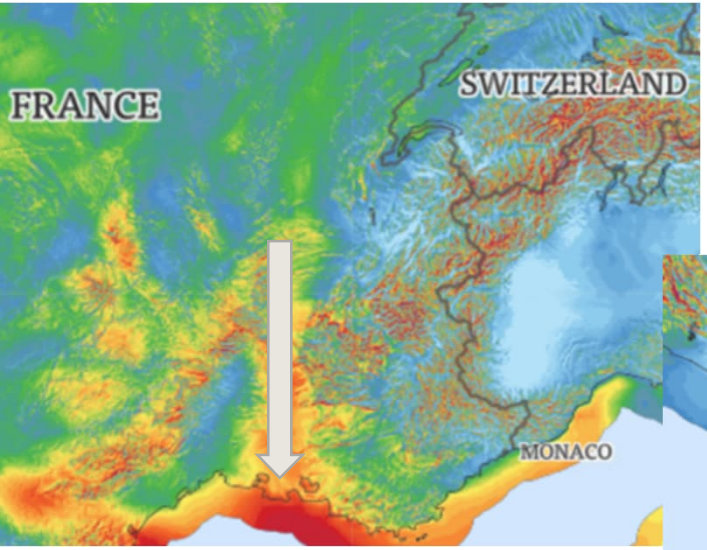


Thermally induced winds (resulting from surface temperature differences) combined with channelling effects by mountain ranges, valleys, etc.

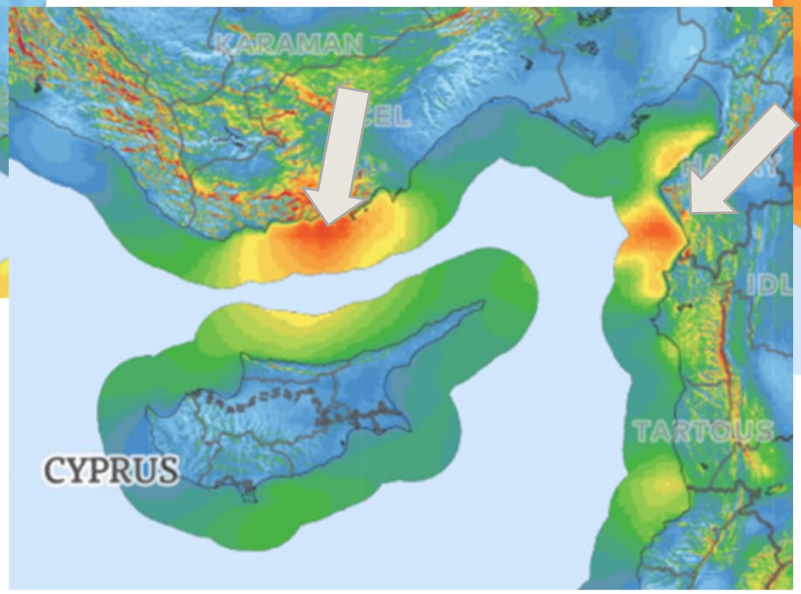
As well as anabatic/ katabatic winds (up or down the mountain slopes and valleys), etc.

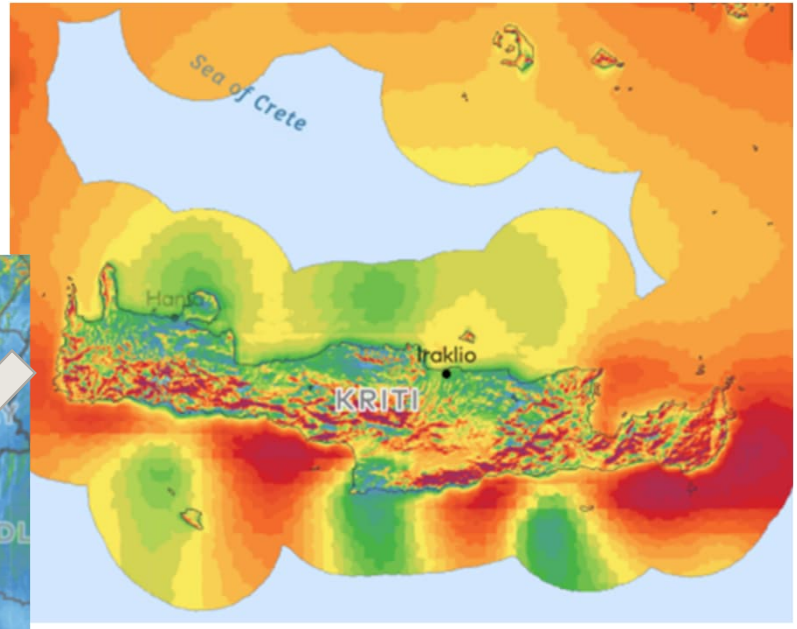
AFRY
ÅF PÖYRY

On a regional / mesoscale…



”Mistral”

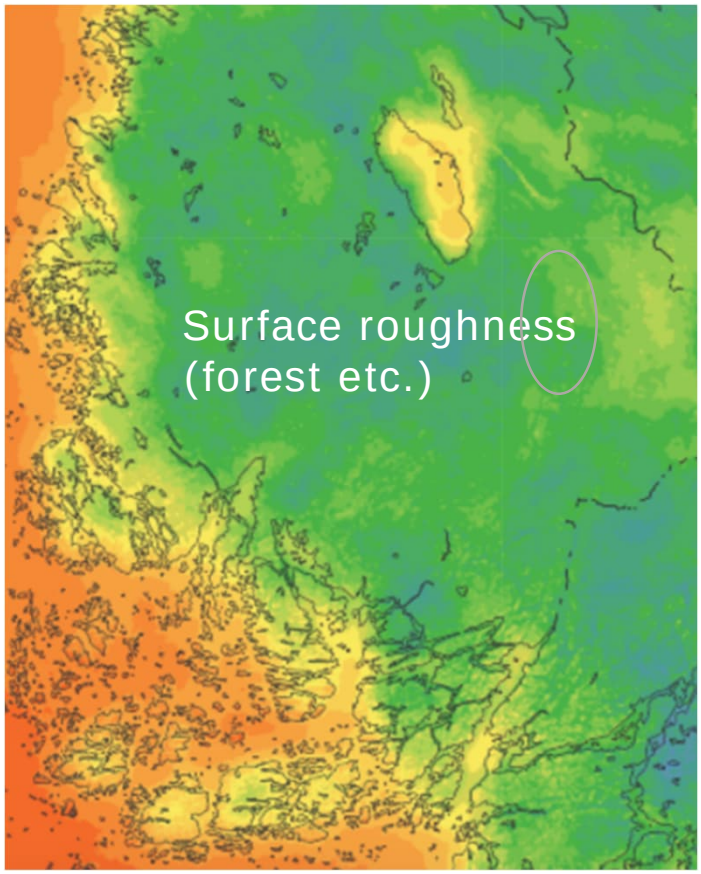


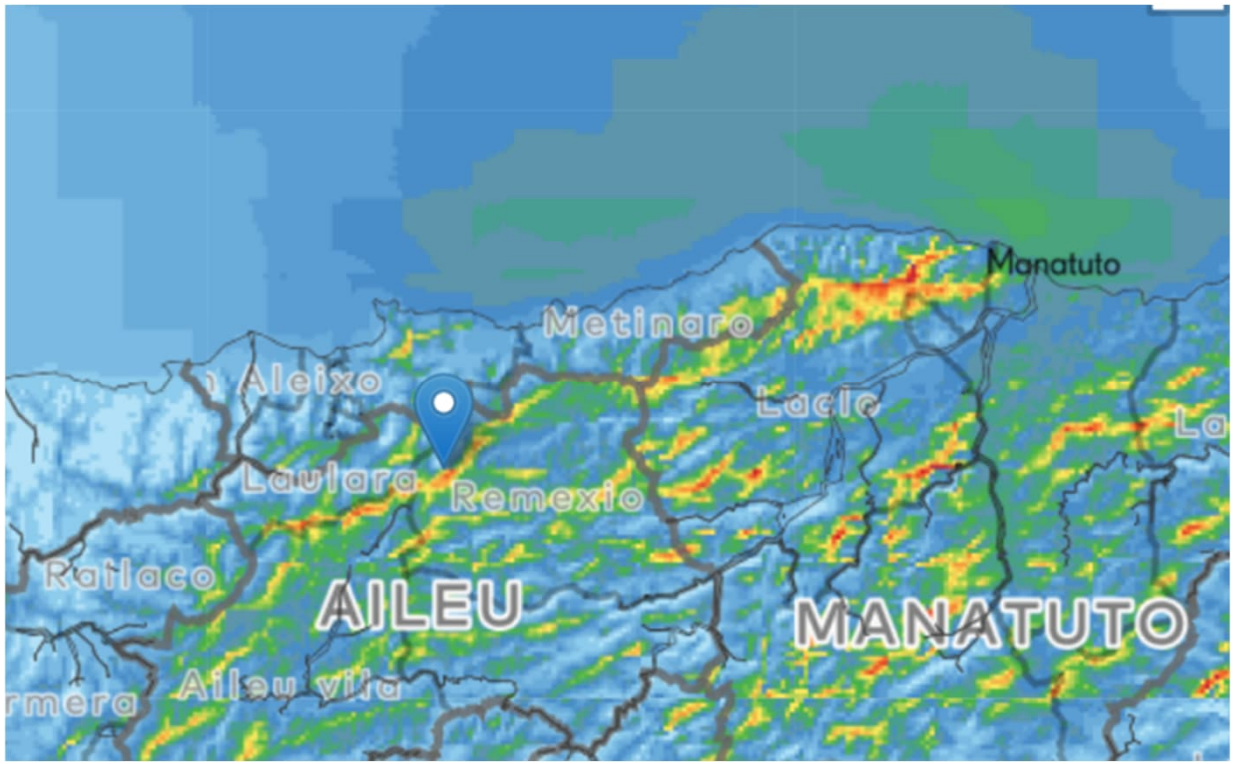


Mountain ranges, valleys and straits acting as ”magnifying lenses”…

AFRY
ÅF PÖYRY

…and on a local / microscale…



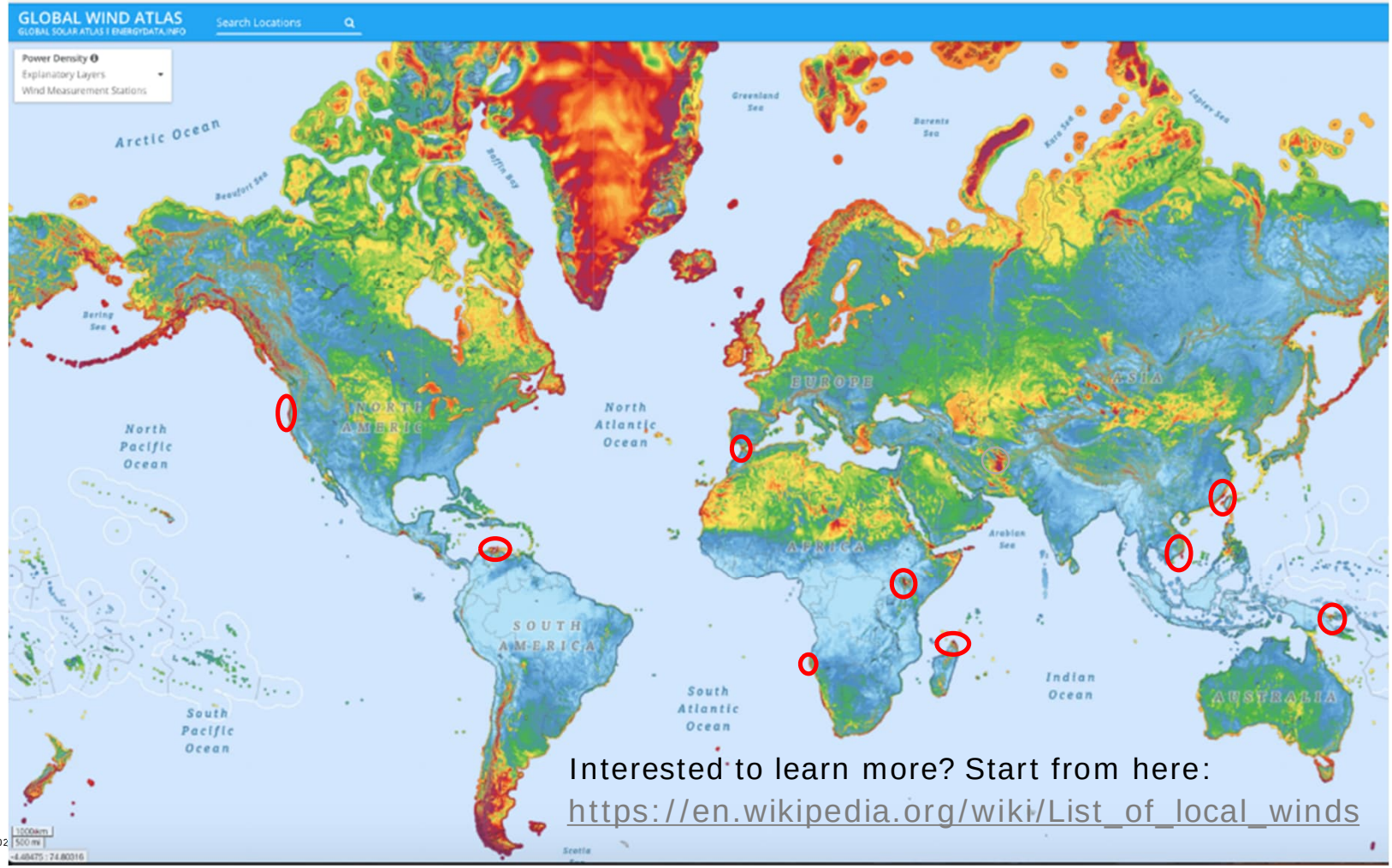


Orography

AFRY
ÅF PÖYRY

To sum up: get to know your winds

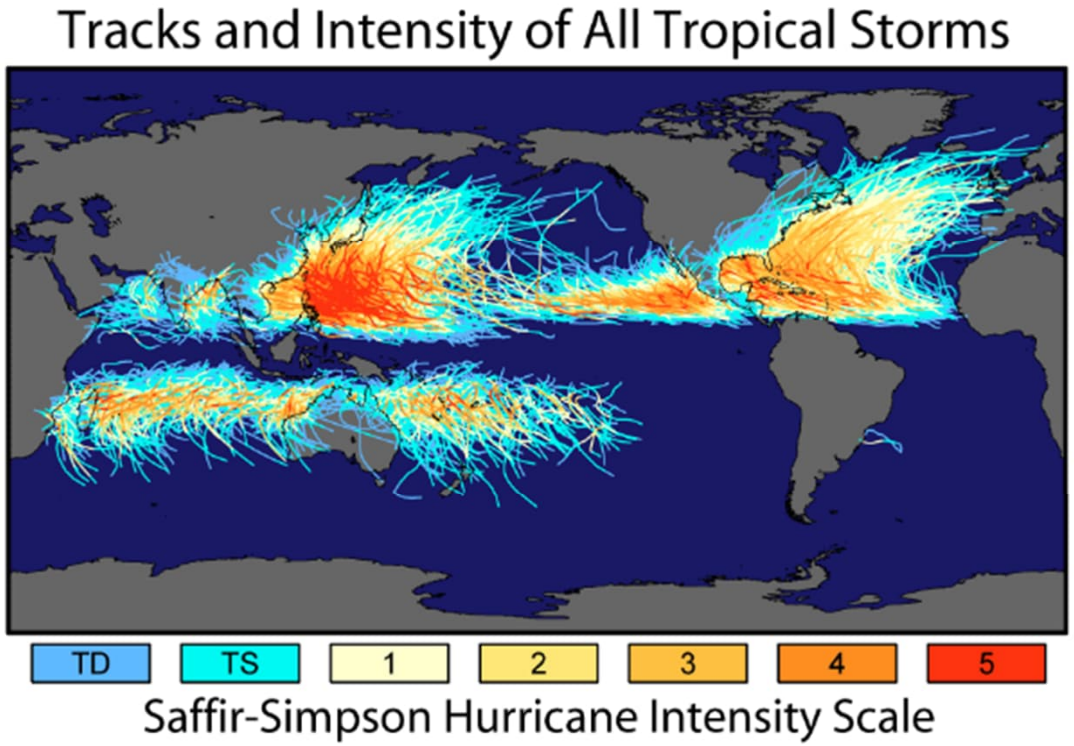
Identifying hotspots, understanding the meteorological drivers behind the potential!

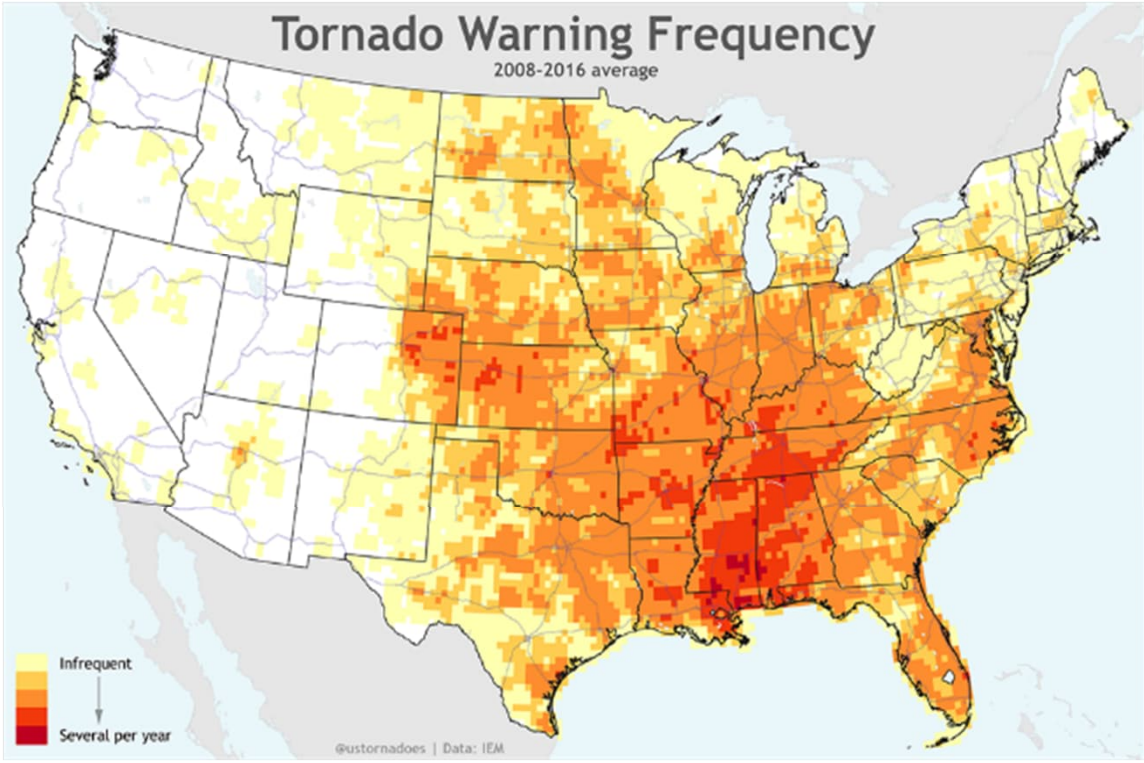


Interested to learn more? Start from here:
https://en.wikipedia.org/wiki/List_of_local_winds

AFRY
ÅF PÖYRY

And it’s not just the annual average that matters!





Keep in Mind: Extreme wind speeds vs. turbine design values
Low average wind speed site may still have high extreme winds!

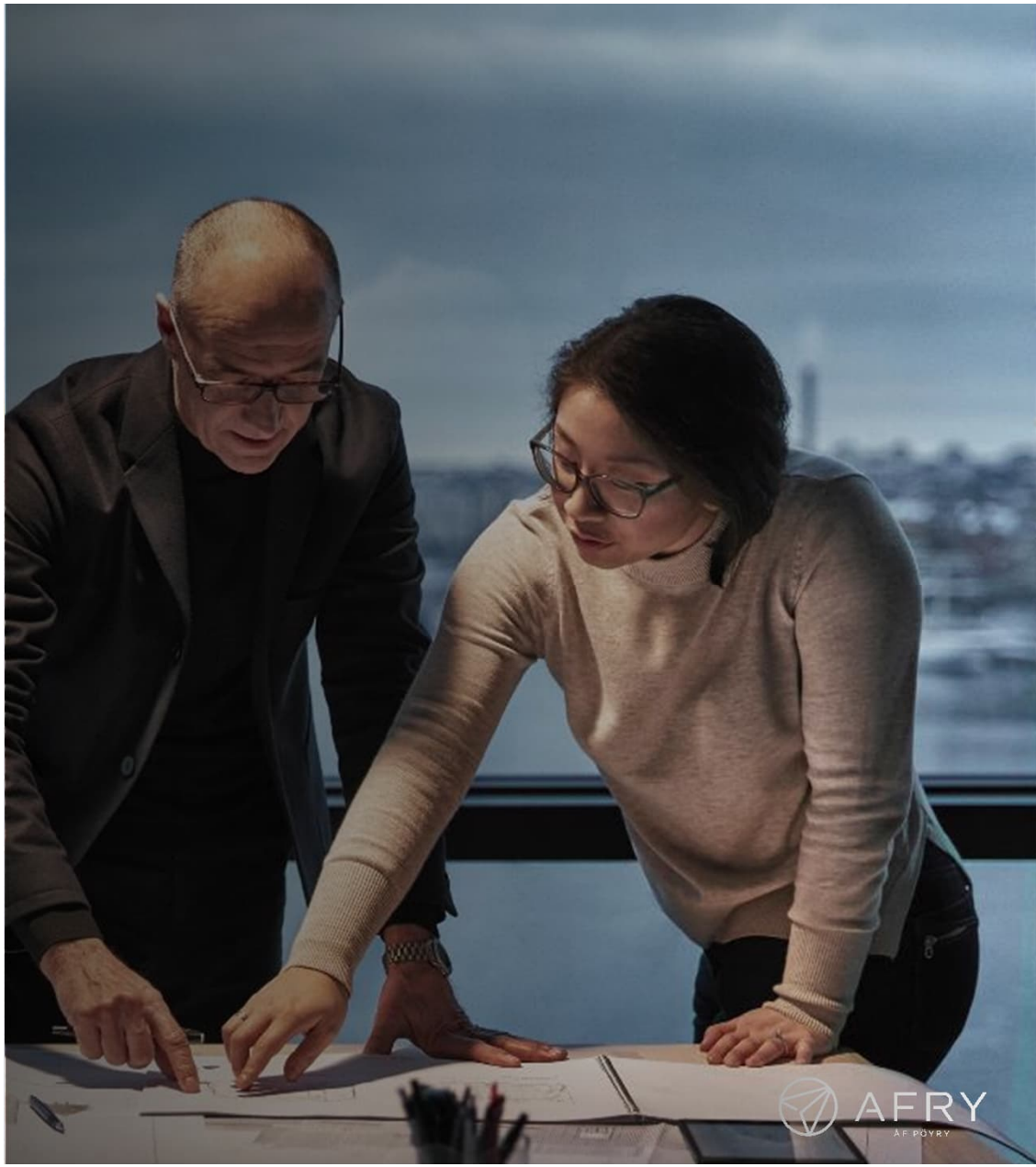
AFRY
ÅF PÖYRY

How to find out about the wind

1. Wind Atlas
2. Measurements
   - Indirect (Lidar/Sodar)
   - Direct (Mast & booms, cup anemometers and wind vanes OR Sonic sensors (2D/3D)
   - Check your data!!!
3. Long term correlation
   - Correlate short term measurements with long term data available from met. organizations etc and apply the correction factors (on both the wind speed and the wind direction data!)

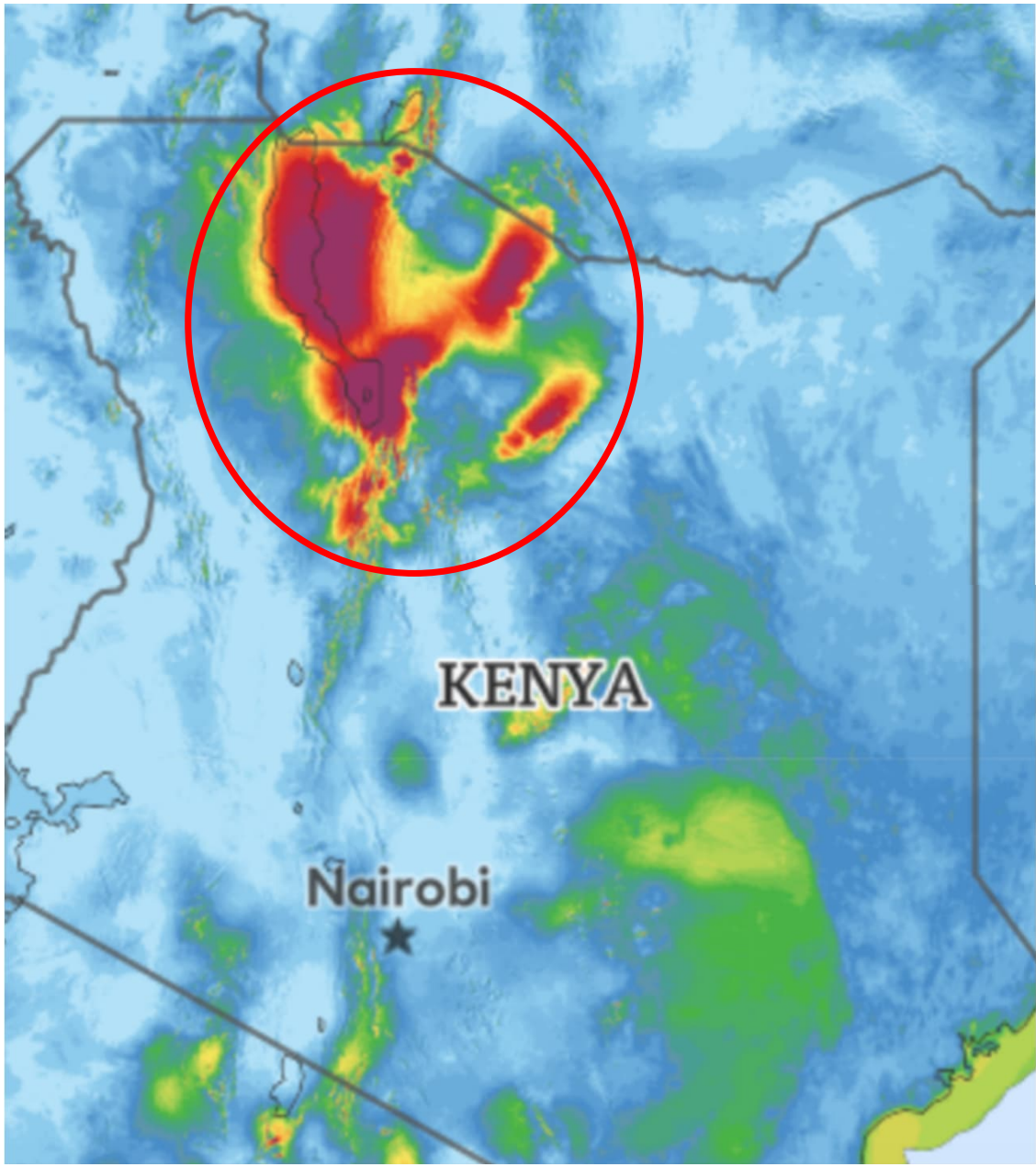
Starting from cheap, quick & dirty

High precision measurements and studies at later stages of project development



Wind Atlases

- Several versions available:
  - Global, European, National...
- Cheap & quick
- Should be used only for:
  - identifying ”promising” areas,
  - comparing nearby locations to each other,
  - getting a rough picture of whether the project could make sense,
  - understanding of issues impacting the wind resource of this specific location,
  - …and convincing financiers to invest in further work
- NOT TO BE USED for financial assessment of the project itself!



WIND MEASUREMENT

Indirect: Lidar (Light Detection and Ranging)

- Small and lightweight
- Easy to install and move around
- Low power consumption
- Relatively high accuracy
- Quite expensive (70…80 kEUR), but getting cheaper – and relocation cost is close to zero!
- Data tends to be ”lost” at higher elevations above the ground (>100 m)
- Needs to be calibrated next to a mast

WIND MEASUREMENT

Indirect: Sodar (Sound Detection and Ranging)

— Not as small and lightweight as Lidar

— Relatively easy to install and move around

— Relatively low power consumption

— Accuracy not best possible

— Cheapest option (40…60 kEUR)

— Data tends to be ”lost” at higher elevations above the ground (>100 m)

— Needs to be calibrated next to a mast

— Not a stand-alone solution for financing a wind farm investment!

— Gradually being replaced by lidars

WIND MEASUREMENT

Direct: Mast measurements

— Expensive to assemble / disassemble and relocate

— Higher power consumption

— High accuracy IF DONE RIGHT

— You can measure many things: wind, pressure, temperature, humidity, icing…

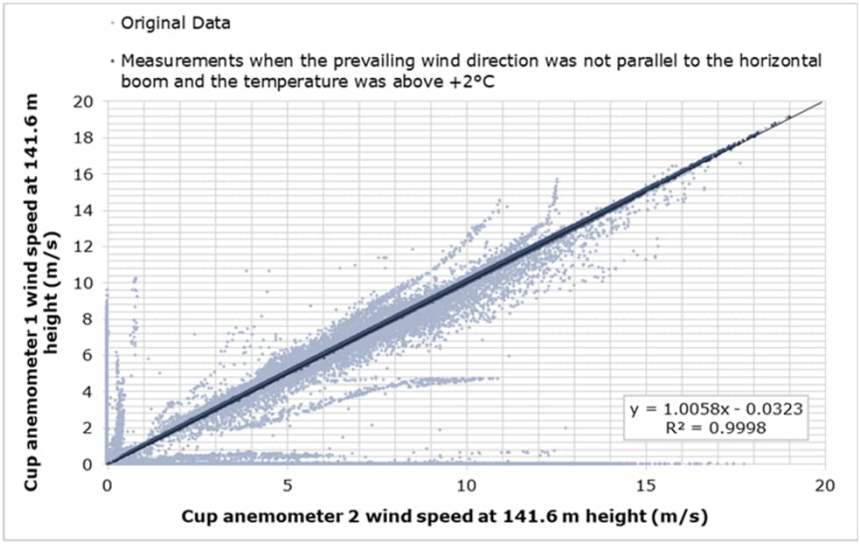
— Sensors need to be calibrated!

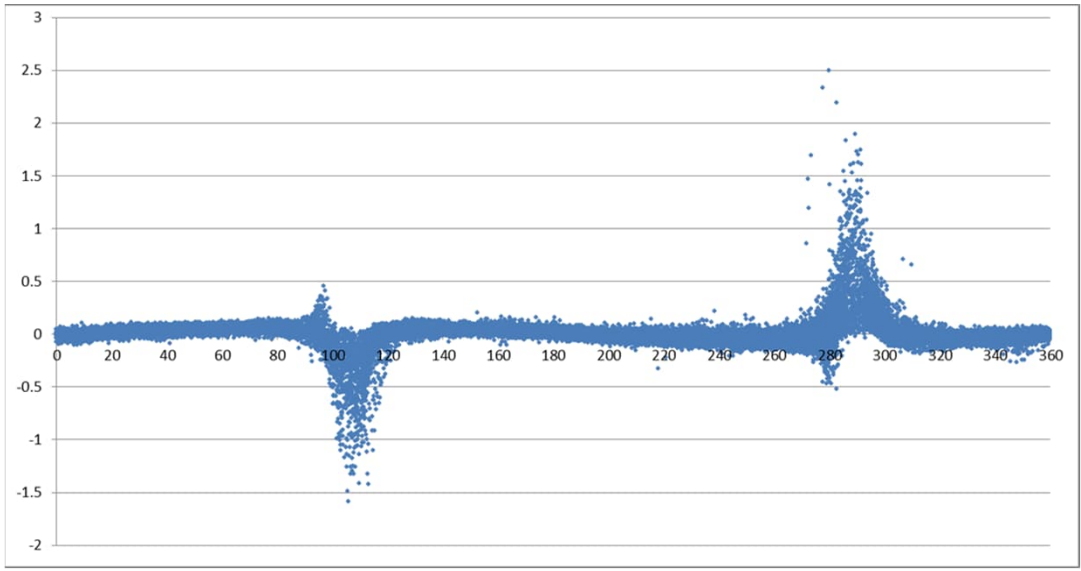
— High masts and high quality sensors are expensive! (Total cost incl. installation 150…300 kEUR)

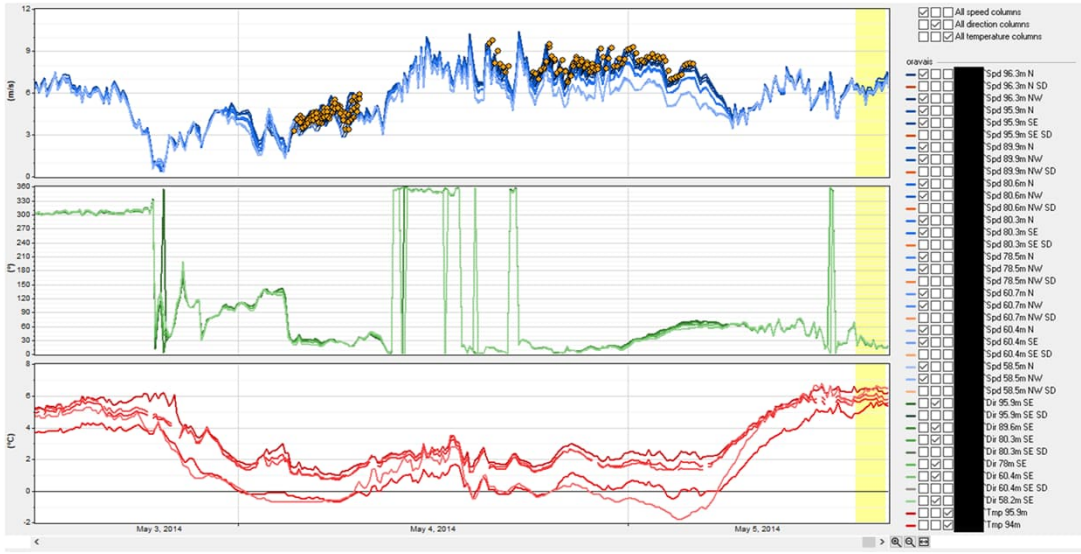
Not a good idea to invest in such a system until it's relatively sure that the project is doable!

Data filtering and quality control

- Mast shadow
- Icing of sensors
- Other suspicious data
- Filling of gaps



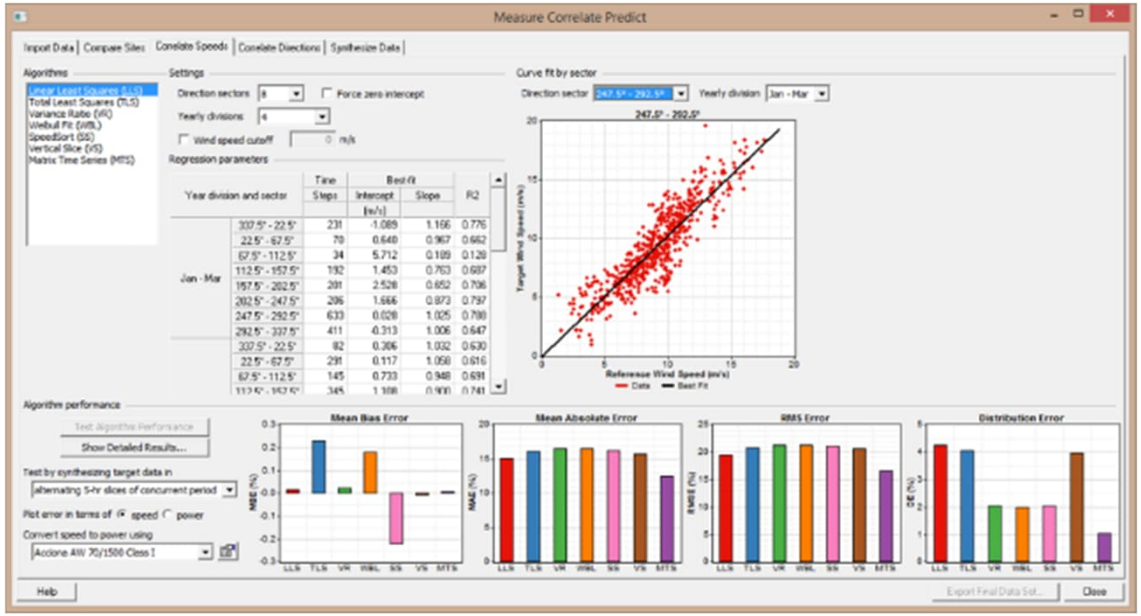




Long term correlation & correction

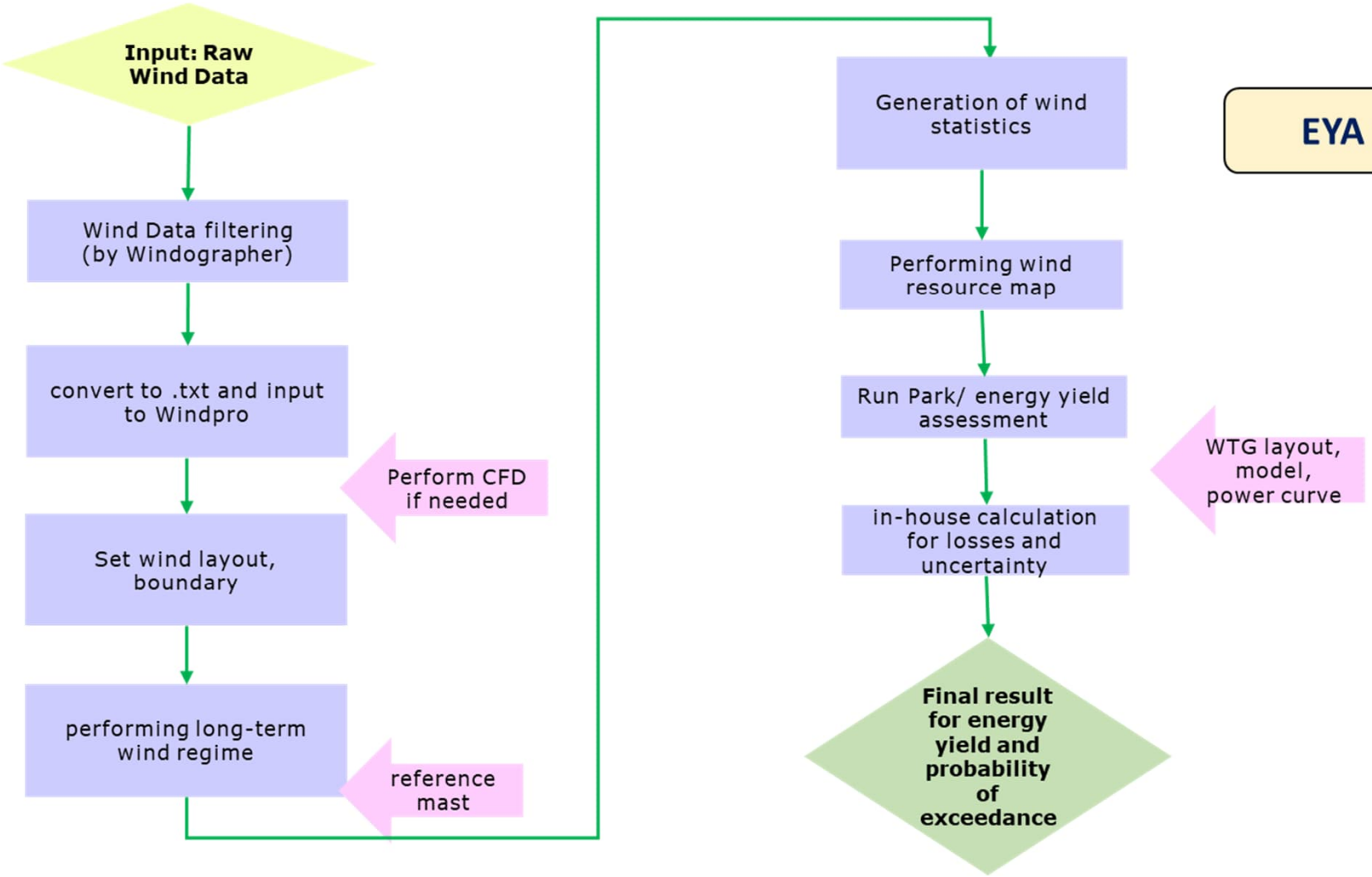
MCP = Measure, Correlate, Predict

- Statistical treatment to correct the on-site measurement data for unrepresentativeness of the measurement period
- For how long should you measure (on site)?
  - Depends on the location: climate etc.
  - Depends also on data coverage and quality
  - Usually min. 12 months (seasonal variations)
- Reference data: How long is ”long term”?
  - Also depends on the location!
  - Not necessarily ”the longer the better” – Climate is changing!
  - Future can’t be predicted based on the past – there’s always uncertainty involved
- Reducing of uncertainties is the key to assessing the project profitability!



AFRY
ÅF PÖYRY

EYA methodology



AFRY

Losses

Loss Parameter	Source	Value Range
Park Efficiency/ Wake loss (Internal, External wake)	Park Simulation	Project specific
Park electrical loss	Project Specific	Project specific
WTG availability	Project Specific/ Contractual	Depending on WTG contract For conservative: 3%
BoP availability	Project Specific/ AFRY's assumption	Conservative: 0.5% Project specific
Grid availability	Project Specific/ AFRY's assumption	Project specific
Wind Sector Management	Project Specific	Depending on Supplier
Environmental Degradation	Project Specific/ AFRY's assumption	Project specific
WTG Performance	Project Specific	Project specific
Environmental curtailment	Project Specific	Project specific
Other losses	Project Specific	hysteresis, derated PC, cap. capacity

AFRY

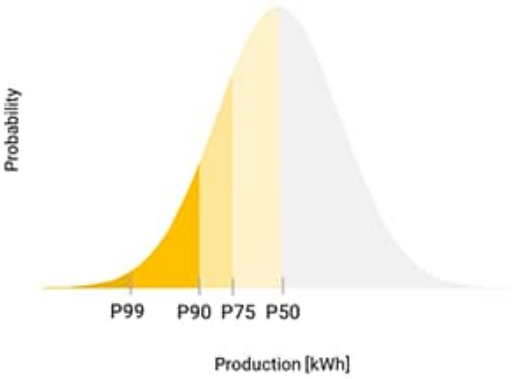
Uncertainty

Loss Parameter	Unit	Value Range
Wind measurement	of wind speed	Project specific depending on met mast installation
Vertical extrapolation	of wind speed	Depending on mast and hub height
Long term wind regime	of wind speed	Project specific
Power curve	of energy	Project specific
Flow modelling	of wind speed	Project specific
Wake modelling	of energy	Project specific
Electrical losses	of energy	Project specific
Availability	of energy	Project specific
Future variability	of wind speed	Project specific
Energy loss	of energy	Project specific

AFRY

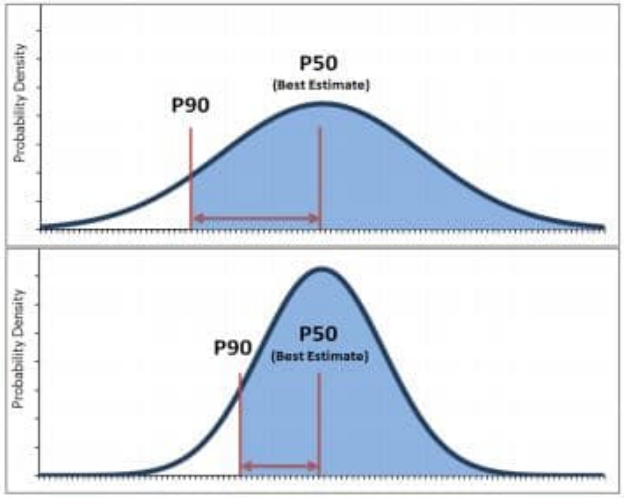
Energy Yield Assessment (EYA)

- Combining of wind speed statistics, terrain and topography data, turbine location coordinates, and the wind turbine characteristics
  - Utilizing verified software tools (WasP, WindPro, CFD models, etc.)
  - Result: estimated gross production (MWh/a) for each turbine location on an ”average wind year”
- From estimated gross production to estimated net production:
  - Taking into account the various losses (wake losses from other turbines, electrical losses, unavailability losses,…)
  - And uncertainties!
- Probability of exceeding a certain production level:
  - Production estimate is not a single MWh-figure, it’s a probability distribution!
  - P50 – ”50% chance that the production is at least this much”
  - P90 – ”90% chance that the production is at least this much”



Energy Yield Assessment (EYA)

— If there are lots of uncertainties in your measurements (due to bad location, poor quality equipment, gaps in data, bad documentation, short measurement period…) or in the data handling and modelling…
  — …There will be a huge difference between P50 and P90
  — And the financiers are typically more concernced of P75 and P90 than of P50 !



Two identical sites with identical P50 production estimate…

- One with ”bad EYA”
- Another with ”good EYA”

… have very different P90 values…

One gets financed, while the other perhaps not!

— Conclusion: No matter how windy the location is, the wind resource still needs to be properly verified!

AFRY
ÅF PÖYRY

Content

Part I 7.10.2022

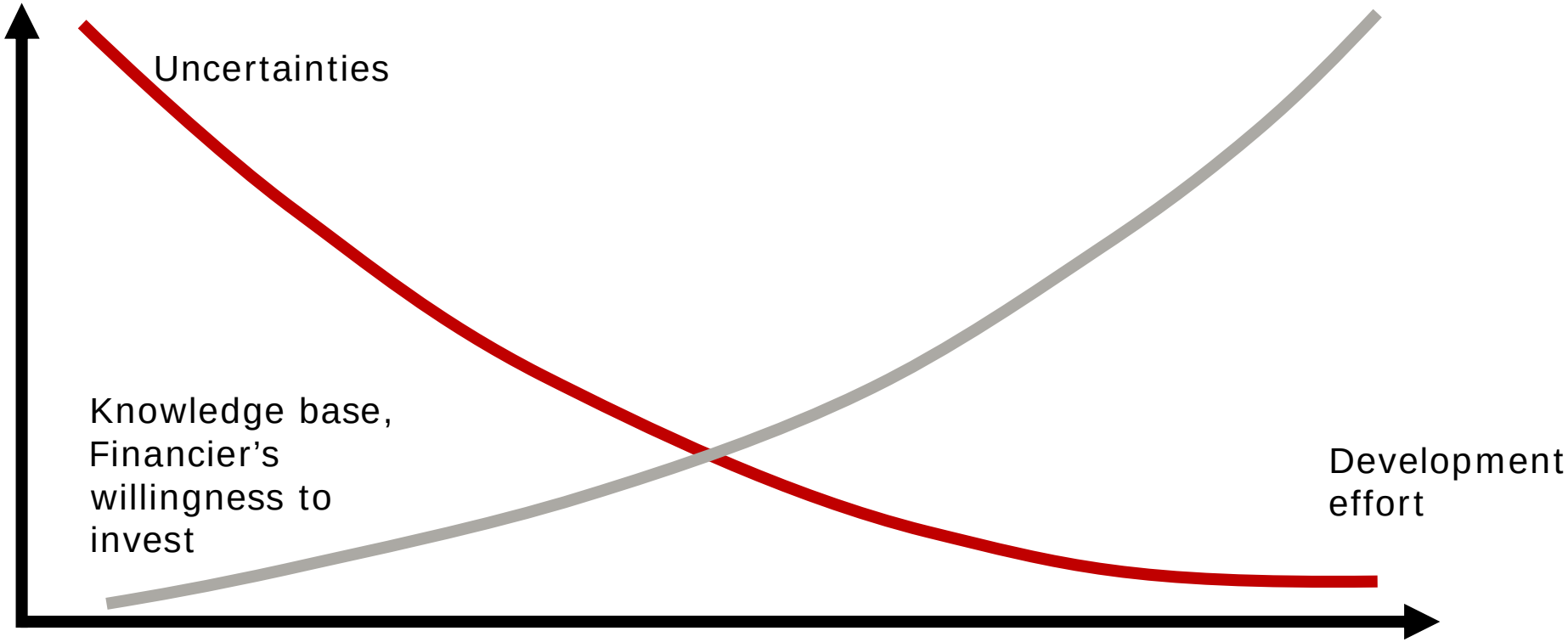
1. Wind resource estimation
2. Wind project development

Part II 14.10.2022

1. Project economy and financing
2. Building of a wind farm
3. Briefly about offshore wind

Main focus on the ONSHORE wind projects

The Golden Rule of (any) project developmet



AFRY
ÅF PÖYRY

Who are “project developers”?

Deeper pockets

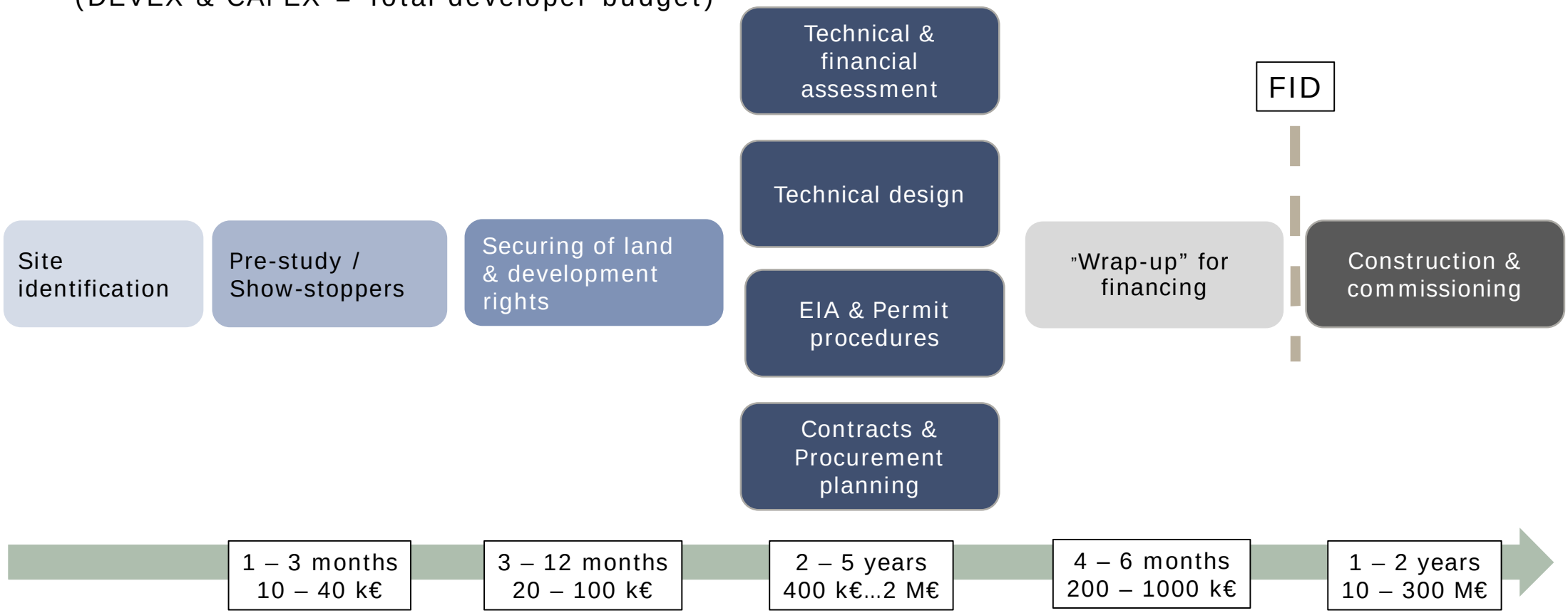
1. Companies trying to increase the commercial value of their work and sell the project to an external client at some point, e.g.
    1. After finding a site and signing land lease contracts with landowners
    2. After acquiring necessary permits and signing (some of the) contracts needed for the construction
    3. After building the whole thing ready and operating it for a while to prove it’s working
2. Companies working throughout the value chain to make fully operational projects for their owners or for themselves
    1. Energy companies (local / national / international)
    2. Independent Power Producers (”IPP”s)

Company sizes ranging from ”a man and a van”
up to multi-billion-dollar global corporates

AFRY
ÅF PÖYRY

Onshore wind project: Time frame and budget

(DEVEX & CAPEX = Total developer budget)



AFRY
ÅF PÖYRY

Wind-specific issues

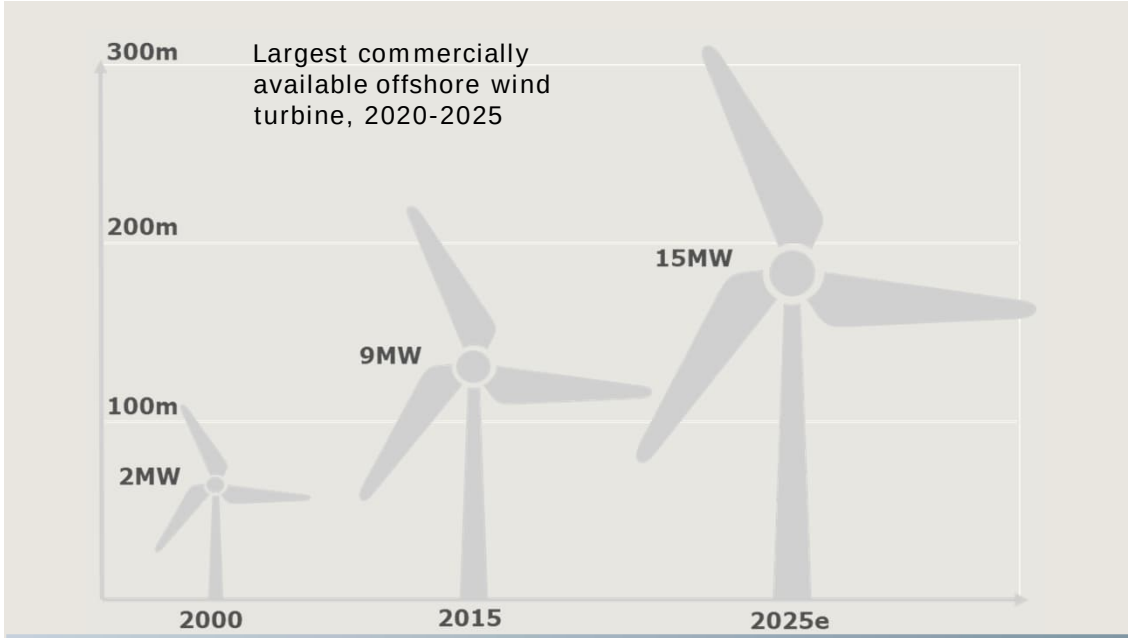
1. ”Air is thin”: Projects need huge areas of land!
   - 10 to 20 ha per MW
   - A 100 MW project needs a 10 to 20 km2 site
   - PLUS a ”buffer zone” due to noise etc.
   - Land acquisition, permitting & stakeholder dialogue are often critical for project success & can cause long delays & need for modifying project technical design

2. Modelling of ”fuel supply” is important!
   - Wind measurements & modelling, incl. long term prediction & statistical assessment
   - Complex terrain: CFD (Computational Fluid Dynamics)
   - Meteorology, understanding local weather phenomena
   - Turbulence, ”wake effect”, ”blockage effect”

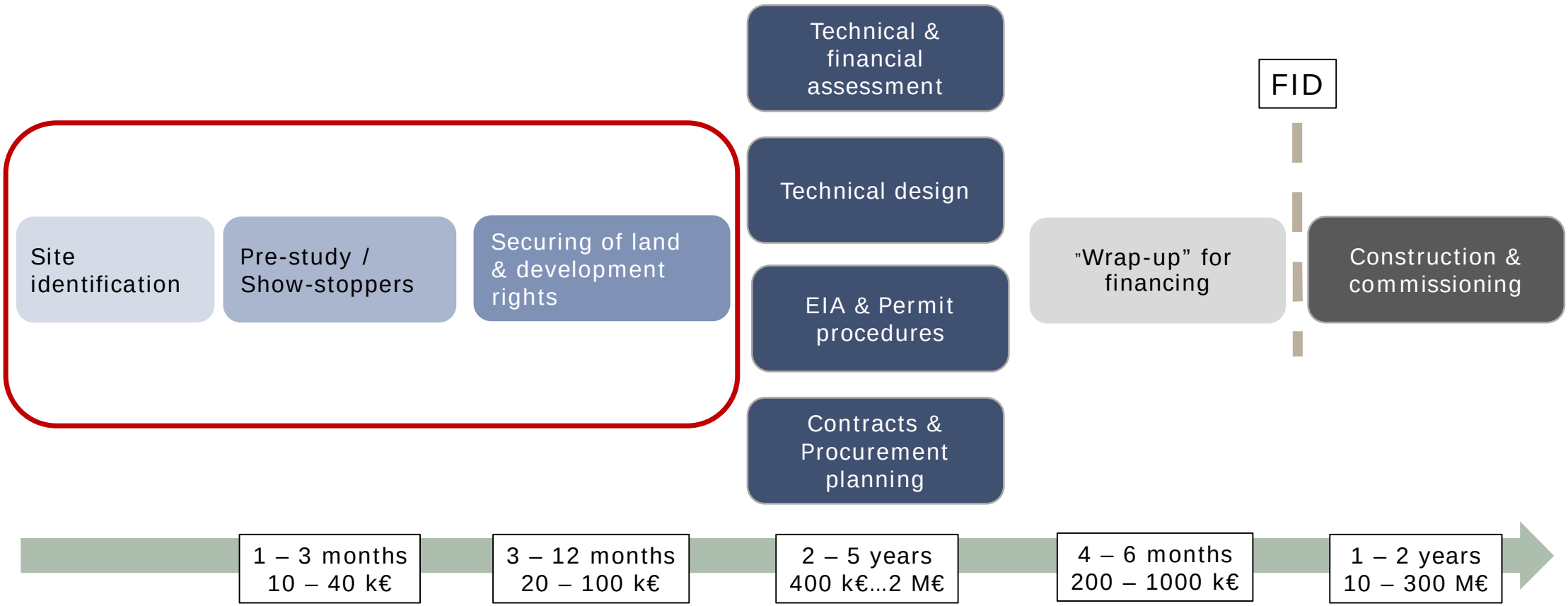
Wind-specific issues

3. Rapidly evolving technology
   - Combined with long timespan of project development (often more than 5 years from Greenfield to FID)
   - When the project development starts, turbines that will eventually be built are not even designed yet!

4. Standardized technology, simple supply chain
   - 60…80% of plant investment cost comes from a single supplier (turbine manufacturer)
   - Standard, off-the-shelf products, no project specific engineering on turbines

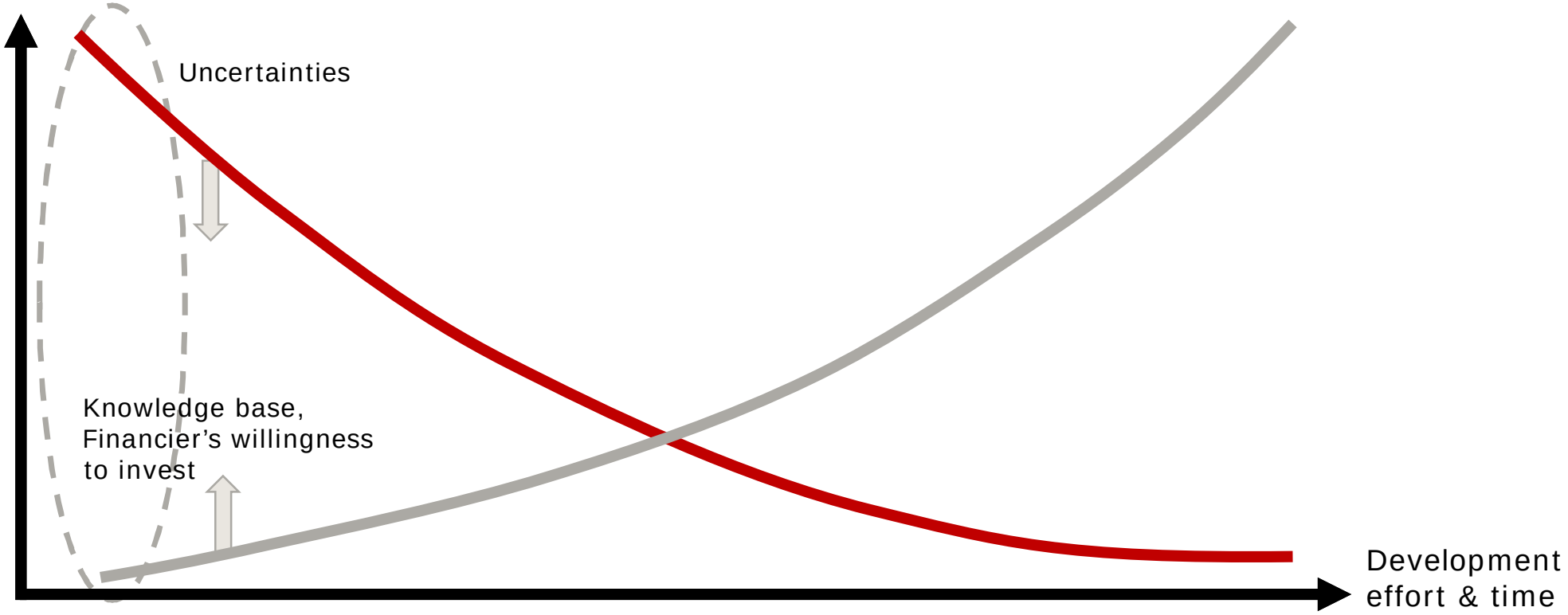


The first critical steps



AFRY
ÅF PÖYRY

Not much data => high uncertainty =>
cautious spending



AFRY
ÅF PÖYRY

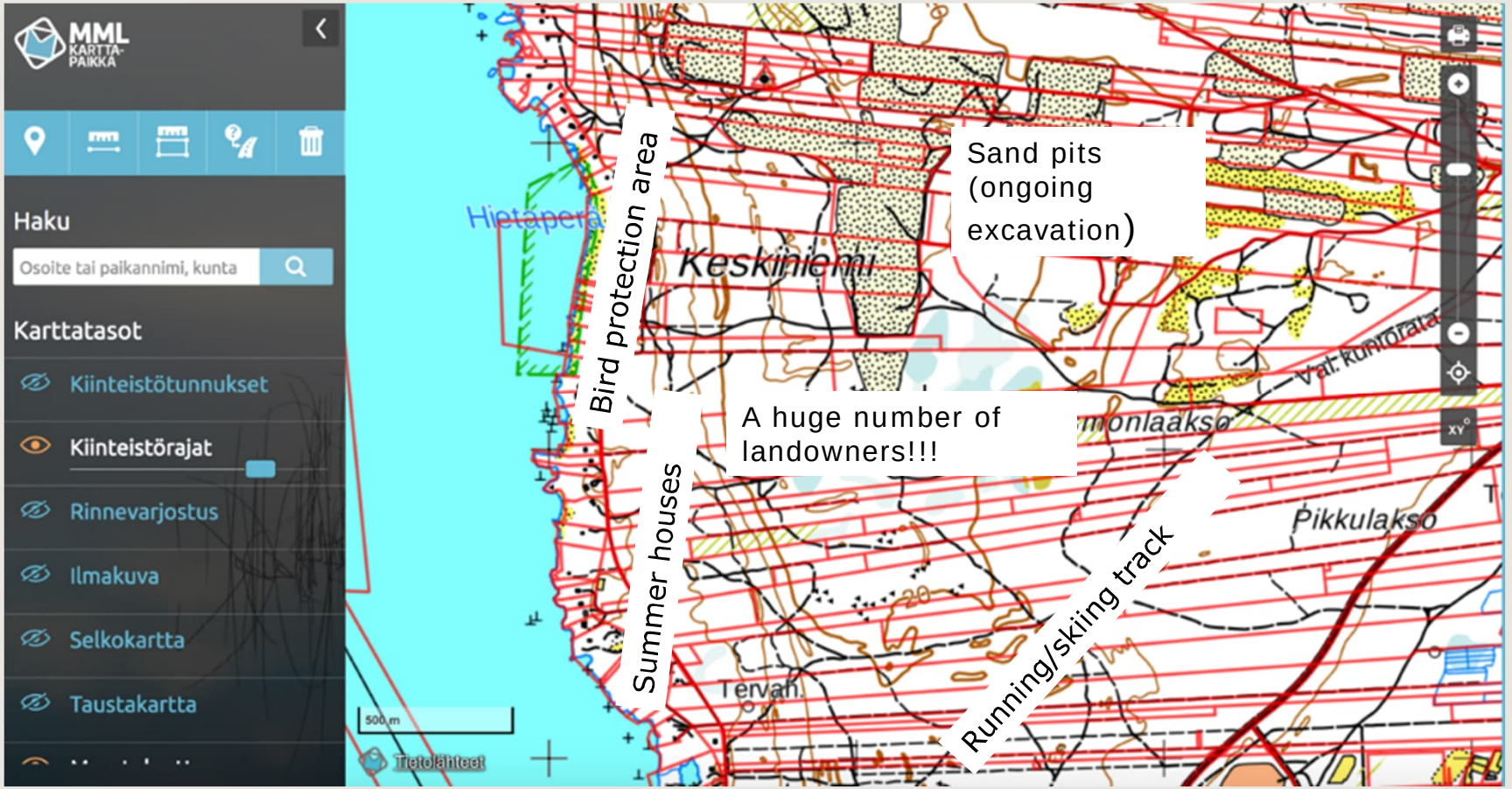
The first critical steps

1. Finding a location that seems doable :
   - Wind resource
   - Land ownership
   - Sufficient space (incl. safety distances / buffer zones)
   - Grid connection
   - Road access and feasibility for construction
   - Environmental issues and local acceptability
   - Restrictions caused by military and other authorities, etc…
2. Quick & dirty ”sanity check”, identifying possible show-stoppers
3. If all still looks good, securing the land availability (lease contracts with landowners)
4. Starting the permitting procedures and other preparatory work incl. Technical design, more detailed wind resource assessment, etc.

Is it a suitable location?

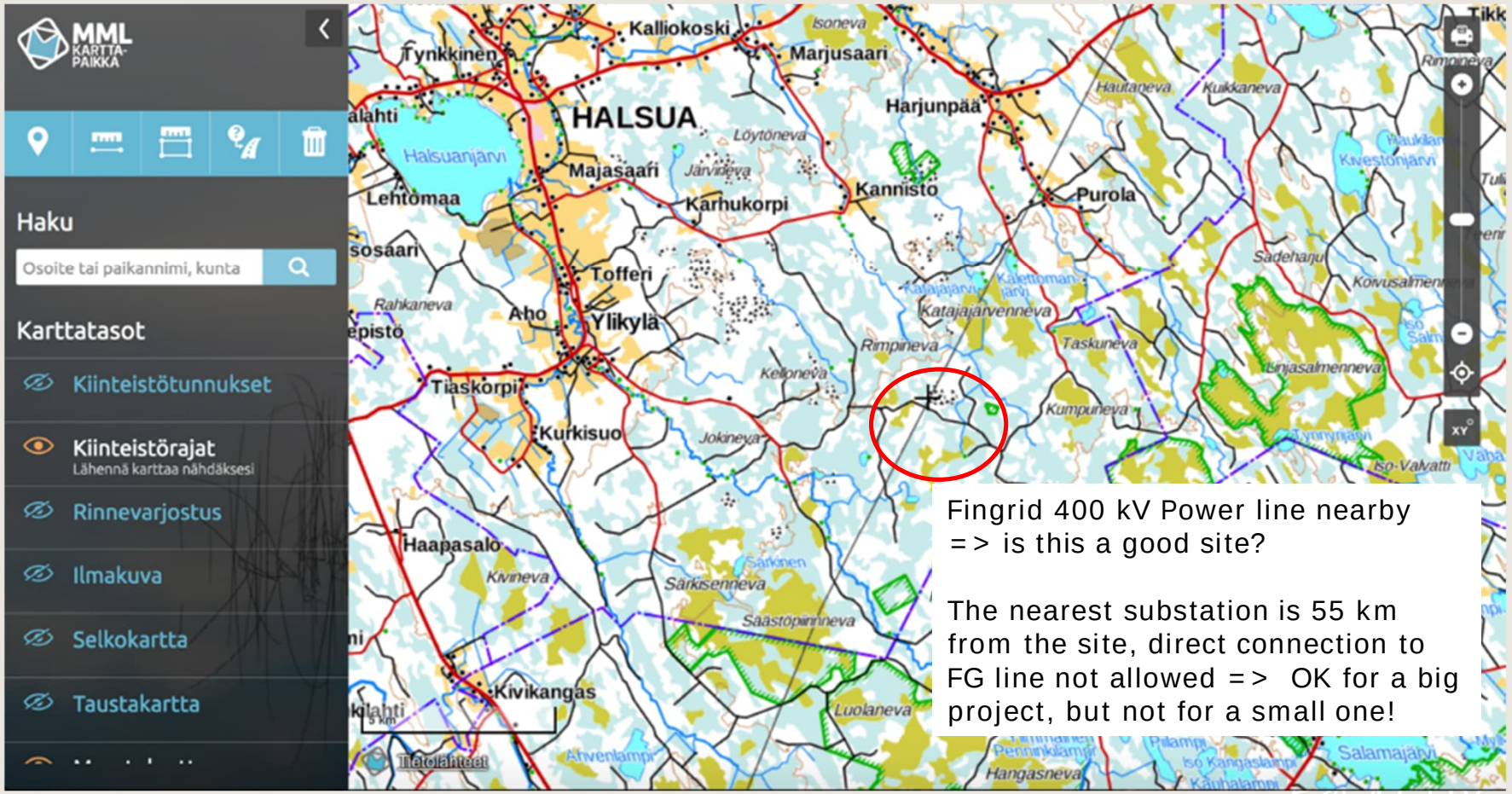
Land ownership

Sufficient space; Safety distances / buffer zones



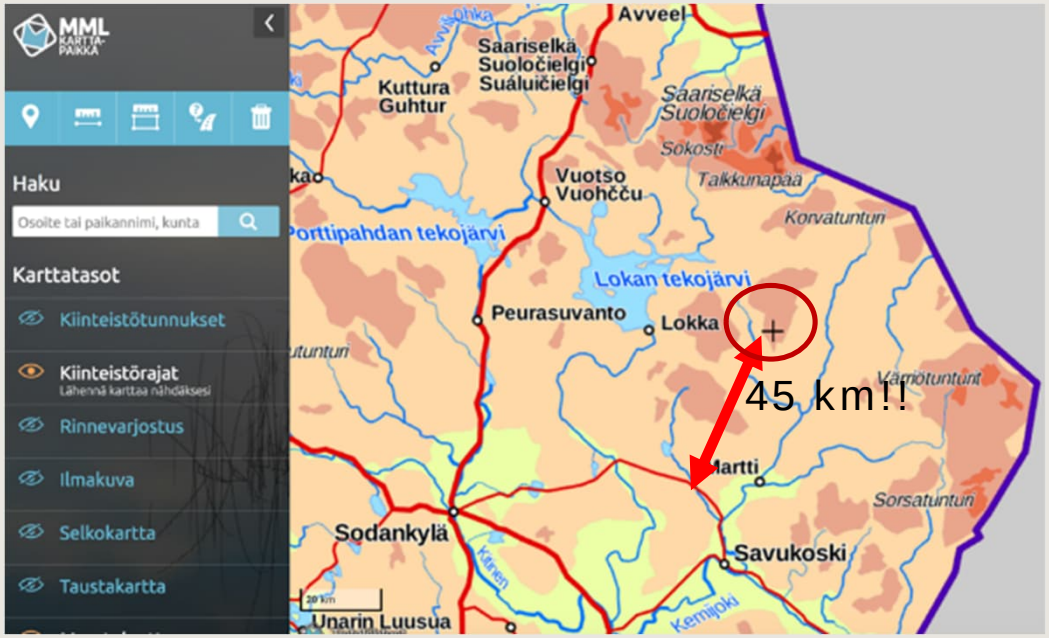
Is it a suitable location?

Grid connection



Is it a suitable location?

Road access and feasibility for construction

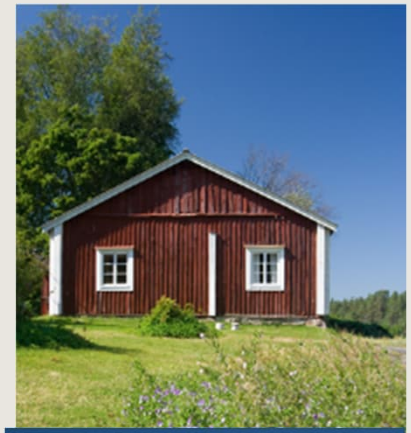


AFRY

Is it a suitable location?

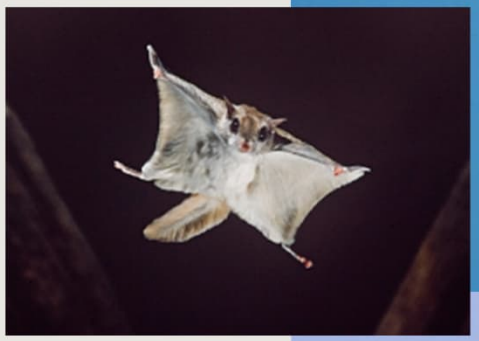
Environmental issues and local acceptability

Neighbours



Protected landscapes

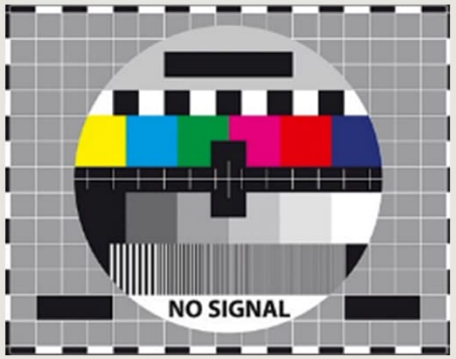
Protected biotopes



Protected species

Is it a suitable location?

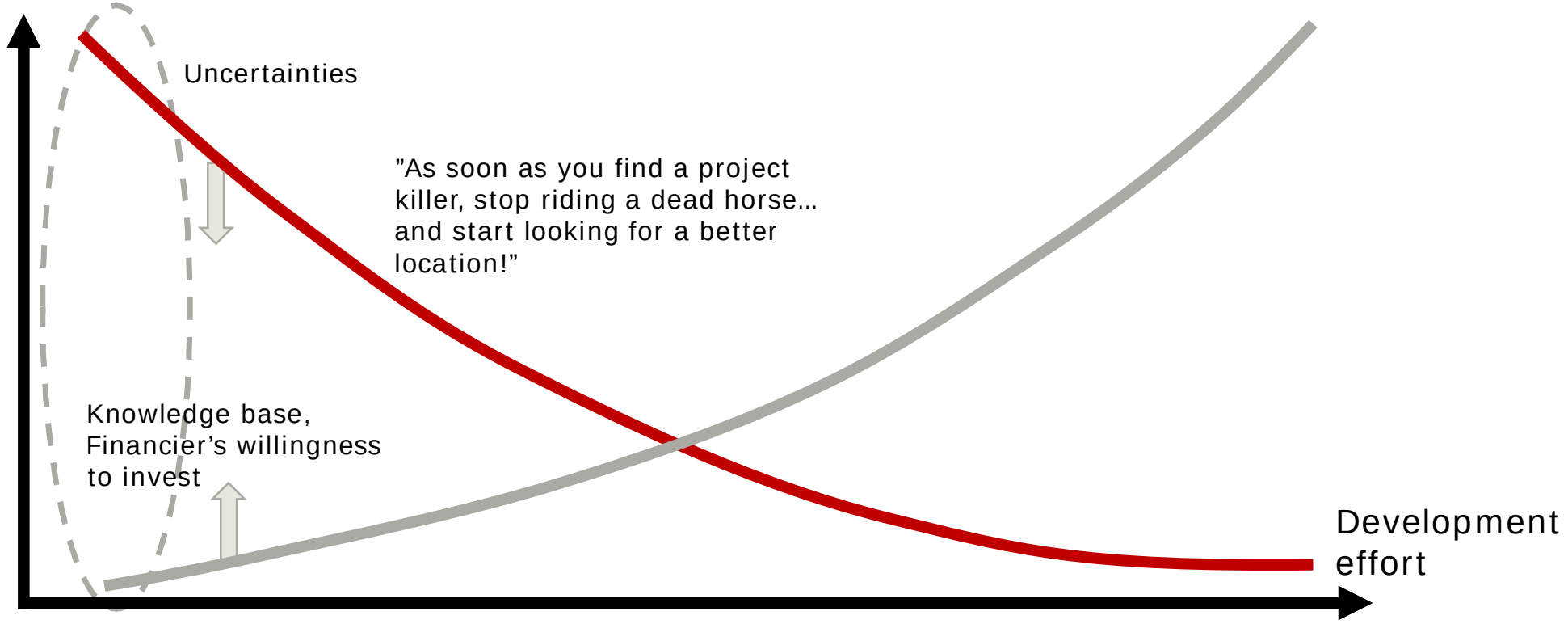
Restrictions caused by military, transportation, telecom and other authorities, etc…



AFRY
AF PÖYRY

Remember where you are along the curve!

”Trying to get a hundred thousand by spending ten”



AFRY
ÅF PÖYRY

PROJECT DEVELOPMENT

The next steps

1. Find a suitable location
   - Wind resource
   - Land ownership
   - Sufficient space (incl. safety distances / buffer zones)
   - Doable gird connection
   - Road access and feasibility for construction
   - Environmental issues and local acceptability
   - Restrictions caused by military and other authorities, etc…
2. Do a quick&dirty ”sanity check”, identify the possible show-stoppers
   If you’re still convinced to go ahead, then…
3. Secure the land availability
4. Start the permitting procedures and other preparatory work

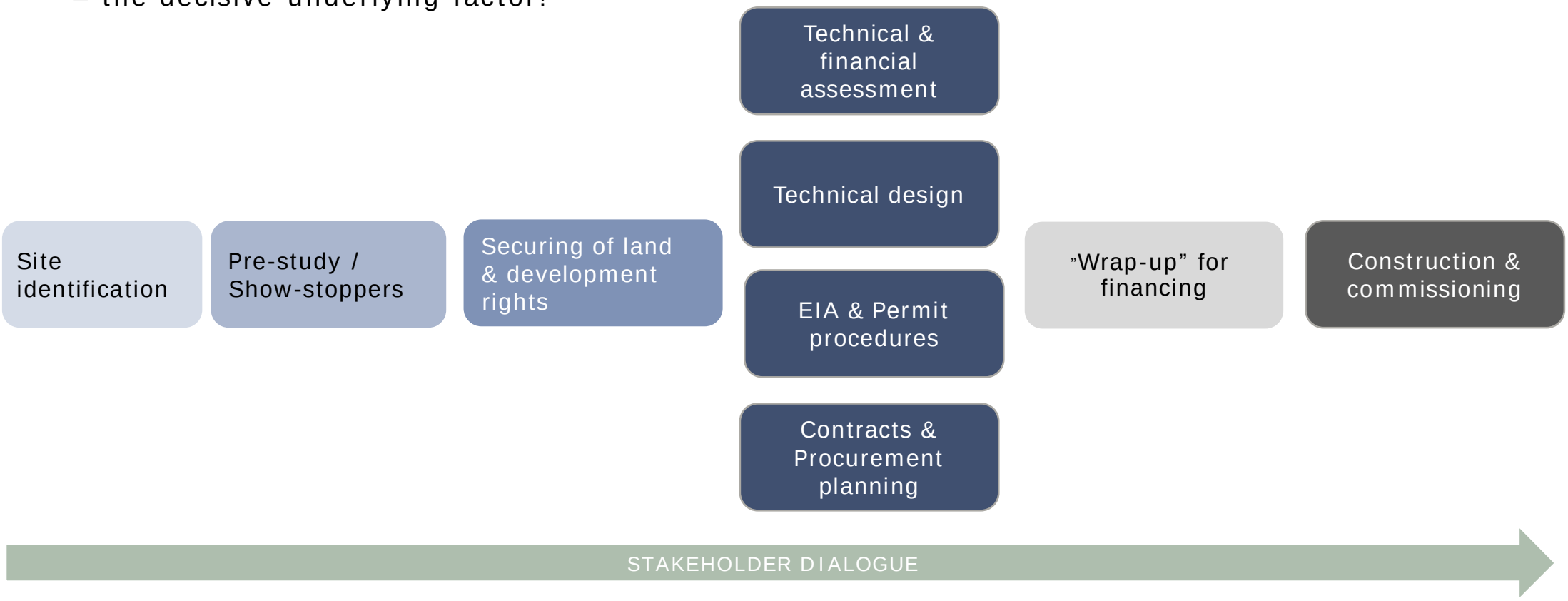
The next steps

1. Negotiate contracts with a sufficient number of landowners, securing rights to a) develop, b) build, and c) operate the project for min. 25 years
   - Keep in mind that ”some people are greedy, envy their neighbors, and love to gossip”…
   - Respect the safety distances to whatever/whomever you may disturb!
   - Equal treatment of all involved landowners, transparency & fair play are key to success
2. Arrange a round of informal discussions with relevant stakeholders
   - Municipality, villages/communities, local interest groups…
   - Get to know your neighborhood, the local spokespersons and ”unwritten laws” of the community
3. …And then start the official procedures: Environmental Impact Assessment, Land Use Planning etc.
   - To be covered in another lecture in two weeks’ time

AFRY
ÅF PÖYRY

Stakeholder dialogue

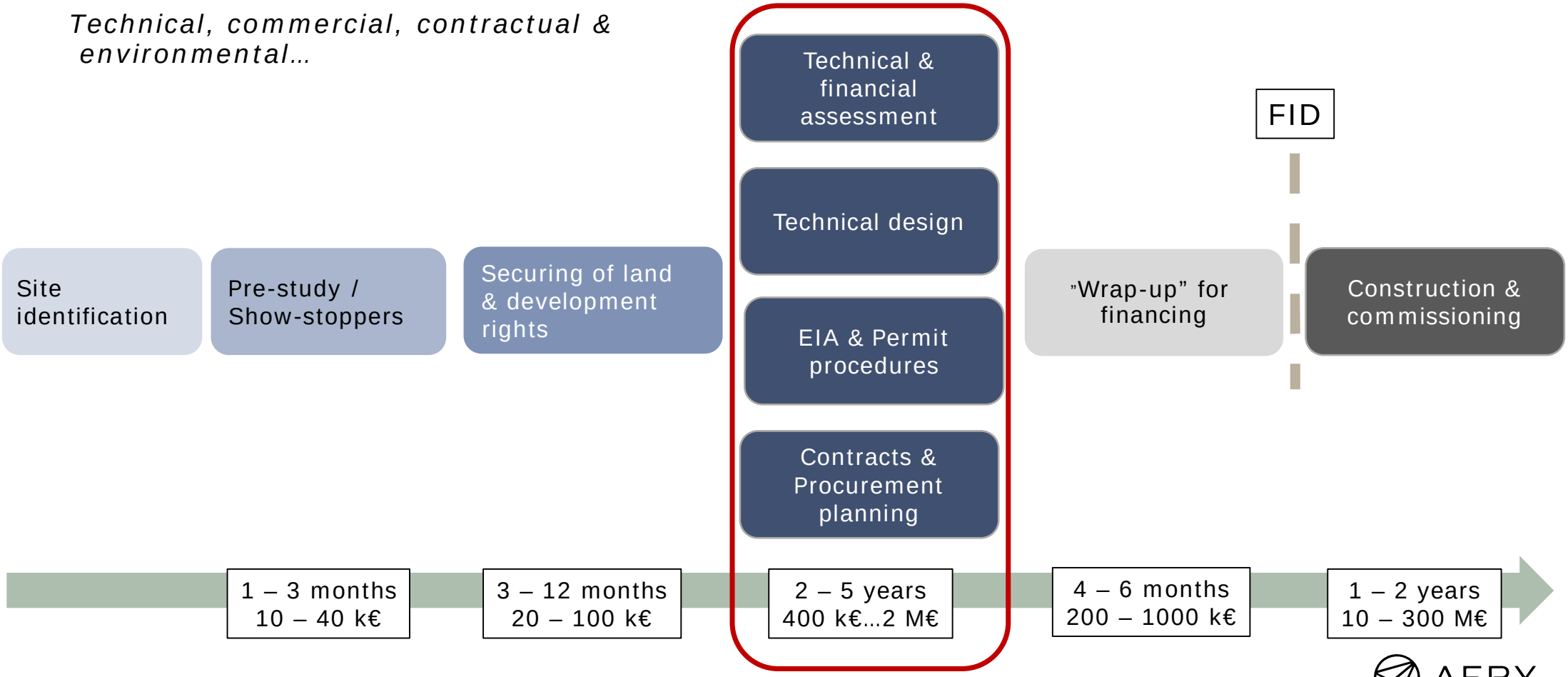
– the decisive underlying factor!



AFRY
ÅF PÖYRY

Parallel workstreams

Technical, commercial, contractual & environmental…



AFRY
ÅF PÖYRY

Key challenge:

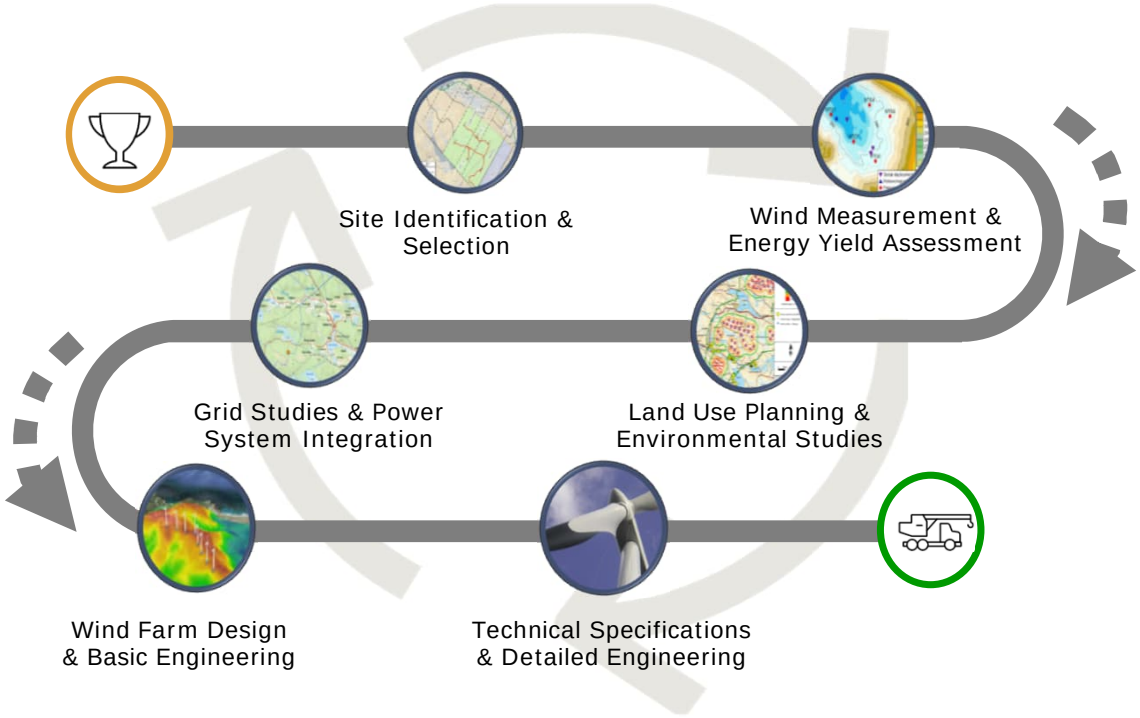
Keeping options open without running in circles

- Various parallel & intertwined workstreams
  - Continuous exchange of information and numerous iterations! – Within budget and deadlines!!
- Technical design: Number of turbines? Nominal power and dimensions of turbines? Spacing and siting of turbines? Road and power line routing? Grid capacity restrictions?
  - Also in parallel: wind measurements and modelling (step by step)
- Environmental: Areas to be avoided? Distance to neighbors and sensitive areas? Noise impacts? Maximum allowed turbine size? Protected species and biotopes? Other projects being planned in nearby areas? Authority requirements...
- Contracting: Turbine Supply & BOP Contracts, Grid connection contract, Offtake / grid usage contracts, Financing contracts,...

AFRY
ÅF PÖYRY

Project Development supported by state-of-the-art tools for design, modelling, simulation and validation

AFRY ENGINEERING & PM TOOLBOX

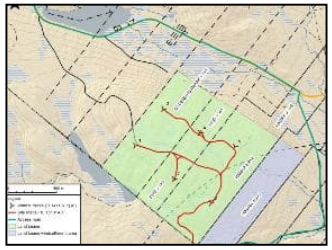


- Cross-disciplinary competence & experience
- State-of-the art software tools
  - Land access and land use planning
  - Wind measurement & modelling
  - Noise emission calculation
  - Wind farm design & optimisation
  - Grid & power system modelling
  - 3D design
- Advanced information management process
  - Document management systems
  - Integration of data from various modelling & simulation tools
  - Vast experience in Project Management
- Virtual tools for simulation and validation
  - Digital twins
  - Augmented & virtual reality
- Latest technology in construction monitoring
  - LiDAR distance sensors & profile scanners
  - Drone-based monitoring and data collection

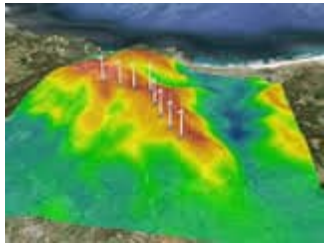
AFRY
ÅF PÖYRY

Core engineering activities and state-of-the art tools

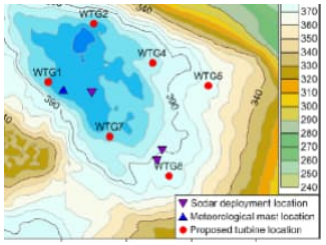
WIND PROJECT DESIGN TOOLS



Determination of land access and necessary roads using GIS tools

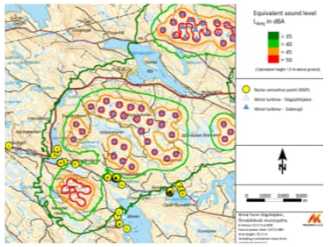


Wind Farm Design and Optimisation performed with the help of WindPro



Rigorous wind measurements and modelling using WAsP and CFD

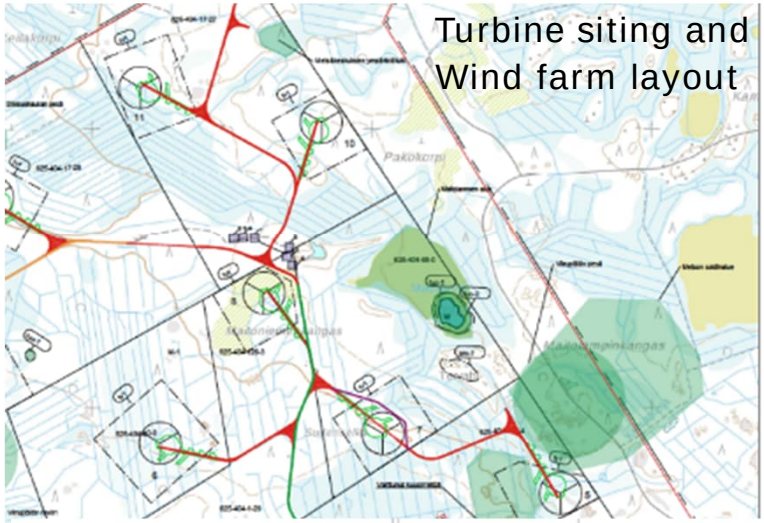
Use of WindPro to calculate the wake effects



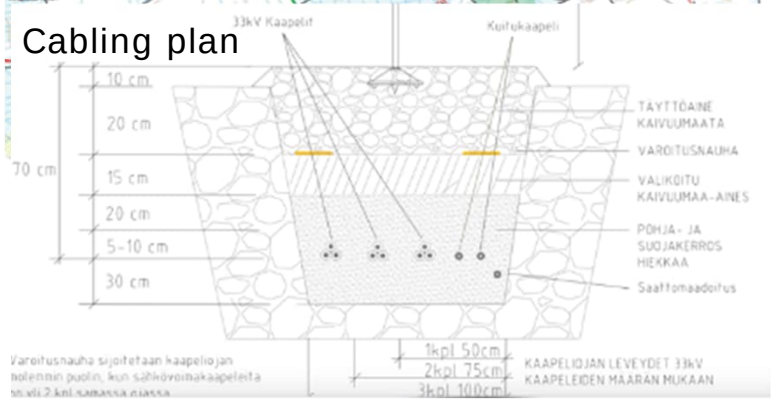
Noise imission calculations according to practice using the Nord2000 model

Grid connection (internal and external) performed using PSSE

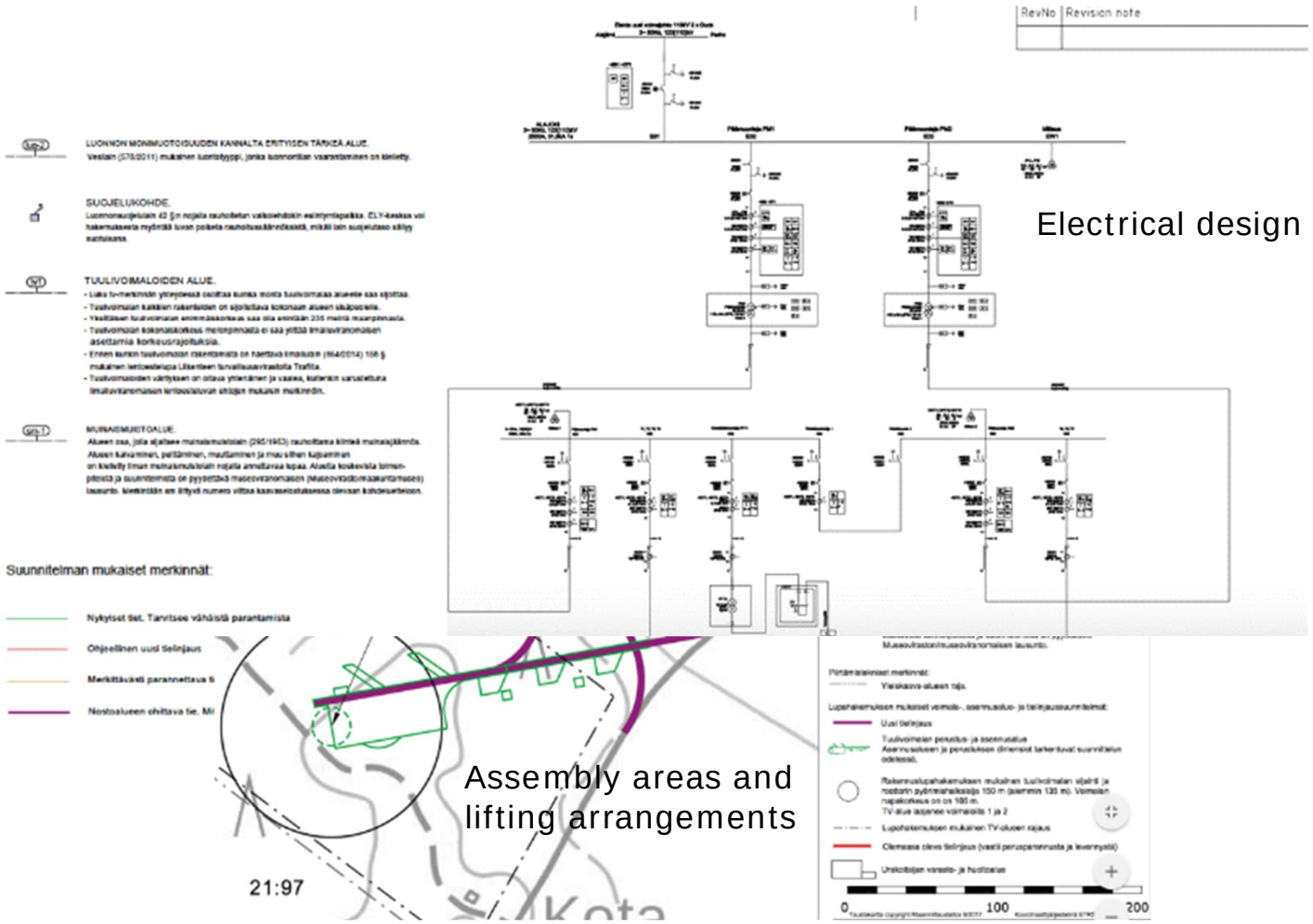
Technical Design



Turbine siting and
Wind farm layout



Cabling plan

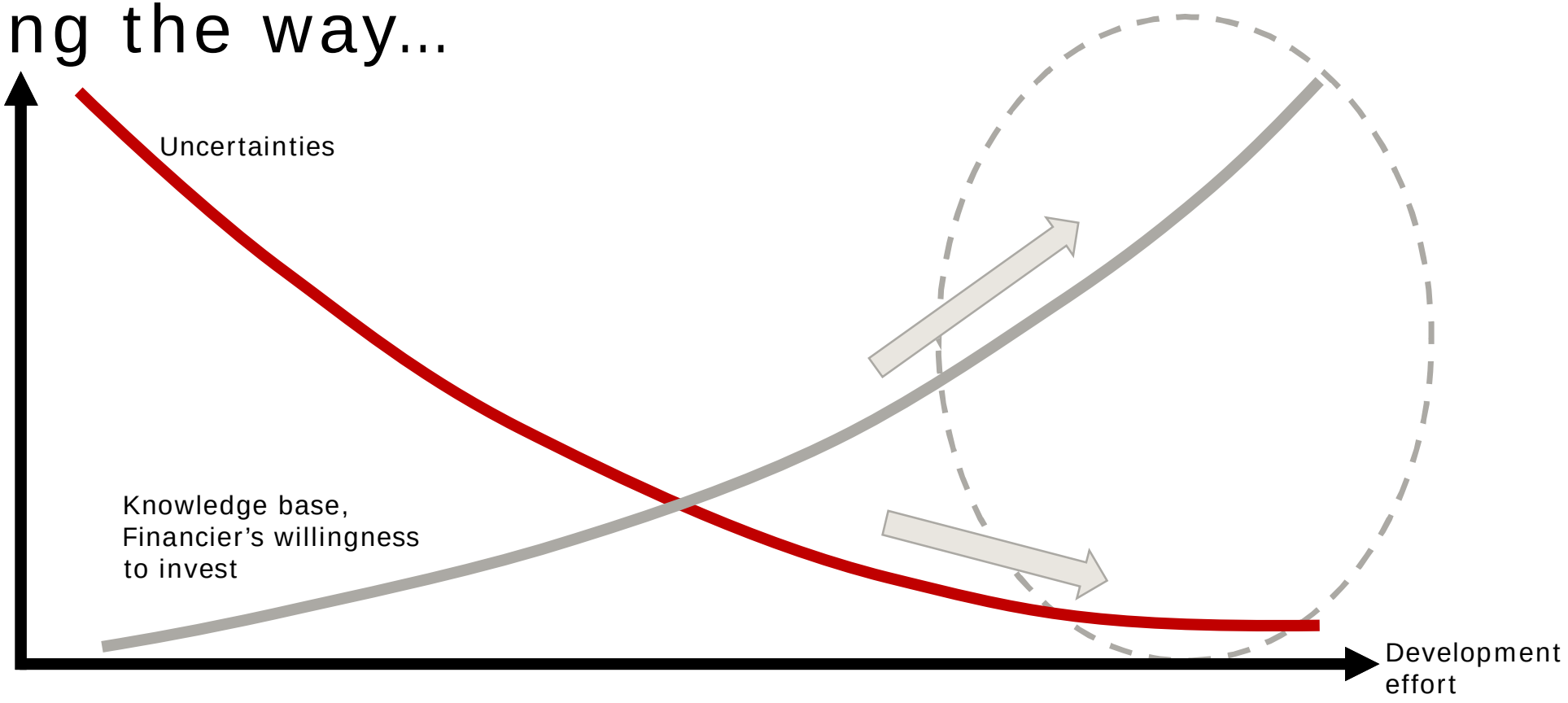


Electrical design

Assembly areas and
lifting arrangements

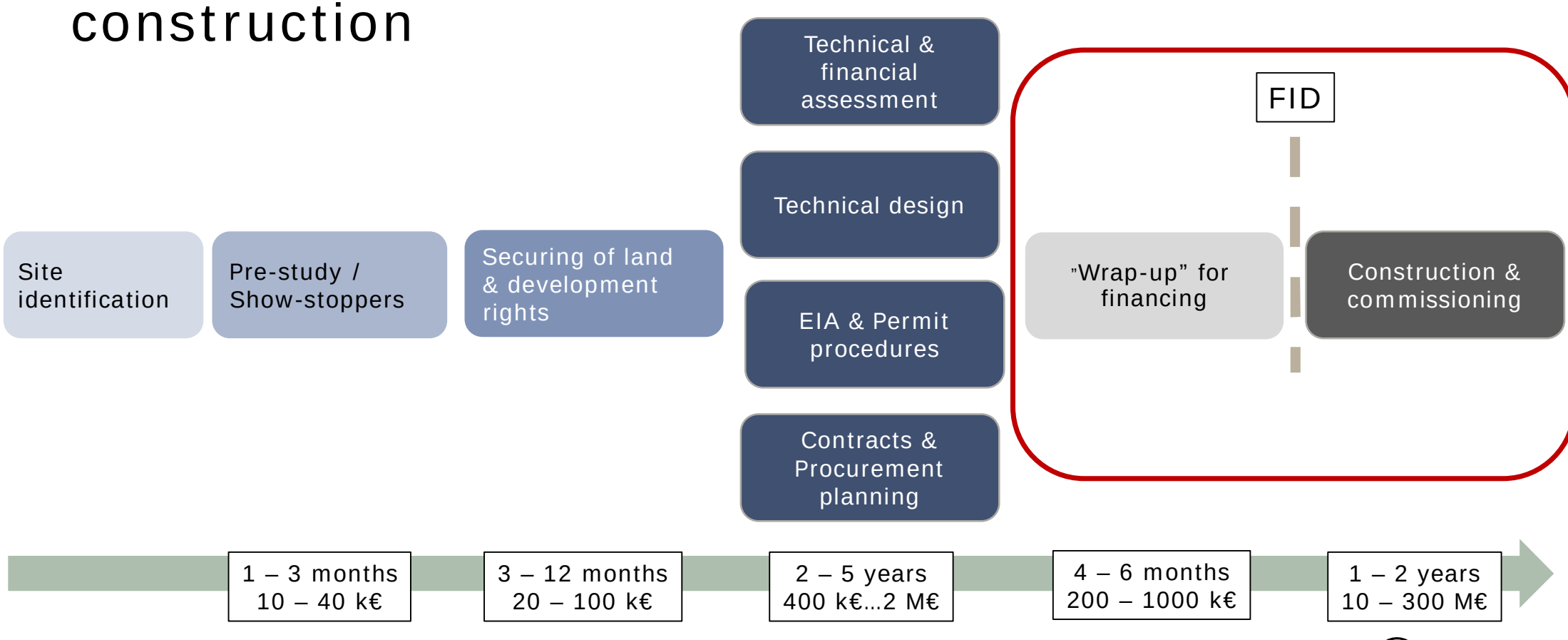
AFRY
ÅF PÖYRY

...assuming the right decisions were made along the way...



AFRY
ÅF PÖYRY

…the project moves on to financing and construction



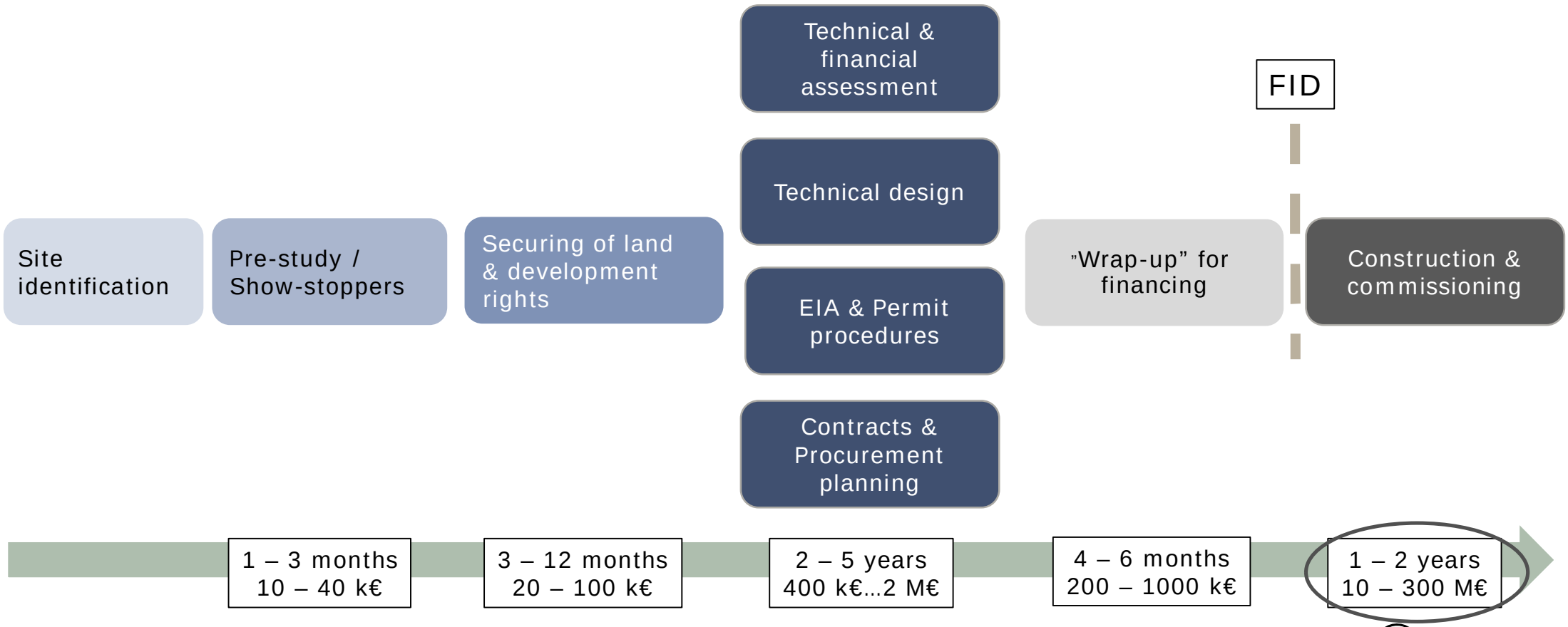
AFRY
ÅF PÖYRY

The last steps can then be taken before FID

- Technical planning:
  - Detailed wind resource assessment based on high quality measurement data and for the chosen wind turbine type
  - Detailed engineering design for civil and electrical works incl. soil investigations for the chosen wind turbine type
- Permitting:
  - Acquiring final building permits for the chosen turbine type and detailed siting plan (based on the detailed engineering design)
  - Acquiring environmental permits and any other remaining authority approvals / concessions (if required)
- Contracting:
  - Turbine acquisition contract ready to be signed
  - Construction contracts: Roads and assembly areas, turbine foundations, internal cabling, wind farm substation, connecting line to public network, site supervision incl. HSEQ, etc. ready to be signed
  - Financing contracts: Equity & debt finance, sales and transmission of electricity, balancing of production / hedging of market price risks, etc. ready to be signed
  - Service and management contracts for the operation of wind farm ready to be signed
  - Insurance contracts for construction and operation ready to be signed
- Financing:
  - Financial modeling of the project, based on all negotiated contracts listed above and the wind resource assessment, showing with sufficient certainty that the project fulfills the profitability requirements of the financiers

AFRY
ÅF PÖYRY

Point of No Return: Final Investment Decision

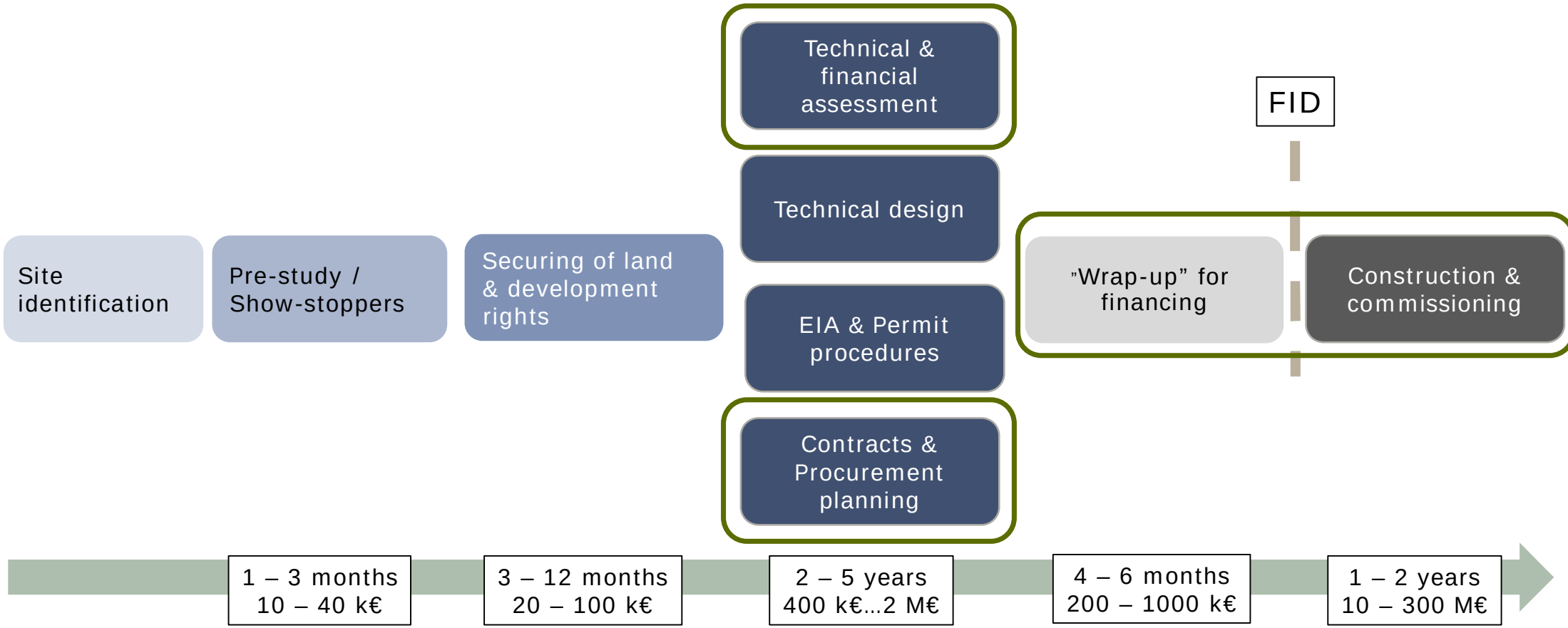


How to succeed as Project Developer?

- Find the right sites
  - Feasibility in terms of both technoeconomic and environmental/social issues
- Recognise the showstoppers of each project early on, and react accordingly
- Invest in right things at the right time
  - Avoid upfront spending when risks and uncertainties are still high
  - Maximise the added value of the new information you acquire at each stage
- Make sure the interplay between technical, environmental and contractual work functions at all times
  - Keep on the flow (but not overflow!) of information between experts working on different fronts
  - Be prepared for surprises and keep options open; modify project size, relocate turbines, etc.
- Report to your financiers and external stakeholders openly and without delay!
- Not all eggs in one basket: Have a healthy mix of projects
  - in different stages of development,
  - in different geographical areas,
  - and in different markets (different legislative / administrative frameworks)

AFRY
ÅF PÖYRY

Topics for the next time:



AFRY
ÅF PÖYRY

THANKS FOR YOUR PATIENCE!